

Pink-footed Goose

Anser brachyrhynchus
(Greenland/Iceland population) in Britain
1960/61 – 1999/2000

Carl Mitchell¹ and Richard Hearn¹

with contributions from
Mike Bell, David Boertmann, Hugh Boyd, Ivan Brockway, Allan Brown, Peter Cranswick, Paul Fisher,
Derek Forshaw, Tony Fox, Rick Goater, Peter Gordon, Frank Mawby, Malcolm Ogilvie,
David Patterson, Ian Patterson, Paul Shimmings, Arnór Sigfússon and David Stroud

¹The Wildfowl & Wetlands Trust, Slimbridge, Glos GL2 7BT, UK



JOINT
NATURE 
CONSERVATION
COMMITTEE

Waterbird Review Series

© The Wildfowl & Wetlands Trust/Joint Nature Conservation Committee

All rights reserved. Apart from any fair dealing for the purpose of private study, research, criticism or review (as permitted under the Copyright Designs and Patents Act 1988), no part of this publication may be reproduced, sorted in a retrieval system or transmitted in any form or by any means, electronic, electrical, chemical, optical, photocopying, recording or otherwise, without prior permission of the copyright holder.

ISBN 0 900806 43 5

This publication should be cited as:

Mitchell, CR & RD Hearn. 2004. *Pink-footed Goose* *Anser brachyrhynchus* (Greenland/Iceland population) in Britain 1960/61 – 1999/2000. Waterbird Review Series, The Wildfowl & Wetlands Trust/Joint Nature Conservation Committee, Slimbridge.

Published by:

The Wildfowl & Wetlands Trust
Slimbridge
Gloucestershire
GL2 7BT

Joint Nature Conservation Committee
Monkstone House
City Road
Peterborough
PE1 1JY

T: 01453 891900
F: 01453 890827
E: research@wwt.org.uk

T: 01733 562626
F: 01733 555948
E: communications@jncc.gov.uk

Design and typeset by Paul Marshall
Cover design by Pyneapple

Printed by Crowes Complete Print, 50 Hurricane Way, Airport Industrial Estate, Norwich, Norfolk NR6 6JB

Front cover: Pink-footed Goose by Chris Gomersall
Back cover: Loch Leven (Scotland) by Chris Gomersall

CONTENTS

Summary	v
1 The Pink-footed Goose	1
1.1 Introduction	1
1.2 Background	1
1.3 Monitoring and population assessment	3
1.3.1 Counts	3
1.3.2 Productivity	4
1.3.3 Ringing	5
1.3.4 Hunting bags	6
1.3.5 Population assessment	6
1.4 Annual cycle	12
1.4.1 Breeding season	12
1.4.2 Autumn migration	14
1.4.3 Winter	14
1.4.4 Spring migration	17
1.5 Conservation and management	17
1.5.1 Legislation and other conservation measures	17
1.5.2 Hunting	20
1.5.3 Agricultural conflict	21
2 Survey of wintering areas	23
2.1 Britain	25
2.1.1 Moray basin	25
2.1.2 Aberdeenshire	28
2.1.3 Angus/Dundee (incl. Firth of Tay)	32
2.1.4 Perth & Kinross	38
2.1.5 Fife	46
2.1.6 Central Region	49
2.1.7 Lothian/Borders	52
2.1.8 Clydesdale	59
2.1.9 Dumfries & Galloway (excl. Solway Firth)	60
2.1.10 Solway Firth	65
2.1.11 Southwest Lancashire	68
2.1.12 Northeast England	72
2.1.13 Wash/Norfolk	74
2.1.14 Other regions	79
3 Future monitoring and data needs	84
3.1 Counts and surveys	84
3.2 Age ratios	84
3.3 Ringing	84
3.4 Bag statistics	85

3.5	Management issues	85
3.6	Future collaboration	85
4	Acknowledgements	86
5	References	87

SUMMARY

This report examines changes in the abundance and non-breeding distribution of the Greenland/Iceland population of Pink-footed Goose *Anser brachyrhynchus* during the period 1960/61 to 1999/2000. It also aims to evaluate the historical status of this population, to review published information on the ecology, population dynamics and conservation issues for this species, and to describe numbers, trends and site use at the key resorts in Britain.

This population of Pink-footed Goose breeds primarily in Iceland, with small numbers in eastern Greenland. It spends the non-breeding season almost entirely within Britain.

Co-ordinated censuses began in 1960. From then until the mid 1980s, the population increased from just fewer than 50,000 to around 100,000 individuals. It then underwent a more rapid phase of growth, increasing to around 250,000 by the mid 1990s. Subsequently, it has stabilised and the mean census total for the period 1995/96-1999/2000 was 222,436.

During the winter, Pink-footed Geese feed primarily in agricultural habitats, selecting stubbles, managed grasslands, cereals and root crops. They use nearby inland waterbodies and sheltered coastal bays to roost. At times, the grazing of valuable crops may bring them into conflict with agricultural interests, although the extent of this problem has yet to be quantified.

Pink-footed Geese are hunted throughout their range. A comprehensive harvest monitoring system in Iceland shows that between 10,000 and 15,000 are shot there each autumn. A larger number is probably shot in Britain although no comprehensive monitoring system currently exists there. The extent of hunting in Greenland is poorly known.

The winter distribution is highly concentrated and birds favour sites in eastern Scotland, from the Moray Firth to the Borders, but also the Solway Firth; in England, Lancashire has long been favoured and, since the late 1980s, numbers in Norfolk have increased markedly. Particularly large concentrations may occur at individual roosts during autumn passage in eastern Scotland and in winter in Norfolk.

Thirty-five wintering sites currently support internationally important numbers of Greenland/Iceland Pink-footed Geese (2,250 or more birds), based upon the mean peak winter count for the period 1995/96-1999/2000. Since survey efforts are focussed on co-ordinated autumn counts, however, the status of sites holding large numbers at other times is less likely to have been recognised and it is possible that a higher number of sites are of international importance. Information on numbers, trends and site use at key resorts is provided within this review.

Pink-footed Geese are protected by a number of national and international laws, conventions and directives. The species is currently placed on the 'Amber' list of 'The Population Status of Birds in the UK'.

For future conservation and management of this population to remain effective, greater long-term commitment is needed towards monitoring programmes and research. In particular, there is a need to review methodological aspects of the autumn census, to undertake more frequent and systematic counts away from this period, to enhance and extend current ringing activity, to refine methods of estimating annual reproductive success, and to monitor better and understand the impact of hunting on the dynamics of this population.

1 THE PINK-FOOTED GOOSE

1.1 Introduction

I speak of fowl which come from abroad; throughout the winter they do not dwell amongst us and are not even observed. These are somewhat smaller than swans, and in springtime they occupy the island in an almost countless number. The common report is that every year in autumn, they make for the neighbouring countries of England, Ireland and Scotland.'

Gisli Oddson, the Bishop of Skaholt in southern Iceland, 1638

Twenty-eight years have now passed since the last assessment of the status and distribution of Pink-footed Geese *Anser brachyrhynchus* in Britain by Malcolm Ogilvie and Hugh Boyd (Ogilvie & Boyd 1976). Between then and now, information on the numbers and distribution of Pink-footed Geese during the autumn census has been presented in annual reports produced by The Wildfowl & Wetlands Trust (WWT). This current report assesses the changes in numbers and distribution of the Pink-footed Goose since 1960, and provides current estimates of population levels.

The report is split into two sections. The first provides a brief summary of our present understanding of the ecology of the population of Pink-footed Goose that breeds in Greenland/Iceland. This has been partly gathered from the text written for *Goose Populations of the Western Palearctic* (Madsen *et al.* 1999). We make no excuses for this repetition because we believe that the text is relevant to this report. This section poses as many questions as it provides answers, and helps to identify the gaps in our knowledge of this population.

The second section reviews the monitoring of the Pink-footed Goose in Britain from 1960 onwards on a regional basis. It is fortunate that when Hugh Boyd organised the 'grey goose' censuses he sought the help of regional organisers, local goose counters who understood the habits of Pink-footed Geese in their region. It is also fortunate that the Pink-footed Goose is a creature of habit and has tended to winter in the same areas for five decades.

The format of the review follows that presented for Greenland White-fronted Goose *Anser albifrons flavirostris* by Fox *et al.* (1994b). For each site that currently supports, on average, more than 1% of the international population estimate (i.e. 2,250 birds, Rose & Scott 1997), a graph shows the peak count in any month, 1960/61 to 1999/2000. For the most

important sites, where count data were available, the change in use during the course of the non-breeding season is also shown.

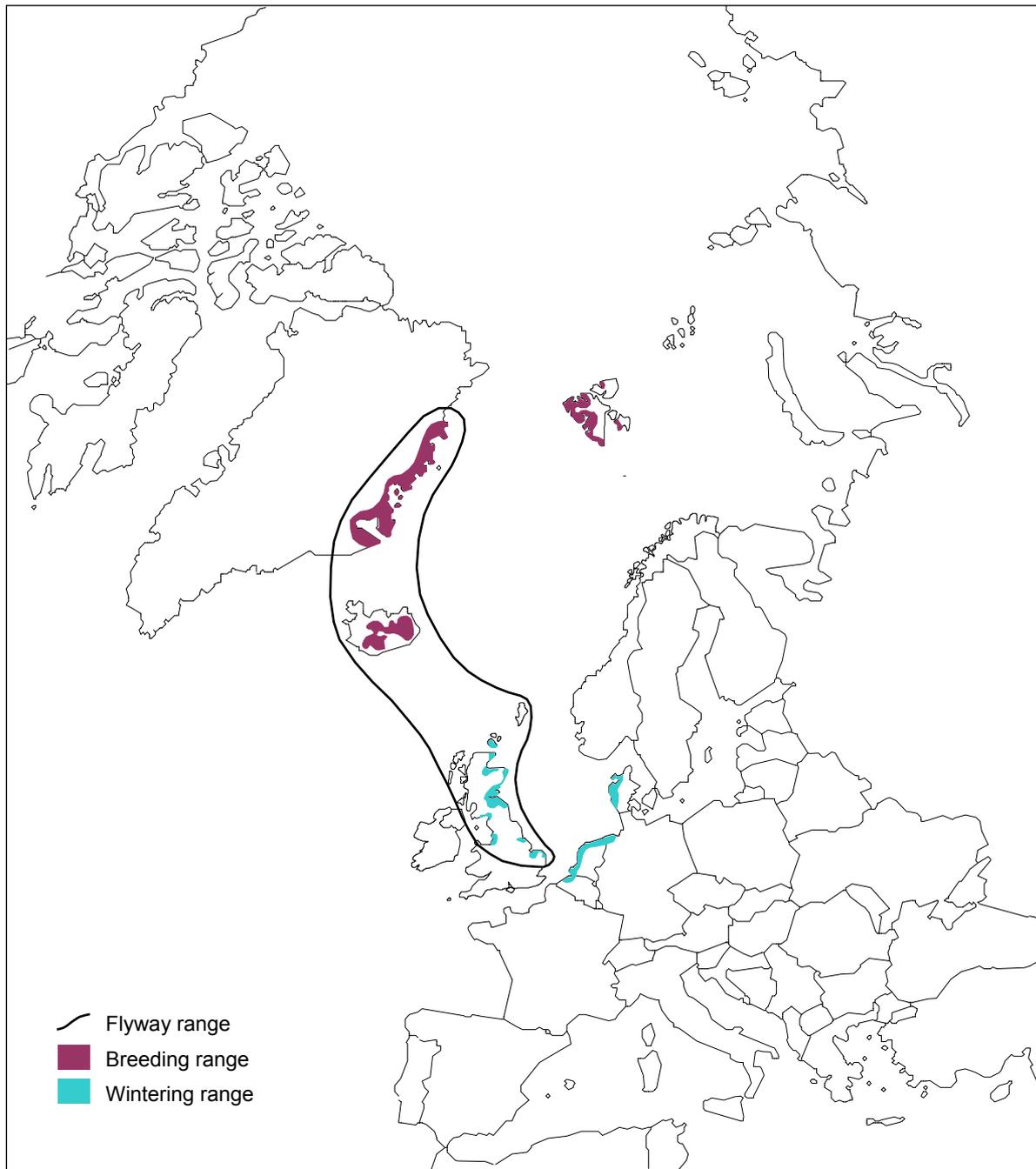
The Pink-footed Goose is an emotive animal. To many, the sight of a flock of Pink-footed Geese flying from a roost, on a bright, clear morning, is truly a wildlife spectacle. The Pink-footed Goose was amongst the first animals to be studied at a population level, by Peter Scott, Hugh Boyd and their colleagues. In world terms, it is not abundant: there are approximately 277,000 in the world, around 85% of which winter in Britain (Wetlands International 2002). Books have even been written about fictional individual Pink-footed Geese (e.g. Watkins-Pitchford 1939, Pope 1995). Yet to some individual farmers, the Pink-footed Goose is considered a pest, a species whose numbers need controlling. In such interactions, conservation and agriculture come face to face.

1.2 Background

The Pink-footed Goose breeds primarily in central Iceland and in smaller numbers along the east coast of Greenland, mostly from Kangertittivaq/Scoresby Sund (70°N) to Nordmarken, northern Germania Land (77°N; Boertmann 1991, 1994) (Fig. 1). East Greenland is a major moulting area for Icelandic breeders. A smaller population, numbering around 37,000 individuals (Wetlands International 2002), breeds in Svalbard and winters primarily in the Low Countries, but is not considered in this review.

In early autumn, Greenland/Iceland Pink-footed Geese migrate to winter almost exclusively in Britain (Fig. 1); very small numbers also occur in Ireland (e.g. Colhoun 2001). Its wintering range is now associated with farmland, taking advantage of reservoirs, other freshwater bodies and estuaries for roosting (Owen *et al.* 1986). Large concentrations can occur in early autumn, especially in east-central Scotland, making annual population estimates relatively easy. There is considerable redistribution in winter especially to sites further south, particularly Lancashire and Norfolk. Birds at the southern limit of the wintering range begin their northward migration through Britain in late winter probably in response to grass growth (Fox *et al.* 1994a). They leave Britain from mid April and stage in the southern lowlands and other coastal areas of Iceland before departing for the breeding grounds in central Iceland or east Greenland, where they arrive from mid May.

Figure 1. Breeding and wintering ranges of Pink-footed Goose *Anser brachyrhynchus* and flyway range of Greenland/Iceland population (adapted from Lack 1986, Madge & Burn 1988, Scott & Rose 1996, Snow & Perrins 1998, Mitchell *et al.* 1999 and WWT data).



Mass summer ringing in Iceland in the early 1950s (Scott *et al.* 1953, Scott *et al.* 1955) and autumn ringing in Britain (Boyd & Scott 1955, Fox *et al.* 1994a) underpins our knowledge of migration routes, phenology and winter distribution. During the 1950s, over 14,000 Pink-footed Geese were newly-ringed in Iceland and over 14,000 were caught in Britain. Since 1987, just over 2,300 Pink-footed Geese have been caught in Britain at Martin Mere (Lancashire), Loch Leven (Perth & Kinross) and a number of others sites in Scotland and these have been fitted with individual plastic leg bands and neck collars. Subsequent analysis of ringing and resighting data, particularly of individually marked birds, has confirmed movements within winter in Britain and the timing of passage through Scotland and Iceland (Fox *et al.* 1994a), and led to a better understanding of population dynamics (Frederiksen *et al.* in press). Studies in Iceland have also provided a basis for understanding of patterns of occurrence there in spring (Fox *et al.* 1992). Ringing has confirmed the geographic discreteness of the Svalbard and Greenland/Iceland populations although a very small number of individuals marked in Denmark have been recorded wintering in Britain.

1.3 Monitoring and population assessment

Owing to former confusion with the Bean Goose *Anser fabalis*, virtually no data exist to assess how common the Pink-footed Goose was in Britain before the 20th century, although it is considered to have been a scarce winter visitor (Berry 1939). Until the early 1900s, there were few data to suggest that Pink-footed Geese bred in Iceland in appreciable numbers (see Freme 1955), although remains of geese have been found in Hvannalindir, central Iceland, which date back to 1770 (Skarphéðinsson 1983). The passage written by Oddson in 1638 (page 1) also alludes to the fact that a sizeable population of geese lived in the Iceland interior and that they were exploited. Oddson's statement that the geese of Iceland wintered in Britain and Ireland is also remarkable, given the ideas then prevalent about bird migration.

The status of the Iceland breeding population in the early part of the 20th century is uncertain. Berry (1939) suggested that, from 1890 to 1930, Pink-footed Geese breeding in Iceland increased and extended their range, yet the expansion may have been held in check as a result of some human exploitation, when a number of colonies (e.g. at Grafarlönd) are known to have been almost wiped out (Einarsson 1983), although the colony at

Hvannalindir, an area inaccessible to egg collectors, also declined during the same period.

1.3.1 Counts

1.3.1.1 Autumn population census

In 1956, Hugh Boyd, at the then Wildfowl Trust (now WWI), was instrumental in putting together a reliable system for estimating the size and distribution of the population on its wintering grounds. The Wildfowl Trust had begun a population study of the Pink-footed Goose in 1950. Early investigations involved expeditions to Iceland to study the breeding biology and distribution of the species, and ringing in Britain and Iceland generated much information on their winter distribution, movements, population size and mortality rates through recaptures and recoveries (Boyd 1955, 1956, Boyd & Scott 1955).

The locations and habits of Pink-footed Geese pose problems for regular counting as they are usually away from their estuarine or lake roost sites during the day. For a long time it did not seem practicable to make a complete census of the geese, because they were widely scattered, not all of their haunts were known and it seemed too difficult to count all the birds even when they were found. After several years of trials, including extensive aerial surveys and the formation of a network of volunteer observers, a census, covering all the haunts likely to be in use at that time of year, was made in early November 1960 and has since been repeated annually.

Counts had to be concentrated on a weekend so that sufficient people could take part and the weekend chosen was normally the first or second in November. Counters were selected from persons with a prior knowledge of the whereabouts and habits of geese in the vicinity and were asked to obtain as accurate a total as possible for the geese using a particular roost, preferably by counting the birds leaving the roost in the morning or returning to it in late afternoon. This was not possible in some places, and here the geese had to be found while feeding in fields, often many kilometres from the roost.

In 1990, a supplementary autumn count was introduced in October, in order to investigate the optimal time to census the species (Kirby & Cranswick 1991), following suggestions by Newton *et al.* (1990) that a better assessment of the winter population could be obtained at this time, when large concentrations were known to occur in east and central Scotland. For some areas at least, counts in

mid November were less accurate as the roosting and feeding behaviour could be unpredictable as a result of disturbance by shooting, temporary flooding or local variability in food supply. Since 1990, the October count has been more accurate (larger) in all except two years (e.g. Mitchell 1996). However, these large autumn flocks soon break up and the geese become more widely dispersed so that autumn distribution may bear little resemblance to the eventual destination of a large proportion of this population.

1.3.1.2 Midwinter counts

The large-scale daytime counts of waterbirds undertaken throughout Britain, under the auspices of the Wetland Bird Survey (WeBS), provide some additional monitoring of individual site use, although, to be effective for geese, the counts need to be carried out at dawn or dusk as birds flight to or from the roost.

The WeBS counts are not as comprehensive as the autumn grey goose counts and, although a great many grey goose roosts are covered, no more than a half of the autumn population estimates are usually recorded by WeBS (Owen *et al.* 1986, Stenhouse & Mitchell 1994). Between 1993/94 and 1995/96, WWT organised additional midwinter roost counts of the principal resorts and despite good coverage, again only a proportion of the autumn population estimates was recorded (Mitchell 1995).

1.3.1.3 Spring counts

A spring count – in late March/early April – has been undertaken periodically, from 1963 to 1967, from 1982 to 1986, from 1988 to 1990, and from 1994 to 1996. Results from the 1960s, though consistent with each other, failed to record sufficient geese to be compatible with the November counts, probably because in late March some geese did not consistently return to roost on permanent water, preferring instead to roost on temporary floodwaters. In addition, after the break-up of the large autumn gatherings, the geese tend to be more widely dispersed in areas that are topographically complex and with few local counters. Numbers will also inevitably decrease to some extent as a proportion of the population is shot during the autumn and winter months.

The most recent spring survey results, from the 1980s and 1990s, were also found to be variable and, at least in the last few years, recorded only about 60% of population estimates established by the previous autumn census (e.g. Mitchell 1995).

Spring is a critical period for geese, and they feed vigorously, storing the nutrient reserves required for successful migration and breeding. Conflict between geese and agriculture can, however, occur when geese compete with livestock for the spring growth in grass leys (Kear 1963). It is thus important to examine the distribution of Pink-footed Geese each spring, in order to identify areas where conflict is likely to occur.

The distribution of the Pink-footed Goose population as shown by the spring counts highlights the importance of northeast and east-central Scotland (Mitchell 1995). Southern Scotland and northwest England can, in some years, hold a substantial proportion of the population, although, east England is almost completely deserted by this time.

1.3.1.4 Other counts

Detailed roost counts have been carried out at some sites for many years (e.g. monthly roost counts at Loch Leven since 1966; monthly roost counts in north Norfolk since 1989) and some local feeding and distribution studies have involved detailed roost monitoring throughout the winter months (e.g. Hearn & Mitchell 1995, Bell & Newton 1995).

1.3.2 Productivity

Field observations of the proportions of first-winter birds and family groups have been used for many years as an indicator of annual productivity (e.g. Lebreton 1948, Boyd & Ogilvie 1969) and this measure has become a standard research tool in monitoring goose population dynamics (reviewed in Owen 1980). Under favourable light conditions, an experienced observer with a good telescope can distinguish Pink-footed Geese in their first winter at distances of up to 300 m. Furthermore, it is possible by prolonged observation to recognise family parties (parents accompanied by their young). Emphasis is placed on a combination of plumage characteristics and behaviour. The collection of information on brood sizes is, however, laborious and often frustrating, so that the annual samples are small in comparison to the total population.

Geese caught for ringing can also be identified as 'adult' or 'first-winter', though family parties cannot be identified. For the years 1950-59, the bulk of the annual sample for the proportion of young consisted of geese caught for ringing in rocket-nets. These may have over-represented the proportion of young, however, as many of the catches were of flocks feeding into the catching area and so were biased

towards families feeding on the leading edge of a flock.

The breeding success of Pink-footed Geese has been assessed through field observations by WWT annually since the late 1950s and a summary of the results has been produced in the annual reports (e.g. Mitchell 1996). Preliminary analyses of the trends in the annual proportion of young, and how these have affected population estimates, were carried out by Boyd & Ogilvie (1969), and more recently by Fox *et al.* (1989) and Pettifor *et al.* (1997).

Nearly all broods in autumn are still accompanied by their parents so that the number of successful parents can be found by multiplying the number of first-winter birds by two and dividing by the mean brood size. For the purposes of determining annual breeding success, assessment is made in a relatively short time window between late October and early November, usually coinciding with the annual census.

Although hard to quantify for Pink-footed Geese, it is reasonably well established that the first goose flocks to arrive in autumn contain a higher proportion of families than later arrivals (M.A. Ogilvie & H. Boyd *in litt.*). This has been demonstrated for Russian-nesting Brent Geese *Branta b. bernicla* (e.g. Lambeck 1990); the percentage of first-winter birds in the Netherlands in autumn declines as migration proceeds, i.e. some families are the first to leave for the final wintering area, where early winter counts would give overestimates of the proportion of first-winter birds. The earliest Pink-footed Geese can arrive in Britain in the first week of September but the main influx is in October and the whole population has usually arrived by the middle of this month. Thus, although the proportion of young may be exaggerated very early on in the season, by early November, since virtually all of the wintering birds will have arrived, the proportion of young should decline slightly to reflect this.

Since breeding success in different parts of the range may vary, there may be inter-flock variation in the age-ratios if the breeding sub-populations remain intact on migration or in winter. This has been demonstrated for Greenland White-fronted Geese (Fox *et al.* 1994b) wintering along the western fringes of Scotland and Ireland. For Pink-footed Geese, mass gatherings at traditional sites in October presumably dilute this effect and promote homogeneity of flocks.

Young geese tend to be concentrated at the advancing edge of feeding goose flocks (e.g. Boyd 1953) and care must be taken when sampling flocks

to avoid only sampling flock edges close to the observer. Goose families generally remain intact throughout the winter and it is recognised that in high-latitude breeding species in undisturbed conditions, groups seen in winter represent a pair and their progeny. There is evidence, however, that family units can begin to break-up as the season progresses. Certainly for *Branta* species some family break-up may have occurred by January (Owen unpubl.), and van Impe (1978) found some evidence of break-up in January-March in European White-fronted Geese *Anser a. albifrons*.

Shooting in autumn and winter accounts for the majority of losses in Pink-footed Geese (Fox *et al.* 1989) and, with winter food supplies being adequate in most years, this mortality is responsible for reducing numbers. In many studies of hunted species, juvenile mortality is higher than that for adults (e.g. Gitay *et al.* 1990).

In addition to the above, as the season progresses it becomes increasingly difficult to age grey geese in the field. First-winter geese undertake a body moult during the winter, the timing of which may vary, and key feather tracts used to determine young birds (e.g. mantle, breast and neck) are replaced with feathers similar in size and shape to those found in older geese. Thus, there are considerable differences in the appearance of individual juveniles: some are well developed and have begun to moult in November; others retain most juvenile characteristics well into the winter. The wing feathers, however, are not moulted at this time and are retained until the summer moult.

1.3.3 Ringing

WWT undertook extensive ringing in Britain during the 1950s based mainly on catches made in the autumn. Between 1950 and 1959, over 14,000 Pink-footed Geese were newly ringed and some 3,000 retrapped. This generated 3,753 recoveries and knowledge of the movements (Boyd 1955, Fox *et al.* 1994a) and population dynamics (Boyd 1956) of the species was greatly advanced. The autumn weights of Pink-footed Geese in northern Britain were examined by Beer & Boyd (1962) and Elder (1955). Since 1987, Pink-footed Geese have been caught in smaller numbers at a number of sites in northern Britain (mainly Martin Mere, Loch Leven, and sites close to the Ythan Estuary) and these have been fitted with plastic leg rings and/or plastic neck collars.

In Iceland, two periods of large-scale ringing have taken place, the first during the early 1950s and the

second in the late 1990s. In 1951 and 1953, Peter Scott, and others from WWT and the Icelandic Institute of Natural History (IINH), made two successful expeditions to Þjórsárver, the principal breeding area in Iceland, where they caught and ringed more than 10,000 Pink-footed Geese. Some years later, another joint WWT/IINH initiative captured some 1,300 adult and 2,100 goslings at breeding sites in the northern Highlands and Þjórsárver during the period 1996-2000. Of these, 93% were colour-marked with either a plastic leg ring (mostly goslings) or a plastic neck collar (mostly adults).

1.3.4 Hunting bags

The Pink-footed Goose is legal quarry throughout its range, although restrictions, particularly in the form of close seasons, operate throughout. Further details concerning hunting and its management are provided in section 1.5.2.

The quality of bag monitoring varies greatly between Iceland and Britain. In Iceland, a mandatory licensing system was introduced in 1995, requiring all hunters to renew their hunting licence annually. Licences are only renewed upon submission of a record of the number of each species taken in the previous year (Sigfússon 1996). Reporting of hunting bags is carried out anonymously, thus encouraging high compliance. Since this system began, an average of 11,589 hunting licences has been issued each year and 92.4% of licensees returned an annual report. In addition, a study of the age ratio of the hunting bag for Pink-footed Goose was carried out between 1995 and 2000. Goose wings were collected from hunters and from a company preparing wild geese for sale to restaurants and supermarkets, and were aged as either adult or first-winter.

In Britain, however, no governmental monitoring of bag size is carried out. The British Association for Shooting and Conservation (BASC) has monitored the shooting of geese throughout the country for many years, though information is limited to that provided by its members. This approach is currently being developed, in conjunction with the Scottish Executive, to provide a system for estimating the annual shooting kill of geese in Scotland as a whole.

1.3.5 Population assessment

1.3.5.1 Abundance

The autumn censuses provide an accurate assessment of abundance in Greenland/Iceland

Pink-footed Geese and indicate that the population has increased from 20,000-30,000 birds in the mid 1950s to 200,000-250,000 individuals in the mid 1990s (Fig. 2). The increase shows four distinct phases: growth at about 14% per annum in the 1950s to mid 1960s; near stability at just under 100,000 from the mid 1960s to the mid 1980s; growth at 11% per annum to a high point of over 250,000 from the mid 1980s to 1994; and stability during the late 1990s (see Pettifor *et al.* 1997). The substantial increases, particularly during the late 1980s, are considered to be attributable to site safeguard of important winter roosts, improved winter feeding conditions and a decline in overall mortality (Fox *et al.* 1989).

During the early autumn, as much as 90% of the population can be counted on as few as 30 roost sites (e.g. Mitchell 1996). Dramatic increases in the number of geese using some roosts have mirrored the general population increase (e.g. Loch of Strathbeg, Dupplin Loch, Snettisham, Southwest Lancashire, Montrose Basin, West Water Reservoir and Loch Leven).

1.3.5.2 Productivity

Breeding success has always been variable in this population: between 1950, when recording began, and 1999, the proportion of juveniles in autumn varied between 5.6% and 48.8% (mean 20.4%, 1.12 s.e.), although the estimate of 48.8% from 1950 is probably derived from a rocket-netted sample and is thus likely to be biased in favour of young birds (Fig. 3). Sample sizes up to 1970 were, however, small (often fewer than 1,000), and, since that year, in excess of 25% young in autumn flocks has only been recorded in two years. Using all age counts from 1950, a density-dependent reduction in productivity was evident up to the early 1980s, a process that was adequate to explain the pattern of growth and stability until that time (Pettifor *et al.* 1997). Since then, productivity has increased again and partly provided an explanation for the recent resumption of rapid growth in the population; density-dependence in productivity from the mid 1980s to 1992 could not be detected.

The long-term (1970-1999) mean for the proportion of young in the autumn population is 17.3% (0.96 s.e.) and there has been no significant trend (R^2 0.002, $F_{1,28} = 0.05$, $P = 0.83$) in breeding success during the last 30 years.

Table 1. Breeding success of Pink-footed Geese as five-year means, 1970-1999

Period	% young	brood size
1970-74	20.8	2.1
1975-79	11.7	1.9
1980-84	17.7	2.0
1985-89	22.5	2.4
1990-94	17.9	2.1
1995-99	17.2	2.3
Overall	17.3	2.1

Over 50% of the variation in breeding success was related to meteorological variables on the wintering grounds in spring prior to departure and on the nesting grounds (Fox *et al.* 1989). Given that some early productivity estimates may be biased high, there has been no apparent decline in breeding success as the number of birds in the population has increased, particularly during the period of greatest growth. It is suggested that the lack of decline in breeding output may be due to an extension of the breeding range into new areas where breeding success is comparable with that in the former range. The mean brood size during a similar period (1970-1999) was 2.1 (0.07 s.e.).

Geese wintering in different parts of the autumn range in Britain can exhibit different levels of breeding success, although annual patterns are correlated: a good breeding season means a high proportion of young in all areas, while a poor season, as in 1992, is reflected in low productivity. It has been important to obtain estimates in the field of the proportion of young geese in as many different areas as possible, although the significance of the differences has not been fully examined.

Examination of shot Pink-footed Geese at Loch Leven showed that the proportion of young in the bag was much higher (approximately double) than the corresponding percentages found in observations of flocks (Wright & Boyd 1983) although this effect declined as the winter progressed. Similar results were obtained ten years later when Hearn & Mitchell (1995) found 60% young (n=84) in the bag sample at Loch Leven in October to December compared with 15% young in the field (n=5,539).

1.3.5.3 Hunting mortality

Hunting bag estimates from Iceland show that around 10,000-15,000 Pink-footed Geese are shot there every year (Fig. 4a), far fewer than the less abundant Greylag Goose *Anser anser*. First-winter birds form a greater proportion of the bag than they do of the whole population (Fig. 4b), although the

timing of field assessments means that this difference is likely to be less than suggested by the data. Between 1995/96 and 1999/2000, the proportion in the Icelandic bag varied from 0.27 to 0.43 (mean 0.33, 0.03 s.e.), compared to 0.14 to 0.20 (mean 0.17, 0.01 s.e.) in autumn flocks during the same period.

In Britain, simple estimates of the bag size suggested that around 15,000-25,000 are shot each year (Reynolds & Harradine 1994, 1996). This is supported by a more recent estimate of 25,000 produced using Icelandic bag statistics, ring recoveries and population models (Frederiksen 2003).

1.3.5.4 Survival

Crude adult survival rates (November to November) based on age ratios and census data (after the method of Ogilvie & Boyd 1976) suggest that annual survival varies considerably between years. Overall, mean estimates for ten-year periods since 1950 imply that survival was highest during the 1950s, rising to a second peak during the 1980s (Fig. 5).

This corresponds fairly well with the observed population trend but, as these survival estimates are not independent of census data, this is to be expected. Furthermore, basic problems with these data are highlighted as in some years the survival estimate is greater than one. Of the five years in which this occurs, four are in the 1950s, suggesting that problems with census methodologies had not been resolved at that stage. An analysis of ringing data from the years 1950-1958 estimated survival during this period as 0.86 (Gitay *et al.* 1990). Since 1960, however, these data appear considerably more reliable: only in 1984 has the survival estimate exceeded one, almost certainly because of a low count that year. It is notable that these erroneous survival estimates coincide with the two decades with the highest mean estimate. It is possible that similar anomalies exist in other years when survival is less than one, but these are harder to detect as the derived survival estimate is theoretically possible.

Fox *et al.* (1989) and Pettifor *et al.* (1997) used such crude survival estimates derived from count and productivity data in their analyses. Pettifor *et al.* (1997) found that no trends were discernible in the estimated annual survival probability when plotted against lagged population size, either when using data from years 1960-1992, or when restricted to 1975-1992. They found no evidence of a density-dependent relationship in survival probability, but suggested that conclusions regarding the true survival patterns of Pink-footed Geese must await an

analysis of data from colour-marked birds. Furthermore, they concluded that, although density-dependence in productivity is the most important regulating factor in the population, the size of the population is determined more strongly by survival rates.

Bell *et al.* (1995) carried out comparisons of survival using ringing recovery data from 1950-1958 and 1987-1991 and found no significant change in adult survival rate (86% and 85%, respectively). First-year survival rates were lower in more recent periods (58%) than for the 1950s (77%), but given the low precision of these estimates, it could not be inferred that there had been a significant decline in juvenile survival rates (Bell *et al.* 1995). Estimated annual survival rates using capture-recapture models based on resightings of leg-ringed birds were 79% for adults and 54% for first-year birds, although both were likely to be under-estimates owing to geographical differences in resighting effort and local emigration effects (Bell *et al.* 1995).

More recently, survival estimates using re-encounters of colour-marked individuals and recoveries of dead birds were calculated by Frederiksen *et al.* (in press). Both seasonal and annual survival were estimated for the period 1987-2000, although first-winter survival for the summer-to-autumn interval was only possible for the period 1996-2000, when ringing took place in Iceland.

First-winter survival from ringing until arrival in Britain (summer-to-autumn interval) varied considerably among years, from 0.40 in 1999 to 0.64 in 1996; mean survival was 0.512 (95% C.L. 0.446-

0.577), although excluding 1987 the mean was 0.497 (95% C.L. 0.436-0.558). Adult survival over the same interval varied from 0.90 in 1999 to 1 in 1988 and 1993, with a mean of 0.949 (95% C.L. 0.930-0.963); the mean for the 1996-2000 period was 0.924 (95% C.L. 0.899-0.944). During the autumn-to-spring interval, first-winter survival ranged between 0.71 in 1992/93 and 0.89 in 2000/01. Mean survival for the entire study was 0.784 (95% C.L. 0.722-0.836) and the 1996-2000 mean 0.811 (95% C.L. 0.748-0.862). Adult overwinter survival varied from 0.84 in 1992/93 to 0.95 in 2000/01, with a mean of 0.886 (95% C.L. 0.859-0.909); the 1996-2000 mean was 0.902 (95% C.L. 0.871-0.927). Survival during spring-to-summer was constant for all ages at 0.976 (95% C.L. 0.962-0.985) (Fig. 6).

Frederiksen *et al.* (in press) also calculated annual survival (Fig. 7) and found it was more variable when calculated from summer-to-summer than from autumn-to-autumn. First-year survival varied from 0.33 in 1999/2000 to 0.47 in 1987/88 and 1996/97, with a mean (excluding 1987/88) of 0.394 (95% C.L. 0.339-0.451). First-winter autumn-to-autumn survival varied from 0.68 in 1996/97 to 0.81 in 1987/88, with a mean of 0.726 (95% C.L. 0.668-0.778); the 1996-2000 mean was 0.732 (95% C.L. 0.674-0.784). Annual adult survival varied from 0.78 to 0.89 when calculated from autumn-to-autumn and from 0.76 to 0.86 when calculated from summer-to-summer. The mean for all years was 0.821 (95% C.L. 0.791-0.848), and the 1996-2000 mean was 0.814 (95% C.L. 0.779-0.845).

A summary of the survival estimates from these various studies is provided in Table 2.

Table 2. Estimates of annual survival of Pink-footed Geese. Survival: 'First-winter' denotes survival during the first year after fledging, not survival of first-winter birds ringed in autumn. Method: 'Crude' denotes estimates based on population counts and age ratios in autumn, according to Ogilvie & Boyd (1976) (these estimates represent weighted means of adult and first-winter survival); 'Combined' denotes the use of both recovery and re-sighting data, according to Burnham (1993). Table adapted from Frederiksen *et al.* (in press).

Period	Annual survival		Method	Source
	First-winter	Adult		
1950-1958	0.77	0.86	Recoveries	Gitay <i>et al.</i> (1990)
1987-1994	0.58	0.85	Recoveries	Bell <i>et al.</i> (1995)
1987-1994	0.54	0.79	Resightings	Bell <i>et al.</i> (1995)
1960-1987		0.81	Crude	Fox <i>et al.</i> (1989)
1960-1996		0.86	Crude	Pettifor <i>et al.</i> (1997)
1987-2000		0.84	Crude	WWT unpublished data (from Frederiksen <i>et al.</i> (in press))
1987-2001		0.82	Combined	Frederiksen <i>et al.</i> (in press)
1996-2001	0.39	0.81	Combined	Frederiksen <i>et al.</i> (in press)

Figure 2. The number of Pink-footed Geese counted during autumn censuses, 1960/61-1999/2000

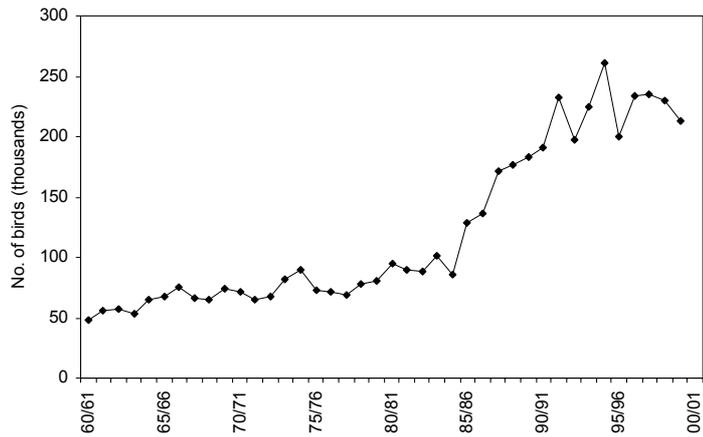


Figure 3. The proportion of first-winter birds (bars) and mean brood size (dots) of Pink-footed Geese, 1950/51-1999/2000.

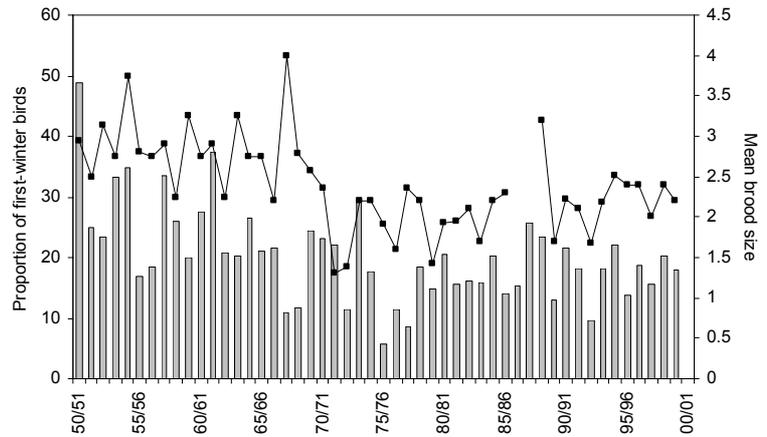


Figure 4a. The total numbers of Pink-footed Geese shot in Iceland, 1995/96-1999/2000.

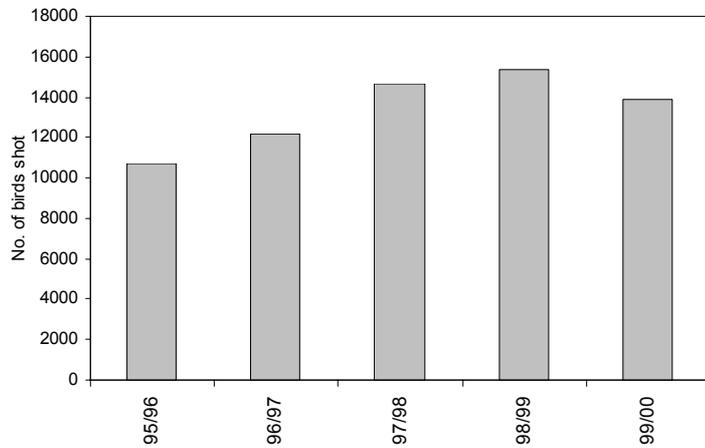
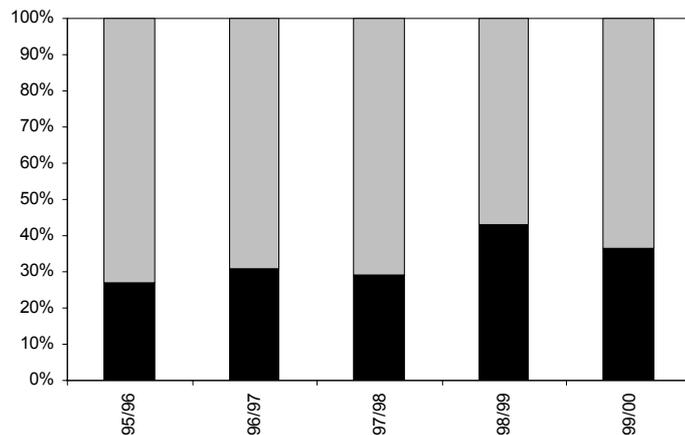


Figure 4b. The proportion of different age classes (black – juveniles; grey – adults) in the Pink-footed Goose bag in Iceland, 1995/96-1999/2000



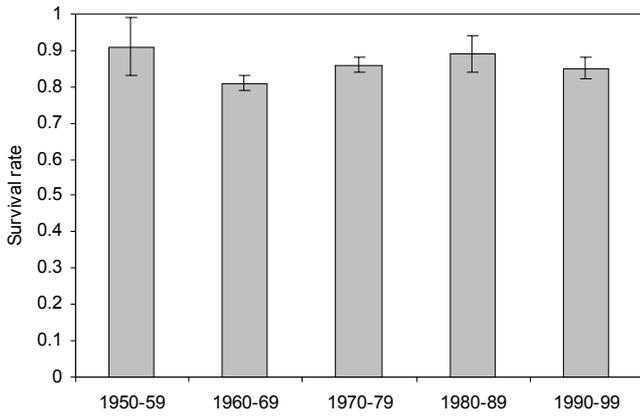


Figure 5. Crude adult survival rates (November to November) for Pink-footed Geese based on age ratios and census data (after the method of Ogilvie & Boyd 1976).

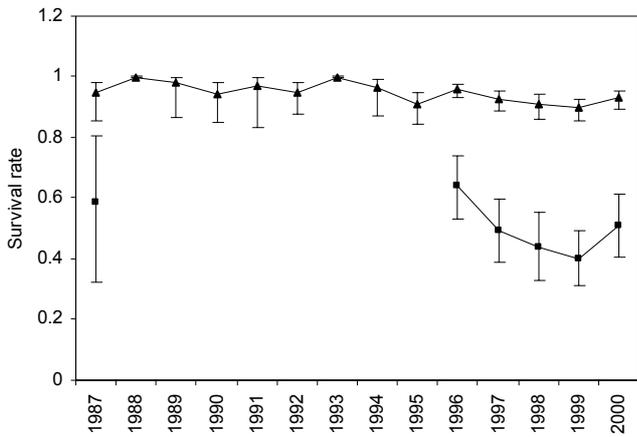


Figure 6a. Summer-to-autumn survival of Pink-footed Geese (estimates are shown with 95% confidence limits) (triangles – adults; squares – juveniles). Reproduced with permission from Frederiksen *et al.* (in press).

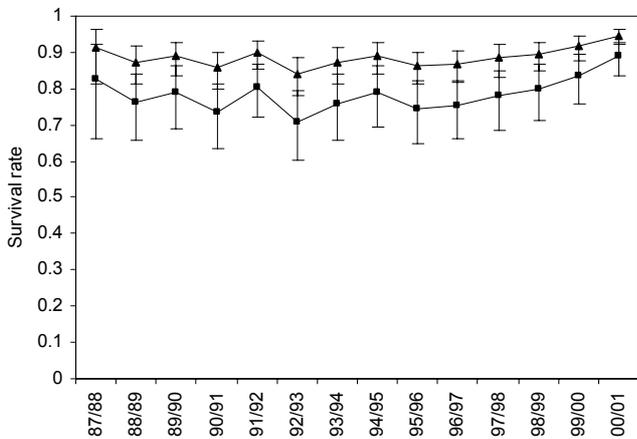


Figure 6b. Autumn-to-spring survival of Pink-footed Geese (estimates are shown with 95% confidence limits) (triangles – adults; squares – juveniles). Reproduced with permission from Frederiksen *et al.* (in press).

Figure 7a. (a) Annual summer-to-summer survival of Pink-footed Geese (estimates are shown with 95% confidence limits) (triangles – adults; squares – juveniles). Reproduced with permission from Frederiksen *et al.* (in press).

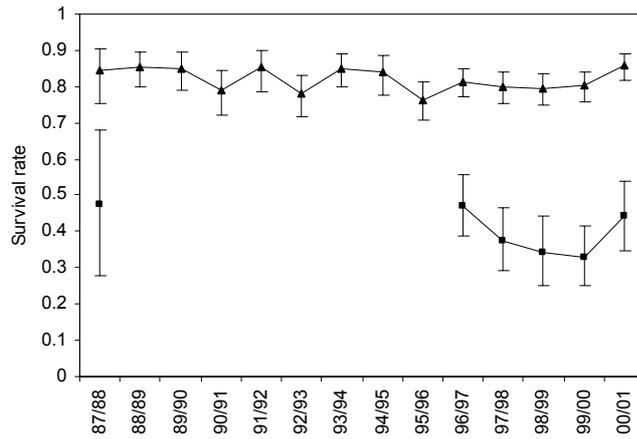
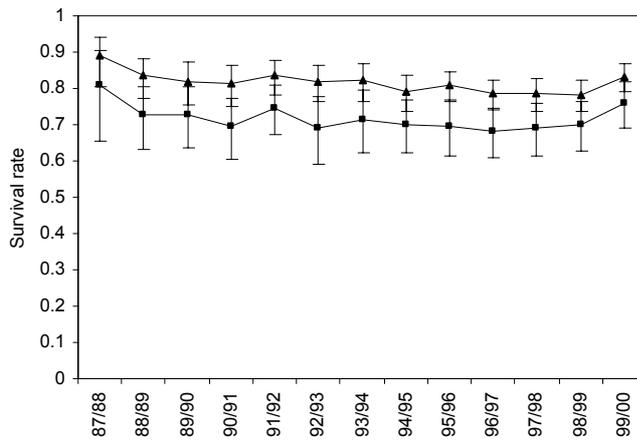


Figure 7b. Annual autumn-to-autumn survival of Pink-footed Geese (estimates are shown with 95% confidence limits) (triangles – adults; squares – juveniles). Reproduced with permission from Frederiksen *et al.* (in press).



1.3.5.5 Population modelling

A number of attempts to model the growth in this population have been carried out (Ogilvie & Boyd 1976, Fox *et al.* 1989, Pettifor *et al.* 1997, Frederiksen *et al.* in press), but as the three earlier studies used crude survival estimates derived from autumn counts and estimates of productivity, the resulting models could only predict continued population growth at the rate described by the autumn counts, since the survival estimates are not independent of the counts (Frederiksen *et al.* in press).

The survival estimates of Frederiksen *et al.* (in press) are independent of census data, and can be used to verify the reliability of the population estimates and trends. They were used in conjunction with hunting bag estimates from Iceland to develop a set of population models for the period 1996-2000 that allowed such an independent assessment of population size and trend to be made, and thus assess the accuracy of current counting effort and the impact of hunting on the population.

For Pink-footed Geese, it was difficult to explain the rapid change in growth rate that occurred around 1992-1994 from what is currently known about demographic parameters in this population, as no large changes in survival or productivity around that time were detected. Data were not available for a number of these demographic parameters, however. Regarding the cause of the rapid increase that began in the early to mid 1980s, Frederiksen *et al.* (in press) were able only to speculate that survival was high at that time and this, coupled with two successive successful breeding seasons (1987 and 1988), led to the rapid increase in abundance.

The models suggested that autumn count and hunting mortality data were accurate, balancing with a slight increase in the observed proportion of first-winter birds (20% rather than 18%). A lack of precision in a model parameter could account for this discrepancy, however, as the observed proportion of first-winter birds corresponds to an annual adult survival of 0.83, well within the 95% confidence interval estimated (0.779-0.845).

1.4 Annual cycle

1.4.1 Breeding season

1.4.1.1 Range

The breeding range was traditionally centred on Þjórsárver, a remote wet meadow area in the central Iceland plateau, associated with the glacial melt rivers draining the Hofsjökull. The highest density of nests in this area (and in other colonies) occurs on river banks and streams – the first sites to become snow free in spring. Breeding also occurs on inaccessible cliffs (also among the first sites to become snow free) in areas where predator avoidance may be important. Much of the restricted breeding distribution, which was still evident in the 1950s, may have been the result of human exploitation during the early part of this century, when a number of colonies were known to have been reduced as a result of egg collecting (Einarsson 1983). In the 1960s, it seems that improved conditions on the wintering grounds resulted in the recolonisation of areas away from the major inland concentrations, notably Þjórsárver, usually in *Carex*-dominated wetlands which occur in the interior. It seems likely that the recolonisation of many formerly occupied nesting areas led to some overgrazing of local food resources, and perhaps decreasing breeding performance, most importantly at Þjórsárver. By the late 1970s, density-dependent factors operating at these interior sites were probably swamped at the overall population level by the breeding success of birds starting to consolidate at recolonised colonies, e.g. a doubling in the breeding population at Hvannalindir between 1976 and 1980 (Skarphéðinsson 1983). In the well studied Jökulsá á Fjöllum area, there were 670 pairs in 1981 and 1,600 pairs in 1988 (K. Skarphéðinsson *in litt.*). In northeast Iceland, the number of nesting Pink-footed Geese has increased dramatically, as the numbers of nests at almost all of the older colonies have increased and several new colonies have been formed. Numbers in eastern Iceland have increased from 1,800 pairs in 1981 to 4,000 in 1988 (K.H. Skarphéðinsson *in litt.*). The annual mean growth rate in the number of nesting pairs at 16 studied colonies was 8.3%, similar to the general growth rate in the population at that time (8.5%, from Fox *et al.* 1989). With the recent increase in population size, the breeding range expansion has brought increasing numbers into lowland areas, where birds nest on islands in areas and habitats formerly associated with the Greylag Goose, and even down to sea level (Skarphéðinsson & Guðmundsson 1990).

In east Greenland, Pink-footed Geese breed from Kangerittivaq/Scoresby Sund (c. 70°N) northwards to Germania Land (77°N; Meltofte 1976, Boertmann 1994), where breeding is thought to be scattered (Madsen & Mortensen 1987). Breeding also has been confirmed in the Ammassalik area (66°N) and probably in the Akerninnarmiit/Skjoldungen area (63°N). Numerous non-breeders, including a large contingent from Iceland, moult in the area (Boertmann 1991).

1.4.1.2 Phenology

In most years, clutch initiation begins in late May. Incubation lasts 26-27 (exceptionally 25 or 28) days and, after hatching, families tend to aggregate into larger groups, often of several hundred, when the young are 10-20 days old. At about this time the adults become flightless. Goslings fledge after about 56 days (Cramp & Simmons 1977).

1.4.1.3 Dispersal

Once breeding pairs have settled into their territory, little movement takes place. In most cases, broods are reared close to the original nest site, although they may move long distances on foot from the nesting areas at this time. Successful adults moult in this location too. Non-breeders tend to separate from the breeding pairs, forming loose flocks, and may make short movements at this time of year to more preferred moulting locations (see 1.4.1.5).

1.4.1.4 Habitat and feeding ecology

Breeding in the interior occurs on inaccessible flat oasis areas and in cliff colonies. In the eastern interior of Iceland breeding sites are primarily in river gorges on ledges, pinnacles or steep cliff ledges, on islands, river banks and braided river flats, or on cliff sites, some of which are many kilometres from the nearest river (K.H. Skarphéðinsson *in litt.*). Palsa or tussock nesting is scarce in eastern Iceland and generally a high proportion of nest sites are accessible to Arctic Foxes *Alopex lagopus*.

Studies at Þjórsárver showed that nest success varied according to how early nests were initiated and the ability of individual females to gain sufficient food during their short absences from the nest (Inglis 1977). Recesses (time spent away from the nest) by some females increased the tendency to vacate the nest again and the duration of the recesses grew greater, and Inglis (1977) concluded that breeding experience may be a crucial factor governing the strength of the female's attachment to the nest.

Pink-footed Geese eat green parts, roots and fruits of a wide variety of tundra plants. The main foods include rhizomes and the seeds of alpine bistort *Polygonum viviparum*, shoots of horetail *Equisetum variegatum*, and cotton grass *Eriophorum* and, in the autumn, the seed heads of sedge *Carex*. Adults feed at first on leaves and catkins of willow *Salix glauca*, switching gradually to graminoids (*Carex*, *Calamagrostis stricta*) which form nearly the whole diet in July and early August. At first, goslings take more herbs and *Equisetum* than adults (Garðarsson 1976). From August, the leaves and ripened fruit of crowberries *Empetrum nigrum* and *E. bermaphroditum* become increasingly important, coinciding with the movements of geese from marshes to higher and drier areas.

In Greenland, Pink-footed Geese breed in areas with lush meadow vegetation, nesting on top of river banks, cliffs and large hummocks (Madsen *et al.* 1984, Boertmann 1994). Moulting birds utilise a range of habitats, but generally favour extensive lowland sedge-rich meadow areas close to early-thawing open water such as lakes and rivers, but including the sea. The *Carex subspathacea* meadows associated with the coast or floodplains of major rivers are favoured areas (Madsen & Mortensen 1987). During the moult the geese are extremely wary and depend on a safe area of water serving as a refuge with nearby food supplies (sedge dominated marshes), grazing up to 200-250 m from the refuge. Food intake was estimated at 149 g organic material per 24 hours, which accounted for up to 100% and c. 60-69% of above ground primary production of a *Carex subspathacea* marsh in 1983 and 1984, respectively (Madsen & Mortensen 1987). The geese spent 41-46% of the 24 hours grazing. Madsen & Mortensen (1987) suggested that the moulting grounds in Jameson Land had reached carrying capacity: Pink-footed Geese competed with Barnacle Geese *Branta leucopsis* for resources with the latter suffering from the presence of the former. Moulting coincided with the onset of growth and peak nutrient levels in the vegetation and it was suggested that Pink-footed Geese undertake a moult migration to east Greenland to avoid competition for resources with breeding geese in Iceland and because they gain advantage from a growing, nutritious vegetation (Madsen & Mortensen 1987).

1.4.1.5 Moulting migration and moulting areas

There is a massive well-described moult migration from Iceland to northeast Greenland involving many thousands of non-breeding birds that arrive during late June and early July (Christensen 1967, Meltofte 1976, Madsen & Mortensen 1987). The major moulting range extends from

Kangertittivaq/Scoresby Sund (70°N) to Germania Land (77°N), with further records north to Konsprins Christian Land (80°N) and Peary Land (83°N), and south to Ammassalik (66°N) and Akerninnarmiit/Skjoldungen (63°N) (Boertmann 1994). Large numbers of moulting Pink-footed Geese concentrate in Germania Land (9,000), Hochstetter Foreland (6,500), Jameson Land (6,000), Hold with Hope (3,000) and Woolaston Foreland (2,000) (Madsen 1984, Madsen *et al.* 1984, Boertmann 1991, J. Turner *in litt.*). Moulting flocks are common along coastlines, in wide rivers and on lakes with open views on all sides. Southward dispersal and main departures from the Greenland breeding and moulting grounds begins in late August when Pink-footed Geese cross to the interior of Iceland joining the breeding and moulting stock there. There is little evidence of staging in Iceland lowland areas in autumn on route to Britain.

The most important non-breeding moulting concentration in Iceland occurs in Eyjabakkar, on an area of vegetated sand flats in the middle of the Jökulsá glacial melt river draining the Vatnajökull in eastern Iceland, where 9,000-13,000 birds have moulted (Fox *et al.* 1987, Skarphédinsson *in press*). Eyjabakkar is currently threatened with inundation by a hydro-electric scheme. Other important moulting areas for non-breeding birds occur around Þjórsárver and the River Þjórsá, where 5,800 were counted in 1991, and around the River Blanda, north of the Hofsjökull glacier, with 1,700 also in 1991 (Skarphédinsson *in press*).

1.4.2 Autumn migration

1.4.2.1 Range

The range at this time remains as it is during the breeding season: there is little evidence of staging in autumn prior to migration to the wintering grounds. Localised redistribution after completion of the moult undoubtedly occurs in some areas, probably in response to local food availability, although this has not been quantified and is likely to be limited.

1.4.2.2 Phenology

Pink-footed Geese generally start to arrive in Britain during early to mid September, especially at major sites, with numbers building in early to mid October. The arrival is pronounced at several well-defined staging areas, especially in northeast Scotland (Loch of Strathbeg), eastern Scotland and the Lothian/Borders area (Newton *et al.* 1990, Brown & Brown 1992): 62,000 Pink-footed Geese were

counted at Dupplin Loch in October 1994, constituting almost a quarter of the population at this one site. Peak numbers occur at major sites generally in the middle of October (Newton *et al.* 1990, Mitchell 1996).

1.4.2.3 Dispersal

Post-migration dispersal is described in section 1.4.3.3.

1.4.2.4 Habitat and feeding ecology

The autumn migration does not include any land mass, consequently, no specific habitats are used at this time. Post-migration habitat use is described in section 1.4.3.4. Studies have not been made of the migration from Iceland to wintering locations. Thus, the height, duration and timing of the migration flight are poorly understood.

1.4.3 Winter

1.4.3.1 Range

The winter distribution of Pink-footed Geese is essentially the east and south of Scotland, northwest and east England and has not changed markedly since the reviews of Boyd (1955) and of Ogilvie & Boyd (1976).

A contraction in the wintering range from the early 1950s to the early 1970s (with particularly dramatic increases in numbers in east-central Scotland) has reversed in recent years as a result of increasing numbers in Lancashire and north Norfolk (e.g. Watkinson & Sutherland 1996), where up to 20% (1982) and 41% (1994), respectively, of the midwinter totals have been counted (Forshaw 1983, Mitchell 1995).

Numbers on the Lincolnshire side of the Wash and in Humberside have not recovered to earlier (1950s) levels, despite the increase in the population as a whole. Although there has been an eight-fold increase in numbers, the early autumn distribution of Pink-footed Geese in Britain has remained consistent with earlier years, with birds particularly loyal to roosts. A number of new roosts within the existing range have, nevertheless, been occupied during the last 20 years in central Scotland (Bell & Newton 1995). This is in contrast to northeast Scotland, where numbers have increased greatly, but where birds have remained loyal to the traditionally occupied sites of Loch of Strathbeg and Meikle Loch (Bell *et al.* 1988).

1.4.3.2 Phenology

There is considerable redistribution in winter, especially to sites further south, particularly Lancashire and Norfolk, where peak numbers occur in January. Pink-footed Geese start to move north again as early as February, when numbers peak in the Fylde and the Solway Estuary (e.g. Mawby 1995). Pre-migration peaks in numbers on the Ythan Estuary, Loch of Strathbeg and on the Moray Basin are recorded in late March (Mitchell 1995). The return passage to Iceland starts in mid/late April, with passage evident from ground-based observations on the Western Isles (e.g. Dix 1991). This appears to differ little from patterns recorded from observations early in the 19th century (Berry 1939) and in the late 1950s and early 1960s (Marr *et al.* 1959).

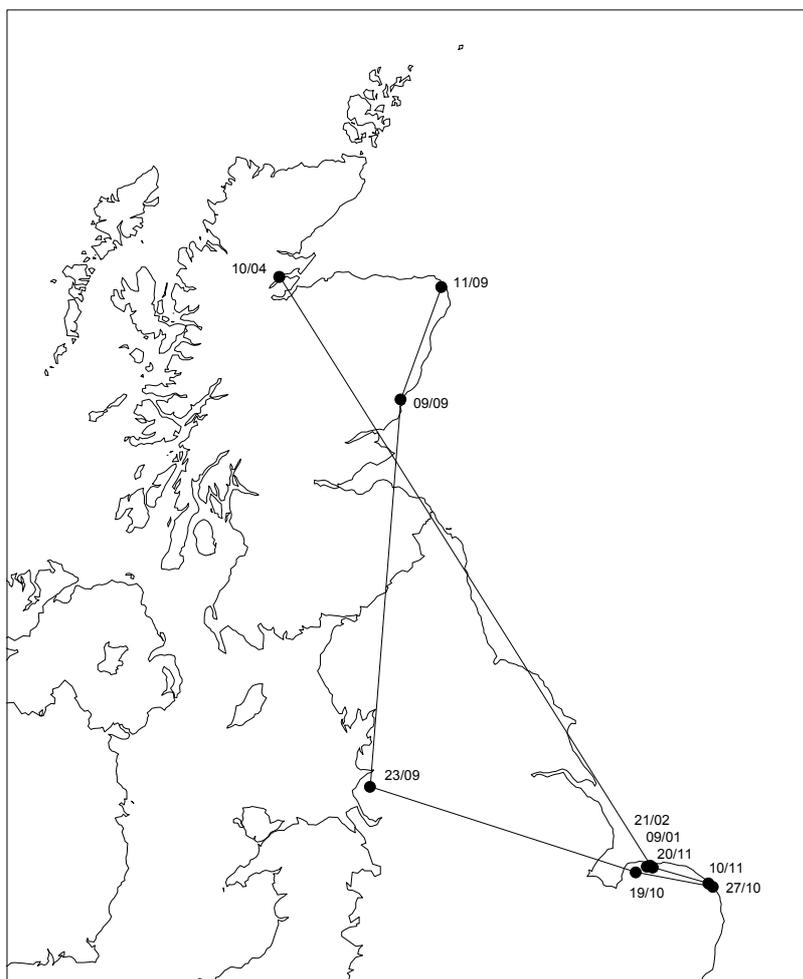
1.4.3.3 Dispersal

Counts show that the distribution of Pink-footed Geese in different parts of their winter range in Britain changes within seasons (Fox *et al.* 1994a)

. Large numbers arrive during October and November in Aberdeenshire, east-central Scotland, the Borders, Lothian and Lancashire. Numbers peak in England during mid winter, with a few persisting into spring. From January there is a conspicuous migration northwards in Britain, with some Pink-footed Geese moving through the Fylde, the Solway and east-central Scotland, reaching northeast Aberdeenshire and the Moray Firth by mid March. Maximum numbers occur in these last two areas from March onwards and peak during April.

Fox *et al.* (1994a) compared the movements of individually colour-marked Pink-footed Geese with recovery and recapture data from the 1950s and concluded that this pattern is long established. Resightings of individually marked birds confirm 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 northeast Scotland and the Moray Basin (Fox *et al.* 1994a). An example of the within-winter movements of an individually marked Pink-footed Goose is shown in Fig. 8.

Figure 8. The within-winter movements of an individually-marked adult male Pink-footed Goose.



Boyd (1955) showed that some Pink-footed Geese were sedentary in winter, although others were relatively mobile. Adults were more sedentary than birds caught in their first winter, but there were regional differences. A high degree of site fidelity was recorded by Fox *et al.* (1994a) with up to 76% of Pink-footed Geese returning to the same site between winters. Major shifts in the distribution of wintering Pink-footed Geese also demonstrate this species' mobility in responding to adverse weather conditions or food availability. The site-loyalty therefore fits within a more flexible wintering strategy that takes wintering birds through a series of different localities in response to weather and food availability (see Forshaw (1983) and Bell (1988) for details of local changes in distribution and abundance in response to feeding behaviour).

1.4.3.4 Habitat and feeding ecology

The traditional main winter habitat is thought to have been saltmarsh (Owen 1976), but from late 19th century the species has moved inland to feed on farmland, taking advantage of reservoirs, other freshwater bodies and estuaries for roosting (Owen *et al.* 1986). The geese tend to be conservative in their choice of roost, preferring sites larger than 20 ha in areas that are sheltered and quite isolated (Owen *et al.* 1986). Roosts may be shifted locally in response to disturbance – Pink-footed are the most wary of geese – or feeding conditions (Giroux 1991, Keller *et al.* 1998). When the density of birds is high, birds may be forced to fly further afield and will adopt or establish new roost sites closer to the feeding areas (Gill *et al.* 1996).

In northeast Scotland, individually marked Pink-footed Geese changed their roost approximately once every 10 nights between December and April and, on average, each bird visited 3.4 roosts, returning to the same site on many occasions (Giroux 1991). In the Strathallan area of central Scotland, use of the main roost showed little seasonal variation, occupancy being 89% in autumn, 90% in winter and 93% in spring (Bell *et al.* 1998). In central Scotland, the main determinant of choice of roost was freedom from disturbance by people, and especially by shooting; other factors such as exposure, shoreline vegetation, including trees, and availability of grazing seemed unimportant (Bell *et al.* 1998).

Newton & Campbell (1973) showed that Pink-footed Geese usually fed in larger and tighter flocks than did Greylag Geese, although both species fed increasingly in small flocks as the season progressed (see also Hearn & Mitchell 1995). There was a tendency for the geese to return to areas where they

had already fed safely, such fidelity resulting in particular fields being used to an extraordinarily large extent. Hearn & Mitchell (1995) showed that of 1,492 fields checked around Loch Leven, only 14% were ever used and just 10 fields accounted for 24.6% of daytime feeding.

Most Pink-footed Geese do not range far from the roost site, mainly remaining within 5-10 km (Newton & Campbell 1973, Bell *et al.* 1998, Giroux & Patterson 1995), although they range further than do Greylag Geese (e.g. Newton & Campbell 1973, Owen *et al.* 1986, Bell & Newton 1995), probably because of their mobility on traditional habitats (Owen 1976) and because they are less tolerant of disturbance. Most feeding is done by day, although there is some moonlight feeding.

In Norfolk, where sugar beet fields are favoured, the major features determining use of the fields were the distance of the fields from the roost site and the risk of disturbance associated with the fields; small fields and those closest to roads were used less than others (Gill 1994). Where food density was high, however, the geese tolerated increased disturbance (Gill *et al.* 1996). Disturbance was an important factor in northeast Scotland where wintering Pink-footed Geese tended to avoid the proximity of roads when feeding in agricultural land: flocks were not found within 100 m of the nearest road (median distance 400 m) and fields with centres less than 100 m from a road were not visited (Keller 1991). Other studies have produced similar results (e.g. Newton & Campbell 1973, Madsen 1985).

Overall, Pink-footed Geese use stubble fields in autumn, gleaning the spilt grain before moving to root crops (if available) in midwinter, but with grassland predominating after autumn in most studies of habitat use (e.g. Newton & Campbell 1973, Forshaw 1983, Bell 1988, Stenhouse 1993, Stenhouse & Mitchell 1994, Giroux & Patterson 1995). Winter cereals are also selected in late winter and spring. Fox *et al.* (1994a) put these patterns into a national context and suggested that Pink-footed Geese feeding mainly on grass in spring (principally *Lolium perenne*, the main constituent of the sown sward) are responding to a gradient of plant growth, particularly the high protein content associated with the onset of growth. The geese utilise the late occurrence of the 'spring bite' in northern staging areas as they move towards their ultimate destination, the breeding grounds of Iceland and Greenland.

Local feeding studies have demonstrated seasonal changes in the diet of Pink-footed Geese apparently responding to, and in part driven by, seasonal

changes in the habitats available (e.g. Brotherston 1964, Newton & Campbell 1973, Bell 1988, Cranswick 1992, Stenhouse & Mitchell 1994, Hearn & Mitchell 1995, Giroux & Patterson 1995). In northeast Scotland, where grassland and cereal stubble are favoured, the attractiveness of the stubble was indicated by the distance travelled by geese to reach this crop, by the larger flock size observed in this habitat and the tendency of the birds to return to stubble following disturbance (Giroux & Patterson 1995). In Lancashire, Forshaw (1983), and more recently WWT (unpubl.), showed that root crops (potatoes and carrots) formed a substantial part of the midwinter diet, but from December/January onwards an increase in the use of new grass was apparent. Pink-footed Geese fed exclusively on arable land in north Norfolk and, during 1990-93, showed a strong preference for post-harvest sugar beet waste (Gill 1994). There, such waste has the capacity to support very large numbers of geese during the winter.

The Pink-footed Goose has shown itself well adapted to exploit a patchy and rapidly changing food source, which makes it much less vulnerable to changing patterns of land use than goose species with more traditional habits (Owen *et al.* 1986).

1.4.4 Spring migration

1.4.4.1 Range

Analysis of spring ringing recoveries, resightings and counts of Pink-footed Geese shows major concentrations in the southern lowlands of Iceland (17-21°W; Fox *et al.* 2000) and at other coastal localities (e.g. Skagafjordur and Hunavatnssyla). Up to 12,000 were counted in late April and early May during 1989-92 (Fox *et al.* 2000), and it seems likely that the entire population stages in Iceland at some stage, although there is considerable turnover.

1.4.4.2 Phenology

Pink-footed Geese arrive in southern Iceland from mid April (typically 18-24th), with numbers peaking during between 28 April and 1 May (Fox *et al.* 2000). Individually marked Pink-footed Geese were present in the same fields on the same farm for up to nine days, but they generally leave the lowlands by mid May (Fox *et al.* 2000).

1.4.4.3 Dispersal

From the staging areas in the southern lowlands, Pink-footed Geese tend to gradually move inland,

probably in response to growth patterns of grass, following the progress of the thaw.

1.4.4.4 Habitat and feeding ecology

Extensive surveys in 1989-92 showed that prior to movement to the nesting grounds in the interior, Pink-footed Geese fed mainly on intensively managed grasslands of the southern lowlands (Fox 1993). Faecal analysis showed that geese feeding in hayfields foraged almost exclusively on *Phleum pratensis*, the most commonly reseeded species. *Phleum* shoots had a higher protein content yet similar fibre content to most other grasses present in hay fields. Geese grazed predominantly on the youngest (and shortest) leaves of *Phleum* which also had higher protein content and less fibre than older leaves and attached dead leaves, which were rarely taken. Recently created grassland habitat has increased the opportunities for female geese to supplement their reserves during the crucial prelude to clutch initiation by selecting the highest quality plant species and the most nutritious parts of the forage.

1.5 Conservation and management

1.5.1 Legislation and other conservation measures

1.5.1.1 International

Conservation status

Under BirdLife International's Species of European Concern (SPEC) classification (Tucker & Heath 1994), the Pink-footed Goose is listed as SPEC 4, which means that it has a favourable conservation status, but is concentrated in Europe. This classification system does not recognise biogeographic populations, however, and so does not reflect the status of discrete populations found within the overall range.

Pink-footed Geese, and their habitats, are protected by a number of international conventions and directives. Their status under these in each of the three main countries forming the flyway is shown in Table 3.

Habitat protection

The principal legislation for the protection of sites in the European Union is the EC Wild Birds Directive, which requires Member States to classify Special Protection Areas (SPAs). In the UK, the SPA suite

for Pink-footed Goose comprises 24 sites where it has been listed as a qualifying species Stroud *et al.* (2001), providing for a variety of different requirements, including roost sites and staging areas. Sites are largely nocturnal roosts and feeding areas (especially farmland) are not significantly represented within the SPA suite.

Stroud *et al.* (2001) reports that this suite of sites supports 82% of the national total and 69% of the biogeographic population. This is misleading, however, as two different population estimates are used in these calculations (Kirby (1995) for the national estimate and Rose & Scott (1997) for the biogeographic estimate). Thus, this network supports approximately 69% of this population, based on the national and international population estimates used in this review. The national and international proportion of the population protected is difficult to calculate precisely owing to within-winter movements between different parts of the range.

In Britain, 27 Ramsar sites have been designated at least partly for their importance to Pink-footed Geese, some of which (e.g. North Norfolk Coast) include more than one of the goose sites listed in this review. Of the 35 sites which support more than 1% of the population (Table 4), 28 are designated as

both a Ramsar site and a SPA. In Iceland, one location is declared a Ramsar site for its importance to Pink-footed Geese.

Species protection

The Convention on Migratory Species, and in particular its Agreement on the Conservation of African-Eurasian Migratory Waterbirds (AEWA), provides the most comprehensive suite of measures for this population, at least in Britain. AEWA requires Parties to 'take measures to conserve migratory waterbirds, giving special attention to endangered species as well as to those with an unfavourable conservation status'. These measures include research and monitoring activities to identify population status through counts and ringing, monitoring of hunting, and co-operation with other relevant organisations to support such work. There are further requirements for the implementation of national legislation, single species action plans, habitat conservation, management of human activities, and education and information.

Further international protection of Pink-footed Geese is provided through the EC Birds Directive and the Convention on the Conservation of European Wildlife and Natural Habitats.

Table 3. The status of Pink-footed Goose under international legislation.

	Status	Britain	Iceland	Greenland
Convention on Migratory Species (Bonn Convention)	Appendix II	Yes	No	No
The African-Eurasian Migratory Waterbird Agreement (AEWA)	B2a	Yes	No	No
EC Wild Birds Directive (79/409/EEC)	Annex II/2	Yes	No	N/A
Convention on the Conservation of European Wildlife and Natural Habitats (Bern Convention)	Appendix III	Yes	Yes	Yes
Convention on Wetlands of International Importance (Ramsar Convention)		Yes	Yes	Yes

1.5.1.2 Britain

Conservation status

Pink-footed Goose appears on the ‘Amber’ list of ‘The Population Status of Birds in the UK’ because 50% or more of the UK non-breeding population occurs at 10 or fewer sites, and because 20% or more of the northwest European population occurs in the UK during the non-breeding season (Gregory *et al.* 2002).

Habitat protection

The principal site protection designation in Britain is the Site of Special Scientific Interest (SSSI) and the Area of Special Scientific Interest (ASSI) in Northern Ireland. Legislative protection for these sites derives from the Wildlife & Countryside Act 1981 and the Nature Conservation and Amenity Lands (Northern Ireland) Order 1985, respectively. Under these provisions, operations likely to damage the nature conservation interest of SSSIs or ASSIs are subject to control.

National Nature Reserves (NNR) are areas of national and sometimes international importance which are owned or leased by the appropriate statutory conservation body, or bodies leased by them, or are managed in accordance with Nature Reserve Agreements with landowners and occupiers. NNRs are also classified as SSSIs and attract similar protection.

Sites protected in this way are largely nocturnal roosts, since most monitoring is carried out at such locations. Feeding areas (especially farmland) are not significantly represented within the protected site network.

Species protection

Under the Wildlife & Countryside Act 1981, the Pink-footed Goose is legal quarry in Britain between 1 September and 31 January inclusive (with an extension until 20 February in areas below the high-water mark). Further, the sale of dead geese is prohibited, and this reduces the number shot as it is not possible to exploit this species commercially for food.

Management options for Pink-footed Geese have recently been proposed for consideration by the Scottish Executive (Scottish Office 1996). These include traditional means of dealing with goose grazing, e.g. scaring and shooting, opportunities for offsetting any losses through income from organised hunting, extending the shooting season, easing of present restrictions on the sale of dead wild geese and actions by other countries, and international co-operation including the restriction of breeding

success by the destruction of eggs/chicks on the breeding grounds. The Scottish Office document focuses only on impacts of wild geese on agriculture and provides suggestions for remedies, despite a paucity of data on the scale and distribution of alleged agricultural damage (see below). The document did not develop wider issues, such as the economics of goose hunting and bird-watching, and falls short of a flyway management approach to the conservation of this population.

This document was later used to formulate a population specific recommendation for each of Scotland’s geese (Scottish Executive 2000). In the case of Pink-footed Geese, this states that ‘Subject to improved monitoring of the population and of mortality from hunting, additional shooting of Icelandic pink-footed geese would be acceptable’.

1.5.1.3 Iceland

Habitat protection

Site protection in Iceland is limited. Einarsson (2000) lists three Important Birds Areas (IBAs) in Iceland for Pink-footed Geese, two for their breeding populations and one for its moulting aggregation. Of these, however, just one is formally protected; the Ramsar site and National Nature Reserve at Þjórsárver. Access to Þjórsárver is forbidden from 1 May to 10 June and flying below 1,000 m is not permitted. The other sites are Gudlaugstungur-Álfgeirstungur and Eyjabakkar.

Other breeding colonies are within sites protected by the Nature Conservation Act, although they were not designated for their importance to Pink-footed Geese. These include the Mývatn-Laxá area and three sites to the north of Vatnajökull: Herðubreiðarlindir, Hvannalindir and Kringilsárrani.

Species protection

The Act on the Conservation, Protection and Hunting of Wild Birds and Wild Terrestrial Mammals 1994 (known as the Bird and Mammal Protection Act) specifies a number of measures that protect Pink-footed Geese. Although the species is legal quarry, two measures to limit this harvest are in place. Firstly, a close season operates from 16 March to 19 August inclusive, to ensure that full-grown birds are protected during the breeding season. Secondly, egg collection for personal consumption is limited through a legal requirement to leave at least two eggs in each nest from which some harvest is taken. Furthermore, these eggs cannot be exchanged in any way, either for sale or as gift (Æ. Petersen pers. comm.) an additional measure that is not afforded its congener, the Greylag Goose.

The Act also provides for the licensing of hunting in Iceland and, whilst this does not provide direct protection, since no controls to limit the number taken are currently in place, it does provide the means to collect valuable data that facilitates effective management, and thus conservation, of this population (see 1.3.4). Certain measures to restrict the level of harvest further may also be enforced through this legislation. It allows for a shortening of the hunting season, the closure of specific areas to hunting, the introduction of a bag quota system and the full protection of the species by removing it from the quarry list. In addition, landowners can refuse any hunting on their land.

1.5.1.4 Greenland

Habitat protection

Two major moulting areas with small breeding populations are protected as Ramsar Sites, namely Heden (Jameson Land) and Hochstetter Forland, protecting an estimated 13,000 birds (Jepsen *et al.* 1993).

Boertmann (2000) lists five Important Birds Areas (IBAs) in Greenland for Pink-footed Geese, two for their breeding populations and all five for their moulting aggregations. Other IBAs also support this species. These include the two Ramsar sites above and three other sites that are all partially protected by the North and Northeast Greenland National Park and the North and Northeast Greenland Biosphere Reserve.

Earlier threats from oil exploitation in northeast Greenland (Madsen 1984, Madsen *et al.* 1984), especially increased disturbance (Mosbech & Glahder 1991), subsided due to abstraction costs, but could recur with price changes.

Species protection

Pink-footed Geese are legal quarry in Greenland during an open season in spring and autumn.

1.5.2 Hunting

1.5.2.1 Britain

In Britain, the Wildlife and Countryside Act 1981 permits an open season for Pink-footed Geese from 1 September to 31 January, extended on the foreshore until 20 February. Goose shooting there typically takes the form of either morning or evening 'flights' at birds moving between feeding and roosting sites, or shooting over decoys in feeding areas.

Inland goose shooting, typically over decoys, tends to be associated with larger organised parties, often from abroad, and is typically organised by local guides, some of whom are affiliated to BASC. By conducting surveys of relevant interest groups, Rayment *et al.* (1998) estimated that in 1997/98 some 4,150 hunters shot geese on 10,000 hunter days with a goose guide in Scotland. Of these, only 1% were from Scotland, 60% were from elsewhere in the UK, 35% from Europe and 4% from the rest of the world. This type of shooting can provide an attractive source of income to some farmers: the current charge per gun per flight can be in the region of £35-£65. Furthermore, it was estimated that over £2 million was spent in local economies and that goose guides make annual payments to landowners of around £200,000 for access to goose shooting.

In contrast, coastal goose shooting is more typically associated with British hunters, both those from the local area and those travelling from elsewhere within the UK to take advantage of the public right to recreation, including wildfowling, on the Scottish foreshore (Rayment *et al.* 1998). This form of goose hunting is normally free of charge and carried out alone. It therefore contributes considerably less to the local economy.

Since the only licence currently required by a shooter is the one relating to the ownership of a gun, rather than the right to shoot, there are relatively few reliable figures on the level of participation in wildfowling in Britain, and even fewer from recent years. In 1981/82, the BASC National Shooting Survey estimate that 580,000 people participated in game, wildfowl and rough shooting, with approximately 160,000 (28%) of these shooting ducks and geese (Harradine 1983). This survey also indicated that most (almost 70%) goose shooting took place during January. The absence of a national register of all who shoot meant, however, that questionnaires could not be sent to a representative sample of the shooting community during this survey. More recently, total expenditure by all shooters in Scotland was estimated to have contributed in the region of £78 million to the Scottish economy in 1989, and supported some 7,212 full time equivalent jobs (McGilvray *et al.* 1990). It is not currently possible to quantify the contribution of Pink-footed Geese to these figures, although the vast majority of goose shooting in Britain will involve either this species or Greylag Goose, since all other migratory geese in Scotland are protected from hunting during the winter.

1.5.2.2 Iceland

Pink-footed Geese are an increasingly important quarry for Icelandic hunters (Fig. 4a), although, in comparison to Greylag Geese, the bag remains relatively small as a proportion of their population size due to their habit of remaining in the relatively remote interior prior to autumn departure.

Annual hunting licences are granted only on submission of a record of the number and species taken in the previous year. There are around 17,000 active hunters in Iceland, and, on average, 11,589 hunting licences are issued each year. Most hunters take a small number of birds for personal consumption, although there is currently no limit to the hunting bag and the sale of dead geese is permitted. Consequently, a small number of hunters take a large number of birds each autumn for commercial sale, although they are likely to take primarily Greylag Geese because this species occurs in more accessible areas and departs for wintering areas later than Pink-footed Geese do. Recent efforts by the Icelandic Wildlife Management Institute to discourage the hunting of Greylag Geese, however, may have accounted for the slight increase in numbers of Pink-footed Geese shot between 1995 and 1998 (Fig. 4a). Although the geese are protected in the spring, some may be killed illegally at this time.

1.5.2.3 Greenland

Pink-footed Geese are hunted during an open season in spring and autumn, although there is little information relating to hunting bags. Born (1983) estimated that 500-1,000 geese (both Barnacle and Pink-footed Geese) were shot annually by the hunters of Ittoqqortormiit/Scoresbysund, the only settlement within the main range of Pink-footed Geese in east Greenland.

1.5.3 Agricultural conflict

1.5.3.1 Britain

Although the switch from natural habitats to agricultural ones shown by Pink-footed Geese may have been forced on the geese, through a reduction in availability of these natural habitats, they have fared well on farmland. Pastures are heavily fertilized and provide palatable and digestible forage. It was probably not until the 1960s that Pink-footed Geese began to pose problems for farmers. On autumn stubbles, and in fields containing post-harvest root crops (such as potato) and waste sugar beet, they do no harm, but they graze pastures throughout the

winter, and on occasions, especially in spring, graze winter wheat and barley. In the latter part of April and in early May, farm stock are being let out onto specially prepared 'spring bite' grassland, expensively managed and fertilised. Pink-footed Geese prefer this young grass to older leys and they congregate on these pastures, competing directly with stock for forage.

Pink-footed Geese are frequently accused of damaging growing winter and spring-sown cereals, but clipping studies showed that the effect was slight (Kear 1970), although studies on other geese (e.g. Greylag Geese) do suggest that damage from grazing and puddling of the soil can occur in waterlogged conditions on heavy soils. Clipping experiments to measure yield loss in fields which support Pink-footed Geese, together with measuring goose grazing levels from dropping densities, were also carried out in northeast Scotland in the late 1980s (Patterson 1991). There was evidence that goose grazing was associated with significant loss of yield, but there was great variability in the degree of loss suffered at any given level.

Serious allegations of crop damage were made in Lancashire in 1973-74, when large numbers of Pink-footed Geese visited unharvested carrot fields and gouged out the tops of the roots to a depth of 3-4 cm, making the whole crop unmarketable. Damage to this high value crop has been alleviated by careful siting of the carrot fields and regular patrols by the farmers. On grass, Pink-footed Geese are more difficult to discourage, although small areas of high value spring bite can be protected by the intensive use of scaring devices.

The variability in the effects of goose grazing is so great because yield is affected by a complex interaction of factors which influence the response of the vegetation to grazing (e.g. Patterson *et al.* 1989). These factors include time of year, type of crop, spring weather, crop growing conditions and management and grazing intensity. Spring is the most critical time of the year since goose grazing in April causes greatest losses in yield. As yet, there has been no attempt to assess the scale and distribution of alleged agricultural damage nationally.

Interactions between geese and agriculture have been reviewed by Kirby *et al.* (1999). Their report evaluates studies of the effects and impacts of goose grazing in a British context and includes summaries of the work undertaken on Pink-footed Geese. The report concludes that despite a large number of research studies investigating damage by geese to crops, methods and measurement have been variable and/or inconsistent, and there are important

differences with respect to locations, farmland characteristics and management. The authors urge care in interpreting results.

Whilst farmers have tolerated the geese for years, concern has been growing, particularly where numbers are high, with rising numbers of complaints of agricultural damage. There have been a number of complaints from farmers about loss of yield as a result of goose grazing on grass and cereal crops. In addition to reduced yields, there have been other alleged agricultural effects of goose grazing such as reduced stocking densities, uneven ripening of crops, increased weediness of crops, puddling of ground and delays in turning out livestock.

In Scotland, a number of Local Goose Management Schemes (LGMS) exist in order to manage this conflict. Farmers receive payments as compensation for damage caused by geese to crops. Local Goose Management Schemes provide alternative, non-lethal, means of reducing or compensating for goose damage. These schemes exist primarily to manage the conflict between farmers and specially protected goose populations, such as Greenland White-fronted Geese. There is a general presumption against schemes for populations not requiring special protection, although such schemes may be appropriate on areas immediately surrounding large, established roosts, where these form part of properly-managed reserves and where significant damage to crops and grass is caused by heavy concentrations of geese on agricultural land.

For Pink-footed Geese, one such scheme has operated under this principle on farms close to the Loch of Strathbeg (Aberdeenshire). A pilot Scheme was in operation there between 1994 and 1997 and had two objectives: (1) to demonstrate that the feeding behaviour of Pink-footed Geese could be managed by the provision of refuge areas coupled with a co-ordinated scaring programme; and (2) to demonstrate that farmers in those areas most heavily affected by goose grazing could be persuaded to enter into a management agreement which would help to resolve the conflict.

On this basis, a Goose Management Scheme was approved by the National Goose Management Review Group (NGMRG) in 2002 and 2003. The Scheme aimed to reconcile the conservation of the migratory geese using the Loch of Strathbeg with the needs of the farmers in the area by managing the goose population to minimise the economic losses of farmers who suffer goose damage. It operated during the spring within an 87 km² core area around the loch and there were three management categories:

Feeding Zone, Buffer Zone and Scaring Zone, with participants able to apply for one or more of them.

In 2003, the total amount allocated to the Scheme was £52,250. It operated with 20 farmers (from a total of 59 in the Scheme area) with 525 ha in the Feeding Zone and 576 ha in the Buffer Zone. These zones supported 175,925 goose days, estimated from dropping counts, or 28.5% of the local roost population in March and 46.5% in April. Payments to farmers in these zones totalled £45,905, an average cost of £0.25 per goose day. Participants in the Scaring Zone received a one off payment, up to a value of £250, for the purchase of scaring equipment (with the exception of shotguns or firearms).

Outwith the Feeding and Buffer Zones both active and passive scaring is encouraged and spring shooting of the geese under licence is allowed. Sport shooting during the open season is also permitted as this does not coincide with the operational period of the scheme. The Scheme has been welcomed by farmers and was over-subscribed in 2003, with applications totalling 1,102 ha and approvals for 760 ha. Sixty-three percent of respondents to the evaluation questionnaire believed that the Scheme helped keep geese off their other crops and 83% would offer fields again. For further information see Scottish Natural Heritage (2003).

1.5.3.2 Iceland

Although unlikely to cause significant agricultural damage, complaints are sometimes received from individual farmers, although in many cases it is unknown whether they refer to Pink-footed Geese or Greylag Geese. A small number of licences has been granted in the last decade to shoot Pink-footed Geese in spring for the purpose of preventing damage. Formerly (before 1985), licences were issued more freely, with little attempt made to quantify the extent of the alleged damage, or to encourage alternative methods (e.g. scaring). More recently, however, greater emphasis has been placed upon consideration of these factors, although improvements are still needed and there is currently no mechanism for compensation payments.

2 SURVEY OF WINTERING AREAS

The following section provides a detailed site-by-site review of the status of Pink-footed Geese wintering in Britain. For all sites in this review, the principal source of data was the autumn Grey Goose counts, now known as the Icelandic-breeding Goose Census (IGC, see section 1.3.1 for further details). These data have been supplemented by counts made as part of the Wetland Bird Survey (see Pollitt *et al.* 2003), specific studies (e.g. Hearn & Mitchell 1995), county bird reports, and other supplementary counts submitted for this review by volunteer counters and site managers throughout the wintering range. Political or geographically discrete regions containing sites of importance for wintering Pink-footed Geese are considered and split into the following sections:

Background

A brief overview of the region's landscape and the availability of suitable habitat for Pink-footed Geese found there.

Historical status

An overview of the status of Pink-footed Geese up to 1960, when the current review period begins. Additional information for the period 1960/61 to 1999/2000 that is not provided elsewhere is also given here.

Internationally important sites

Detailed accounts of internationally important sites are presented (see also Table 4, Fig. 9). Sites are selected using the threshold for international importance at the time of the last year under consideration in this report (2,250 birds, Rose & Scott 1997). International population estimates, and subsequent thresholds, are revised periodically and the threshold for Pink-footed Goose now stands at 2,400 (Wetlands International 2002, Kershaw & Cranswick 2003). In line with accepted practice, however, we have not retrospectively applied this threshold and so some sites may no longer qualify as internationally important in future assessments.

Each site account contains information on status, site safeguards, habitat, trends, site usage and threats. For definitions of international site safeguards and selection criteria/guidelines used, see Ramsar (1999) for Ramsar sites, Stroud *et al.* (2001) for Special Protection Areas (SPAs), Heath & Evans (2000) for Important Bird Areas (IBAs), and see www.english-nature.org.uk and www.ehsni.gov.uk for Sites/Areas of Special Scientific Interest and National Nature Reserves in England and Northern Ireland.

For each site, figures are presented showing the peak counts recorded in each season since winter 1960/61. Years in which no counts were made at a site are highlighted by a dot. Figures illustrating the phenology of use are presented for those sites with adequate data. Columns represent mean counts made in each month between 1995/96 and 1999/2000. Bars represent maximum and minimum counts over this period.

Other sites

Brief accounts of sites that were previously of international importance, but no longer support such numbers, or have supported large numbers for short periods of time are presented.

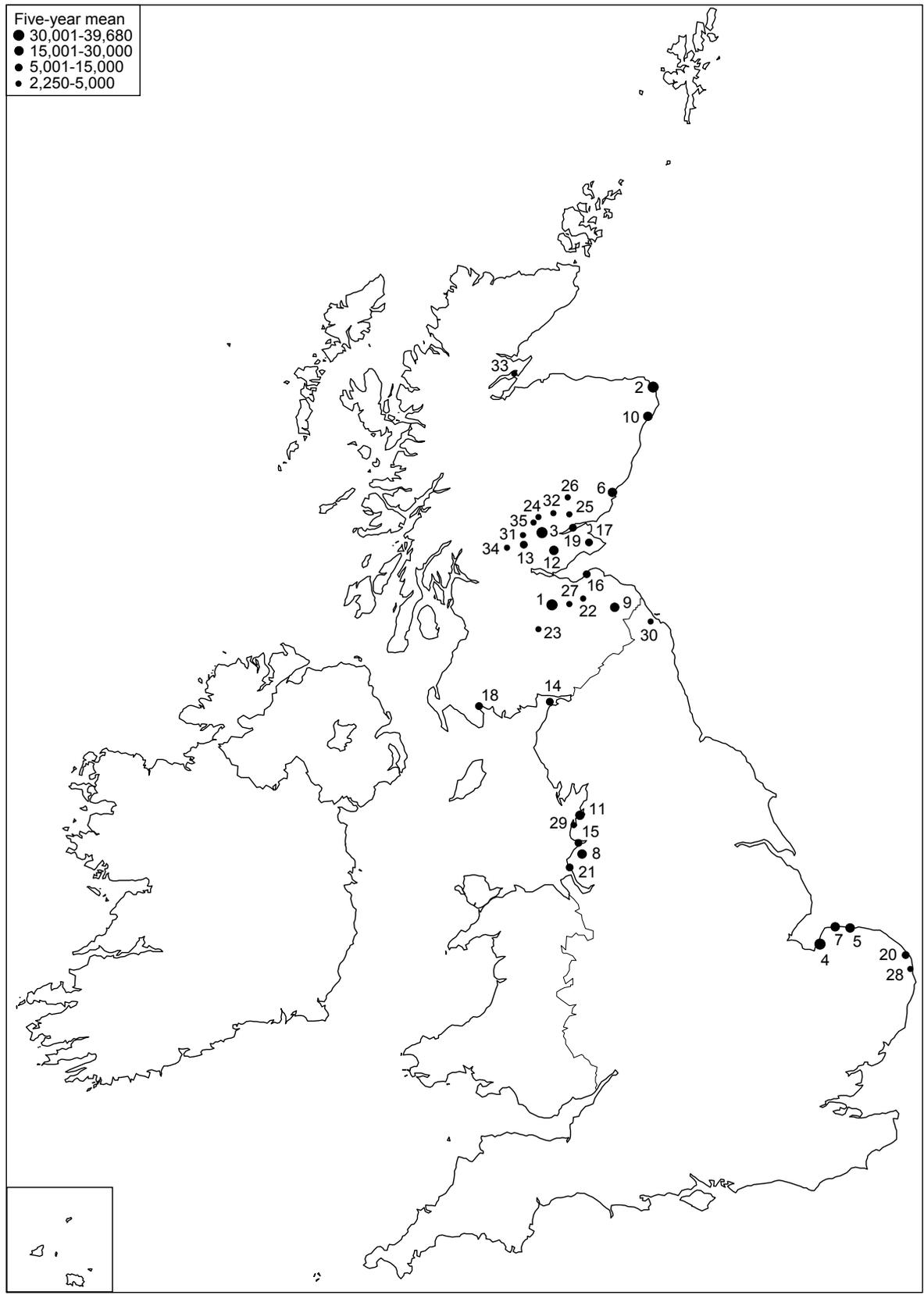
Key references

This section provides a list of relevant literature and published monitoring data on Pink-footed Geese in each region.

Table 4. Sites of international importance for Pink-footed Goose in Britain (arranged in descending order of importance)

Site name	5-year mean (1995/96-1999/2000)
1. Westwater Reservoir	39,680
2. Loch of Strathbeg	36,433
3. Dupplin Loch	34,130
4. Snettisham	34,083
5. Holkham Bay	28,844
6. Montrose Basin	24,428
7. Scolt Head	23,205
8. Martin Mere	19,368
9. Hule Moss	18,866
10. Ythan Estuary/Meikle Loch	17,300
11. Lune Estuary	16,160
12. Loch Leven	15,286
13. Carsebreck/Rhynd Lochs	14,592
14. Inner Solway Firth	14,045
15. Ribble Estuary	12,287
16. Aberlady Bay	10,742
17. Cameron Reservoir	7,850
18. Wigtown Bay	6,246
19. Firth of Tay	5,753
20. Heigham Holmes	5,680
21. Alt Estuary	5,442
22. Fala Flow	4,917
23. Upper Cowgill Reservoir	4,784
24. Loch Tullybelton	4,431
25. Long Loch	4,422
26. Loch of Lintrathen	4,368
27. Gladhouse Reservoir	4,358
28. Breydon Water & Berney Marshes	3,740
29. Wyre Estuary	3,200
30. Holburn Moss	2,650
31. Drummond Loch	2,645
32. River Tay at Kercock	2,525
33. Cromarty Firth	2,346
34. Loch Mahaick	2,333
35. Loch Mullion	2,250

Figure 9. Internationally important sites for Pink-footed Goose in Britain and Ireland (see Table 1 for key to sites)



2.1 Britain

2.1.1 Moray basin

2.1.1.1 Background

The area around the Moray Firth is a region set apart by the mountains along the southern and western boundaries stretching from Brora in the north to Buckie in the east, and includes the three drowned valleys of the Beaully and the Inner Moray Firth, the Cromarty Firth and the Dornoch Firth. These firths together provide an important area for Pink-footed Geese, all having extensive areas of saltmarsh adjacent to intertidal flats of sand and silt surrounded by feeding grounds of low-lying arable and pasture land. Between Inverness and Buckie in the east there are several areas where Pink-footed Geese are found at various times from autumn to spring, most notably around Loch Flemington and Castle Stuart, Findhorn Bay, and Loch Spynie. The land adjacent to these lochs and bays is an extensive area of mixed agriculture providing excellent feeding grounds. To the east of Buckie, the Banffshire hills reach almost to the coast with an area of sea cliffs and rocky bays. A number of reserves have been established in recent years: these include a NNR over parts of Nigg Bay and Udale Bay in the Cromarty Firth, two Local Nature Reserves (LNR) on Munloch Bay and Findhorn Bay in the Inner Moray Firth, a Scottish Wildlife Trust (SWT) reserve on the tidal basin of Loch Fleet and a Royal Society for the Protection of Birds (RSPB) reserve at Nairn and Culbin Bar.

2.1.1.2 Historical status

In the early part of 20th century, the Pink-footed Goose was described as a common autumn and spring passage visitor to this area, having undergone a great increase (Berry 1939). Several thousands were said to frequent the Dornoch and Cromarty Firths and very large numbers were said to gather on the Beaully Firth. The colonisation of the Beaully Firth is of interest since it demonstrates the rapidity with which this species can change its regular haunts: in 1918, a single specimen was recorded as a rarity; spring 1920 saw about 100 on the firth, but from then onwards the increase was rapid to flocks of thousands being recorded within a few years. In the area as a whole there was a rapid increase from about 1910 to 1930 but numbers thereafter appeared to fall up until 1940 (Berry 1939). In recent years numbers have again increased. Pink-footed Geese were abundant at Loch Spynie, especially in the 1930s, when flocks of many thousands occurred in autumn

and in spring. These concentrations dated from the 1920s, and coincided with increases on the Beaully Firth and Easter Ross (Berry 1939). Although there have been many fluctuations in numbers in the intervening years, flocks of several thousand are again present at particular times of year.

2.1.1.3 Internationally important sites

i) Cromarty Firth

Five-year mean 95/96-99/2000: 2,346

Site conservation status

SPA (Cromarty Firth: non-qualifying species)

Ramsar (Cromarty Firth: non-qualifying species)

SSSI (Cromarty Firth)

IBA (Moray Basin, Firths and Bays: criteria A4i, B1i, C3)

Site description and habitat

The Cromarty Firth (NH6667) is a long sheltered arm of the North Sea. Including Easter Ross, it covers some 12,500 ha and stretches inland for nearly 30 km. It has a deep water channel for half its length with the lower reaches, especially the important roost sites at Nigg and Udale Bays, having very extensive mud and silt flats exposed at low tide surrounded by large areas of saltmarsh. The firth is surrounded by a narrow strip of arable land, including forestry on the northern shore, with similar mixed farming extending further inland in Easter Ross and on the Black Isle. Despite the industrial growth of the 1970/80s, the Cromarty Firth is still important for Pink-footed Geese.

The towns of Dingwall, Alness and Invergordon lie along the firth with smaller villages found especially along the Black Isle shore. Invergordon has a deep water port used not only by shipping but also as an oil rig repair and supply base.

Numbers and trends

During the late 1960s and early 1970s, flocks of several hundred Pink-footed Geese were regularly seen in the Nigg Bay area, most often in spring (300 on 13 March 1972) but sometimes during the late autumn or winter (500 on 14 January 1967, 350 on 14 November 1971). Similar numbers could be found at these times in Udale Bay (345 on 13 November 1965, 600 on 17 January 1967, 600 on 16 January 1971) and smaller numbers at other sites in the Cromarty Firth. From the mid 1970s through to the early 1980s, however, numbers increased to several thousand (Fig. 10) (1,500 at Nigg Bay on 10 March 1974 and 16 March 1975, 3,000 at Nigg Bay on 18 March 1984, 2,000 on 14 March 1983 and 1,000 near Invergordon on 19 February 1984).

During these two decades very few Pink-footed Geese were noted during early autumn. Since 1984, however, they were heard passing through the area from early September, often at night. The majority appear to pass straight through, probably on route to Aberdeenshire, where an early build up is notable around Loch of Strathbeg. By mid to late September and into October, up to several thousand may be present in the Moray Firth Basin mainly in the Easter Ross/Nigg Bay areas. This is not a reliable feature of their autumn arrival, however, as in some years very few appear on the ground during this period. The use of the area as a staging point may last for several weeks but by the time the Greylag Geese arrive in early to mid October the majority of Pink-footed Geese have moved on. Throughout the winter, numbers can be very variable but flocks of around 1,000 can be present for up to several weeks at a time. By early spring, numbers again increase with several thousand often present in the Easter Ross/Nigg Bay/Udale Bay areas with flocks of between 1,000 to 2,000 often seen in the Dingwall area and in the inner part of the firth.

Site use

The principal roosts on the firth are Nigg and Udale Bays, which can be used whenever geese are present. The birds feed over a wide area of the surrounding arable land and saltmarsh areas, but tend to restrict their feeding to fields within two or three kilometres of the firth. The main feeding areas are close to Nigg Bay, Loch Eye, just to the south of Udale Bay on the Black Isle, and Conon Islands and low lying fields around Dingwall and Maryburgh. Stubbles are favoured in autumn and grassland in winter, but during the spring build-up, cereals, grass and saltmarsh are all used.

2.1.1.4 Other sites

Although the Cromarty Firth and surrounding area has traditionally been considered to be the principal site for Pink-footed Geese, there are other sites which could be considered of equal or even greater importance, particularly during the winter and spring. As with Greylag Geese, it appears that from late autumn through the winter and during the spring, Pink-footed Geese use traditional roost sites less and less often, preferring to roost on any convenient areas of water, flooded fields or even remaining in the feeding field throughout the night. Therefore, counts at traditional roosts, especially if these are restricted to the autumn, will often underestimate the use of an area by Pink-footed Geese.

i) Lossiemouth/Spey Bay/Loch Spynie

This area supports 3,000 to 4,000 Pink-footed Geese during the winter and especially during the spring build-up prior to migration, although smaller numbers occur at times during the autumn passage. They feed on the surrounding farmland, utilising grass and cereals, and roost at various sites including Loch Spynie (NJ2366), which lies between Elgin and Lossiemouth and is surrounded by a mixture of farming and forestry plantations. Since the end of the 1980s, they have roosted there in the autumn (max 2,300 in November 1997) and in the spring (max 3,000 in March 1996) (Fig. 11). Surveys by Highland Ringing Group (HRG) since 1992 have revealed that flocks of up to 2,000 can be found in the area throughout the winter, increasing to a maximum of up to 4,000 during the spring. The mean peak winter count (1995/96-1999/2000) at Loch Spynie was 1,760.

ii) Findhorn Bay/Kinloss

This is an area of mixed farming with some forestry plantations. Findhorn Bay (NJ0462) is a wide inlet with extensive mudflats and saltmarsh. The River Findhorn makes its way to the North Sea through this bay and out via a narrow exit between the villages of Findhorn and Culbin Sands. Although many geese must pass over Findhorn Bay during the autumn passage on their way to Loch of Strathbeg, few use it to roost during the autumn. Counts give some indication of its use in the spring, however, with a peak of 2,800 in April 1996 (Fig. 12). HRG surveys have revealed that in recent years 4,000 to 5,000 Pink-footed Geese can be present in the area during late spring and only slightly fewer are present from mid winter onwards. Findhorn Bay is the principal roost, although other sites are used occasionally.

Access to Findhorn Bay is open and the site is often disturbed by low-flying aircraft and the activities of wildfowlers.

iii) Poulton/Castle Stuart/Loch Flemington/Munlochy Bay

To the east of Inverness lies an area of farmland which is used extensively by Pink-footed Geese. The traditional sites of Castle Stuart (NH7449) and Loch Flemington (NH8152) along with the Loch of the Clans (NH8353) provide convenient roosts, although the open water of the firth is also used. Counts at the Loch of the Clans (2,000 in November 1997 and April 1998) and at Loch Flemington (2,500 in January 1994 and November 1999) give some indication of the importance of this area to Pink-

Figure 10. Pink-footed Geese at the Cromarty Firth, 1960/61-1999/2000: peak counts (bars) and British index (line) (circles denote years with no known data)

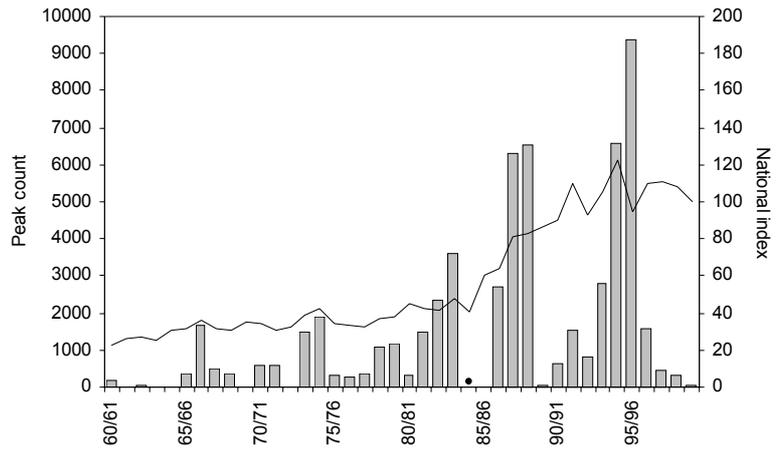


Figure 11. Pink-footed Geese at Loch Spynie, 1960/61-1999/2000: peak counts (bars) and British index (line) (circles denote years with no known data)

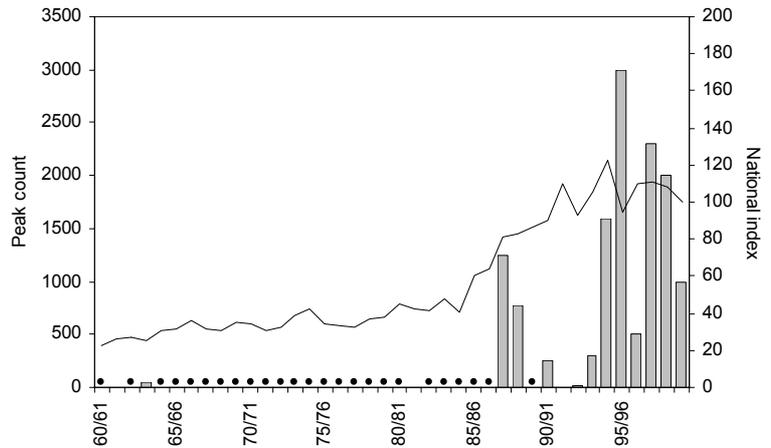
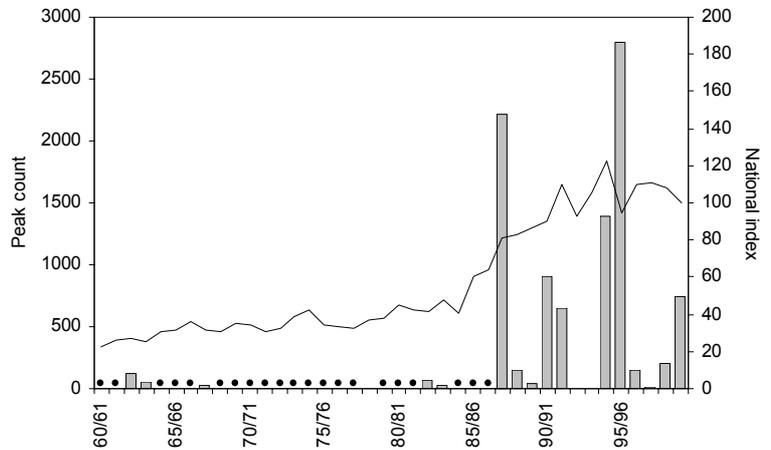


Figure 12. Pink-footed Geese at Findhorn Bay, 1960/61-1999/2000: peak counts (bars) and British index (line) (circles denote years with no known data)



footed Geese. Recent surveys, however, have shown that up to 5,000 Pink-footed Geese may use the area, particularly in late spring. Across the firth from this area lies Munloch Bay (NH6753) and movement of geese between the two areas is common. Several thousand Pink-footed Geese often use the bay and the surrounding farmland on the Black Isle, particularly in winter and through to late spring (Fig. 13).

iv) Loch Eye/Easter Ross

Loch Eye (NH8379) is one of the most important roosts for Icelandic Greylag Geese in Scotland, yet only briefly, in early autumn and again in spring, does it hold significant numbers of Pink-footed Geese. In the autumn, they overfly the area in large numbers heading for sites further east such as Loch of Strathbeg. In some years, several thousand may stop for a period of a week or two in September before moving on, but this is by no means a regular occurrence. In spring, although several thousand Pink-footed Geese may be present in Easter Ross, Loch Eye may only occasionally be used as the roost site, with Nigg Bay and the open water of the Cromarty and Dornoch Firths providing convenient alternative roosts at this time of year.

2.1.1.5 Key references

Stenhouse (1993)

2.1.2 Aberdeenshire

2.1.2.1 Background

Away from the coast, the fertile lowlands of Aberdeenshire extend inland for upwards of 40 km along the valleys of the Dee and the Don, and throughout Formartine and Buchan. The farming is predominantly arable, with a high proportion of cereals. Pink-footed Geese are typically confined to two traditional roosts, the Loch of Strathbeg and in the Ythan Valley, some 30 km to the south. During the course of the winter there is interchange between the roosts (Giroux 1991). This relationship is emphasised by the scarcity of the species elsewhere in the eastern parts of the region; except for Lochs Davan and Kinord and Loch of Skene, the nearest concentrations are more than 80 km away in Angus and Moray. In October and November, at the time of the autumn peak, there are flocks of several tens of thousand, often at both resorts. The numbers then decrease during mid winter as Pink-footed Geese move south. In March and April, prior to the spring migration, the flocks increase again, especially

in the Ythan Valley, where peaks of over 20,000 have been recorded in several recent years. There is also evidence of an increase at Strathbeg, often to over 30,000.

2.1.2.2 Historical status

As with the Moray Firth, Aberdeenshire appears to have been colonised by Pink-footed Geese during the first 40 years of 20th century, and by the late 1930s they were recorded as plentiful in some areas (Berry 1939). In spring, local flocks were augmented by a large influx of migrants from further south. It was suggested that the cause of the increase may have been excessive disturbance and hunting pressure on the Firth of Tay.

2.1.2.3 Internationally important sites

i) Loch of Strathbeg

Five-year mean 95/96-99/2000: 36,433

Site conservation status

SPA (Loch of Strathbeg: selection stage 1.2)

Ramsar (Loch of Strathbeg: qualifying criterion 6)

SSSI (Loch of Strathbeg)

IBA (Loch of Strathbeg: criteria A4i, B1i, C3)

Site description and habitat

The loch (NK0858) constitutes the largest dune slack pool in Britain and the largest water body in the northeast Scottish lowlands. It lies within 800 m of the sea, just west of Rattray Head, has an area of 200 ha and a mean depth of only 1-1.5 m. On the seaward side it is flanked by a ridge of calcareous dunes, and the slightly brackish water is also rich in lime. The submerged vegetation includes an abundance of wildfowl food plants, but the shores are almost bare and wave-washed, except at the northwest end, where sizeable stands of *Phragmites* provide the only shelter. The loch is an important staging area for other Scandinavian and Iceland/Greenland migrants which make their landfall in this easternmost corner of the Scottish mainland.

Numbers and trends

There is an almost unbroken run of counts for every month from 1960/61. The number of Pink-footed Geese using this, the second most important site in the whole of Britain, is in line with the growth of the population as a whole (Fig. 14).

There is a remarkable jump in numbers between winters 1983/84 and 1984/85. Five-year peak mean counts for the two periods either side show an

average of 5,900 for 1979/80 to 1983/84, and 25,790 for 1984/85 to 1988/89. The highest count at Loch of Strathbeg was of 58,150 birds in September 1994.

Site use

Peak winter counts occur during mid autumn, usually in October (Fig. 15). A winter flock of over 10,000 birds remains until spring, augmented by migrants from further south between February and April. Undoubtedly more geese pass through this site, especially on migration in spring.

The feeding range covers a wide area of arable and pasture farmland, ranging at times as much as 15 km inland to the west of the Mormond Hill, and as far south and south west as the Ugie Waters (see Keller *et al.* 1998).

ii) Ythan Estuary/Meikle Loch

Five-year mean 95/96-99/2000: 17,300

Site conservation status

SPA (Ythan Estuary, Sands of Forvie and Meikle Loch: selection stage 1.2)

Ramsar (Ythan Estuary and Meikle Loch: qualifying criterion 6)

SSSI (Meikle Loch and Kippet Hills, Sands of Forvie and Ythan Estuary Lochs)

IBA (Ythan Estuary, Sands of Forvie and Meikle Loch: criteria A4i, B1i, C3)

Site description and habitat

The Ythan Estuary (NK0028) runs inland for more than 6 km and contains two different types of habitat. On the lower reaches below the road bridge, the channel is narrow and sandy with coarse gravels and mussel beds and is bounded to the north by a tract of dune and heath. Further upstream the estuary broadens into a shallow muddy basin. The margins of the estuary are varied, with areas of saltmarsh, reedbed and poor fen, in addition to the Sands of Forvie dune system. The Meikle Loch (NK0331), a small shallow loch screened by low hills, lies about 3 km north of the estuary and supports limited aquatic vegetation.

Numbers and trends

Counts of roosting geese have been undertaken on both the estuary and at Meikle Loch since the 1960s and they are usually combined, since birds can be using both sites (primarily in spring) and both are normally counted on the same day. Despite their proximity, it is however worth considering the two sites separately. Meikle Loch is one of the most important sites for autumn arrivals, and despite the fact that it is shot over regularly during the shooting season, flocks of over 10,000 birds have been

regularly supported since the mid 1960s (Fig. 16). Birds disturbed from Loch of Strathbeg through excessive shooting will head 30 km south to the loch. A peak of at least 25,000 was recorded in October 1995 and the over-wintering flock averages 6,000-8,000 birds.

Apart from an autumn count of 11,601 in November 1969, Pink-footed Geese rarely use the Ythan Estuary until after the foreshore hunting season has ended on 20 February. By March, Formartine has received large numbers of migrating Pink-footed Geese that have wintered further south and the estuary then becomes as attractive as the Loch of Strathbeg, 23,880 being recorded in March 1993. Pink-footed Geese remain in the area until mid to late April, e.g. 21,440 in April 1995. Combined totals over 20,000 have occurred regularly since the mid 1980s, with a peak count of 30,300 in March 1990.

Site use

There is a pronounced passage of birds using the loch during October, with numbers declining in mid winter (Fig. 17). During spring passage, when the geese typically roost on the estuary, numbers increase and are sometimes even greater than those in the autumn.

The feeding grounds are widely spread, extending southwards to Balmedie and westwards to Ellon and beyond. Agricultural lands dominate this coastal landscape and include grasslands characterised by *Lolium perenne* used for grazing, silage and hay production, as well as barley and wheat sown in autumn and spring (Patterson *et al.* 1989).

2.1.2.4 Other sites

i) Loch of Skene

Pink-footed Geese occur in two or three localities on Donside and Deeside, and for a while in the 1960s, it seemed they might succeed in establishing a major roost at the Loch of Skene (NJ7807). The flock reached a peak of 2,800 in 1966/67, but then declined and had disappeared within five years. Since 1982/83, small numbers once again started to roost here, gradually building to over 1,000 birds by the late 1990s, usually in the autumn (Fig. 18).

ii) Lochs Davan & Kinord

Lochs Davan & Kinord (NJ4400) lie at the western extremity of the Deeside lowlands and were the most important winter Greylag Goose roost in Britain. Surprisingly, however, they hold relatively few Pink-footed Geese, which were first reported roosting there from the mid 1980s.

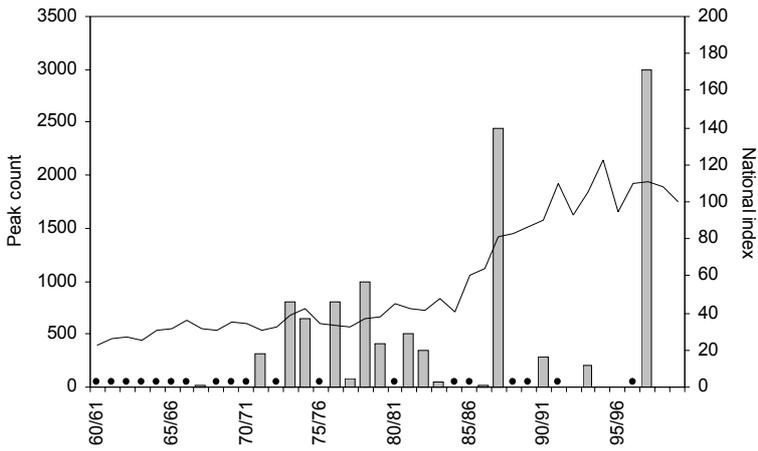


Figure 13. Pink-footed Geese at Munloch Bay, 1960/61-1999/2000: peak counts (bars) and British index (line) (circles denote years with no known data)

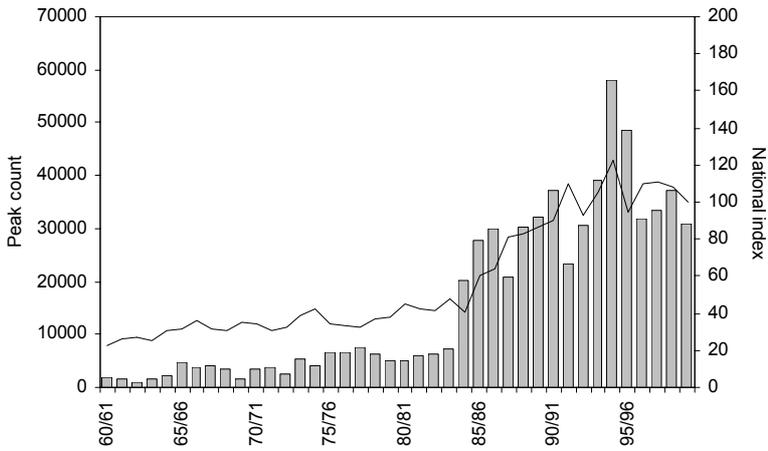


Figure 14. Pink-footed Geese at Loch of Strathbeg, 1960/61-1999/2000: peak counts (bars) and British index (line) (circles denote years with no known data)

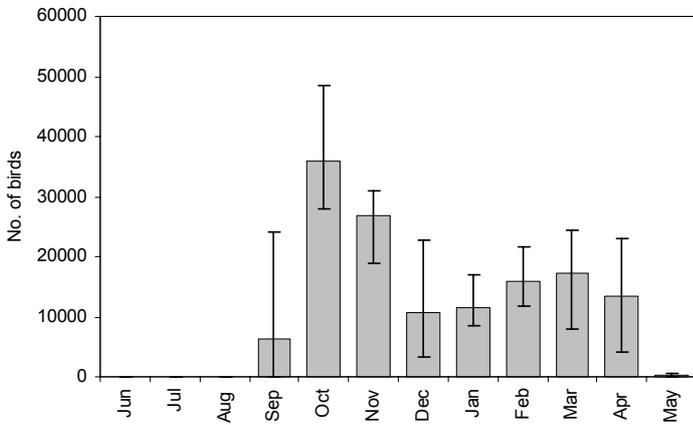


Figure 15. Pink-footed Geese at Loch of Strathbeg, 1995/96-1999/2000: mean peak counts by month (error bars denote minimum and maximum peak counts during the period)

Figure 16. Pink-footed Geese at Ythan Estuary/Meikle Loch, 1960/61-1999/2000: peak counts (bars) and British index (line) (circles denote years with no known data)

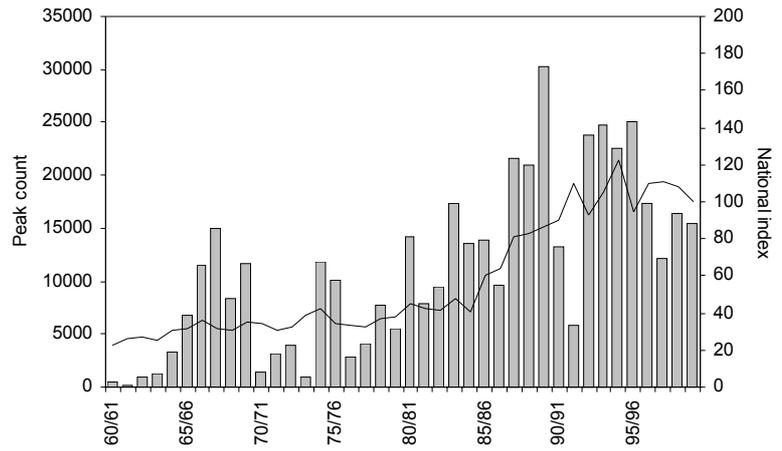


Figure 17. Pink-footed Geese at Ythan Estuary/Meikle Loch, 1995/96-1999/2000: mean peak counts by month (error bars denote minimum and maximum peak counts during the period)

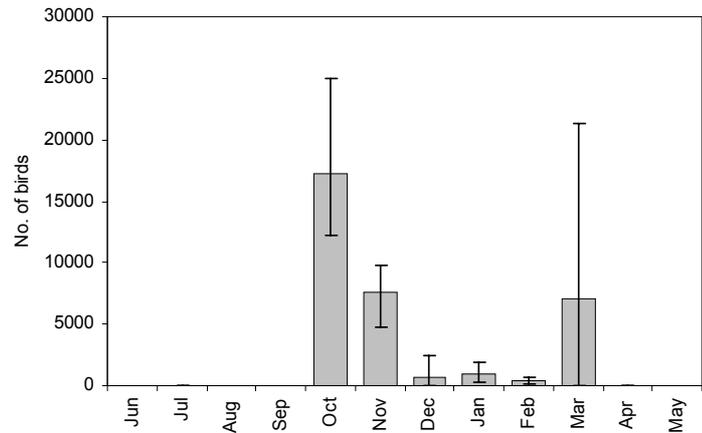
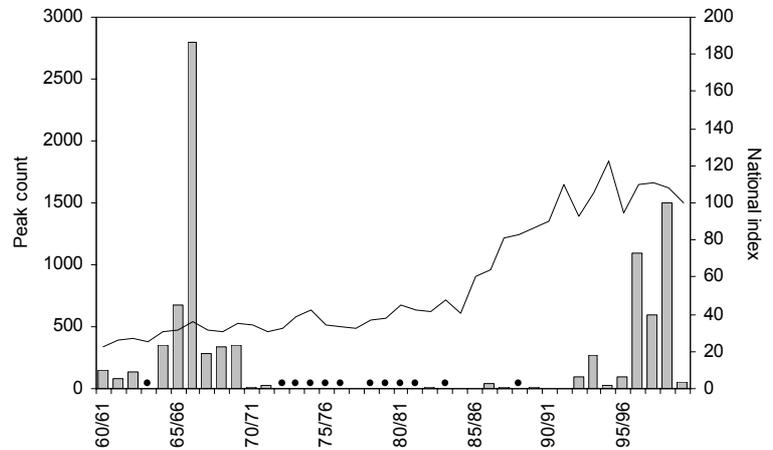


Figure 18. Pink-footed Geese at Loch of Skene, 1960/61-1999/2000: peak counts (bars) and British index (line) (circles denote years with no known data)



Small numbers may roost there in any month from September to April, but numbers usually increase in late winter and early spring, including a peak count of 3,807 in April 1996.

iii) Minor roosts

Corby Loch (NJ9214) is close to the major roost on the Ythan Estuary, and feeding grounds at Balmedie/Blackdog. Pink-footed Geese were recorded there in small numbers through the 1980s, with a peak of 900 roosting in January 1992.

Despite being only 12 km west of the Ythan Estuary, Pink-footed Geese have been recorded roosting at Haddo Country Park (NJ8835) only since 1987/88. Peak counts of 4,200 in October 1996 and 3,800 in April 1995 were exceptional, with usually fewer than 1,000 birds roosting there.

The Winter Loch (NK1053) at St Fergus Gas terminal, a very shallow dune-slack loch which dries out in summer and in dry winters, is used erratically by Pink-footed Geese when there is sufficient water. A series of weekly roost counts from October 1995 to March 1996 found geese on 14 of 23 occasions, with 5,000-7,000 birds in October and early November. The loch is also used as a daytime roost and bathing place. It is likely that these birds normally use the Loch of Strathbeg, 6 km to the northwest.

Pink-footed Geese recorded at Inverquhomery Pools (NK0246) presumably involve feeding birds that normally roost at Loch of Strathbeg 10 km to the north, but some may roost on the pools at night, and a count of 1,950 in March 1988 has not been surpassed. Fedderate Reservoir (NJ8652) has occasionally held roosting Pink-footed Geese since 1987/88, with peak counts of 1,460 in April 1988 and 1,170 in November 1990. Small flocks were also reported from the Haughs of Don, near Kemnay (NJ7216), in the 1960s and 1970s and this site may still be in use.

2.1.2.5 Key references

Bell (1988), Bell *et al.* (1988), Patterson *et al.* (1989), Giroux (1991), Giroux & Patterson (1995), Keller *et al.* (1998)

2.1.3 Angus/Dundee (incl. Firth of Tay)

2.1.3.1 Background

At the northern limit of the Angus coast lies Montrose Basin, the almost totally enclosed estuary of the River South Esk. This is the most important site in the area for Pink-footed Geese and they benefit from good feeding sites along the eastern end of Strathmore. Some 40 km south lies the Firth of Tay, an extensive estuary that can support large numbers of Pink-footed Geese, although counting effort there has been irregular. The sands at Buddon Point provide an alternative roost for Pink-footed Geese which feed on the rolling farmland between Monikie and Letham. They also use Tentsmuir Point and Abertay Sands on the south side of the firth, but little is known about their preferences, which may be affected by prevailing weather conditions.

2.1.3.2 Historical status

Pink-footed Geese were not recorded on the Firth of Tay until 1872, although they may have been overlooked amongst the Bean Geese which formed the bulk of the shot bag during the previous 20 years (Berry 1939). By the early 1900s, Pink-footed Geese were said to winter near the mouth of the Tay in very large numbers, although the construction of aerodromes at Leuchars and Montrose, and a local gunnery, appear to have caused considerable disturbance. These factors, and apparent over-shooting in the 1930s, caused winter numbers to decline.

It was not until the beginning of the 20th century that flocks of Pink-footed Geese appeared in southeast Angus, but by the end of the 1930s the whole of the lowlands of Angus were considered more or less occupied (Berry 1939).

2.1.3.3 Internationally important sites

i) Montrose Basin

Five-year mean 95/96-99/2000: 24,428

Site conservation status

SPA (Montrose Basin: selection stage 1.2)
Ramsar (Montrose Basin: qualifying criterion 6)
SSSI (Dun's Dish and Montrose Basin)
IBA (Montrose Basin: criteria A4i, B1i, C3)

Site description and habitat

Montrose Basin (NO6597) is an almost land locked estuary immediately to the west of Montrose, half way between Aberdeen and Dundee. Extensive sand and mudflats are fringed with reedbeds and saltmarsh.

Numbers and trends

Throughout the 1960s and 1970s, the basin was badly disturbed, initially by military aircraft, then by excessive wildfowling. In 1981, a Local Nature Reserve was created, covering some 1,024 ha, and taking in virtually the whole of the basin plus a small amount of land above high water. The Scottish Wildlife Trust manages the LNR on behalf of Angus Council and, after shooting was restricted to specific areas, the number of roosting Pink-footed Geese responded immediately (Fig. 19).

In the period 1960/61-1979/80, the annual November count revealed an average of only 200 birds (max 1,050), and in several years there was none. After the designation of the site as a nature reserve, numbers steadily increased to a peak of 35,000 in November 1987. After a short period at the end of the 1980s when numbers were lower, attributed to disturbance caused by wildfowling, numbers increased again in the 1990s, with a peak of 41,210 in October 1993.

Site use

Peak numbers are normally reported in October and November, followed by a steady decline, usually to below 10,000 birds, through the winter and spring (Fig. 20).

Birds disperse to feed on farmland primarily to the south towards Chapleton/Inverkeilor. They also often feed on fields close to the basin at Bridge of Dun and to the south of Montrose towards Mains of Usan.

ii) Firth of Tay

Five-year mean 95/96-99/2000: 5,753

Site conservation status

SPA (Firth of Tay and Eden Estuary: selection stage 1.2)

Ramsar (Firth of Tay and Eden Estuary: qualifying criterion 6)

SSSI (various)

Site description and habitat

A large estuary running some 30 km inland from the Tay bridges (NO3525). On the north shore is the largest reedbed in Britain. Extensive sand/mudflats provide roost sites within the Inner Tay (the Tay

bridges forming a dividing line). On the Outer Tay, the principal roosts are on the north bank around Buddon Ness, or on the south side on the sands off Tentsmuir Point.

Numbers and trends

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 1970/80s, the geese preferring the greater security of inland waters. During the 1990s, however, more regular use as a roost began again, with several thousands present in most years, up to a recent peak of 8,897 in 1996/97 (Fig. 21).

Site use

Pink-footed Geese still flight northwest over the Sidlaw Hills to the Wolfhill/Pitcur area, while others intermittently use the Rhynd Peninsula, between the rivers Tay and Earn. The geese feed mainly in the area bounded by Inverarity, Letham, Arbirlot and Monikie, some 14 km² of open farmland with large fields. Pink-footed Geese used to feed on the Carse of Gowrie but seem now to ignore it, even after the end of the shooting season.

iii) Long Loch

Five-year mean 95/96-99/2000: 4,422

Site conservation status

None

Site description and habitat

The loch is some 6 km to the east of Coupar Angus in the Sidlaw Hills (NO2938).

Numbers and trends

The loch occasionally supports roosting Pink-footed and Greylag Geese, especially when there is wildfowling disturbance on the Firth of Tay. Pink-footed Geese have been recorded sporadically here since 1982/83 with a former peak count of 700 birds in November 1982. More recent counts have found larger numbers roosting, with a peak of 7,200 in November 1998 (Fig. 22).

Site use

Site use is poorly known as counts are infrequent. Feeding areas are located to the north in Strathmore and on the managed grasslands around Pitcur.

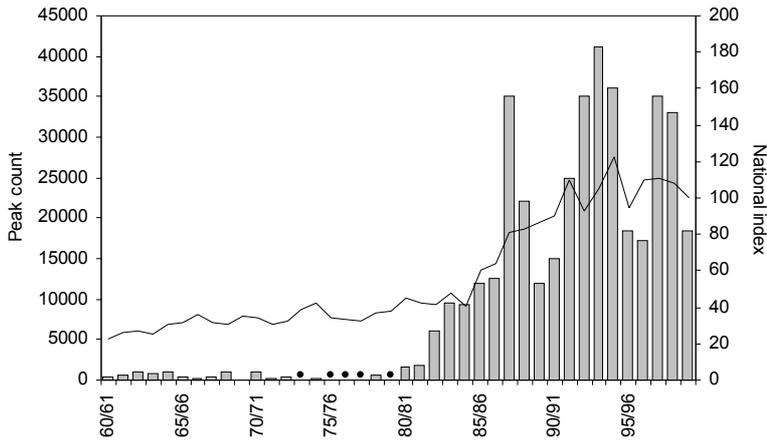


Figure 19. Pink-footed Geese at Montrose Basin, 1960/61-1999/2000: peak counts (bars) and British index (line) (circles denote years with no known data)

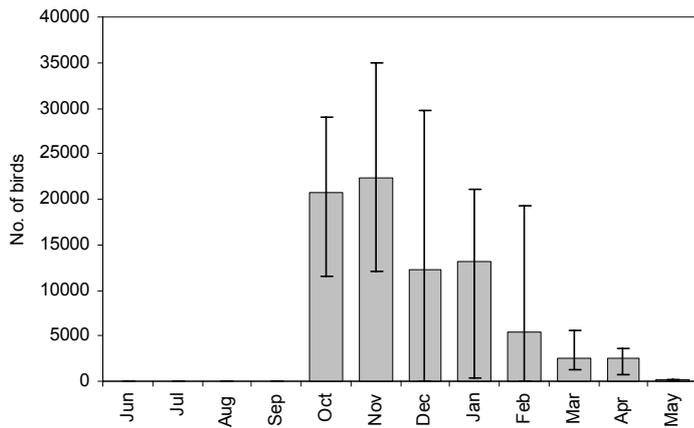


Figure 20. Pink-footed Geese at Montrose Basin, 1995/96-1999/2000: mean peak counts by month (error bars denote minimum and maximum peak counts during the period)

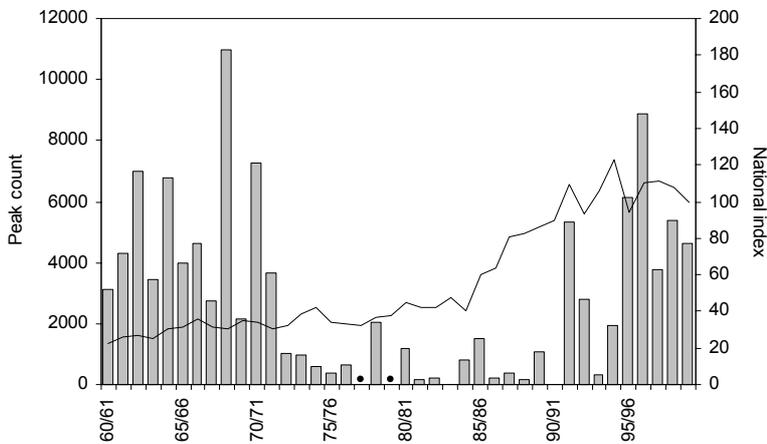


Figure 21. Pink-footed Geese at Firth of Tay, 1960/61-1999/2000: peak counts (bars) and British index (line) (circles denote years with no known data)

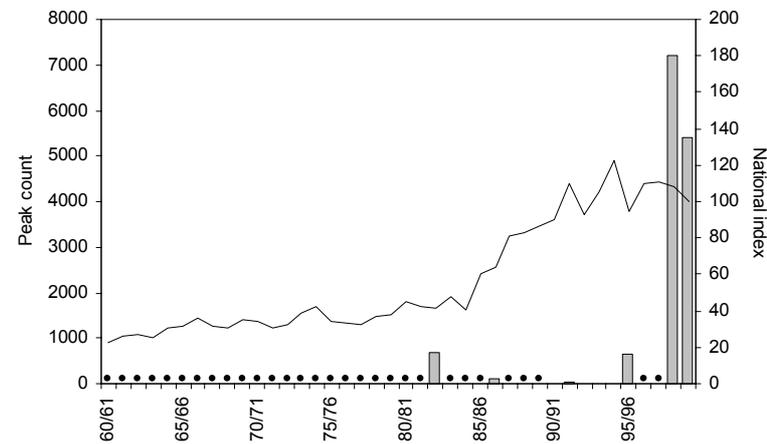


Figure 22. Pink-footed Geese at Long Loch, 1960/61-1999/2000: peak counts (bars) and British index (line) (circles denote years with no known data)

iv) Loch of Lintrathen

Five-year mean 95/96-99/2000: 4,368

Site conservation status

SPA (Loch of Lintrathen: non-qualifying species)
Ramsar (Loch of Lintrathen: non-qualifying species)
SSSI (Loch of Lintrathen)
IBA (Loch of Lintrathen: non-qualifying species)

Site description and habitat

North of Strathmore along the River Isla lays the Loch of Lintrathen (NO2754). It is a large (120 ha) reservoir with predominantly natural banks and is well screened by plantations, mainly to the south and west.

Numbers and trends

Use by roosting Pink-footed Geese has been infrequent. Roosting flocks of up to 4,500 occurred during a period in the mid 1970s, but the site was then abandoned. Smaller numbers returned during the early 1990s, increasing to over 2,000 by 1997/98. Numbers increased more dramatically in November 1999 to a site peak of 10,400 (Fig. 23).

Site use

Little information on feeding areas is available, but most are thought to disperse short distances into surrounding farmland, particularly around Incheoch, Torrax and Easter Peel (M. Robinson pers. comm.).

2.1.3.4 Other sites

i) Loch of Kinnordy

A eutrophic loch with associated wetland communities, notably basin mire, swamp and fen, 5 km to the west of Kirriemuir (NO3555). Submerged aquatic plant communities are absent and the grassland and woodland fringe is incomplete. The loch was formerly much larger in extent, but a series of drainage attempts were made, initially to facilitate marl removal. It has however been increasing in extent in recent years due to silting of the loch's current outflow stream.

Pink-footed Geese have been recorded using the loch since the early 1960s, when 3,700 were counted in March 1967. Throughout the 1970s, numbers were low and several years were without records of roosting birds. After winter 1987/88, roost counts of over 5,000 birds were regular, especially in the autumn, although numbers have again dropped off (Fig. 24) and have possibly switched to Loch of Lintrathen, 10 km to the west. The peak winter mean (1995/96-1999/2000) was 650.

Feeding occurs on farmland mostly within Strathmore. The site is a Ramsar site, SPA and SSSI. Eutrophication may pose a problem and Scottish Natural Heritage (SNH) monitor water quality to determine if the interests are threatened. Fishing is regulated through the restriction to certain areas. Water levels are controlled by a sluice and by clearance of debris and silt from the main outflow.

ii) Crombie Reservoir

Apart from a small flock in 1971/72, records only started in the early 1980s, when by far the highest number of Pink-footed Geese was recorded (15,000 in November 1980). Since then, counts of over 5,000 birds have been less frequent (Fig. 25) and, since 1993/94, the site has not been counted and goose usage is thought to be greatly reduced.

iii) Monikie Reservoir

Located just north of the Outer Tay, halfway between Dundee and Arbroath (NO5038). Few birds had been recorded using the loch until November 1979 when 10,650 were counted roosting there (Fig. 26). Clearly this was exceptional and probably a result of birds being displaced from the Firth of Tay or Montrose Basin. Birds continued to return, albeit infrequently, throughout the 1980/90s with occasional counts of up to 3,000 as recently as November 1995.

iv) Rescobie and Balgavies Lochs

To the east of Forfar are Rescobie (NO5151) and Balgavies (NO5351) Lochs. The Pink-footed Geese roosting on Rescobie Loch seem separate from those feeding just to the south; instead they flight north to feed in the valley of the South Esk between Aberlemon and Brechin, or sometimes on the rolling farmland a little closer to the roost. The loch was important as a Pink-footed Goose roost in the early 1970s, with a five-year average of 1,466 between 1969-73 (Fig. 27). Its importance is now much diminished, partly due to an increase in trout fishing and associated disturbance, with usually fewer than 150 birds roosting there in the late 1990s. The most recent large count was of 1,900 in November 1986.

Balgavies Loch has supported Pink-footed Geese since the early 1980s, perhaps having switched from Rescobie Loch, with a peak of 2,000 in November 1988 (Fig. 28). In the late 1990s, fewer birds roosted there (usually only a few hundred), although 1,000 were counted in November 1992.

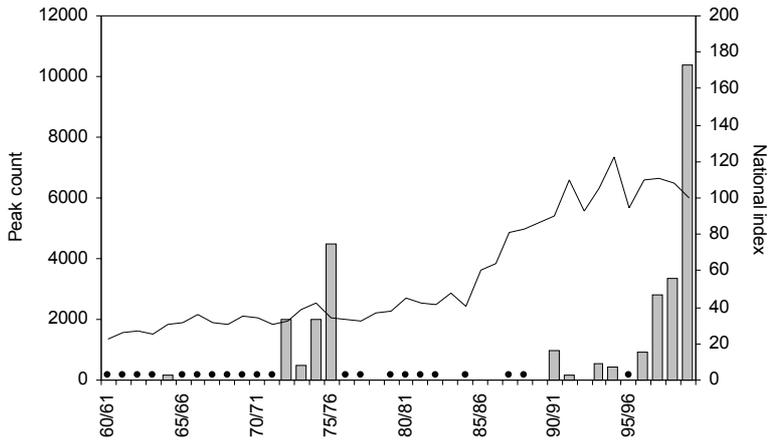


Figure 23. Pink-footed Geese at Loch of Lintrathen, 1960/61-1999/2000: peak counts (bars) and British index (line) (circles denote years with no known data)

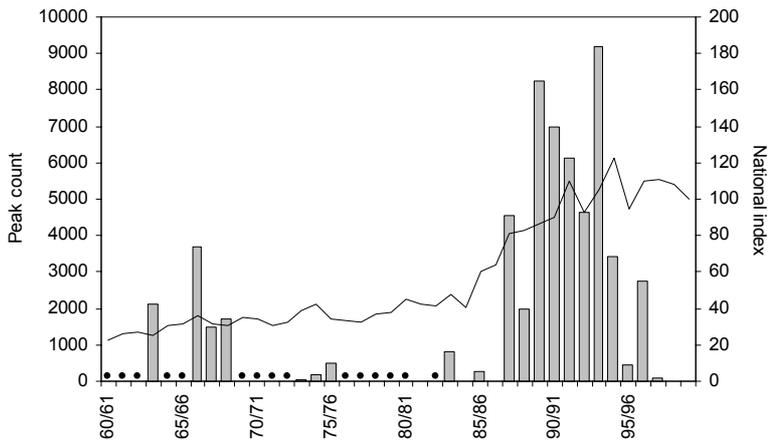


Figure 24. Pink-footed Geese at Loch of Kinnordy, 1960/61-1999/2000: peak counts (bars) and British index (line) (circles denote years with no known data)

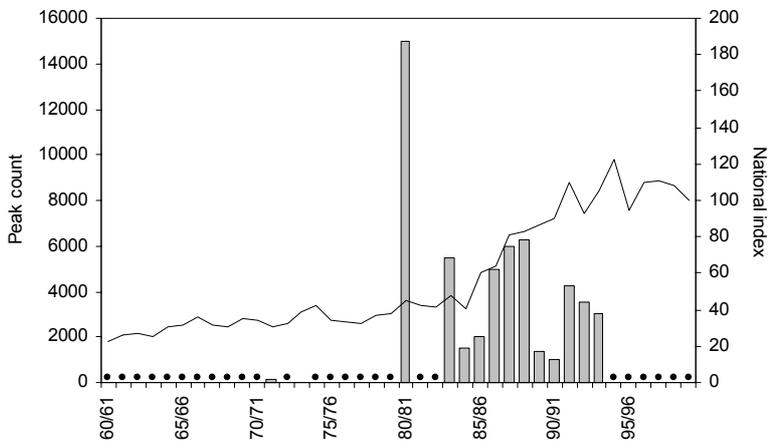


Figure 25. Pink-footed Geese at Crombie Reservoir, 1960/61-1999/2000: peak counts (bars) and British index (line) (circles denote years with no known data)

Figure 26. Pink-footed Geese at Monikie Reservoir, 1960/61-1999/2000: peak counts (bars) and British index (line) (circles denote years with no known data)

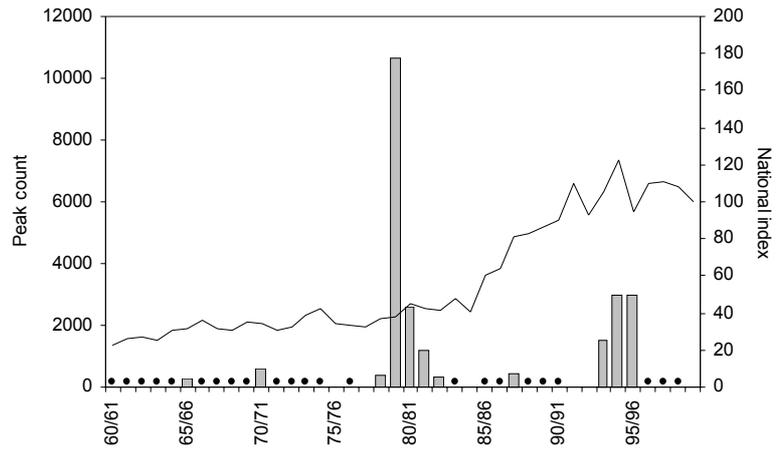


Figure 27. Pink-footed Geese at Rescobie Loch, 1960/61-1999/2000: peak counts (bars) and British index (line) (circles denote years with no known data)

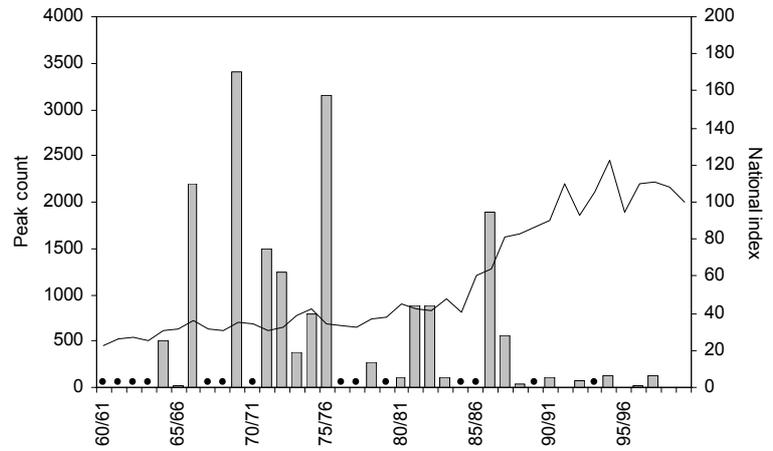
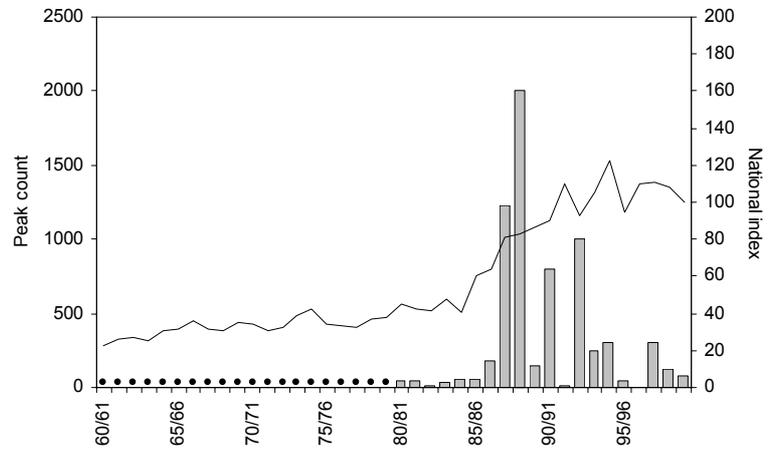


Figure 28. Pink-footed Geese at Balcavies Loch, 1960/61-1999/2000: peak counts (bars) and British index (line) (circles denote years with no known data)



v) Forfar Loch and Padanaram

Forfar Loch (NO4450) and Padanaram (NO4252) lie to the west of Forfar in the heart of Strathmore and regularly supported around 2,000 roosting Pink-footed Geese during the 1960/70s, with a peak of 4,900 in 1964/65. Use of the loch is now greatly reduced, especially since the early 1980s when it became a recreation park for the town, with usually only up to 100 birds roosting (Fig. 29). Padanaram was the main feeding area for birds using the loch and a resting place when floodwaters were present. Smaller numbers occasionally feed there today.

vi) Dun's Dish

To the northwest of Montrose Basin lies Dun's Dish (NO6460), which has occasionally supported Pink-footed Geese since the mid 1980s. It is probably used most when there is disturbance at the basin, and at times up to 2,000 birds are present, with a peak of 2,400 in October 1993 (Fig. 30). Access is restricted, however, and consequently counts have been rather infrequent. The site is also occasionally disturbed by wildfowling activity. The main feeding areas appear to be to the north on farmland around Ballochry.

vii) Minor roosts

In the Sidlaw Hills, southwest of Coupar Angus, are a group of some nine lochs, mostly lying above 200 m. Long Loch (see above) and Redmyre Loch (NO2833) are occasional roosts for Pink-footed Geese which feed around Pitcur, stopping there instead of flying down to the Tay. The same pattern of roosting occurred at Redmyre Loch with a peak count of 3,200 birds in November 1990, although frequent and persistent wildfowling on the loch has virtually eliminated roosting there (K. Brockie pers. comm.).

Field counts of Pink-footed Geese using the Lour area (NO4844) have been collected since the 1960s and reflect a period of sustained use up to the late 1980s; the peak count was 8,030 in November 1971. The geese presumably roost to the south at Crombie and Monikie Reservoirs (see above) or on the Firth of Tay. Up to 2,400 have been recorded feeding around Kinaldie (NO6746) and Cuthlie (NO5941) and, since there is no obvious roost here, they are presumably birds which roost at Montrose Basin, some 18 km to the north.

2.1.4 Perth & Kinross

2.1.4.1 Background

To the west and southwest of Perth lie three major Pink-footed Goose roosts, Dupplin Loch about 8 km west of Perth, Drummond Loch near Crieff and Carsebreck/Rhynd Lochs, near Auchterarder. Between them, these sites regularly hold over 10% of the whole Pink-footed Goose population, and have held substantially more on occasions. A number of other key roosts, such as Loch Leven, make this region one of the most important in Britain for Pink-footed Geese.

The status and winter ecology of geese in the area has been studied in detail since the 1987/88 winter by the Central Scotland Goose Group (e.g. Bell & Newton 1995). Better coverage, and the inauguration of a national October count, accounts for the apparent increase in numbers in the late 1980s. All the roosts in the area hold their largest numbers in the autumn, with some very large flocks at the main roosts just after the geese arrive in Scotland. Within a few weeks many birds move on to the smaller roosts in the area and by November many have departed south. The area total counted in November is typically about half that in October. The geese are very dependent on barley stubbles in autumn and the size and duration of the autumn peak depends on the amount of grain spilt before and during harvesting. Each of the three main roosts occasionally holds over 10,000 Pink-footed Geese in the second half of the winter. Almost all the roosts are on private estates under sympathetic ownership. The main threats to the populations of wintering Pink-footed and Greylag Geese in the area are changes in the agricultural cropping regime, particularly changes from cereals to oil seeds, more autumn and less spring sowing of cereals and less intensive grassland management, and increased disturbance from farmers wishing to protect crops and from organised goose shooting parties. Geese have already deserted some previously favoured feeding areas and the holding capacity of areas like Strathearn and Strathallan is considerably lower than 20 years ago.

2.1.4.2 Historical status

In the 1930s, the Pink-footed Goose was considered common in the areas around the Firth of Forth, with large flocks reported from Grangemouth on Forth, Loch Leven and Flanders Moss (Berry 1939). A remarkable increase in numbers was noted at the end of the 19th century that continued into the early 20th century. A local drop in numbers at Loch Leven in

the late 1930s was attributed to over-shooting on the roosting grounds and disturbance from low-flying aircraft. The lochs at Dupplin and Carsebreck were occupied during the 1930s, the former site perhaps in response to disturbance from shooting on the Firth of Tay. When the national grey goose counts started in 1960, Perth and Kinross was the most important area in Britain for both Pink-footed and Greylag Geese (Newton *et al.* 1973). The numbers of Greylag Geese are now much lower, but numbers of Pink-footed Geese are little changed, though a number of new roosts have been occupied.

2.1.4.3 Internationally important sites

i) Dupplin Loch

Five-year mean 95/96-99/2000: 34,130

Site conservation status

SPA (South Tayside Goose Roosts: selection stage 1.2)

Ramsar (South Tayside Goose Roosts: qualifying criterion 6)

SSSI (Dupplin Lakes)

IBA (South Tayside Goose Roosts: criteria A4i, B1i, C3)

Site description and habitat

The two small eutrophic lochs at Dupplin (NO0320) are together only 40 ha and are set within mature mixed woodland and conifer plantations. They are situated at 120 m asl on the Gask ridge between Strathearn and the valley of the Pow Water. The lochs are well sheltered by the surrounding woodland and are prone to freezing over. The surrounding farmland is mixed and in places quite well wooded with numerous small plantations and shelter belts. In autumn the geese feed on barley stubbles and the peak numbers and their length of stay are closely related to the amount of grain spilt before or during harvest. Later in the autumn the geese move onto grass and winter cereals. In mid winter and spring the geese often roost on floodwater pools along the Earn and Pow and the lochs can be deserted (Bell *et al.* 1998).

Numbers and trends

An almost complete run of November counts from 1960 highlight the importance of this site (Fig. 31). Counts of 21,000 in October 1966 and 27,500 in November 1973 represented approximately one third of the then entire Greenland/Iceland population. Since 1987, regular counts in late September and early October, just after the geese arrive in Britain, have consistently found very large totals and Dupplin is clearly one of the most important arrival sites in Scotland for this species

(Fig. 32, see Newton *et al.* 1990). In late September 1991, a remarkable total of 57,500 was counted, but this was surpassed in October 1994 when 62,000 flighted in, representing approximately one quarter of the population at that time.

Site use

In autumns with clean cereal harvests, the geese move on within a few days and numbers have on occasion dropped by 25,000 over eight days, though a decrease of 10,000 per week is more typical. Because of changes in agricultural practice, the area no longer supports large flocks later into the autumn as it did regularly during the 1970s. Between November and April, 4,000-8,000 Pink-footed Geese are typically present in Strathearn (Fig. 32, Bell & Newton 1995).

The main feeding areas are in the Earn Valley to the south and the Pow Water Valley to the north. At times the geese flight south towards Glenfarg, north into Glenalmond and northeast beyond Perth.

ii) Loch Leven

Five-year mean 95/96-99/2000: 15,286

Site conservation status

SPA (Loch Leven: selection stage 1.2)

Ramsar (Loch Leven: qualifying criterion 6)

NNR (Loch Leven)

SSSI (Loch Leven)

IBA (Loch Leven: criteria A4i, B1i, C3)

Site description and habitat

Located approximately 20 km south of Perth (NO1401), Loch Leven is the largest naturally eutrophic loch in Britain (14 km²), yet two-fifths of this area is less than 3 m deep. The loch is surrounded by farmland, with a diverse aquatic flora and shoreline vegetation. It is set in rich agricultural land, and the increased use of phosphorus-based fertilisers in the surrounding area, together with sewage effluent and industrial waste from Kinross and Milnathort, has caused over-eutrophication and resulted in severe algal blooms which have greatly reduced the submerged vegetation (P. Brooks pers. comm.).

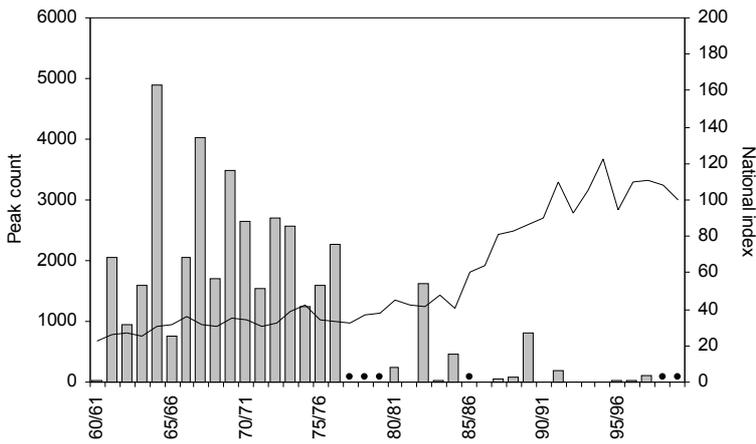


Figure 29. Pink-footed Geese at Forfar Loch/Padanaram, 1960/61-1999/2000: peak counts (bars) and British index (line) (circles denote years with no known data)

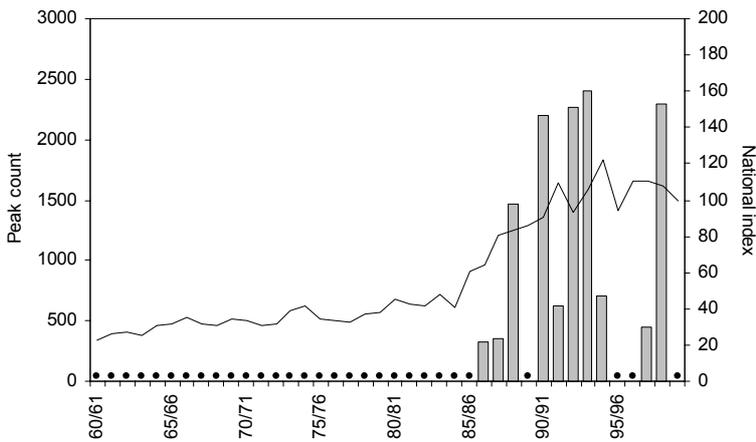


Figure 30. Pink-footed Geese at Dun's Dish, 1960/61-1999/2000: peak counts (bars) and British index (line) (circles denote years with no known data)

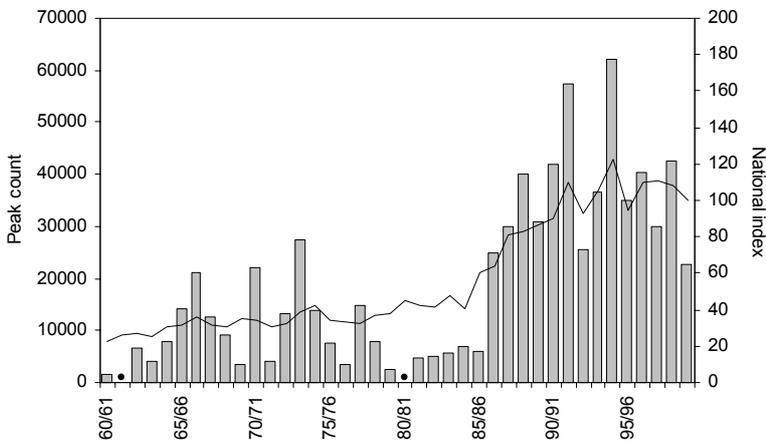


Figure 31. Pink-footed Geese at Dupplin Loch, 1960/61-1999/2000: peak counts (bars) and British index (line) (circles denote years with no known data)

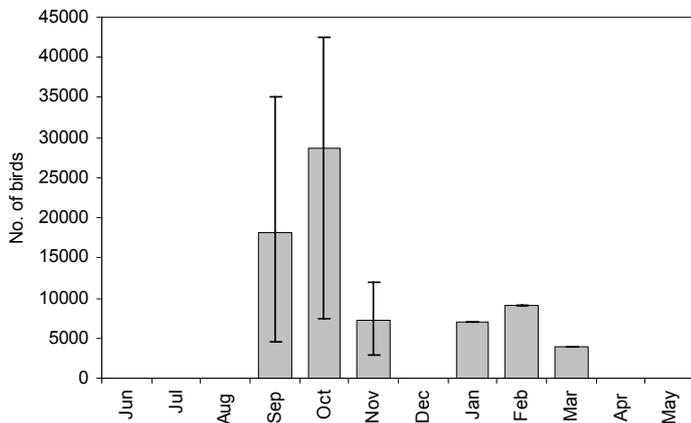


Figure 32. Pink-footed Geese at Dupplin Loch, 1995/96-1999/2000: mean peak counts by month (error bars denote minimum and maximum peak counts during the period)

Numbers and trends

An unbroken run of roost counts from 1960 highlight the importance of the loch. Numbers did not reach 10,000 until winter 1979/80, after which the average peak count has been closer to 17,000 birds (Fig. 33). A peak count of 23,070 was made in October 1992 although numbers have decreased in the late 1990s.

Site use

The loch forms a major arrival point for Pink-footed Geese from Iceland and in most years counts are highest in the early autumn, falling to a lower though fluctuating level for the rest of the winter. Numbers generally reduce to 6,000-7,000 during mid winter, but there is a pronounced passage during March (Fig. 34) involving many more birds (see Hearn *et al.* 1996).

The surrounding farmland provides much feeding, though variations in harvest success and crops grown cause variations in the numbers of geese and how long they stay. Feeding occurs mostly within 20 km of the roost, covering 140 km² of agricultural land interspersed with pockets of woodland, varying in altitude from 100 m at Auchmuirbridge in the east to 230 m near Glenlomon. Most feeding is on stubbles (especially in autumn) and grassland (throughout the winter period) (Newton & Campbell 1973, Hearn & Mitchell 1995). The pattern of feeding in the mid 1990s (Hearn & Mitchell 1995) was found to be broadly similar to that observed in 1968-72 (Newton & Campbell 1973). Some geese roosting at Loch Leven feed in unknown areas to the south and east (A. Lauder pers. comm.). 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 (Hearn & Mitchell 1995).

iii) Carsebreck/Rhynd Lochs

Five-year mean 95/96-99/2000: 14,592

Site conservation status

SPA (South Tayside Goose Roosts: selection stage 1.2)

Ramsar (South Tayside Goose Roosts: qualifying criterion 6)

SSSI (Carsebreck and Rhynd Lochs)

IBA (South Tayside Goose Roosts: criteria A4i, B1i, C3)

Site description and habitat

Three small lochs, with a total area of 41.5 ha, situated between the villages of Braco and Blackford in Strathallan (NN8710). There is little bankside shelter round any of the lochs and they are very

exposed to the prevailing west and southwest winds. The winters are considerably more severe here than in the Forth Valley to the southwest or in Strathearn to the east. The climate in Strathallan is marginal for growing arable crops so that spring ploughing and sowing are the normal regime. Harvests can be late and sometimes very dirty. Most feeding in autumn is on barley stubbles and waste potatoes with geese moving onto grass as these food sources are finished. A number of smaller lochs and floodwater pools in the valley are used for roosting at times, especially after the end of the shooting season (Bell *et al.* 1998).

Numbers and trends

An unbroken run of November counts since 1960 emphasises the importance of these lochs. Numbers were generally fewer than 7,000 up to the 1987/88 winter, after which counts of over 10,000 were common, with a peak of 18,500 in October 1998 (Fig. 35). This change in status is, however, partly a result of regular counts being made in October just after the geese have arrived. Recent changes on the feeding areas (see below) mean that the autumn peak is now rarely sustained for more than a few days.

Site use

After an autumn peak, numbers usually fall to fewer than 5,000 in mid winter, especially after snow, but increase in late March (Fig. 36). Over 10,000 were present in April 1992 and 1993 (Bell & Newton 1995). A feature of this site are the large numbers which remain into May, with over 100 sometimes present into the third week.

Feeding areas are located in Strathallan, from Gleneagles to Dunblane, with at times large flights northeast into Strathearn and southwest into the Forth Valley (Bell & Newton 1995). During periods of snow cover in Strathallan, the Pink-footed Geese often move to the Forth Valley.

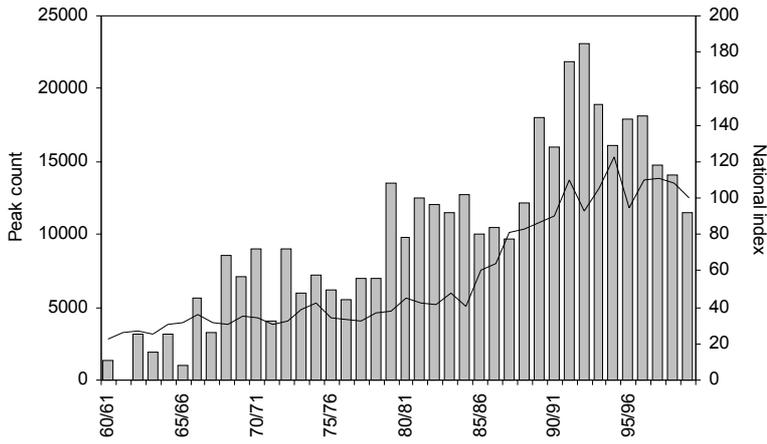


Figure 33. Pink-footed Geese at Loch Leven, 1960/61-1999/2000: peak counts (bars) and British index (line) (circles denote years with no known data)

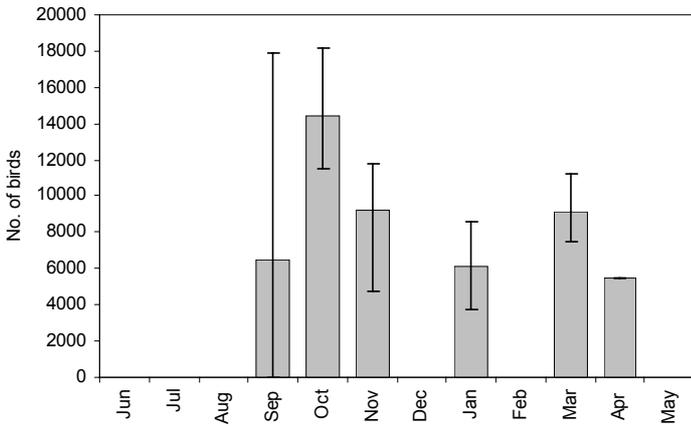


Figure 34. Pink-footed Geese at Loch Leven, 1995/96-1999/2000: mean peak counts by month (error bars denote minimum and maximum peak counts during the period)

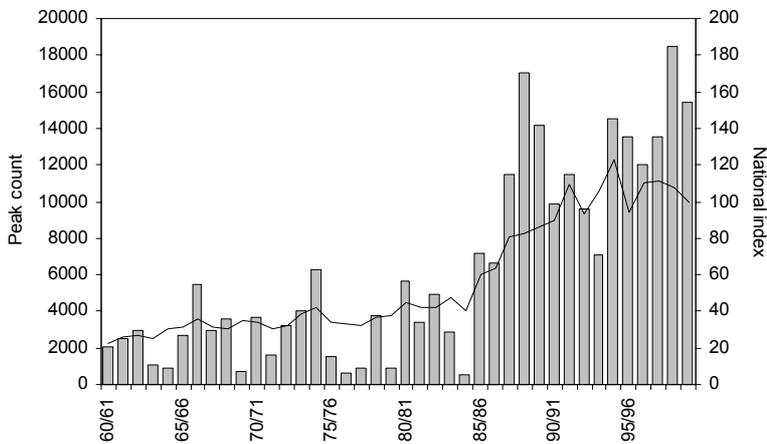


Figure 35. Pink-footed Geese at Carsebreck/Rhynd Lochs, 1960/61-1999/2000: peak counts (bars) and British index (line) (circles denote years with no known data)

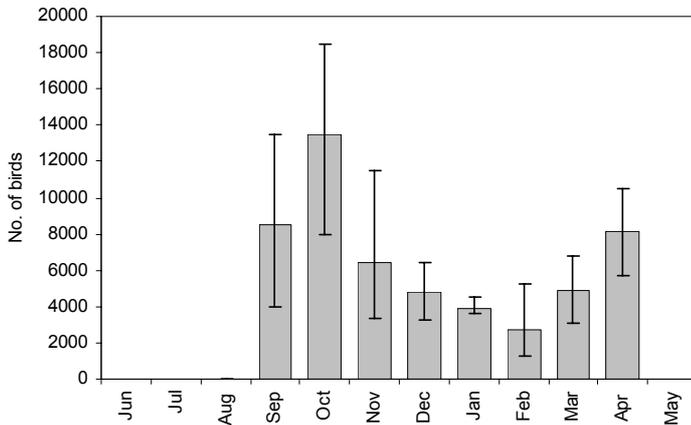


Figure 36. Pink-footed Geese at Carsebreck/Rhynd Lochs, 1995/96-1999/2000: mean peak counts by month (error bars denote minimum and maximum peak counts during the period)

iv) Loch Tullybelton

Five-year mean 95/96-99/2000: 4,431

Site conservation status

None

Site description and habitat

North of Glenalmond (NO0034), this hill loch (215 m asl) is exposed to the prevailing southwesterly wind. The loch readily freezes over and the roost is usually abandoned in mid winter, with much smaller numbers present in spring.

Numbers and trends

Used frequently as a roost since the mid 1980s, the loch has held up to 5,000 birds regularly since, with a peak of 8,100 in October 1998 (Fig. 37).

Site use

The loch is used less from November. Feeding areas are in farmland to the east as far as Stanley and Luncarty. Pink-footed Geese from Dupplin Loch often feed in the same area.

v) Drummond Loch

Five-year mean 95/96-99/2000: 2,645

Site conservation status

SPA (South Tayside Goose Roosts: selection stage 1.2)

Ramsar (South Tayside Goose Roosts: qualifying criterion 6)

SSSI (Drummond Loch)

IBA (South Tayside Goose Roosts: criteria A4i, B1i, C3)

Site description and habitat

A lowland (40m asl) eutrophic loch (34.5 ha) near Crieff (NN8518) in west Strathearn some 17 km west of Dupplin Loch. The loch is surrounded by mature mixed woodland with parkland along part of the southern shore and is quite well sheltered.

Numbers and trends

This site was the main Greylag Goose roost in Britain during the 1960s and 1970s (11,700 in October 1973) when the Pink-footed Goose was a rare visitor. Flocks of Pink-footed Geese were first noted in December 1988, following the very dirty harvest of that autumn, when up to 2,900 from Carsebreck, 8 km to the south, fed in an unharvested field of barley near Muthill. The site has been used in autumn since then, and numbers peaked at 7,000 in 1996/97 (Fig. 38).

Site use

The geese are only present for a few weeks in October, often coinciding with the October count. The roost was also occupied in spring 1997 and 1998 by several hundreds of birds. Feeding takes place in farmland within a few kilometres to the east and south of the loch. The feeding area to the south is shared by Pink-footed Geese from Carsebreck and the peak numbers at Drummond Loch are usually a week or two after the peak at Dupplin and Carsebreck.

vi) River Tay at Kercock

Five-year mean 95/96-99/2000: 2,525

Site conservation status

SSSI (Meikleour area)

Site description and habitat

This site is variously described as Bloody Inches, Meikleour, Tay/Isla Valley or Kercock. It lies on the River Tay 2-4 km upstream of the confluence with the Isla (NO1439). Dupplin Loch lies 21 km to the SSW and Loch Tullybelton 14 km to the WSW. It is a broad meandering part of the river with large shingle banks and some old flooded meanders with adjacent meadows prone to flooding. The geese roost along about 2 km of river and on adjacent floodwater. As with most sites supporting both Greylag and Pink-footed Geese, the two species tend to roost apart in quite well defined areas.

Numbers and trends

This is another roost that was formerly used exclusively by Greylag Geese, but where Pink-footed Geese have appeared with increasing frequency since the late 1980s. Over 2,000 were noted in April 1988 and 1990 and, since then, they have become regular in the autumn (Fig. 39). It is believed that Pink-footed Geese displaced from Lochs Tullybelton and Mullion, either by disturbance or frost, may come here.

Site use

Pink-footed Geese using this roost feed on fields on the adjacent floodplain and the farmland to the west and south where there is overlap with geese from Lochs Tullybelton and Mullion and from Dupplin Loch. Birds may occasionally flight out between the northeast and southwest to feed in the Isla Valley and around Wolfhill.

vii) Loch Mullion

Five-year mean 95/96-99/2000: 2,250

Site conservation status

None

Site description and habitat

A small remote lochan situated in the foothills north of Glenalmond (NN9833), 2 km southwest of Loch Tullybelton.

Numbers and trends

Counted since winter 1991/92, when 1,475 roosted in November. It has regularly supported over 2,000 birds since, with a peak of 5,500 in 1999/2000 (Fig. 40). The site is rarely visited in midwinter, but numbers increase again in spring. Some 2,200 were present in March 1994. There is complete interchange between this site and Loch Tullybelton, possibly on a night-to-night basis depending on the weather and disturbance. Loch Mullion is more sheltered and offers some feeding at the loch, but is regularly disturbed by shooting.

Site use

Feeding occurs on farmland to the east, shared with geese from Loch Tullybelton, and on a few fields by the loch where barley is put down for ducks.

2.1.4.4 Other sites**i) Glenfarg Reservoir**

To the north of Loch Leven, in the Ochil Hills, and midway between the loch and the Earn Valley is Glenfarg Reservoir (NO1111). The reservoir is used for trout fishing and the fishing season was extended in 1997. Consequently, the site is probably now untenable as a goose roost. There is also considerable disturbance from shooting nearby. The reservoir was formerly an important Greylag Goose roost. It also held occasional flocks of roosting Pink-footed Geese in the mid 1960s (max 810 in November 1963), but was largely abandoned until a more frequent period of use during the early 1990s (Fig. 41). It tends to be used in October and abandoned shortly afterwards. A peak count of 9,080 was recorded in October 1994.

Feeding is on mixed farmland within a few kilometres of the reservoir. Pink-footed Geese from Loch Leven and Dupplin Loch also use the same feeding areas at times.

ii) Blairgowrie lochs

A string of lochs to the west of Blairgowrie occasionally hold roosting Pink-footed Geese, including Loch of Lowes (NO0443) (400 in November 1977), Loch Clunie (NO1144) (350 in October 1990) and Stormont Loch (NO1942) (900 in November 1988). A co-ordinated count of the lochs in March 1962 revealed 1,487 birds. These may be birds disturbed from roosting on the River Tay at Kercock, some 5 km to the south. Since the late 1980s, Pink-footed Geese have occasionally roosted on the River Tay near Almondmouth (NO1125) with a peak of 750 in November 1987. There is an exceptional record of 2,133 Pink-footed Geese roosting at Loch Tay (NN6838) in March 1964.

iii) Minor sites

A wide variety of other sites have been used as roosts varying from temporary floodwater to permanent small pools. Many of these sites should best be regarded as satellites of the larger roosts as they lie within the feeding areas of geese from the main roosts (Bell *et al.* 1998). Floodwater pools along the Earn between Dalreoch and Aberdalgie and on the Pow Burn to the north regularly hold several thousand birds, with over 4,000 at times, especially after the shooting season (Bell *et al.* 1998); these are geese which would otherwise use Dupplin Loch. Similarly, in Strathallan, geese from Carsebreck used another 12 roosts between the 1987/88 and 1993/94 winters, with five of these sites holding over 2,000 birds and one, Upper Glen Devon Reservoir (NN9004), up to 7,360 (Bell *et al.* 1998). This last reservoir was also used in the 1960/70s as an alternative roost when Carsebreck was disturbed by shooting. To the southwest of Loch Leven, sporadic roosting occurs at Cleish Plantation Lochan (NO0998) with 2,000 recorded there in November 1989; these have probably been disturbed from Loch Leven.

2.1.4.5 Key references

Newton & Campbell (1973), Newton *et al.* (1973), Newton *et al.* (1990), Bell & Newton (1995), Hearn & Mitchell (1995), Bell *et al.* (1998)

Figure 37. Pink-footed Geese at Loch Tullybelton, 1960/61-1999/2000: peak counts (bars) and British index (line) (circles denote years with no known data)

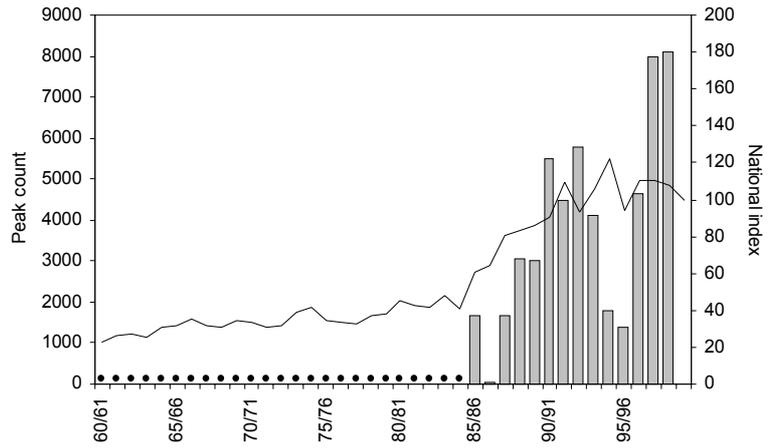


Figure 38. Pink-footed Geese at Drummond Loch, 1960/61-1999/2000: peak counts (bars) and British index (line) (circles denote years with no known data)

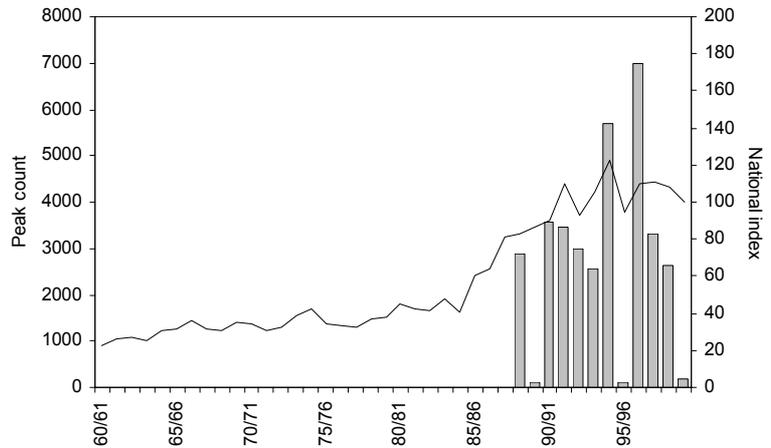


Figure 39. Pink-footed Geese at River Tay at Kercock, 1960/61-1999/2000: peak counts (bars) and British index (line) (circles denote years with no known data)

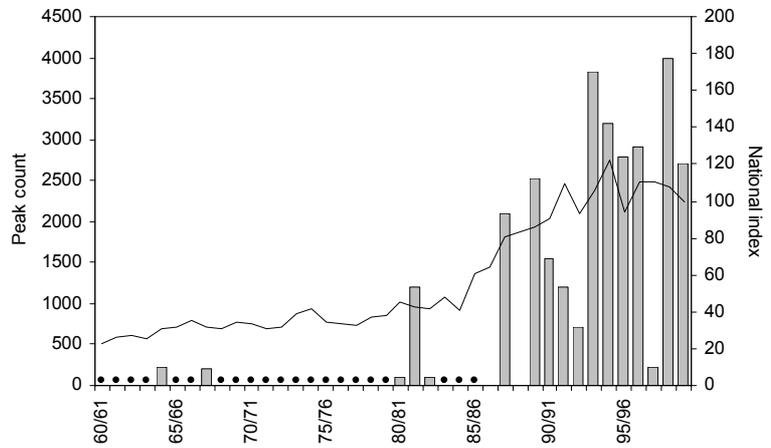
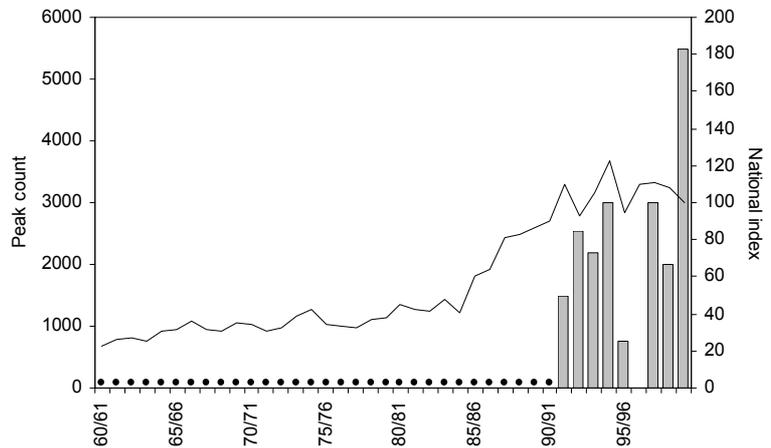


Figure 40. Pink-footed Geese at Loch Mullion, 1960/61-1999/2000: peak counts (bars) and British index (line) (circles denote years with no known data)



2.1.5 Fife

2.1.5.1 Background

Fife is situated between the firths of Tay and Forth, with the North Sea on its eastern boundary dominated by the Eden Estuary. It covers an area of 1,305 km² and comprises a broad peninsula with a 170 km coastline, much of which is designated as SSSI because of its biological and geological significance. In spite of its relatively small size, Fife has a remarkably varied landscape which incorporates a diverse range of habitats of varying degrees of naturalness. The twin peaks of the Lomond Hills (522 m at West Lomond) dominate central Fife and are visible from much of the Midland Valley of Scotland. The North Fife Hills bound the south side of the Tay while west Fife rises into the Cleish Hills. Volcanic vents such as Largo Law dominate the rolling hills that are more characteristic of much of the rest of the area. In contrast, coastal hills and cliff are found along much of the shore from St Andrews to North Queensferry.

Other than these upland features, Fife is predominantly a low-lying agricultural area with three principal rivers: the Eden flowing through Cupar to the Eden Estuary, the Leven originating at Loch Leven and flowing to the Forth via Glenrothes and the Ore which joins the Leven near Windygates. There are probably few natural lochs in Fife, most having been drained for agricultural improvements, but standing waters exceed 400 - a number increasing every year with the formation of new farm ponds and reservoirs - of which some 45 can be considered as major still waters, being over 2 ha in extent (Corbet 1998). Most of the larger waters are man-made reservoirs (e.g. Cameron Reservoir) but the largest, Loch Ore and Loch Gelly, are natural.

Fife is one of the most intensively farmed areas of Scotland (75% of the total area is agricultural) with a clear division between the arable land of the east and the more extensive pasture of the west. The coastal location and topography of Fife have a considerable influence on its weather. Prevailing winds are from the west-south-west, and upland areas over 200 m receive up to 1,000 mm of rain per year. Spring and early summer is often characterised by fog on the east coast which can persist inland in winter. Snow is more common in the west of the area during January and February, which are also the coldest months, and freshwater lochs often freeze over (for more information on the character of Fife, see Corbet 1998).

Early arrivals or passage of Pink-footed Geese can be recorded at the end of September and early October, but late October and early November tend to see the peak arrival with numbers reducing during the winter as feeding opportunities decline and weather conditions deteriorate. A return passage in late winter/early spring tends to involve fewer birds and most have gone by early April. Most of the feeding areas are in central, east and northeast Fife and are associated with the principal roosts, although their use can vary during and between winters.

2.1.5.2 Historical status

Pink-footed Geese were not recorded in Fife until 1870, yet by the 1930s they were considered common in all lowland districts (Berry 1939). By the 1950s, Baxter and Rintoul (1953) refer to 'big flocks every winter, and in some years in incredible numbers, on the sand-banks of the Tay and in the fields about the East Neuk of Fife'. Numbers were high during the 1960s and it was still considered to be a common winter visitor in the early 1980s (Smout 1986). The early 1990s saw record counts at feeding and roosting areas, but numbers have declined or become variable in recent winters.

2.1.5.3 Internationally important sites

i) Cameron Reservoir

Five-year mean 95/96-99/2000: 7,850

Site conservation status

SPA (Cameron Reservoir: selection stage 1.2)

Ramsar (Cameron Reservoir: qualifying criterion 6)

SSSI (Cameron Reservoir)

IBA (Cameron Reservoir: criteria A4i, B1i, C3)

Site description and habitat

Constructed by 1914, Cameron Reservoir (NO4711) is located 6 km southwest of St Andrews at a height of 150 m asl. It is one of the largest reservoirs in Fife, covering an area of approximately 40 ha, and can be considered as an artificial mesotrophic loch with beds of aquatic and marginal vegetation. On the south and north sides are conifer plantations (on the south side rather derelict) with extensive scrub and areas of tufted hair grass. The surrounding land is predominantly improved or semi-improved pasture, but also contains some arable land.

Numbers and trends

Counts from the 1960s to 1980s show regular roosting flocks of over 5,000 birds, with 8,000-9,000 often recorded in the 1960s and 1980s (Fig. 42). By 1990, the peak count was 9,500 in November 1989.

In the early 1990s, however, there was a sharp and dramatic increase with 11,000-12,000 birds regularly counted at the roost and a record peak of 27,300 in October 1993. Unlike many other lochs, however, the rate of increase in numbers using the loch has not kept pace with the increase in the total population; indeed the late 1990s has seen a decline and a roost of over 10,000 birds is now uncommon.

Site use

Regular monitoring, especially during the 1990s, has shown that the roost is of importance throughout most of the winter, after the initial peak arrivals in October or November, and that increased usage can occur during spring passage in late February and March (Fig. 43).

There are two distinct regular feeding areas for birds using this roost: to the south in the vicinity of the reservoir based around Radernie and Northbank Farms, and 5 km to the southeast around Pittarthie and Lochty. Other flocks feed to the east as far as Boarhills (8 km away) and south of St Andrews. Initial arrivals in autumn tend to feed in stubbles to the north of Cameron Farm. Thereafter, the birds disperse to other locations and can be difficult to find due to the amount of 'dead ground', but by late winter and early spring more regular use of the Radernie pasture fields occurs. In recent winters a closer link with the Eden Estuary roost appears to have become established.

2.1.5.4 Other sites

i) Eden Estuary

Other than counts of 3,000 in November 1965 and November 1970, the Eden Estuary (NO4719) was little used by Pink-footed Geese until the mid 1980s, when 100-300 birds were regular, peaking at 800 in December 1988. The 1990s saw more regular patterns of use, although numbers have remained relatively low (usually under 500), with a maximum of 2,500 in November 1993 (Fig. 44). This is not an easy site to count and, as wildfowling takes place there, it is possible the birds arrive late and leave early, as more can often be found feeding in the Craigie Farm area, 3 km to the north, than are found at the roost.

ii) Morton Lochs

Morton Lochs (NO4626) was a key roost up to the mid 1970s, with a maximum of 3,000 in November 1969. This site is now not suitable for roosting geese, however, owing to extensive vegetation, although Pink-footed Geese are often found feeding in the surrounding area.

iii) Minor roosts

Tentsmuir Point and Abertay Sands (NO5128) used to be a major roost prior to the 1960s; recent evidence of feeding birds south of Tayport, around Pickletille and Craigie suggests that this roost may again be in use with possible linkage to the Eden Estuary.

Carriston Reservoir (NO3203), east of Glenrothes, occasionally holds Pink-footed Geese, and birds feeding in the Glenrothes, Star and Markinch areas may use this roost (they may also be from Loch Leven). Counts are limited, however, and it is thought that shooting disturbance may have affected this roost. Clatto Reservoir (NO3607) is used irregularly, and usually by small feeding flocks rather than roosting birds, with a maximum roost of 200 in March 1996. Kilconquhar Loch (NO4801) rarely holds many Pink-footed Geese, with a maximum of 128 in November 1993. Carnbee Reservoir (NO5206) appears to have been used by geese only in recent years and is associated more with feeding than roosting geese. A few are also occasionally seen at Carlhurlie Reservoir (NO3904).

Of the Lomond Hills reservoirs, Ballo (NO0205) is the only one used regularly as a goose roost, with a peak of 1,100 in November 1967, but more recently only 100 in November 1996.

Lindores Loch (NO2616) has had few roosting birds since the 1960s, when there was a peak of 750 in December 1964. Although close to the Tay Estuary and Mugdrum Island roost, there is no evidence of wildfowling there displacing birds to Lindores.

Pink-footed Geese make relatively limited use of sites in west Fife for roosting or feeding. Town Loch in Dunfermline (NT1291) held small numbers during the 1960s, with a peak count of 125 in November 1964, but increased recreational use, including water skiing, make future goose use unlikely. Loch Fitty (NT1291) was used by small numbers in the late 1980s but is heavily disturbed by fishing. Loch Glow (NT0895) is used sporadically, with a peak of 226 birds in November 1991. The Devilla Forest near Kincardine includes a small group of lochs – Peppermill Dam (NS9489), Moor Loch (NS9488) and Keir Loch (NS9687) – which has occasionally held Pink-footed Geese. Records date from the late 1960s to the late 1980s, with a peak of 350 in November 1968. More recently, Peppermill Dam appears to be the favoured, if only occasional, roost in autumn, with a peak of 1,200 in October 1996. Cullaloe Reservoir (NT1887) held 160 birds in November 1972, but the main reservoir has now been drained and future use is unlikely.

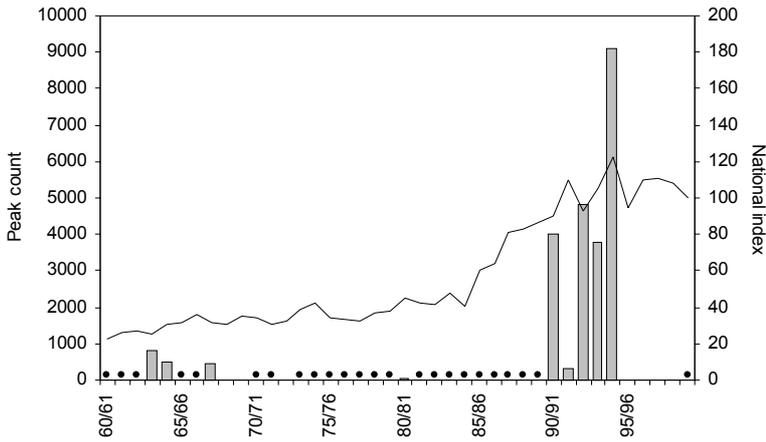


Figure 41. Pink-footed Geese at Glenfarg Reservoir, 1960/61-1999/2000: peak counts (bars) and British index (line) (circles denote years with no known data)

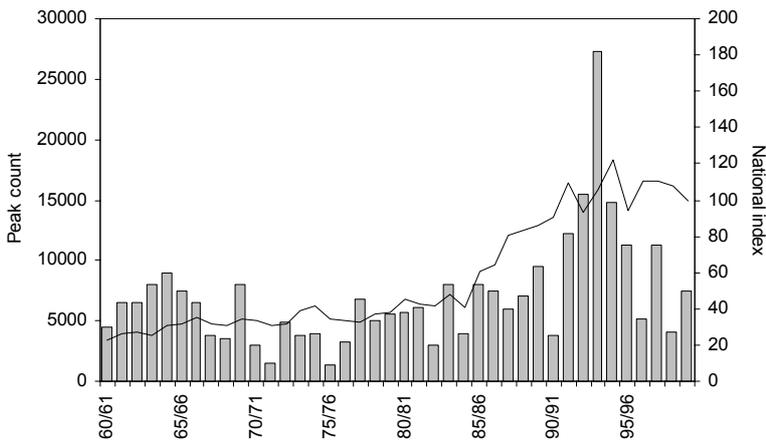


Figure 42. Pink-footed Geese at Cameron Reservoir, 1960/61-1999/2000: peak counts (bars) and British index (line) (circles denote years with no known data)

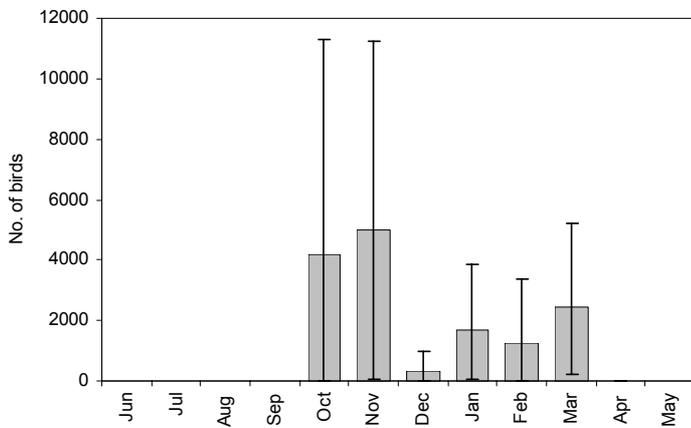


Figure 43. Pink-footed Geese at Cameron Reservoir, 1995/96-1999/2000: mean peak counts by month (error bars denote minimum and maximum peak counts during the period)

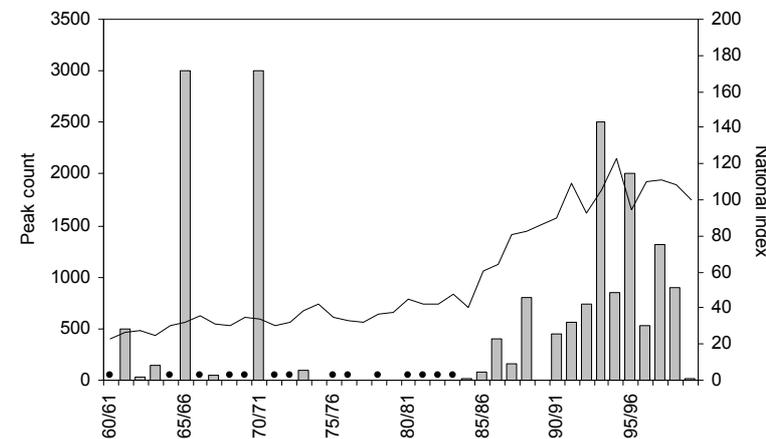


Figure 44. Pink-footed Geese at the Eden Estuary, 1960/61-1999/2000: peak counts (bars) and British index (line) (circles denote years with no known data)

Count data are very limited for some sites and their true status as roosts throughout the winter is far from certain. Linking feeding birds with specific roosts remains problematic.

2.1.5.5 Key references

Smout (1986), Brown (1996), Brown (1997), Brown (1998), Corbet (1998), Brown (1999), Brown (2000)

2.1.6 Central Region

2.1.6.1 Background

In its upper reaches the Firth of Forth lies in a broad valley bounded on the north by the steep escarpment of the Ochil Hills and on the south by the foothills of the Pentlands. The valley continues beyond Stirling for a further 30 km, gradually changing from rich arable and pasture farmland to the extensive peat areas and forestry plantation of Flanders Moss. In the upper stretches of the Forth Valley, the principal sites of interest are Loch Mahaick and the Lake of Menteith on the north side of Flanders Moss.

2.1.6.2 Historical status

Berry (1939) detailed the historical status of geese in the area and this was summarised in Bell & Newton (1995). The Flanders Moss/Lake of Menteith area was one of the few inland haunts of Pink-footed Geese in Scotland in the early 1900s. By the 1930s, Pink-footed Geese were also common in the Grangemouth area, but the roost at Skinflats was deserted during the war because of disturbance from aircraft. The roost was re-occupied in the 1950s with autumn numbers regularly over 1,000. Lake of Menteith and Flanders Moss were the main roosts on the Carse of Stirling at that time, though up to 500 birds regularly used Loch Rusky in the early 1960s. This site was then deserted following disturbance from fishing and boating but has been used occasionally since.

The lochan on Flanders Moss presents a major problem when determining the numbers of geese in the upper Forth Valley by counting roosts. Access is very difficult and virtually impossible at dawn without disturbing the birds and the flightlines are difficult to observe from the periphery of the moss due to trees. An SNH/RSPB survey of the roosts at the west end of the Carse in winter 1993/94 (December-February) found the lochan at Flanders Moss to be the most important site, with up to 2,050 birds, while the Lake of Menteith was deserted on

some dates. The lochan can, however, be regularly disturbed by shooting and readily freezes over. Most counts outwith the autumn national counts are therefore of feeding flocks and information on the use of the various roosts is poor. The situation is further complicated by the fact that the field searches in the area west and southwest of Lake of Menteith are difficult because of poor visibility, while large numbers of geese flight into the Forth Valley at times to feed from Bridge of Allan westwards as far as Thornhill. Up until the 1995/96 winter, geese feeding at the Carse of Lecropt, Bridge of Allan, had always flighted from Strathallan but since then that is no longer always the case. The feeding range of the geese from Loch Mahaick is also unclear and geese may occasionally roost at Loch Watston, near Doune. Searches of the Carse of Stirling between the M9 and Flanders Moss have consistently found the highest numbers in late winter and spring. The Carse frequently remains free of snow when areas further north have deep cover.

2.1.6.3 Internationally important sites

i) Loch Mahaick

Five-year mean 95/96-99/2000: 2,333

Site conservation status
SSSI (Loch Mahaick)

Site description and habitat

The upland Loch Mahaick (NN7006) lies to the north of Braes of Doune.

Numbers and trends

Goose use of Loch Mahaick remains rather erratic and unpredictable. Though regularly used in autumn since 1960, numbers are usually low and, up to the 1986/87 winter, did not exceed 2,000 (Fig. 45). Then in November 1988 the loch held 6,531 birds, thought to be displaced by a shoot at Carsebreck. Numbers peaked at over 4,500 in the next two autumns but, over the following five autumns, 1,471 was the largest count. Another high count of 6,465 birds was then recorded in October 1997.

Site use

The loch appears to be occupied only for a few weeks in autumn from about mid October to mid November, though it is undisturbed and relatively well sheltered from the prevailing southwesterly wind. It is rarely used in spring. The main flight line is from southwest to southeast, with geese feeding in the Teith Valley and the Forth Valley, probably as far as Thornhill and Blairdrummond Moss. Very occasionally a few birds flight east into Strathallan.

2.1.6.4 Other sites

i) Lake of Menteith

Lake of Menteith (NN5800) is a large lowland loch at the west end of the Carse of Stirling to the north of Flanders Moss. Much of the south and east shores are wooded, whilst the west shore is exposed.

An unbroken run of November counts reveals the regular use of this site. Numbers rarely reached 2,000 birds until the early 1980s, when 8,700 were counted in March 1983 (Fig. 46). It transpired that the lake probably received more birds during the spring passage than during the autumn months, and the importance of the site had probably been underestimated.

Recent autumn counts have been lower and there are few recent spring counts. Most counts in winter and spring have been of geese on the feeding areas during the day because of the uncertainties surrounding the use of the Flanders Moss lochan as a roost. Feeding areas are mostly on fields round the periphery of Flanders Moss, the Carse, east of Thornhill/Kippen and at times further out to the west and southwest, although the precise locations remain unknown.

Nearby, Loch Macanrie (NS5699), a much smaller loch to the southwest of the lake is used very occasionally, presumably when the lake is disturbed. Numbers here peaked at 2,100 in October 1990.

ii) Inner Firth of Forth (Skinflats)

The Skinflats section of the inner Forth (NS9358), from Grangemouth to the Kincardine Bridge, is mostly taken up by a large mudflat bounded on its inner edge by a narrow saltmarsh.

The number of wildfowl there, including Pink-footed Geese, declined during the 1970s, probably because of excessive wildfowling, and remained low throughout the 1980s (Fig. 47). From 1990, however, the number of roosting geese increased and the area now regularly supports over 2,000 roosting birds with a peak of 3,070 in October 1995. The mean peak winter count (1995/96-1999/2000) was 1,981. Most counts later in the winter have been of geese on the feeding areas and the roost sites for most flocks are not known.

Feeding is concentrated on fields near the estuary at Skinflats and Kennetpans, around Clackmannan and upstream to the eastern edge of Stirling. The site is an SSSI, but is heavily disturbed by shooting. The roost is sometimes deserted (e.g. autumn 1997) with

the geese then moving on to Peppermill Dam just across the river in Fife, or perhaps staying out in the fields; the light from the petrochemical refinery at Grangemouth means it is rarely dark.

iii) Inner Firth of Forth (Alloa Inch)

The site comprises two islands in the river at Alloa: the smaller Tullibody Inch is reed-covered and the larger Alloa Inch was farmed until recently (NS8792).

After the end of the shooting season, most of the Pink-footed Geese roosting on the estuary move upstream and are believed to roost at Alloa Inch. Most midwinter and spring counts from this area are, however, of feeding flocks so the precise roost sites for most flocks are not known. During spring in the early 1990s, several thousand geese remained in the Alloa Inch area until mid or late April, peaking at 7,180 in 1996. A composite graph showing the numbers of geese counted at either Tullibody Inch, Alloa Inch or feeding flocks between the last island and the Kincardine Bridge is shown in Fig. 48.

The geese use much the same area for feeding as they do when roosting at Skinflats but spend most of the time in fields about 5 km from Alloa Inch. The site is a SSSI, but disturbance from shooting makes it untenable during the shooting season.

iv) Minor roosts

Loch Watston (NN7100), a small lowland loch to the southwest of Doune, occasionally holds roosting Pink-footed Geese, with sporadic counts from 1975/76 to 1996/97. A peak count of 2,100 birds was recorded in October 1986. The Pink-footed Geese are usually attracted there only as a day-time drinking and bathing place, preferring to roost at Loch Mahaick.

The lochan at Flanders Moss (NS6398) has held up to 2,050 roosting Pink-footed Geese in recent years. Access to the roost pools is very difficult. To the west of Torrie Forest, and some 5 km to the northeast of the Lake of Menteith, Loch Rusky (NN6103) occasionally holds roosting birds, with a peak of 1,742 in October 1995.

The Loch Ellrig (NS8874) area is becoming increasingly important for Pink-footed Geese (three counts, including 350 in December 1996 and 800 on fields in April 1997). Other nearby sites include Loch Coulter Reservoir (NS7687) (three counts, max 159 in November 1997) and Gartmorn Dam (NS9194) (two counts, max 400 in November 1990), the latter presumably involving birds displaced from Skinflats.

Figure 45. Pink-footed Geese at Loch Mahaick, 1960/61-1999/2000: peak counts (bars) and British index (line) (circles denote years with no known data)

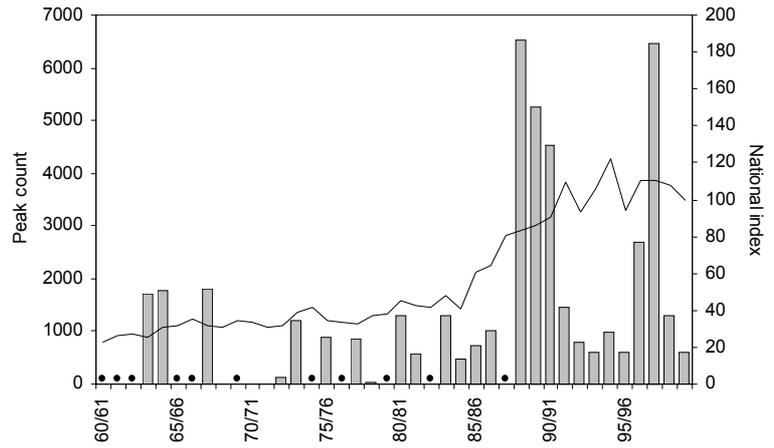


Figure 46. Pink-footed Geese at Lake of Mentieth, 1960/61-1999/2000: peak counts (bars) and British index (line) (circles denote years with no known data)

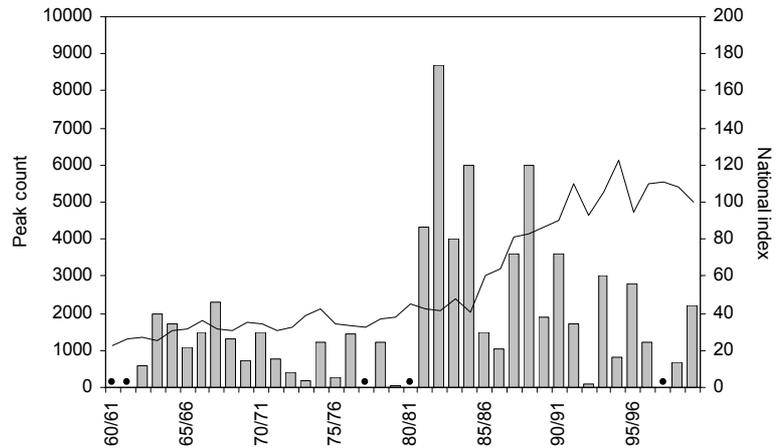


Figure 47. Pink-footed Geese at Inner Firth of Forth (Skinflats), 1960/61-1999/2000: peak counts (bars) and British index (line) (circles denote years with no known data)

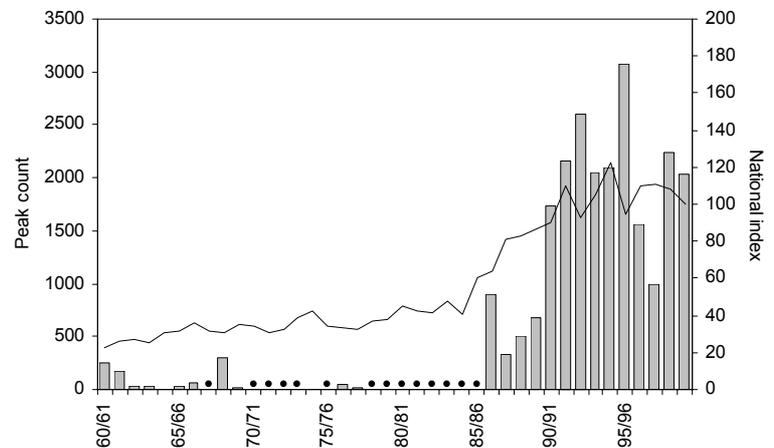
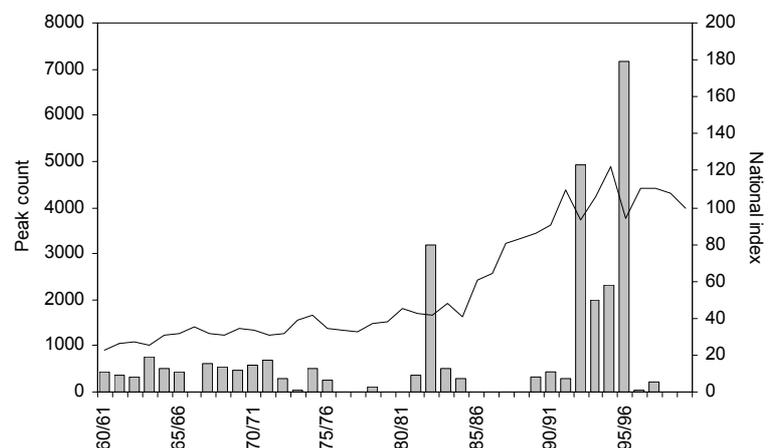


Figure 48. Pink-footed Geese at Inner Firth of Forth (Alloa Inch), 1960/61-1999/2000: peak counts (bars) and British index (line) (circles denote years with no known data)



2.1.6.5 Key references

Newton *et al.* (1990), Bell & Newton (1995), Bell *et al.* (1998)

2.1.7 Lothian/Borders

2.1.7.1 Background

There are few natural inland waters of any size in Lothian and the Borders. The demand for water by the inhabitants and industries of the Edinburgh area has, however, led to the creation of about 30 reservoirs in the Lammermuir, Moorfoot, Pentland and Tweedsmuir Hills, some of which have been adopted as important roost sites by Pink-footed Geese.

The largest numbers of Pink-footed Geese occur during autumn passage, usually in early October. A rapid drop in numbers often occurs as geese move on, typically leaving few by mid winter. A much smaller secondary peak may occur in spring. A number of key roosts in this region are designated as SPAs, including Westwater Reservoir, which now holds the greatest number of birds in Britain, Fala Flow, Gladhouse Reservoir and Aberlady Bay, which is part of the Firth of Forth SPA. Another SPA, Hoselaw Loch, now holds smaller numbers compared to the early/mid 1980s, but Whitton Loch, although occupied rather irregularly, also attains a mean maximum of over 2,000 birds. Some of these sites, especially Aberlady Bay and Fala Flow, are also used as daytime roosts when birds are disturbed from their feeding areas, which include much of the suitable farmland between the hills and coast. Birds use traditional fields, however, and shun many other seemingly suitable fields. Stubbles are used in early autumn and the timing and efficiency of harvesting partly determine whether birds linger or move on to other parts of the country. Unharvested potatoes are a secondary but sometimes important foodstuff, particularly in the Aberlady Bay area. Improved grassland fields support many geese, but this habitat is scarce in the Lothian coastal plain and this may partly account for the quick departure of geese from this area in some years. Although birds feed extensively on winter cereals, conflict with agriculture is rarely perceived as serious and existing mechanisms for dealing with problems seem to be generally adequate.

2.1.7.2 Historical status

Around 1880, Pink-footed Geese were reported to be increasing in this region and it was specifically

noted that they were replacing Bean Geese, making misidentification of these two species seem less likely. Very large autumn flocks were reported from Lothian in 1912, with smaller numbers remaining through the winter (Berry 1939). The principal roost was in the Lammermuir Hills, at Hule Moss on Greenlaw Moor, although, some flocks visited the area daily from Fenham Flats in Northumberland, and from the shores of East Lothian, especially Aberlady Bay. Wartime activity at the coast during 1939-45 led to birds moving to less disturbed inland roosts, but controlled wildfowling at coastal sites has, perhaps, been partly responsible for a return to Aberlady and Tynninghame Bays (Andrews 1986). Agricultural improvements and changes in arable cropping practices have generally favoured Pink-footed Geese, although the scarcity of grass pastures in the intensively farmed coastal belt may be partly responsible for relatively low numbers staying to winter once stubbles have been exhausted as a food source.

2.1.7.3 Internationally important sites

i) Westwater Reservoir

Five-year mean 95/96-99/2000: 39,680

Site conservation status

SPA (Westwater: selection stage 1.2)

Ramsar (Westwater: qualifying criterion 6)

SSSI (Westwater Reservoir)

IBA (Westwater: criteria A4i, B1i, C3)

Site description and habitat

Westwater Reservoir is located at 320 m asl in the Pentland Hills (NT1253). It is an artificial reservoir providing part of the Lothian water supply. The reservoir is surrounded by sheep pasture and heather moorland. The grassy margins and embankments are sheltered from most winds.

Numbers and trends

The reservoir has supported roosting Pink-footed Geese since its creation in the mid 1960s and, as of the late 1990s, is the most important roost site for this species. 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 made regularly, and 55,000 were recorded in both October 1995 and 1996 (Fig. 49).

Site use

Peak counts occur in October and numbers decline rapidly through late autumn and winter, with a much smaller secondary peak sometimes evident in spring (Fig. 50). The geese feed in nearby areas to the east

at West Linton and up to 14 km southwest in the Biggar area.

ii) Hule Moss

Five-year mean 95/96-99/2000: 18,866

Site conservation status

SPA (Greenlaw Moor: selection stage 1.2)
Ramsar (Greenlaw Moor: qualifying criterion 6)
SSSI (Greenlaw Moor)
IBA (Greenlaw Moor and Hule Moss: criteria A4i, B1i, C3)

Site description and habitat

A natural upland loch in the Lammermuir Hills, 5 km north of Greenlaw, surrounded by extensive heather moor at 230 m asl (NT7149).

Numbers and trends

Hule Moss forms the most important winter roost for Pink-footed Geese in the Tweed Basin, with flocks of up to 5,000 recorded regularly between 1960 and 1988 (Fig. 51). A dramatic increase then took place with a peak count of 25,735 birds in October 1989. Peak winter counts have since remained high.

Site use

Fewer geese remain after December at this site, which frequently freezes over (Fig. 52). Feeding areas are mostly to the south and southwest, especially around Greenlaw.

iii) Aberlady Bay

Five-year mean 95/96-99/2000: 10,742

Site conservation status

SPA (Firth of Forth: selection stage 1.2)
Ramsar (Firth of Forth: qualifying criterion 6)
SSSI (Aberlady Bay)
IBA (Firth of Forth: criteria A4i, B1i, C3)

Site description and habitat

Aberlady Bay (NT4682) holds extensive areas of sand and mud that are exposed at low tide, and is one of the prime sites for waterfowl in the Firth of Forth. A tidal estuary, geese there either land on the water within the bay, on the nearby sea if the tide is in, or on the sand and mudflats if the tide is out. They will move onto the saltmarsh during the night if there is no disturbance, otherwise they remain in the bay.

Numbers and trends

The estuary regularly supported over 1,000 birds during the 1960s, and has increased in importance

since then (Fig. 53). Roosting flocks often surpass 10,000 birds and a notable peak of 26,000 was counted in October 1993.

Site use

Peak numbers occur in October, falling rapidly into winter and spring (Fig. 54). Feeding areas are found mostly to the south and east in the rolling farmland south of Gullan, especially the area from Spittal (4 km from the estuary) to Drem and Dirleton (7 km), 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 it is possible that some Pink-footed Geese roosting at Aberlady Bay feed in south Fife.

iv) Fala Flow

Five-year mean 95/96-99/2000: 4,917

Site conservation status

SPA (Fala Flow: selection stage 1.2)
Ramsar (Fala Flow: qualifying criterion 6)
SSSI (Fala Flow)
IBA (Fala Flow: criteria A4i, B1i, C3)

Site description and habitat

Fala Flow is found at 325 m asl in the Lammermuir Hills to the southeast of Edinburgh (NT4258). It is a blanket mire, with some pools, and occurs at a lower altitude than most other blanket mires in Midlothian. The vegetation comprises heather/cotton grass blanket mire, with other characteristic species including cowberry, common cottongrass and *Sphagnum* mosses.

Numbers and trends

Regular counts date back to the early 1960s, and roosting flocks of over 3,500 were common throughout that decade (Fig. 55). Use of the site appeared to decline during the 1970s, but from 1980 onwards, much larger flocks were encountered, with a peak of 17,000 in October 1994.

Site use

Peak numbers occur in October and decline into winter, although there are usually few counts after the autumn. The main feeding area is generally in the farmland lying between Middleton to the west through to Townhead and Blackcastle to the northwest, about 3-6 km away, but birds will arrive from more distant areas if alternative roosts are temporarily unsuitable (e.g. through shooting activity). Middleton Mains, 4.5 km west of Fala Flow, is one of the areas most frequently used (Boyd 1999).

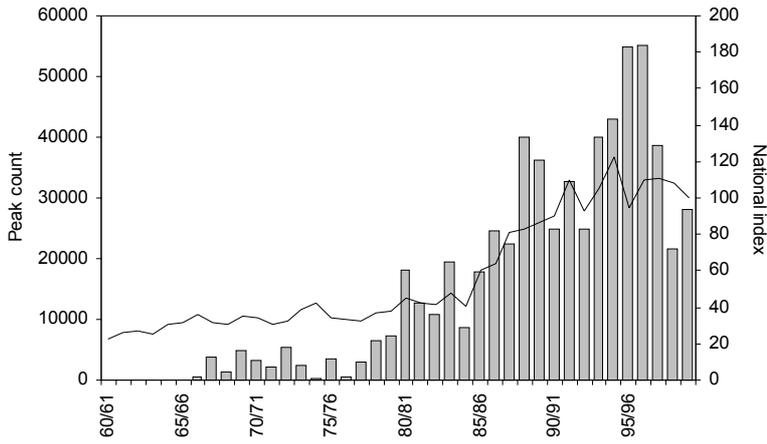


Figure 49. Pink-footed Geese at Westwater Reservoir, 1960/61-1999/2000: peak counts (bars) and British index (line) (circles denote years with no known data)

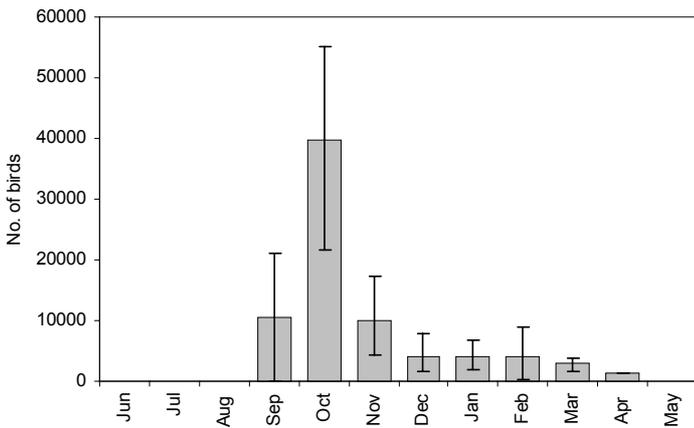


Figure 50. Pink-footed Geese at Westwater Reservoir, 1995/96-1999/2000: mean peak counts by month (error bars denote minimum and maximum peak counts during the period)

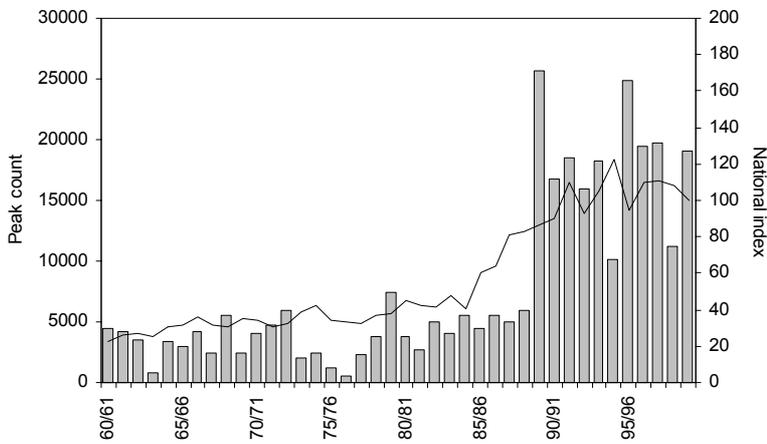


Figure 51. Pink-footed Geese at Hule Moss, 1960/61-1999/2000: peak counts (bars) and British index (line) (circles denote years with no known data)

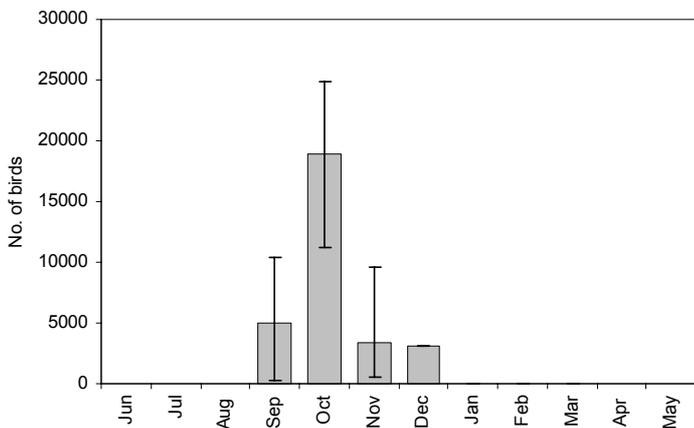


Figure 52. Pink-footed Geese at Hule Moss, 1995/96-1999/2000: mean peak counts by month (error bars denote minimum and maximum peak counts during the period)

Figure 53. Pink-footed Geese at Aberlady Bay, 1960/61-1999/2000: peak counts (bars) and British index (line) (circles denote years with no known data)

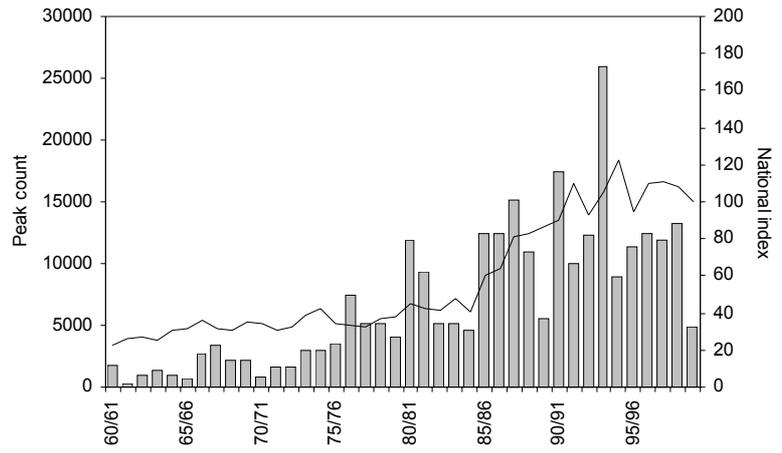


Figure 54. Pink-footed Geese at Aberlady Bay, 1995/96-1999/2000: mean peak counts by month (error bars denote minimum and maximum peak counts during the period)

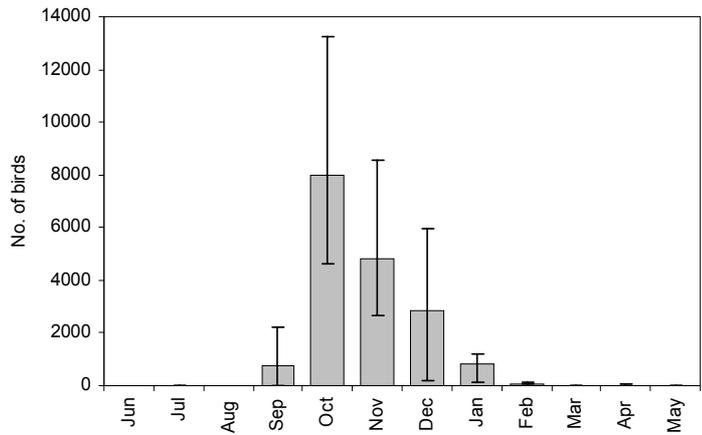
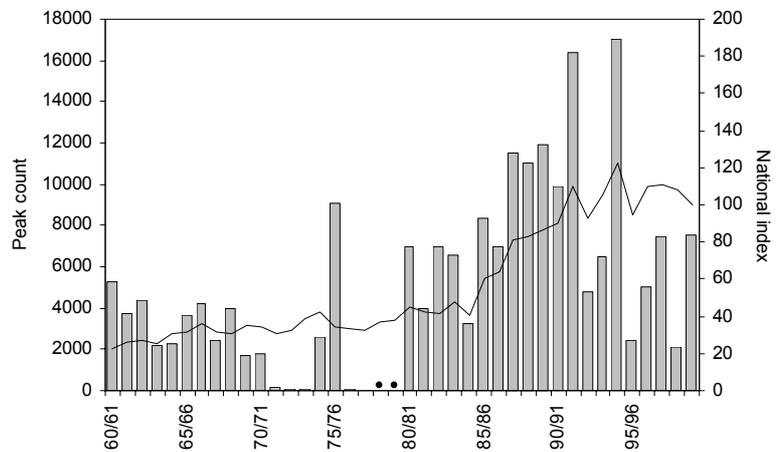


Figure 55. Pink-footed Geese at Fala Flow, 1960/61-1999/2000: peak counts (bars) and British index (line) (circles denote years with no known data)



v) Gladhouse Reservoir

Five-year mean 95/96-99/2000: 4,358

Site conservation status

SPA (Gladhouse Reservoir: selection stage 1.2)
Ramsar (Gladhouse Reservoir: qualifying criterion 6)
SSSI (Gladhouse Reservoir)
IBA (Gladhouse Reservoir: criteria A4i, B1i, C3)

Site description and habitat

An upland reservoir, on the northern edge of the Moorfoot Hills (NT3054), built for public water supply, with limited aquatic and emergent vegetation. The reservoir is the largest freshwater body in Lothian and is surrounded by both coniferous and mixed woodland and grassland. At 270 m asl, this is an exposed waterbody, although the conifer plantations and islands provide some shelter. The reservoir is surrounded by rough grazing and improved pastures.

Numbers and trends

The reservoir regularly held flocks of over 7,000 from the 1960s to mid 1980s (Fig. 56), with peak numbers recorded in the early 1980s (max 13,700 in October 1982). Fewer geese roost there now, with recent peak counts between 2,000 and 4,000, although three of the last four have been 5,000 or more.

Site use

The largest numbers usually occur in October, with few birds recorded after November. Feeding is mostly to the northeast, between Esperton (5 km from the roost) and Blackcastle (10 km).

2.1.7.4 Other sites

i) Watch Water Reservoir

In the Lammermuir Hills, Watch Water Reservoir (NT6656) has regularly supported around 1,000 birds since the early 1980s (max 4,000 in November 1987 and 1991, Fig. 57).

ii) Whitton Loch

Whitton Loch (NT7519) lies to the east of Jedburgh at the north end of the Cheviot Hills and has supported modest numbers of Pink-footed Geese since the 1980s (max 6,500 in November 1986, Fig. 58).

iii) Hoselaw Loch

Hoselaw Loch (NT8031), to the east of Kelso, has held small numbers of Pink-footed Geese since the

early 1980s. Numbers increased to over 3,000 (max 12,000 in 1985/86), although they have declined greatly in recent years (Fig. 59). Access to this site is open and is often disturbed by low-flying jets, agricultural/recreational access and the activities of wildfowling. Changes in agricultural practice have occurred in the area with cereal stubbles ploughed increasingly early in the autumn and a decrease in the amount of permanent grassland and potatoes grown. The geese can flight out from the loch in any direction and feed on farmland up to 5 km from the loch. The peak winter mean (1995/96-1999/2000) was 126.

iv) Cobbinshaw Reservoir

Despite apparently suitable alternative roosts close to Westwater Reservoir, these are used infrequently and usually by far fewer birds. To the northwest, Cobbinshaw Reservoir (NT0158) has held relatively small numbers of Pink-footed Geese since the early 1960s (Fig. 60), with a maximum of 4,500 recorded in March 1985. Use of this site decreased during the late 1990s.

v) Baddingsgill Reservoir

Pink-footed Geese used to roost at Baddingsgill Reservoir (NT1255), to the north of Westwater Reservoir, during the early 1960s when roosting flocks of over 2,500 were common. A peak count of 10,100 was recorded there in November 1979, although roosting appears to have ceased after 1980 (Fig. 61).

vi) Rosebery Reservoir

To the north of Gladhouse Reservoir, Rosebery Reservoir (NT3056) has held occasional flocks since 1970 throughout the winter months, with a peak count of 3,000 in October 1985 (Fig. 62).

vii) Tynninghame Estuary

At the very east of this area, Tynninghame Estuary (NT6379) regularly supports spring passage birds (Fig. 63), with occasional large flocks of up to 2,000 birds. Pink-footed Geese feeding near Peffer Burn (NT6183) probably roost at either Aberlady Bay or Tynninghame Estuary.

Figure 56. Pink-footed Geese at Gladhouse Reservoir, 1960/61-1999/2000: peak counts (bars) and British index (line) (circles denote years with no known data)

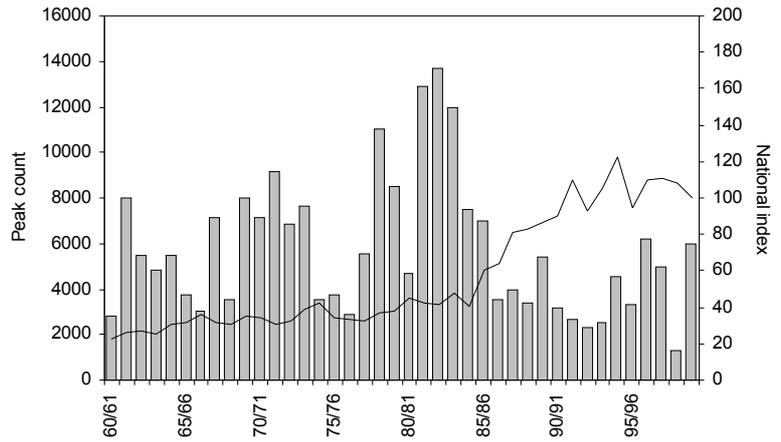


Figure 57. Pink-footed Geese at Watch Water Reservoir, 1960/61-1999/2000: peak counts (bars) and British index (line) (circles denote years with no known data)

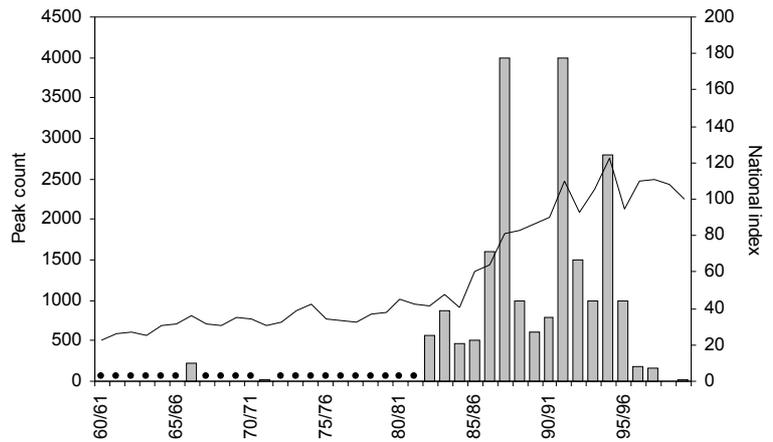


Figure 58. Pink-footed Geese at Whitton Loch, 1960/61-1999/2000: peak counts (bars) and British index (line) (circles denote years with no known data)

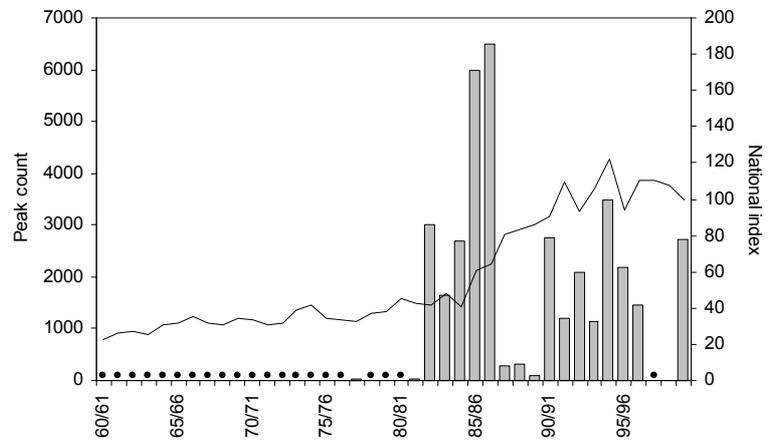
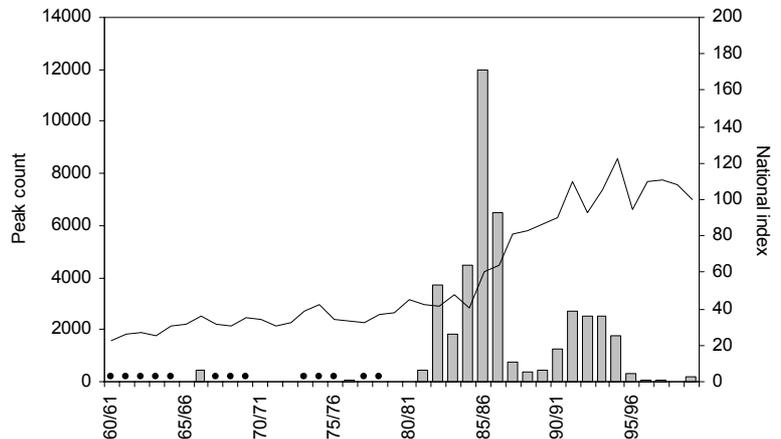


Figure 59. Pink-footed Geese at Hoselaw Loch, 1960/61-1999/2000: peak counts (bars) and British index (line) (circles denote years with no known data)



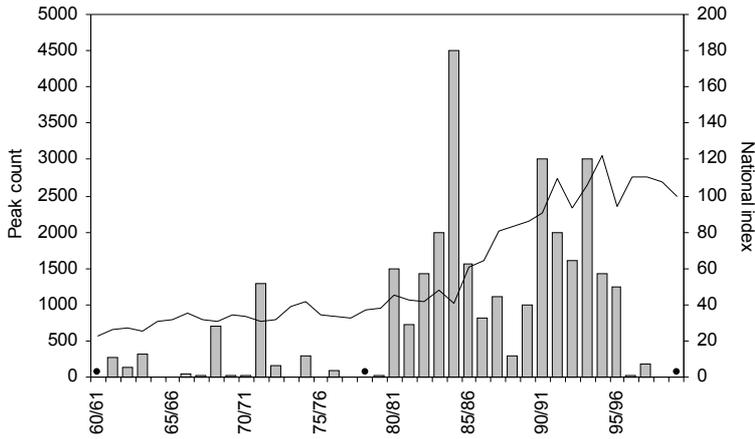


Figure 60. Pink-footed Geese at Cobbinshaw Reservoir, 1960/61-1999/2000: peak counts (bars) and British index (line) (circles denote years with no known data)

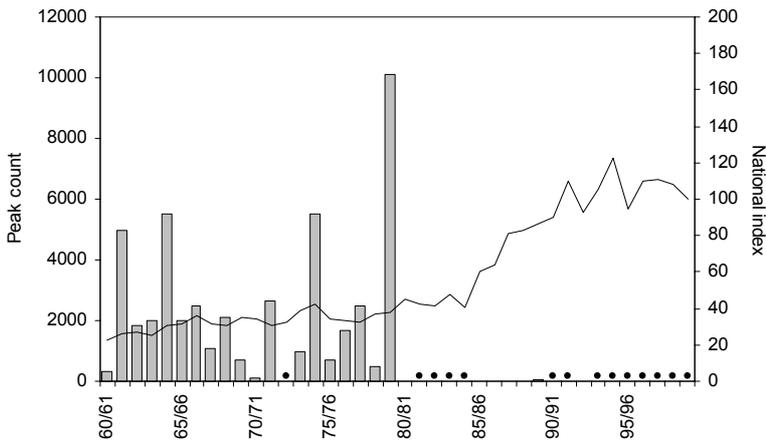


Figure 61. Pink-footed Geese at Baddingsgill Reservoir, 1960/61-1999/2000: peak counts (bars) and British index (line) (circles denote years with no known data)

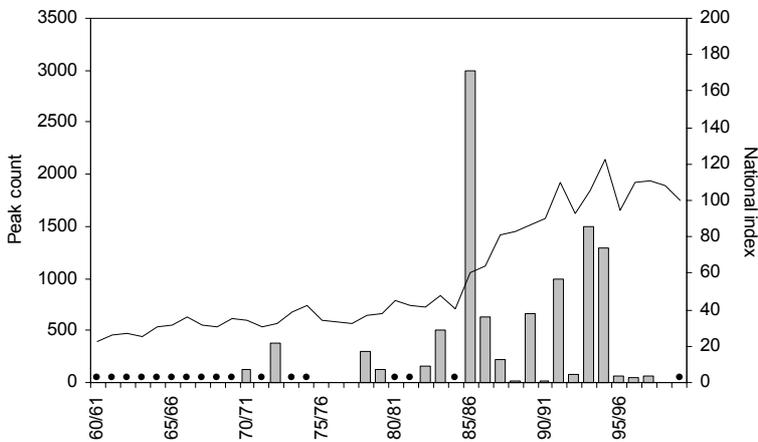


Figure 62. Pink-footed Geese at Rosebery Reservoir, 1960/61-1999/2000: peak counts (bars) and British index (line) (circles denote years with no known data)

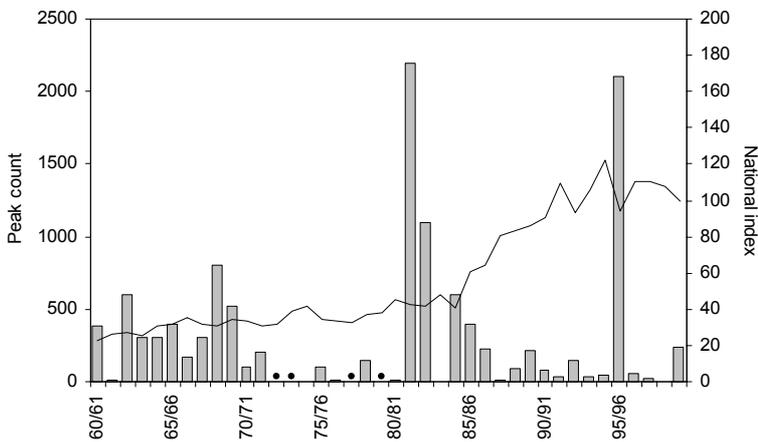


Figure 63. Pink-footed Geese at Tynninghame Estuary, 1960/61-1999/2000: peak counts (bars) and British index (line) (circles denote years with no known data)

viii) Portmore Loch

Portmore Loch (NT2550), on the west edge of the Moorfoot Hills, regularly supported hundreds of roosting Pink-footed Geese during the 1970s and 1980s (notably 2,000 in November 1964, and 3,570 in November 1973). Nowadays, the site is only used occasionally and by much smaller numbers (Fig. 64).

ix) Minor roosts

Hirsel Lake (NT8240) held small numbers of Pink-footed Geese in the late 1980s/early 1990s, with a peak of 600 in January 1988. Up to 800 were recorded roosting at Fawside Splash (NT6545) during winter 1988/89. Bemersyde Loch (NT6133) has held geese irregularly since the late 1980s (max 150 in December 1992).

Occasional flocks encountered during WeBS counts include 240 birds on the River Tweed near Coldstream (NT7737) in February 1984, and Whiteadder Water (NT9555) held 130 feeding Pink-footed Geese in March 1984.

Crosswood Reservoir (NT0557) is only 9 km northwest of Westwater Reservoir, yet has only been used by a very small number of Pink-footed Geese from the late 1970s, with a peak of just 140 birds in October 1995. Harperrig Reservoir (NT0961) is relatively large but is close to the A70 and only supports modest numbers of geese, the maximum being 300 in November 1992. At the northern end of the Pentland Hills, Threipmuir and Harlaw Reservoirs (NT1764) have also held small numbers since the 1960s, with a peak of 1,200 in March 1992.

In the heart of Edinburgh, Duddingston Loch (NT2872) held 130 birds in March 1985. Very occasionally, Pink-footed Geese will also roost at Rosebery Pool (NT3057), 4 km north of Gladhouse Reservoir, where 1,300 birds were counted in October 1994. Quarryford Pool (NT5565) holds very small numbers, with a maximum of 120 in November 1988.

Inland, and to the east of Aberlady Bay, pools at Brownrigg (NT5580) have recently held small numbers of Pink-footed Geese during the spring, with a peak of 300 in March 1996. Small numbers have roosted at Edgelaw Reservoir (NT2958), with a peak of 500 in November 1980. Rosslynlee Reservoir (NT2759) rarely holds geese, although a flock of 540 was recorded there in March 1978.

In the middle of the Lammermuir Hills, Hopes Reservoir (NT5462) is rarely visited by Pink-footed Geese (max 100 in November 1994). Further east,

Whiteadder Reservoir (NT6563) also holds few Pink-footed Geese (max 250 in October 1995).

2.1.7.5 Key references

Brotherston (1964), Brown & Brown (1992), Cranswick (1992), Boyd (1999)

2.1.8 Clydesdale

2.1.8.1 Background

The greater part of southern and western Lanarkshire is hilly and lacks open water resorts for roosting geese. Upper Cowgill Reservoir and Culter Waterhead Reservoir are used, as is Lochlyoch on the other side of the Clyde. The geese feed regularly in the farmland close to Lochlyoch, and along the Clyde between Symington and Lanark. There have certainly been instances when birds roosting at Westwater Reservoir in the Pentland Hills have fed in this part of the Clyde Valley, and this may be the origin of some of the larger feeding flocks.

2.1.8.2 Historical status

The Pink-footed Goose was regarded as rare in the Firth of Clyde in the 1930s, yet one or two 'very large' flocks were reported from Lanarkshire (Berry 1939).

2.1.8.3 Internationally important sites

i) Upper Cowgill Reservoir

Five-year mean 95/96-99/2000: 4,784

Site conservation status

None

Site description and habitat

To the southeast of Lamington lie two reservoirs: Lower Cowgill (NT0029), which is surrounded by trees, and Upper Cowgill (NT0027).

Numbers and trends

Counts of over 1,000 roosting birds go back to the late 1960s for Upper Cowgill, with a steady increase in numbers since the late 1980s. The highest count (9,400) was recorded in November 1997 (Fig. 65). Since then, there was a marked reduction in numbers using the reservoir, the cause of which is unknown.

Site use

Typically, numbers build up during September, reach a peak in October and fall rapidly in mid November as hard frosts and cold winds prevail. The roost is probably also used by small numbers through the remainder of the winter and in spring, although there are few counts from this period.

Although no direct observations have been made, flight patterns suggest the main feeding areas are usually to the north along the Clyde Valley between Lamington and Symington and often into Lanark. Flight patterns appear to be very predictable, with the main outward flight north along the Cow Gill, swinging northwest to the south of Lamington Hill before heading north again towards Symington and Thankerton along the Clyde Valley. Evening flights follow the same route, although significant numbers (>30%) can enter the glen from a northerly route over Turkey Hill and Howegill Rig.

2.1.8.4 Other sites**i) Culter Waterhead Reservoir**

Culter Waterhead Reservoir (NT0327), to the south of Lamington, regularly held modest numbers of roosting birds (peak 800 in 1974/75 and 1979/80) from the mid 1960s until 1981, but now appears to be largely deserted (Fig. 66), although local residents suggest occasional flocks of up to 200 birds may still be encountered.

ii) Lochlyoch

Lochlyoch (NS9335), in the Tinto Hills, regularly held 2,000 roosting geese through the late 1960s and 1970s (max 2,580 in November 1982), although they appear to have abandoned the site in the late 1980s (Fig. 67).

iii) Springfield Reservoir

Several hundred Pink-footed Geese roosted at Springfield Reservoir (NS9052), north of Lanark, during the period 1969-1986 (max 317 in November 1982), but this site also seems to have been abandoned (Fig. 68). The causes of the desertion or reduction in use of these roosts sites are not known, although it is notable that they all ceased to support Pink-footed Geese from the early 1980s. The displaced geese may, however, have sought refuge at Upper Cowgill Reservoir, since it was at this time that numbers started to increase there.

iv) Minor roosts

A scattered array of minor water bodies have occasionally held roosting Pink-footed Geese. These include a maximum of 500 at Douglas Estate Loch (NS8432) in October 1997, 320 at the small Bowmuir Loch (NT0042) in November 1974, and 654 at Crane Loch (NT0452), in the southwest edge of the Pentland Hills, in October 1969.

Flocks of feeding Pink-footed Geese are regularly encountered along the upper River Clyde, for example, at Lamington (NS9833, max 2,600 in October 1997), at Hyndford Bridge (NS9839, max 1,974 in January 1987), at Libberton (NS9839, max 4,150 in November 1962) at 'The Meetings' (NS9744, max 1,700 in October 1996), at Pettinairn (NS9444, max 1,500 in November 1990), at Carstairs Junction (NS9744, max 8,000 in October 1997 and 5,650 in March 2000), and also at Biggar Floods (NT0637, max 2,500 in December 1986). These low-lying areas are prone to occasional winter flooding and, when conditions permit, offer suitable roosts. For example, Pink-footed Geese occasionally roost on flooded fields at Biggar Water (NT1036) with 2,000 recorded there in March 1994.

2.1.9 Dumfries & Galloway (excl. Solway Firth)**2.1.9.1 Background**

The main interest in the eastern half of Dumfries, away from the Solway, lies in the cluster of lochs around Lochmaben. The Pink-footed Geese of Galloway are more or less confined to the coast for roosting and most of their feeding. The principal Pink-footed Geese roost is Wigtown Bay, although a recent increase in numbers at Loch Ken and a tendency for longer flights from the roost at Wigtown Bay suggests that inland feeding is becoming more prevalent.

2.1.9.2 Historical status

According to Berry (1939), the Pink-footed Goose was not common anywhere on the Solway (presumably including Galloway) in the early part of last century. Records from the 1950s suggest small occasional flocks consorting with Greenland White-fronted Geese at Loch Ken and, in 1959, a flock of 2,000 was reported from the merse below Wigtown at the end of March. Kirkcudbright Bay held small roosts of both Greylag and Pink-footed Geese in the 1960s, but they have largely abandoned the bay.

Figure 64. Pink-footed Geese at Portmore Loch, 1960/61-1999/2000: peak counts (bars) and British index (line) (circles denote years with no known data)

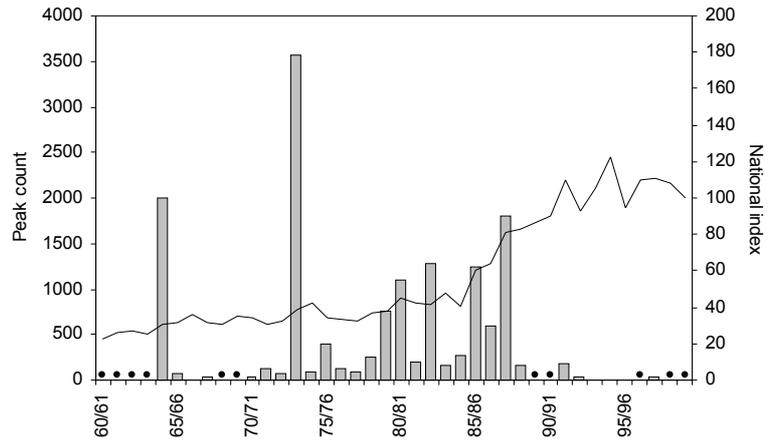


Figure 65. Pink-footed Geese at Upper Cowgill Reservoir, 1960/61-1999/2000: peak counts (bars) and British index (line) (circles denote years with no known data)

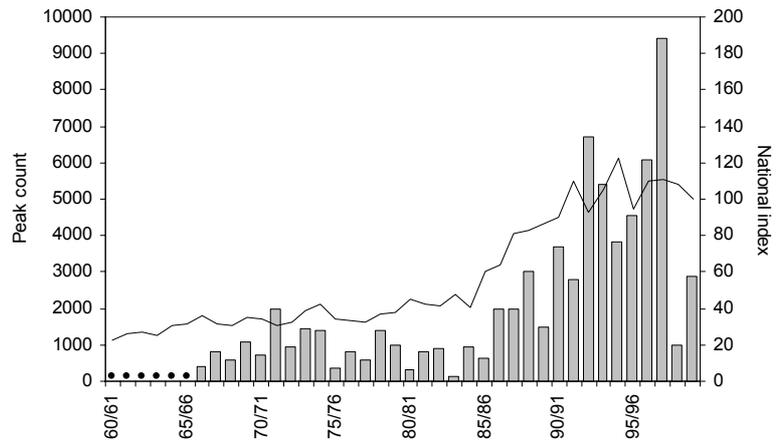
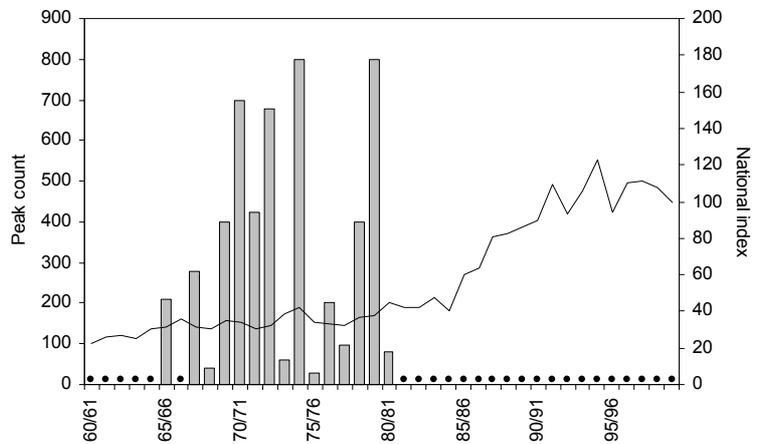


Figure 66. Pink-footed Geese at Culter Waterhead Reservoir, 1960/61-1999/2000: peak counts (bars) and British index (line) (circles denote years with no known data)



2.1.9.3 Internationally important sites

i) Wigtown Bay

Five-year mean 95/96-99/2000: 6,246

Site conservation status

SSSI (Cree Estuary)

IBA (Wigtown Bay: criteria A4i, B1i, C3)

Site description and habitat

A large, southeast facing estuary at the extreme west end of the Solway Firth (NX4652). Extensive sands and saltmarsh occur, with the geese favouring either the Baldoon Banks or Wigtown Sands for roosting.

Numbers and trends

Small groups recorded in October and November are infrequent and thought to be birds migrating south, usually staying only for a matter of days. Counts in March 1986 reached 17,000 birds (Fig. 69), although this was exceptional and reflected a period of no disturbance when the birds were feeding in fields close to the bay. In recent years, the number of birds using the bay has not exceeded 8,000.

Site use

Generally, the geese are rarely seen before January and the peak numbers do not appear until February or March (Fig. 70), after the end of the shooting season, though earlier arrivals in times of hard weather have been recorded. Feeding takes place on farmland along the whole length of the west edge of the bay, and to the west of the Moss of Cree and south of the Baldoon Sands.

2.1.9.4 Other sites

i) Castle Loch/Hightae Loch

The larger Castle Loch (NY0982), together with Hightae Loch (NY0880) just to the south, comprise a 137 ha Local Nature Reserve, declared in 1962. Castle Loch is also a Ramsar site, SPA and SSSI. Both are sometimes used by considerable numbers of Pink-footed Geese for roosting, particularly in the spring. Both are freshwater lochs with a range of surrounding habitat types, including emergent vegetation, birch and alder carr, areas of acidic, marshy grassland and plantation woodland. Hightae Loch also has more extensive reedbeds.

Pink-footed Geese are rarely recorded using the site before the New Year. Small numbers were present at Castle Loch through the 1960s and 1970s, gradually building to a peak of 16,380 in February 1991 (Fig. 71). At Hightae Loch, records have been very

infrequent since 1987/88 (max 4,000 in February 1988 and March 1994). The mean peak winter count (1995/96-1999/2000) for the combined site was just 301.

Most birds feed in the Annan Valley often up to 10 km from the roost. The principal threat to the roost there is general disturbance from human activities. The current management regime appears to be successful in preventing disturbance to the roosting geese, although shooting between September and the end of January may stop birds from settling earlier in the season. The shooting is regulated by a permit system. Fishing has taken place at both Castle Loch and Hightae Loch, although it may have ceased at the latter loch recently.

ii) Waterside Mains

Alongside the River Nith, 20 km upstream of Dumfries, Pink-footed Geese were regularly recorded near Thornhill at Waterside Mains (NX8692) from the late 1960s to the mid 1980s. The flock regularly exceeded 2,000 birds with a peak of 11,950 in March 1984 (Fig. 72).

iii) Minor roosts

Small parties have been recorded at Kirk Loch (NY0783, max 760 in February 1973) and Blind Lochs (NY0683, max 1,000 in October 1994) since 1985/86, and at Cumrue Loch (NY0686, max 650 in March 1992) since 1981/82, suggesting that all three may be infrequently used as a temporary roost when Castle Loch and Hightae Loch are disturbed.

Occasional feeding flocks occur inland, and some of these birds may roost on small lochs and flooded fields *e.g.* Ironhurst Loch (NY0471, max 300 in December 1974) and Chapelcroft (NY0684, max 1,550 in January 1991).

Loch Kindar (NX9664) occasionally holds roosting Pink-footed Geese (max 2,740 in March 1996, although usually fewer than 500) and has done so since the early 1970s, especially in the spring. These are probably birds that have sought refuge from wildfowling disturbance on the coast. Some occasionally move to Loch Arthur, 6 km further inland (NX9068, max 300 in winter 1978/79). Inland roosts may include temporary flooded areas around the Water of Ae (NY0684, 108 in January 1990).

Figure 67. Pink-footed Geese at Lochlyoch, 1960/61-1999/2000: peak counts (bars) and British index (line) (circles denote years with no known data)

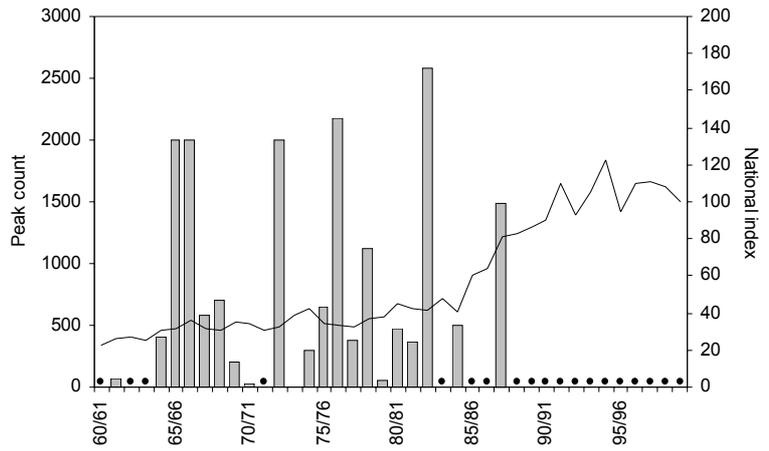


Figure 68. Pink-footed Geese at Springfield Reservoir, 1960/61-1999/2000: peak counts (bars) and British index (line) (circles denote years with no known data)

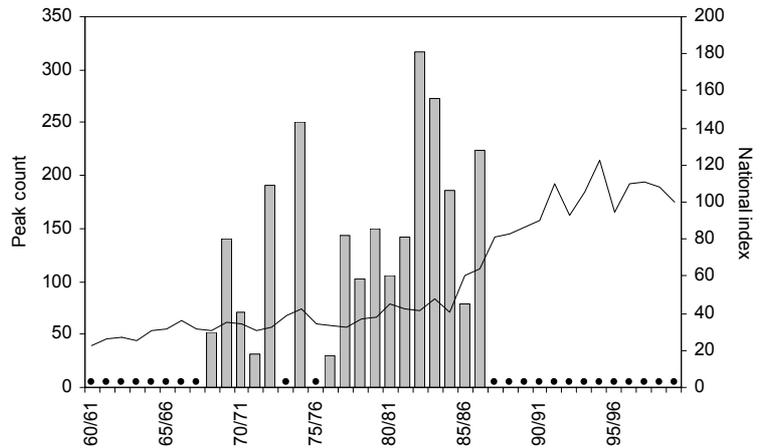
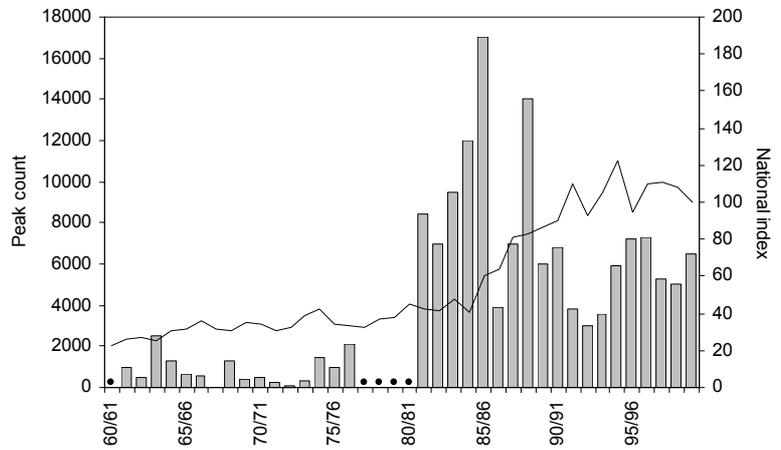


Figure 69. Pink-footed Geese at Wigtown Bay, 1960/61-1999/2000: peak counts (bars) and British index (line) (circles denote years with no known data)



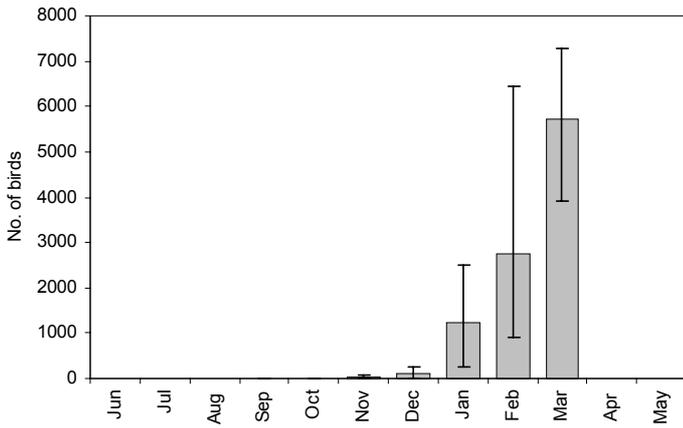


Figure 70. Pink-footed Geese at Wigtown Bay, 1995/96-1999/2000: mean peak counts by month (error bars denote minimum and maximum peak counts during the period)

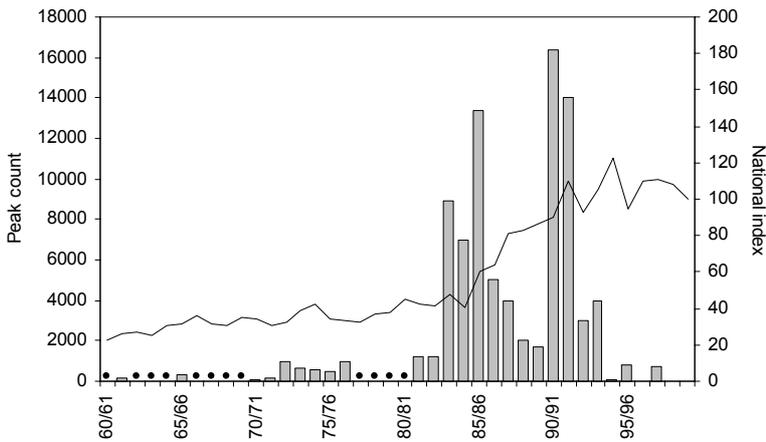


Figure 71. Pink-footed Geese at Castle Loch/Hightae Loch, 1960/61-1999/2000: peak counts (bars) and British index (line) (circles denote years with no known data)

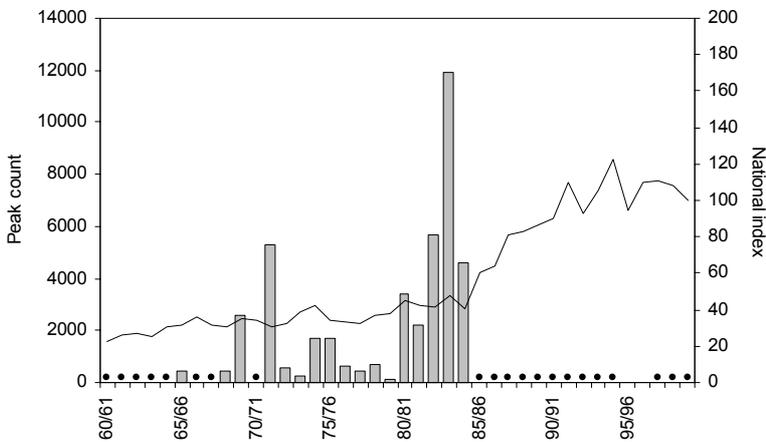


Figure 72. Pink-footed Geese at Waterside Mains, 1960/61-1999/2000: peak counts (bars) and British index (line) (circles denote years with no known data)

Pink-footed Geese are regularly encountered westwards along the outer parts of the Solway Estuary, for example at Kirkconnel Merse (NX9868, max 1,580 in March 1995) and Mersehead (NX9055). These birds, however, roost and are counted within the Inner Solway Estuary (see 2.1.10). The Lochar Moss (NY0573) is occasionally used as a goose roost, but it has been drastically changed and much reduced in size by forestry.

Loch Rutton (NX8972) is occasionally used in the spring, with 850 birds recorded in March 1988, although numbers there are usually much smaller than this. Milton Loch (NX8471) has held Pink-footed Geese during the spring since the 1970s, with a peak count of 400 in March 1987. The area around Auchrocar (NX0960) held 150 geese in November 1995.

The sandy flats of Auchencairn/Orchardton Bay (NX8151) have held small numbers of Pink-footed Geese on infrequent occasions in the spring since 1987/88, with a peak count of 2,500 at the former site in January 1987 and 1,000 at the latter in March of the same year. Further west, Pink-footed Geese have been occasionally found in the Kirkcudbright and Dee Estuary (NX6849) since 1992, with a peak of 343 in November 1996.

Passage birds are also occasionally encountered at Loch Ken (NX6870), with 192 in November 1980, although most records are from later in the winter, with a peak of 356 in February 1991 (in very recent years occasionally up to 800, P. Collins, pers. comm.) and flocks are becoming more regular. At the southern end of Loch Ken, Pink-footed Geese have been encountered around the Threave Estate (NX7362) since 1990, with a peak of 1,000 in December 1997. Access to the estate is open and the site is occasionally disturbed by the activities of wildfowling. The geese tend to feed on farmland to the west of Castle Douglas.

Further west, flocks of Pink-footed Geese have, since the early 1990s, become more frequent and a winter tradition is becoming established in the Stranraer area. In February 1990, 2,400 Pink-footed Geese were counted at West Freugh (NX1055), and a flock of 2,000 was there in 1996. At Stranraer, occasional flocks have been recorded roosting with Greylag Geese at Black and White Lochs (NX1060), with 108 in February 1995 and 110 in October 1997. Loch Connell (NX0168) and Cults Loch (NX1260) have also held Pink-footed Geese. More detailed roost counts in this area are recommended as a priority.

2.1.10 Solway Firth

2.1.10.1 Background

The hinterland of the Solway Firth is a glacial landform of low drumlins, esker ridges, and extensive areas of lowland along the several rivers that drain into the estuary. The river valleys were once areas of extensive wetland, but most has been drained for agriculture and forestry over the past century. Small remnants remain where drainage has proved difficult. On both the Scottish and English sides of the estuary there are extensive areas of peat, several of which form the Solway Mosses pSAC. The peaty and alluvium soils have mostly been converted to arable grassland which is attractive to the geese.

Annual rainfall is, on average, 900 mm. The climate is generally mild and persistent snow is rare. In recent years prolonged frost has been rare. The Solway Firth freezes up readily in long frosty spells, however, because of the high volume of freshwater (although 1985/86 was the last time this occurred).

The primary agriculture is stock rearing of cattle and sheep. Sheep numbers have increased in recent years, probably as a response to pressures to reduce sheep numbers on the Lakeland hills. Many 'hill breeds' are being over-wintered on the Solway Plain and on the marshes. Increased winter sheep grazing may have a detrimental effect on the geese: Pink-footed Geese do not mix readily with sheep, and goose grazing may be perceived as a problem by local farmers.

Much less corn and fodder root crops are grown now compared with the 1970s/1980s. There has been a corresponding increase in arable grassland for silage. These are heavily fertilized either with slurry or artificial fertilizers. Farmers are increasingly concerned about Pink-footed Geese feeding on these fields from late March onwards. Grazing geese may retard growth and affect the timing of the first cut in mid May.

2.1.10.2 Historical status

Until the 20th century, Pink-footed Geese were uncommon on the Solway Firth. By the 1930s, however, they were to be found feeding in the eastern end of the estuary (Berry 1939). Since then, the inner firth has traditionally been a very important haunt for this species, and November counts date back to 1960, with some information for the northern shore back to 1950. Arriving from the end of September, by the middle of October up to 16,000-20,000 birds were typically present. After a stay of 6-8 weeks, the birds tended to disperse, it was

thought at the time, to the Humber and the Wash. A decline in autumn levels was recorded in the late 1960s and early 1970s, and, after a recovery, again in the late 1990s. Numbers in the autumn are considerably affected by the available food supply in the regular autumn haunts in eastern Scotland.

2.1.10.3 Internationally important sites

i) Inner Solway Firth

Five-year mean 95/96-99/2000: 14,045

Site conservation status

SPA (Upper Solway Flats and Marshes: selection stage 1.2)

Ramsar (Upper Solway Flats and Marshes: qualifying criterion 6)

NNR (Caerlaverock)

SSSI (various)

IBA (Upper Solway Flats and Marshes: criteria A4i, B1i, C3)

Site description and habitat

The flats and marshes of the Inner Solway Firth (NY1664) form one of the largest continuous areas of intertidal habitat in Britain. The main roosts are at Moricambe Bay at the confluence of the Rivers Waver and Wampool, on the Blackshaw and Priestsides Banks between the channels of the Nith and the Annan Water, and on the extensive sandflats off the Rockcliffe saltmarsh. The latter comprises intertidal sand and mudflats and coastal saltmarsh formed between the Rivers Eden and Esk at the head of the Solway Firth.

The middle and upper reaches of the estuary form a large complex of interdependent resorts. The area amounts to over 10,000 ha and there are also more than 3,300 ha of saltmarsh. Most of the marsh, especially on the Cumbrian shore, is covered only by the highest tides, and is grazed in the summer by cattle and in the winter by sheep to a short sward which provides important feeding areas for the geese. The largest areas are at Rockcliffe and Burgh around the estuaries of the Eden and the Esk, at Caerlaverock between the channels of the Nith and Lochar, at Kirkconnel on the estuary of the Nith near Glencaple, and in Moricambe, Newton, Border, Calvo and Skinburness around the outfall of the Wampool and Waver.

Numbers and trends

Monthly dawn roost counts of the whole of the Inner Solway Firth (Mersehead to Grune point) have been carried out since 1987/88. Prior to that year counts were less co-ordinated and comprehensive. They reveal a steady increase from the 1960s to the

mid 1990s, followed by a decline in the late 1990s. The maximum count recorded was 28,850 in March 1991 (Fig. 73). Feeding area counts proved very difficult due to the undulating landform creating large areas of 'dead ground'. Counts are undertaken on neap tides on a dark phase of the moon to try to ensure that the geese are not pushed off by high tides at night or use moonlight to feed inland. It has become apparent, however, that Pink-footed Geese do roost inland, especially during periods of gales or when there is floodwater there. It is difficult to know if this is a recent occurrence or whether counting and a general awareness have brought this to our attention. For example, at Kirkbride, a field close to the village and about 1 km inland is used by Pink-footed Geese in most years and it is clear that once the geese settle, they stay over night. Other records of inland roosts have been reported from the Eden Valley and the Esk near Longtown.

Site use

The timing of peak numbers emphasises the strategic nature of the estuary with peaks recorded in both autumn and, especially, in the spring (Fig. 74), although autumn numbers have decreased in recent years. The counts show a very consistent pattern. From mid September to mid October the estuary is a brief stop-over for geese en route to Lancashire and, more recently, Norfolk. They feed mostly on the Scottish side roosting off Priestsides and flying over Priestsides and Browell. The October count is rarely high. Usually very few remain into November and these numbers have declined in recent years. There tends to be a small increase in December, usually thought to be related to feeding conditions deteriorating further north in Scotland. Numbers begin to build up from mid to late January, and these too may involve Pink-footed Geese moving south from Scotland, as well as early movements north from Lancashire. February to early March is the peak period when the geese feed exclusively inland all round the estuary. Once the shooting season ends (20 February), the geese tend to move to the saltmarshes, especially in Moricambe Bay, Rockcliffe Marsh, Caerlaverock NNR and Kirkconnel Merse. Separate daytime counts have also been undertaken on Rockcliffe Marsh since 1960 (Fig. 75).

The Caerlaverock NNR (NY0464) takes in all the extensive intertidal flats lying between the rivers Lochar and Nith, together with the saltmarsh. For Pink-footed Geese this is the most important site on the Inner Solway (Fig. 76, also see above), reflecting the value of the reserve in reducing shooting and disturbance. Since the inception of the NNR in 1957, there has been carefully regulated shooting permit on part of the saltmarsh. A peak count of 25,000 birds was recorded there in January 1984.

Figure 73. Pink-footed Geese at the Inner Solway Estuary (combined), 1960/61-1999/2000: peak counts (bars) and British index (line) (circles denote years with no known data)

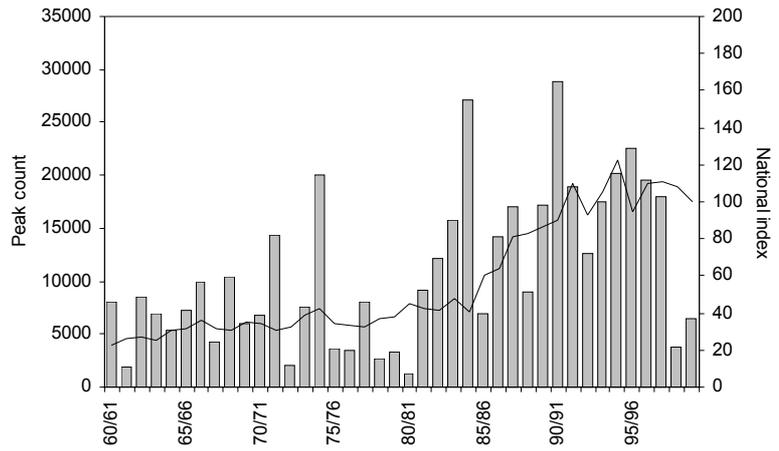


Figure 74. Pink-footed Geese at the Inner Solway Estuary (combined), 1995/96-1999/2000: mean peak counts by month (error bars denote minimum and maximum peak counts during the period)

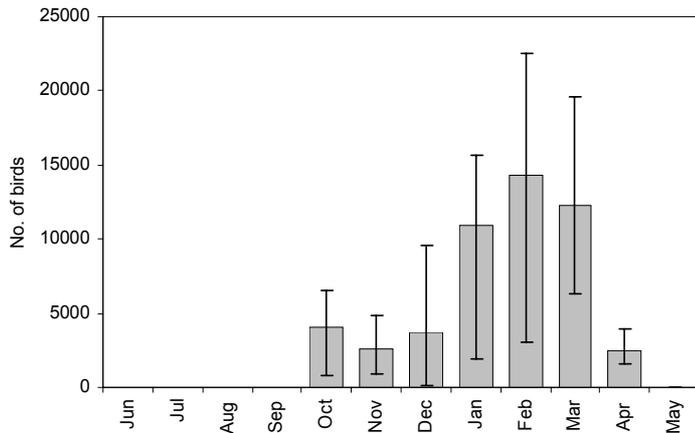


Figure 75. Pink-footed Geese at Rockcliffe Marsh, 1960/61-1999/2000: peak counts (bars) and British index (line) (circles denote years with no known data)

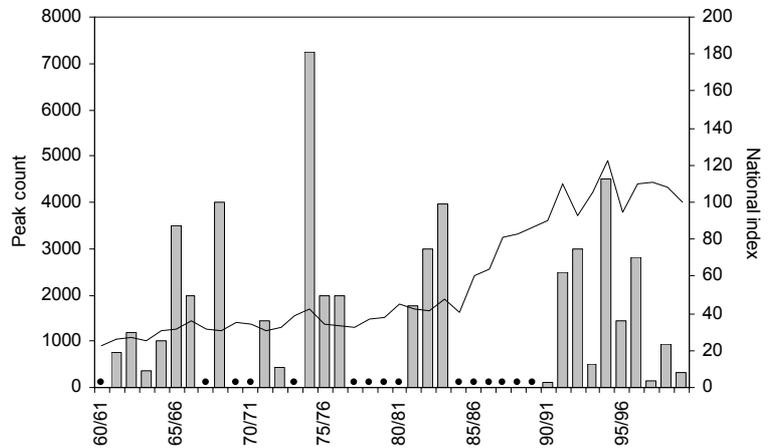
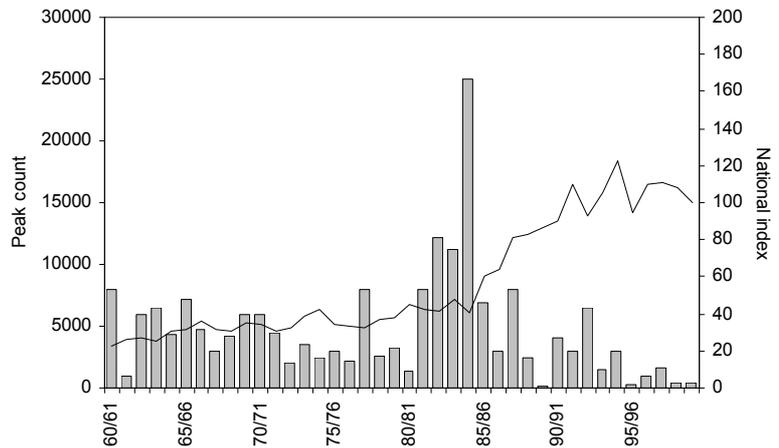


Figure 76. Pink-footed Geese at Caerlaverock NNR, 1960/61-1999/2000: peak counts (bars) and British index (line) (circles denote years with no known data)



There is some suggestion that the very rapid increase in the numbers of Svalbard Barnacle Geese using the estuary (to over 23,000 in the late 1990s) may be having a negative impact on the numbers of Pink-footed Geese, although this is hard to quantify.

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 20-25 km. The geese are regular, often in very large numbers, on the west shore of the Nith, both at Kirkconnel Merse (though rarely before the end of the shooting season, the peak numbers being in spring) and behind Southernness and along to Southwick Water. Feeding Pink-footed Geese may also be encountered along the south shore in suitable saltmarsh west towards Grune Point on the outer part of the estuary (NY1456, max 5,135 in March 1997).

On the landward side there are further feeding grounds which occupy the greater part of the coastal lowlands, notably in the stretch between Annan and Dumfries. There are further feeding areas along the Eden Valley, the Esk Valley and lowlands around Abbeystown and the Rivers Wampool and Waver.

2.1.10.4 Other sites

i) Minor roosts

Inland from the Solway Firth, occasional flocks are located during WeBS counts and include 112 at Bassenthwaite Lake (NY2128) in January 1981, 180 near Longtown (NY3770) in March 1976, and 140 at Arthuret Pond (NY3767) in February 1982. The River Eden occasionally holds feeding flocks, which presumably roost on the Inner Solway. The floodplain between Crosby and Carlisle (NY4658) held up to 300 in winter 1986/87 and a flock of 3,000 was recorded there in January 1991. Feeding Pink-footed Geese have also been found at Scotby Holmes (NY4357, max 350 in January 1996) and nearby Low Crosby (NY4559) held 250 in November 1992.

2.1.11 Southwest Lancashire

2.1.11.1 Background

From the Mersey northwards to Blackpool, much of the coast is either built over or flanked by dunes and bare sandy beaches, the only exception being around the Ribble Estuary. Here there is a huge area of intertidal mud, and siltation of the estuary, hastened by embankments, has led to the formation of salt

and freshwater marshes which provide extensive feeding grounds for wildfowl. North and northeast of Blackpool are the Lune and Wyre estuaries that form part of the vast Morecambe Bay intertidal complex, with huge areas of mudflats and smaller coastal saltmarshes.

The whole of the mossland area inland of Southport and Formby has been reclaimed and cultivated, including the 1,200 ha of marsh and water of the ancient Martin Mere. The rich soil is devoted to agriculture, in particular to cereals (especially wheat and barley), potatoes, carrots and brassicas. During the past 20 years there has been increasingly early ploughing of cereal stubbles, the principal food source for Pink-footed Geese in the autumn, and sowing of the following season's crop, and thus food has become less plentiful for the geese.

The main arrival of Pink-footed Geese is from mid September through to early November, after which over 20,000 are usually present continuously until about mid February, sometimes peaking at over 30,000, although the timing of the peak is highly variable. Numbers then decline rapidly to only a few thousand by late March. After this a small number remain at Martin Mere, often until early May. The geese roam widely in search of food within a vast area from the Ribble Estuary to Altcar and Little Crosby and inland as far as Croston, Ormskirk and Rainford. They also feed in the north Fylde between the Lune Estuary and River Wyre. The main roosts are on the Lune, Ribble, Wyre and Alt estuaries and at the WWT Martin Mere reserve.

2.1.11.2 Historical status

Before the Second World War, only small numbers of Pink-footed Geese visited Lancashire. Agricultural changes since then, and the establishment of protected roosts, have led to a huge increase in numbers using Lancashire in recent years. Owen *et al.* (1986) state that from peaks of 4,500 in the 1950s, they reached 9,000 in 1965 and 15,000 in 1973. Each winter since 1976/77 the peak number has exceeded 15,000 and in the winters of 1981/82 and 1982/83 they reached more than 32,000, almost 40% of the population at that time. Since 1988/89, totals greater than 30,000 birds have been recorded in almost every year. The population has been carefully studied since 1977, with co-ordinated counts of the geese undertaken several times each winter between October and February (Fig. 77 and Fig. 78).

2.1.11.3 Internationally important sites

i) Martin Mere

Five-year mean 95/96-99/2000: 19,368

Site conservation status

SPA (Martin Mere: selection stage 1.2)
Ramsar (Martin Mere: qualifying criterion 6)
SSSI (Martin Mere)
IBA (Martin Mere: criteria A4i, B1i, C3)

Site description and habitat

An artificial wetland reserve of 147 ha created by WWT from an area of rough, damp pasture land, 10 km inland of the Ribble Estuary and 3 km northwest of the village of Burscough (SD4214). The land was purchased by WWT and development of the reserve began in 1972. It is the last remnant of Martin Mere, a large shallow lake originally 8 km by 4 km that was progressively drained from the late 17th to the early 19th centuries.

Since acquisition, the rough grazed pasture has been transformed by means of positive management into a wildfowl refuge of international importance. Areas of open water with associated muddy margins, seasonally flooded marsh and reed swamp habitats are maintained by water level control. In addition, large areas of semi-improved damp grassland, unimproved species-rich damp grassland and rush pasture have been maintained and enhanced via appropriate grazing management.

Numbers and trends

Almost as soon as development of the reserve began, Pink-footed Geese started to use it as a roost; a few thousand at first, exceeding 10,000 by the early 1980s, and rising to 20,000 or more since 1990 (peak 27,500 in November 1995) (Fig. 79).

Site use

From the reserve, the geese fly out to feed on the wider area of Martin Mere towards Southport, as well as Sollom and Burscough Mosses, the Rufford and Croston area and even as far as Knowsley Park near St Helens, 20 km to the south.

ii) Lune Estuary

Five-year mean 95/96-99/2000: 16,160

Site conservation status

SPA (Morecambe Bay: selection stage 1.2)
Ramsar (Morecambe Bay: qualifying criterion 6)
SSSI (Lune Estuary)
IBA (Morecambe Bay: non-qualifying species)

Site description and habitat

A large estuary opening into Morecambe Bay, southwest of Lancaster and northeast of Fleetwood (SD4355). The estuary forms part of the Morecambe Bay complex which is the second largest intertidal area in Britain. There is a huge area of mudflats in the outer estuary, backed by fairly narrow saltmarshes along the southern shore from Pilling to Cockerham. Pilling Sands, which is the principal roost site, forms part of this area. The area immediately inland is given over to a mixture of grazing and arable land, some of it reclaimed from the estuary.

Numbers and trends

There has been a considerable increase in the use of this roost by Pink-footed Geese (Fig. 80), particularly since the occurrence of the peak count of 26,000 in 1993/94. Numbers are much lower in the earlier part of the season, but it is now the most important roost in Lancashire from January onwards.

Site use

Geese from this roost feed over an extensive area of the Fylde Peninsula from Pilling, Cockerham and Glasson in the north, south towards the River Wyre, and including particularly the areas of Pilling Moss, Cockerham Moss, Winmarleigh Moss and Rawcliffe Moss.

iii) Ribble Estuary

Five-year mean 95/96-99/2000: 12,287

Site conservation status

SPA (Ribble and Alt Estuaries: selection stage 1.2)
Ramsar (Ribble and Alt Estuaries: qualifying criterion 6)
NNR (Ribble Marshes)
SSSI (Ribble Estuary)
IBA (Ribble and Alt Estuaries: criteria A4i, B1i, C3)

Site description and habitat

A large estuary at the mouth of the River Ribble (SD3928), opening into the Irish Sea between the holiday resorts of Blackpool and Southport. The estuary comprises huge intertidal mudflats upon which the geese roost, and a very large area of open grazed saltmarsh upon which they feed. Almost all of the saltmarsh is along the south shore of the estuary and is backed by reclaimed arable land, some of it reclaimed from the estuary in the last 25 years. At Marshside, there is an increasing bed of *Spartina* grass, as well as a large area of reclaimed grazing marsh which is almost permanently flooded to varying degrees and provides additional feeding for the geese.

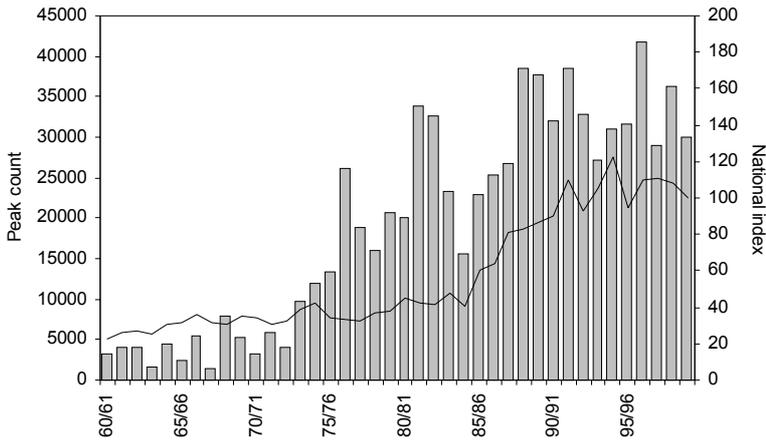


Figure 77. Pink-footed Geese in southwest Lancashire, 1960/61-1999/2000: peak counts (bars) and British index (line) (circles denote years with no known data)

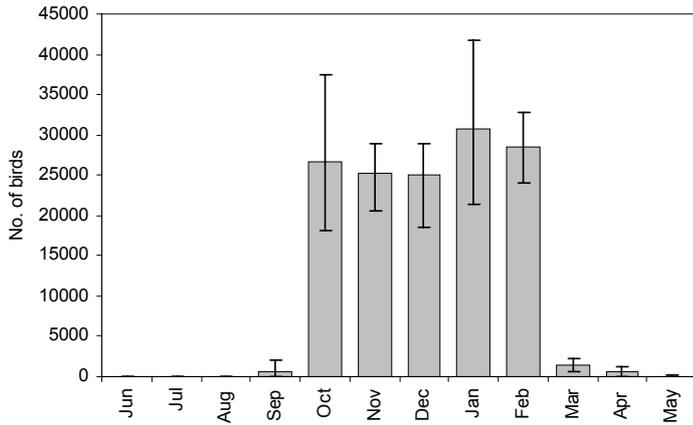


Figure 78. Pink-footed Geese at in southwest Lancashire, 1995/96-1999/2000: mean peak counts by month (error bars denote minimum and maximum peak counts during the period)

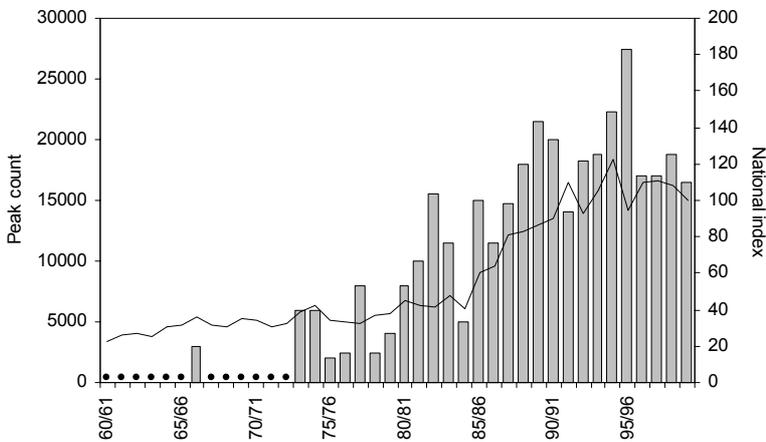


Figure 79. Pink-footed Geese at Martin Mere, 1960/61-1999/2000: peak counts (bars) and British index (line) (circles denote years with no known data)

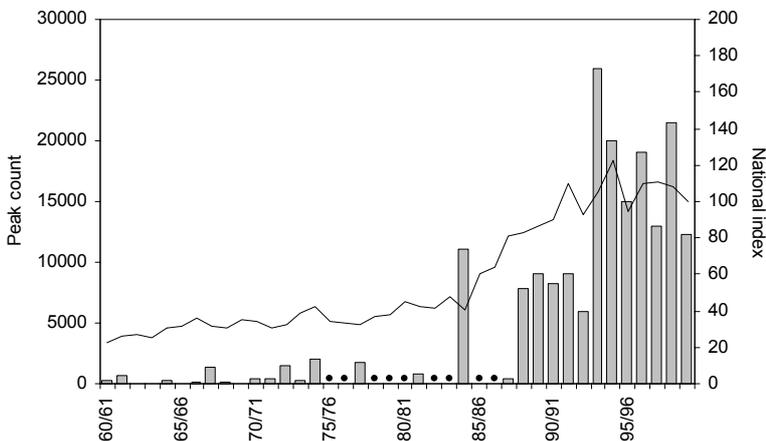


Figure 80. Pink-footed Geese at the Lune Estuary, 1960/61-1999/2000: peak counts (bars) and British index (line) (circles denote years with no known data)

Numbers and trends

The traditional roosting site for Pink-footed Geese in Lancashire, they have occurred here since records began. From a few hundred in the early 19th century, several thousand were regularly counted each winter in the 1950s. Thereafter, numbers rose spectacularly to exceed 20,000 by the late 1980s, with a peak of 29,234 in December 1989. Following this, there was a decline and recently roosting numbers have mainly varied between 7,000 and 12,000 (Fig. 81).

Site use

As well as feeding on the saltmarshes and reclaimed flooded grazing fields (see above), geese roosting on the estuary regularly fly inland to feed on Martin Mere, Sollom Moss, Tarleton Moss, Halsall Moss, and Plex Moss.

iv) Alt Estuary

Five-year mean 95/96-99/2000: 5,442

Site conservation status

SPA (Ribble and Alt Estuaries: selection stage 1.2)
Ramsar (Ribble and Alt Estuaries: qualifying criterion 6)
SSSI (Sefton Coast)
IBA (Ribble and Alt Estuaries: criteria A4i, B1i, C3)

Site description and habitat

A small estuary at the mouth of the River Alt (SD2903) opening into Liverpool Bay just north of the Mersey Estuary, with areas of intertidal mud and foreshore, backed by extensive sand dunes and a small saltmarsh.

Numbers and trends

Possibly a Pink-footed Goose roost as early as the 19th century, but counts there have been infrequent. Its importance increased during the last 15 years following the abandonment of a field roost on Altcar Withens during the early 1980s (Fig. 82).

Site use

Geese using this roost feed on Downholland Moss, Altcar Moss, Altcar Withens and the Ince Blundell and Little Crosby estates.

v) Wyre Estuary

Five-year mean 95/96-99/2000: 3,200

Site conservation status

SPA (Morecambe Bay: selection stage 1.2)
Ramsar (Morecambe Bay: qualifying criterion 6)
SSSI (Wyre Estuary)
IBA (Morecambe Bay: non-qualifying species)

Site description and habitat

A small land-locked estuary opening into Morecambe Bay at Fleetwood, less than 1 km wide and with a narrow strip of saltmarsh on either side. The main area of intertidal mud at Barnaby's Sands is the location of the roost.

Numbers and trends

Roosting Pink-footed Geese were first recorded using this site in 1989/90. In the last few years numbers have risen to around 3,000 birds, peaking at 4,500 in 1999/2000 (Fig. 83).

Site use

The geese fly inland to feed at Rossall, Stalmine, and Hambledon.

2.1.11.4 Other sites**i) Minor roosts**

There are no known Pink-footed Goose roost sites in Lancashire apart from the five outlined above. An important field roost on Altcar Withens, sometimes holding up to 10,000 birds, was abandoned in the early 1980s, possibly as a result of agricultural changes. In the last few years there have been suggestions of a roost at White Man's Dam (SJ4594), a lake in Knowsley Park, Prescott, but so far no data are available. The site is part of the estate of Lord Derby, to which no access is available. Geese have certainly fed in the area for a number of years, being birds originally from the Martin Mere roost.

Over the years a great deal of work has been done to assess the relative importance of feeding sites used by geese in southwest Lancashire, and a summary of the seven most important feeding areas is given in Table 5.

Table 5. Relative importance of feeding sites for Pink-footed Geese in SW Lancashire, south of the Ribble Estuary: 'Goose days' is the number of goose days as a proportion of the total in SW Lancashire, and 'Average peak' is the average peak count, for the period 1993 to 1997.

	Goose days	Average peak
Banks Marsh	14.4%	6,925
Marshside	9.7%	8,030
Martin Mere	28.7%	14,320
Halsall Moss	3.5%	2,295
Plex Moss	6.8%	3,590
Downholland Moss	6.9%	5,395
Altcar Withens	9.3%	2,090

The relatively high percentage of goose days for Altcar Withins reflects the time when this site was important for feeding Pink-footed Geese in the 1970s. The average peak count, however, covers only the most recent five seasons by which time its importance had greatly declined.

Other feeding sites of lesser (but still considerable) importance include Sollom Moss, Burscough Moss, Barton Moss, Altcar Moss, Little Crosby Estate and Bickerstaffe Moss.

2.1.11.5 Key references

Greenhalgh (1976), Forshaw (1983), Forshaw (1996), Forshaw (1997), Forshaw (1998), Forshaw (1999), Forshaw (2000)

2.1.12 Northeast England

2.1.12.1 Background

Compared to other parts of the British coastline, northeast England supports relatively little suitable roosting areas for Pink-footed Geese. Just two areas are notable: the Humber Estuary and north Northumberland. The Humber is a long, relatively narrow estuary, about 62 km in length. It has the second highest tidal range in Britain (7.2 m) and approximately one third of its area is exposed as mud or sand flats at low tide. The upper Humber contains Whitton Sand and adjacent saltmarsh. These lie within the statutory Humber Wildfowl Refuge, established in 1955 with the particular aim of protecting the roost of Pink-footed Geese that had somewhat earlier moved there from Read's Island flats. Northumberland contrasts strongly from west to east. The west is dominated by the uplands of the north Pennines, while the east consists primarily of mixed farmland, with several notable estuaries along the coast. In the south, it is more industrialised and many wetlands have been lost, although they have, to some degree, been replaced by disused quarries and other similar habitats.

2.1.12.2 Historical status

In the 1950s, the Humber was the most important site in England for Pink-footed Geese, exceeding the Wash and the Ribble, and having a regular autumn population of 6,000, with peaks of up to 20,000 (October 1960). In 1955, the Humber Wildfowl Refuge was established with the aim of protecting the Pink-footed Goose roost, although hardly had the refuge been established than the geese started to decline. This was probably due to short-stopping in

Scotland, through the greater amount of autumn feed available on barley stubbles, and to the preferential development of the Ribble concentration. The geese ranged far over the Yorkshire and Lincolnshire Wolds when feeding on stubble fields in the autumn, flights of 30 km being commonplace. In January 1975, Pink-footed Geese feeding near Coleby, 5 km to the south, suffered mass poisoning through ingesting wheat treated with an organophosphate pesticide. The bodies of 243 birds were recovered on the fields or close to the roost. The total kill was undoubtedly higher and the Humber flock slumped from 1,300 before the incident to 300 shortly afterwards. It was 1981 before the flock again reached the thousand mark.

2.1.12.3 Internationally important sites

i) Holburn Moss

Five-year mean 95/96-99/2000: 2,650

Site conservation status

SPA (Holburn Lake and Moss: non-qualifying species)

Ramsar (Holburn Moss: non-qualifying species)

SSSI (Holburn Lake and Moss)

IBA (Holburn Lake and Moss: non-qualifying species)

Site description and habitat

Holburn Moss is a small pond located 6 km inland of Fenham Flats (NU0536) and is surrounded by mire and swamp.

Numbers and trends

Until recently, Holburn Moss was an internationally important roost site for Icelandic Greylag Geese (Hearn & Mitchell 2004), and is designated as a Ramsar site and SPA, and is an IBA, as a result of this former importance. In contrast, Pink-footed Geese occurred only sporadically until the mid 1990s, but since then numbers have increased considerably, and the site is now internationally important, with a peak count of 4,500 in February 1998 (Fig. 84).

Site use

Initially used as an alternative roost when birds were disturbed from Lindisfarne, 6 km to the northeast, Holburn Moss has now surpassed Lindisfarne in importance. The birds feed in the surrounding farmland.

Figure 81. Pink-footed Geese at the Ribble Estuary, 1960/61-1999/2000: peak counts (bars) and British index (line) (circles denote years with no known data)

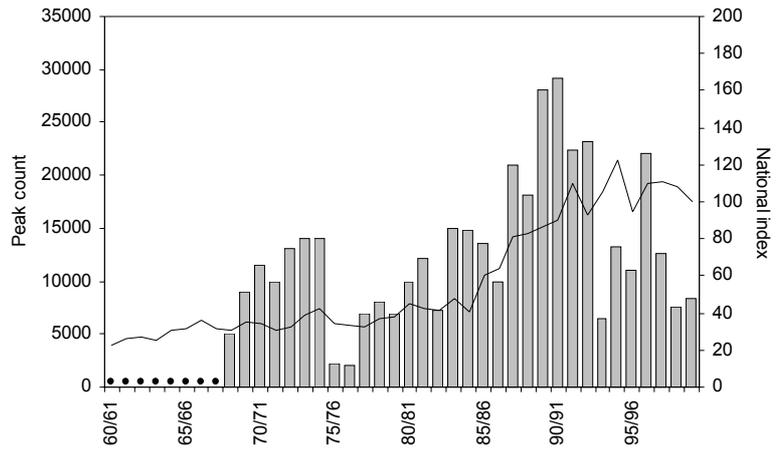


Figure 82. Pink-footed Geese at the Alt Estuary, 1960/61-1999/2000: peak counts (bars) and British index (line) (circles denote years with no known data)

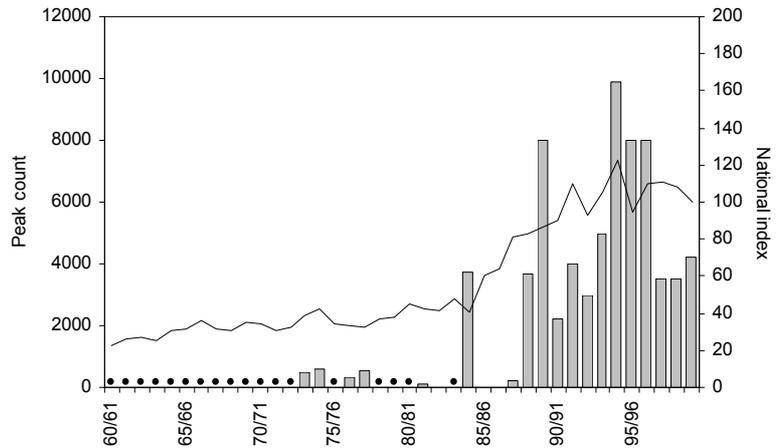


Figure 83. Pink-footed Geese at the Wyre Estuary, 1960/61-1999/2000: peak counts (bars) and British index (line) (circles denote years with no known data)

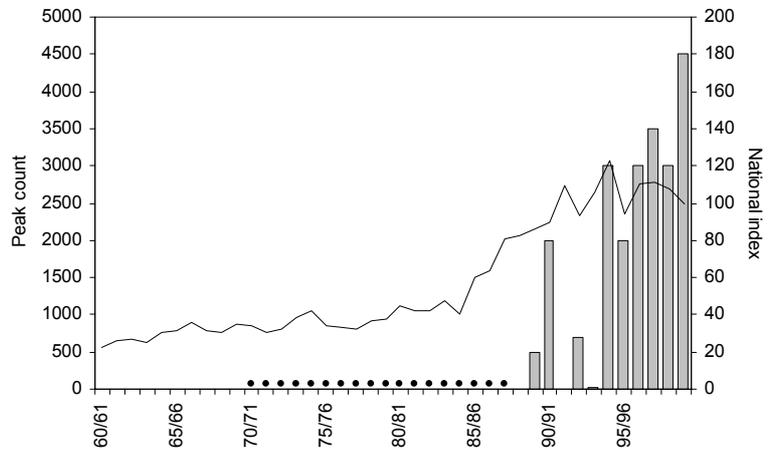
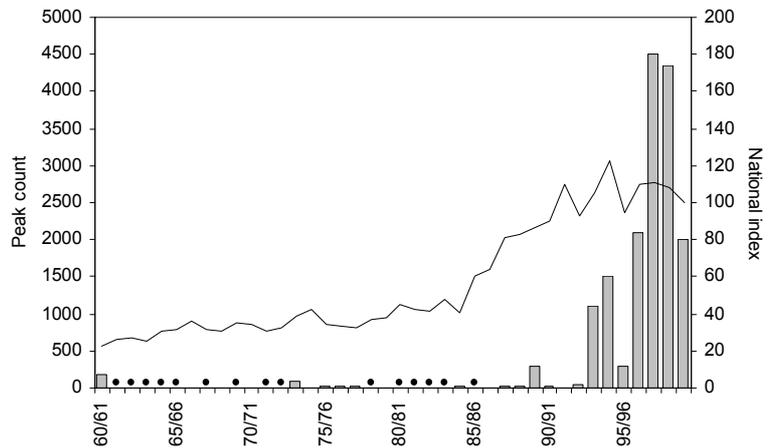


Figure 84. Pink-footed Geese at Holburn Moss, 1960/61-1999/2000: peak counts (bars) and British index (line) (circles denote years with no known data)



2.1.12.4 Other sites

i) Lindisfarne

Lindisfarne (NU1041) is designated as a SSSI and SPA for Pink-footed Geese, and is also a Ramsar site. Like nearby Holburn Moss, however, they only began to occur in large numbers in the mid 1990s (Fig. 85). The peak count was 4,100 in 1998/99 and the mean peak winter count for 1995/96-1999/2000 was 1,840.

ii) Humber Estuary

The inner Humber (SE9524) supports extensive areas of reedbed, and mature and developing saltmarsh backed by grazing marsh in the middle and outer estuary. In the lower reaches, thousands of hectares have been reclaimed from the estuary, around Sunk Island and the northern shore in particular. Formerly much more important for Pink-footed Geese, the decline in numbers there has been well documented (Pashby 1992).

In recent years, numbers have begun to increase again (Fig. 86) and in 1999/2000, internationally important numbers again visited this site (2,410). The mean peak winter count (1995/96-1999/2000) was 1,522. These birds roost primarily at Read's Island flats and feed to the south, particularly around Winteringham.

iii) Minor sites

Further from the estuary itself, Pink-footed Geese occur in small numbers on the Lower Derwent Ings (SE6938, max 400 in February 1997) where they probably also roost. Irregular records have also been reported from Stone Creek (TA3117, max 100 in February 1998), Blacktoft Sands (SE8423, max 102 in January 1991), Goole (SE8324, max 150 in October 1992), Alkborough (SE9721, max 500 in December 1988) and Brough Haven (SE9524, max 500 in January 1968). Scattered feeding records north of the Humber include Hornsea Mere (TA1947, max 250 in February 1980), where the birds probably roosted, at Tophill Low Reservoirs (TA0748, max 457 in February 1998) and at Pulfin Borrow Pit (TA0544, max 102 in February 1998).

In Northumberland, a record of 154 Pink-footed Geese at Cauldcleuch Reservoir (NT4703) in November 1974 presumably refers to birds moving between the Lothian and the Solway Firth.

2.1.12.5 Key references

Pashby (1992)

2.1.13 Wash/Norfolk

2.1.13.1 Background

The Wash is the largest estuarine system in Britain. There are extensive saltmarshes, intertidal banks of sand and mud, shallow rivers and deep channels. The great bay has 22,542 ha of sand/silt flats and 4,228 ha of saltmarsh. The north Norfolk coast from Sheringham, 40 km westwards to Hunstanton, is a nearly continuous strip of prime wildfowl habitat. This was recognised by its designation in 1976 as a Ramsar site, comprising 6,576 ha of intertidal sands and muds, shingle, sand dunes and 2,127 ha of saltmarsh.

A recent upsurge in Pink-footed Goose numbers in east Norfolk gave rise to some speculation as to whether birds from the Svalbard population may be involved. Sightings of colour-marked birds, however, confirm that these birds are from the Greenland/Iceland stock.

2.1.13.2 Historical status

The first Norfolk specimen of Pink-footed Goose was identified in 1841 'since which time this goose has proved to be by far the most common species frequenting Holkham marshes' (Stevenson 1866-90). The species was a common bird for at least a century, the birds roosting on Stiffkey High Sands. A peak of between 5,000 and 8,000 was recorded in the 1930s (Taylor *et al.* 2000).

The unclaimed saltmarsh between Blakeney and Wells, and the claimed marshes west to Burnham Overly supported the largest numbers prior to the 1939-45 War. The geese fed on reclaimed pasture at Holkham and fields inland to Fakenham, although following the establishment of an anti-aircraft firing range at Stiffkey, the numbers decreased rapidly after 1938. War-time ploughing of the fresh marshes followed and very few geese appeared after 1941. Pink-footed Geese remained almost absent from Holkham until the 1976/77 winter, when 250 made a brief appearance in December. The two succeeding winters showed a similar pattern, but during 1980/81 regular wintering began.

The geese regularly flight between sugar beet fields south of Brancaster and roosting grounds at Snettisham, Scolt Head and, as they did in pre-war

days, at Holkham. Since the mid 1990s, the geese have arrived earlier and in larger numbers, no longer relying on hard weather to the north to bring them to Norfolk. Pink-footed Geese have also started to use the Lincolnshire side of the Wash again (Holbeach and Wainfleet), with roosts developing since 1997/98.

2.1.13.3 Internationally important sites

i) Snettisham

Five-year mean 95/96-99/2000: 34,083

Site conservation status

SPA (The Wash: selection stage 1.2)
Ramsar (The Wash: qualifying criterion 6)
NNR (The Wash)
SSSI (The Wash)
IBA (The Wash: criteria A4i, B1i, C3)

Site description and habitat

The stretch of eastern shore from Heacham to North Wootton (TF6533) has fringing shallow lagoons, gravel pits and sizeable areas of fresh and saltmarsh, making it the most populous and varied wildfowl resort on the Wash. The RSPB established a reserve there in 1972. The roost site off Snettisham occupies the centre of a 1,315 ha wildfowl refuge. During high tides at night, the geese float on the water before settling later on the mud and sandbanks.

Numbers and trends

There are scattered reports of Pink-footed Geese using the east shore of the Wash from the early years of the 20th century, including an intriguing record of 2,000 Pink-footed and European White-fronted Geese feeding at Snettisham in 1929. During the late 1950s and 1960s, flocks of up to 200-300 birds were frequently seen. Following hard-weather movements in the 1970s, numbers greatly increased over those in the 1960s, marking a reversal of the trend away from eastern England also noted at the Humber. There has been a notable shift towards the eastern side of the Wash compared with the 1950s. Numbers increased rapidly in the early 1990s, reaching a peak count of 45,925 in January 1994 (Fig. 87).

Site use

In the late 1980s and early 1990s, the Pink-footed Geese tended to arrive in large numbers as late as December, peak in January and start to leave by February. Since the mid 1990s, however, they have started to arrive earlier, often in October, although still peaking in January and beginning to depart in late February (Fig. 88).

Feeding areas are primarily inland arable fields in a rough triangle formed by Tattersett, Fritcham and Heacham. The main forage crop is post-harvest sugar beet tops, although they are very susceptible to disturbance on these fields. The geese often feed on marshes much closer to the roost particularly after the shooting season.

ii) Holkham Bay

Five-year mean 95/96-99/2000: 28,844

Site conservation status

SPA (North Norfolk Coast: selection stage 1.2)
Ramsar (North Norfolk Coast: qualifying criterion 6)
NNR (Holkham)
SSSI (North Norfolk Coast)
IBA (North Norfolk Coast: criteria A4i, B1i, C3)

Site description and habitat

A small estuary with extensive undeveloped coastal habitat between Burnham Overy Staithe and Wells on the north Norfolk coast (TF8845). The area forms part of one of the largest expanses of undeveloped coastal habitat of its type in Europe (reserve area 3,851 ha). The birds tend to roost near Wells on exposed sandbars and shingle ridges off the Lodge and Warham Marshes, and on Stiffkey High Sands.

Numbers and trends

See historical status above. The site was re-established as a roost in winter 1980/81 and has grown phenomenally as part of the increase in Pink-footed Geese using Norfolk in mid winter. A peak count of 2,304 roosted there in winter 1987/88, but in December 1998, 34,100 birds were recorded (Fig. 89).

Site use

Peak numbers occur in December and, as at Snettisham, during the 1990s, the geese have begun to arrive earlier in the season. Departure north starts from mid January (Fig. 90). The birds feed in farmland inland from the roost in a radius of up to 10-15 km, primarily selecting areas of autumn stubbles and post-harvest sugar beet tops.

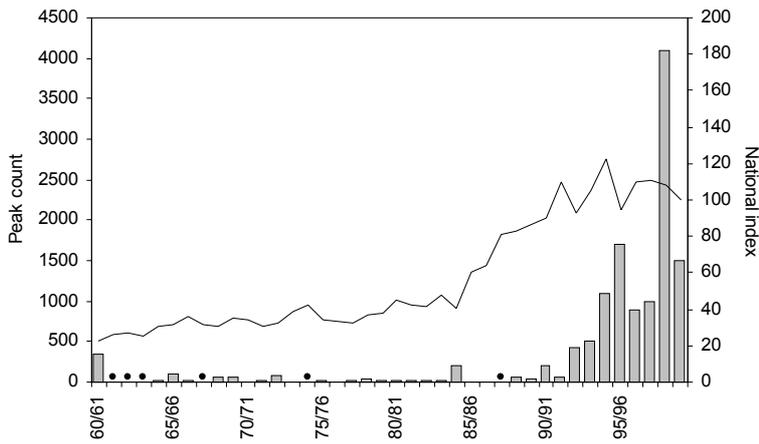


Figure 85. Pink-footed Geese at Lindisfarne, 1960/61-1999/2000: peak counts (bars) and British index (line) (circles denote years with no known data)

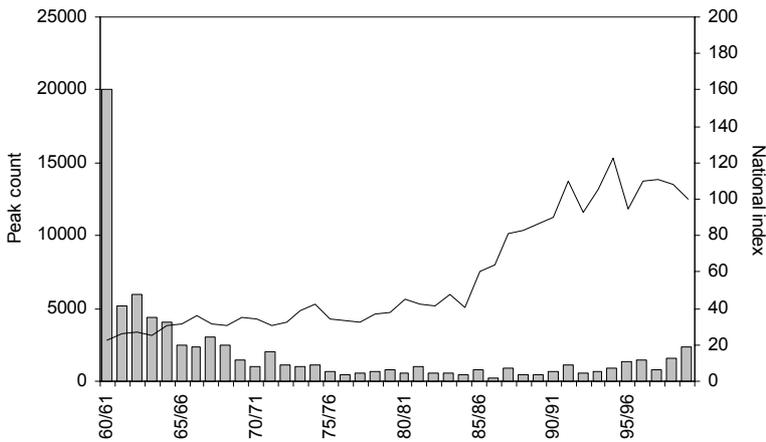


Figure 86. Pink-footed Geese at the Humber Estuary, 1960/61-1999/2000: peak counts (bars) and British index (line) (circles denote years with no known data)

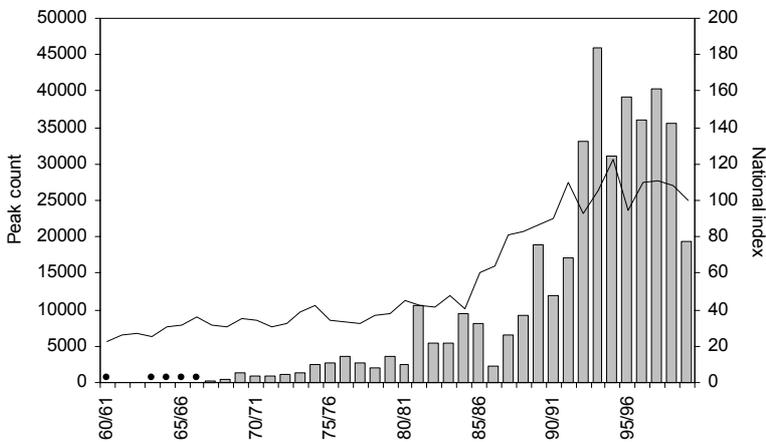


Figure 87. Pink-footed Geese at Snettisham, 1960/61-1999/2000: peak counts (bars) and British index (line) (circles denote years with no known data)

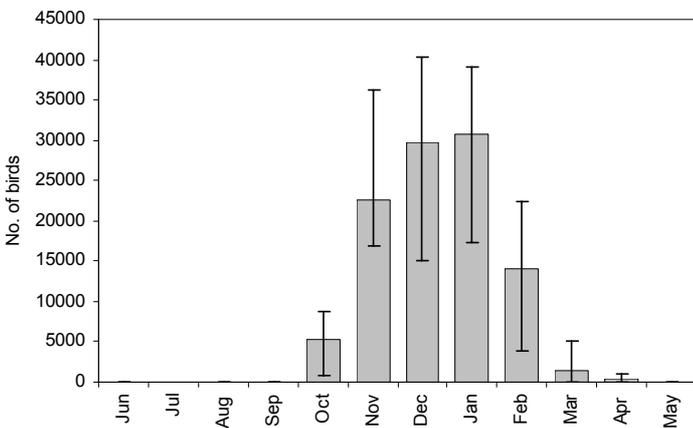


Figure 88. Pink-footed Geese at Snettisham, 1995/96-1999/2000: mean peak counts by month (error bars denote minimum and maximum peak counts during the period)

iii) Scolt Head

Five-year mean 95/96-99/2000: 23,205

Site conservation status

SPA (North Norfolk Coast: selection stage 1.2)

Ramsar (North Norfolk Coast: qualifying criterion 6)

NNR (Scolt Head)

SSSI (North Norfolk Coast)

IBA (North Norfolk Coast: criteria A4i, B1i, C3)

Site description and habitat

A coastal island of some 738 ha, just north of Burnham Deepdale (TF8146). The favoured roost site is amongst the sand and shingle ridges at the extreme western end of the island. The area forms part of one the largest expanses of undeveloped coastal habitat of its type in Europe.

Numbers and trends

Ten years after numbers began to increase at Snettisham, Pink-footed Geese were recorded using this sandy spit in 1979/80. The subsequent increase has been extraordinary. Since 1988/89, roost counts have regularly been over 10,000 birds, with a peak of 35,180 in December 1999 (Fig. 91).

Site use

The phenology of use of the site is somewhat different from either Snettisham or Holkham. Few geese are present in October, peak numbers occur in November to January, and few remain in February (Fig. 92).

Farmland inland from the roost in a radius of up to 10-15 km, particularly between Burnham Market, North Creak and Docking, forms the principal feeding area. Autumn stubbles and post-harvest sugar beet tops are the preferred crop types on which the geese forage.

iv) Heigham Holmes

Five-year mean 95/96-99/2000: 5,680

Site conservation status

SPA (Broadland: selection stage 1.2)

Ramsar (Broadland: non-qualifying species)

SSSI (Upper Thurne Broads and Marshes)

Site description and habitat

A flat, open area (186 ha) of marshes (TG4223), some 8 km inland of Winterton-on-Sea.

Numbers and trends

Pink-footed Geese began wintering in southeast Norfolk during the 1913/14 winter, when 30-40 were using the marshes to the west of Breydon, and

roosting on Scroby Sands, off Yarmouth (Taylor *et al.* 2000). Numbers increased and reached 1,500 in January 1922. The maximum numbers were attained between 1938 and 1946; on both occasions over 3,000 were recorded. Numbers began to fall after 1947, probably due to less frequent flooding of the Bure Marshes after the introduction of electric pumps, and increased disturbance. During the 1960s, numbers did not exceed 40 birds, however, a dramatic change in numbers occurred during the early 1990s. The roost at Heigham Holmes (Fig. 93) was first used in winter 1990/91 and a peak of 10,000 birds was recorded there in February 1998.

Site use

The birds feed in post-harvested sugar-beet fields as far south as Scratby, Filby and Runham.

Occasionally, they have also been recorded at Hickling Broad (TG4121, max 200 in December 1990), Horsey Mere (TG4422, max 450 in October 1997) and St Benets Levels/Ludham (TG3815, max 454 in January 1997).

v) Breydon Water & Berney Marshes

Five-year mean 95/96-99/2000: 3,740

Site conservation status

SPA (Breydon Water: non-qualifying species)

Ramsar (Breydon Water: non-qualifying species)

SSSI (Breydon Water)

Site description and habitat

Breydon Water (TG4907) is a tidal estuary inland of Great Yarmouth at the mouth of the River Yare and its confluence with the Rivers Bure and Waveney. The extensive mud-flats form the only area of such habitat on the east coast of Norfolk. There are also extensive areas of floodplain grasslands on the adjacent marshes.

Numbers and trends

Apart from occasional small flocks, Pink-footed Geese were scarce at Breydon Water prior to 1996/97 (Fig. 94). Since then, they have rapidly increased to a peak of 6,600 in 1999/2000. There is presumably some interchange with birds wintering at Heigham Holmes.

Site use

Pink-footed Geese in the Breydon Water area are found foraging in most of the surrounding marshland areas.

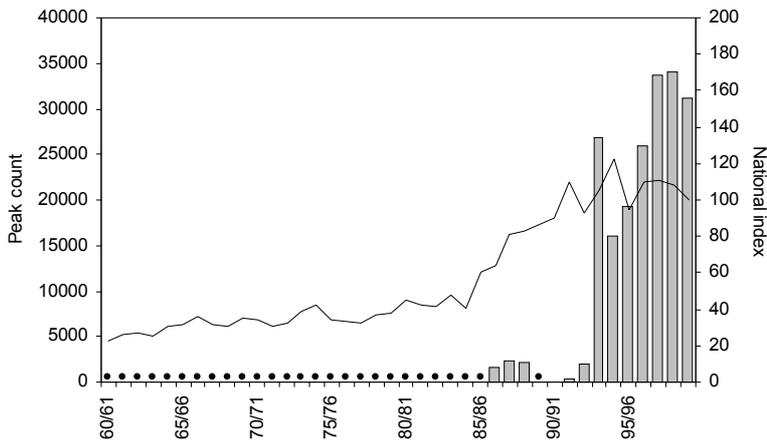


Figure 89. Pink-footed Geese at Holkham, 1960/61-1999/2000: peak counts (bars) and British index (line) (circles denote years with no known data)

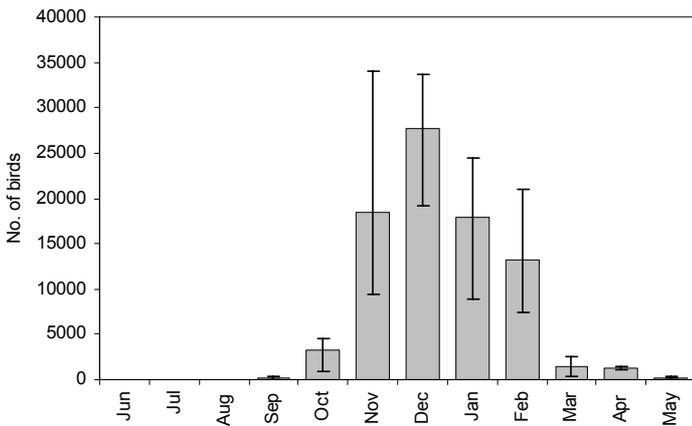


Figure 90. Pink-footed Geese at Holkham, 1995/96-1999/2000: mean peak counts by month (error bars denote minimum and maximum peak counts during the period)

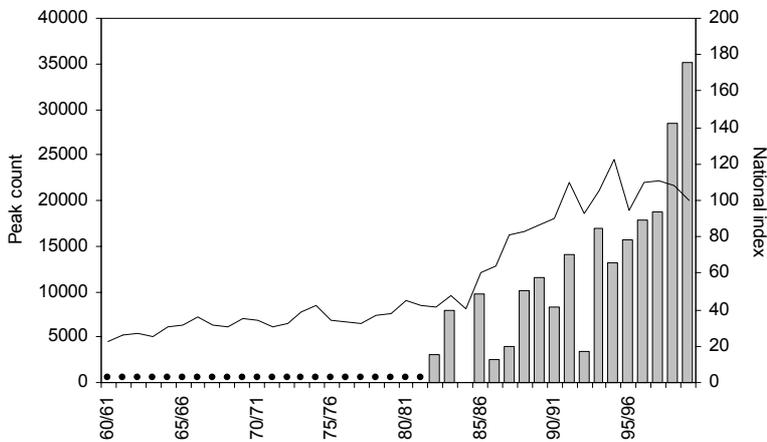


Figure 91. Pink-footed Geese at Scolt Head, 1960/61-1999/2000: peak counts (bars) and British index (line) (circles denote years with no known data)

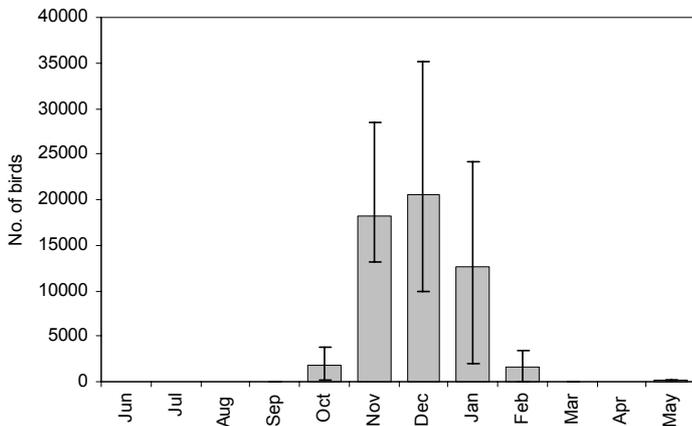


Figure 92. Pink-footed Geese at Scolt Head, 1995/96-1999/2000: mean peak counts by month (error bars denote minimum and maximum peak counts during the period)

2.1.13.4 Other sites

i) West side of the Wash

As Pink-footed Geese declined in north Norfolk and on the Broads in the 1940s/50s, numbers increased along the Lincolnshire shore of the Wash. This was a new tradition and was accompanied by a change in feeding habits. During this period, a regular arrival of up to 7,000, even 10,000, birds took place each autumn on the west Wash at Wainfleet, before moving to Holbeach by mid winter. From there, the majority moved to the Cambridgeshire Fens from January to early spring (see Cambridgeshire account below). This pattern varied little until 1962.

The extensive marshes to the southwest of the Wash can still attract Pink-footed Geese. The area from Butterwick Low, Frampton Marsh, east through the mouth of the River Welland, and towards Holbeach offers feeding opportunities. Pink-footed Geese have again started to use the Lincolnshire side of the Wash (Holbeach and Wainfleet), with roosts developing there since 1997/98.

Pink-footed Geese also feed on farmland and saltmarsh along the west coast of the Wash, for example at Wrangle (TF4548, max 270 in February 1998), Friskney (TF4851, max 250 in November 1991) and Leverton (TF4447, max 102 in December 1991). A little further north, Wainfleet (TF5356) regularly held over 2,000 birds during the early 1960s (max 4,500 in November 1962), and presumably these birds roosted at Gibraltar Point. During the 1950s, Pink-footed Geese also roosting at Gibraltar Point fed in the area of Croft Marsh, behind Skegness (max 5,000 in early autumn in the 1950s) but this was abandoned in about 1965. Small numbers may however be encountered at Gibraltar Point even today (Fig. 95).

Further north still, scattered feeding records along the east coast between the Wash and the Humber Estuary include Sea Bank Clay Pits (TF5477, max 120 in November 1987), Donna Nook (TF4499, max 113 in January 1984), Stonebridge (TA4100, max 130 in January 1998) and Tetney Haven (TA3404, max 120 in November 1964).

2.1.13.5 Key references

Gill (1994), Taylor *et al.* (2000)

2.1.14 Other regions

2.1.14.1 Shetland

The Pink-footed Goose was described as an occasional passage migrant to Shetland, and 'fairly common' on Fair Isle by Berry (1939). Today, Pink-footed Geese are regular passage migrants in Shetland with small numbers arriving during September and October. A mass arrival occurred on 29 September 1966, with skeins of over 100 reported (*Scottish Birds* 5: 316). Few stay, however, although there are usually up to 20 on the islands throughout the period September to April. The spring passage is even less obvious, although small parties are recorded in April and early May (see annual Shetland Bird Reports).

2.1.14.2 Orkney

Pink-footed Geese appear to have been scarce in the 19th century (Berry 1939), but are now a regular, and in some years common, passage migrant (Booth *et al.* 1984). The first autumn migrants arrive in early September. Most do not stay, preferring to continue south, and during September and October flocks can be seen passing overhead, sometimes in the company of Greylag Geese. The total number varies annually, but the scale of the passage can be impressive. Very few birds remain through the winter. Small numbers occur in spring, with most being seen in May (see annual Orkney Bird Reports).

Occasional flocks are encountered during WeBS counts and include 175 at Loch of Bosquoy (HY3018) in September 1992 and 186 on North Ronaldsay (HY7665) in October 1993. Counts from East Mainland (HY2920) have been fairly regular during October and November since winter 1990/91, with a peak of 287 in November 1997. On West Mainland (HY5109), small numbers have been recorded in October from winter 1994/95, with a peak of 176 in 1996.

2.1.14.3 Caithness and North Coast

Although the Pink-footed Goose is a casual winter visitor to this area, it is probable that twice a year the area is traversed by a relatively large proportion of this population. Berry (1939) reported the general line of migration to be SSE up Strath Naver and Strath Halladale and down the valley of the Helmsdale. Observations confirmed that arrivals of Pink-footed Geese on the Beaully Firth, the Firth of Tay, Loch Leven and the Solway followed observation of flocks migrating along this route.

The area between Cape Wrath and Handa (approximately NC1761) has records of Pink-footed Geese staging in October, with up to 230 in October 1971. It is not known if Pink-footed Geese still stage in this area during the autumn passage. Today, the lowland lochs of Caithness are noted chiefly as a centre for Greylag and Greenland White-fronted Geese. Pink-footed Geese in flocks of several hundred, and occasionally several thousand, also appear in spring.

Flocks recorded during WeBS counts include 211 in April 1997 at Loch Scarlet (ND3442), and 700 at Loch of Wester (ND3259) in March 1997. Loch Heilen (ND2568) occasionally supports Pink-footed Geese both in autumn and late spring with a peak of 720 in March 1997. As part of the annual goose counts, various feeding locations have been checked since winter 1994/95. These have revealed modest numbers in the autumn (e.g. 351 in October 1997) but higher numbers on spring passage with 2,940 in April 1994 and 3,916 in March 1995.

2.1.14.4 Upper Strathspey/Badenoch

Upper Strathspey/Badenoch forms a regular passage route for both southward autumn and northward spring migrating flocks, the route between the Moray Firth and Perthshire presumably following this part of the Strath and Glen Garry. Occasionally small parties overwinter, but larger feeding flocks are most often encountered, in late September and early October, and more regularly in the spring. Preferred feeding areas are on managed grasslands around Laggan, Newtonmore and Kingussie, the Insh Marshes and between Boat of Garten and Grantown. Few regular counts exist, although maximum counts recorded at the Insh Marshes (NH8003), including skeins overhead, exceeded 1,000 on a number of occasions in the late 1980s and early 1990s, with a peak of 1,532 in September 1989.

2.1.14.5 North-west Highlands and Skye

Berry (1939) reports that there was no mention of the Pink-footed Goose from any district within this area during the late 1930s. Today, flocks are occasionally encountered on migration, especially at Loch Torridon.

2.1.14.6 Western Isles

Small flocks, seldom of more than 30 birds, appeared in October and November in the 1870s on North Uist, but none was present after about January (Berry 1939). In the early part of the century, the species

was said to be only an occasional winter visitor, and this remains true today (P. Boyer pers. comm.). Regular skeins, often flying high over the Uists, are seen almost every spring and autumn, although they rarely land (Dix 1991).

2.1.14.7 Argyll/Inner Hebridean Islands/Ayr

The Pink-footed Goose was apparently found in small flocks on some of the Inner Hebrides during the early part of the 20th century (Berry 1939). It was formerly a regular winter visitor to Islay and also appeared on Iona and Mull. Throughout much of this area today, it is a rare passage migrant. On Islay, flocks of 100-200 are seen most autumns, although never in spring, and rarely stay for more than a few days. Up to 10 may winter, usually as scattered individuals in flocks of Barnacle and Greenland White-fronted Geese. A passage record of 1,200 at Skate Point, near Largs (NS1759), occurred in October 1994, while 399 were present in the Sound of Gigha (NR6950) in March 1994.

2.1.14.8 South Cumbria

It is probable that many thousands of Pink-footed Geese pass over the northern part of Morecambe Bay twice a year, as geese move between the Solway Firth and southwest Lancashire. It is surprising, therefore, that so few are recorded there, although feeding opportunities, especially to the north, appear limited. Small numbers have roosted on the Kent Estuary (SD4680, max 220 in March 1987), at Humphrey Head (SD3574, max 230 in January 1992) and West Plain at Flookburgh (SD3574, max 164 in March 1997).

Walney Island South (SD2163) held 280 Pink-footed Geese in February 1979, while the same number was recorded at Walney Island North (SD1772) in September 1990.

The Duddon Estuary (Duddon Sands) has held small numbers of Pink-footed Geese (usually fewer than 300) since the end of the 1970s, with a maximum count of 800 in March 1990. Close to the estuary, 100 were counted at Roanhead (SD1875) in February 1992, 400 at Kirkby (SD2184) in February 1993, 1,518 at Millom Marsh (SD1883) in January 1998 and 100 at Haverigg (SD1578) in September 1997.

2.1.14.9 Cheshire/Merseyside/Greater Manchester

Despite its proximity to the Ribble Estuary, the Mersey Estuary (SJ4578) has rarely supported Pink-footed Geese. They have been recorded in three winters since 1963/64, with a peak of 850 in January 1982. A count of 120 at Rostherne Mere (SJ7484) was recorded in the same month.

Very occasionally, Pink-footed Geese have been recorded at wetland sites further inland: Lightshaw Hall Flash (SJ6199, max 123 in October 1996), Shell Pond (SJ7591, 330 in December 1992) and Astley/Wosley Waters (SJ7099, 250 in November 1975).

Counts of Pink-footed Geese at various wetlands in west Lancashire refer to birds feeding away from the roosts on the Ribble/Martin Mere, although some undisturbed areas may support geese on moonlit nights, especially those holding standing water.

2.1.14.10 Wales

Very occasionally, perhaps during times of cold weather, Pink-footed Geese stray further west from Lancashire into Wales, yet no site currently holds important numbers. In the late 19th century, when arable farming was at its peak in the principality, large flocks were recorded on the Dee Estuary. Over 400 were there in 1903, and by 1917, numbers had increased to over 1,000 (Lovegrove *et al.* 1994). From the 1930s, numbers declined dramatically, partly due to increased disturbance on the estuary and probably because the birds could find good feeding on potatoes in Lancashire. At the beginning of the 20th century, Pink-footed Geese were also found on the Dyfi Estuary (SN6594).

During the 1950s and 1960s, a small flock regularly visited the Clwyd Estuary (SJ0079) but by the early 1970s their numbers had dwindled. During severe weather, large flocks can still turn up on the estuary, with 500 there in February 1978, and in February 1979, 1,200 were present at Sealan. A flock of 390 was seen close by between Towyn and Abergele (SH9679) in February 1991.

The displacement of birds from the Ribble Estuary in hard weather may force other flocks into Wales. A maximum count of 360 occurred on the Dyfi Estuary, again in 1979, and other smaller flocks were recorded from various sites in Carmarthenshire and Pembrokeshire. During January to March 1979, it is estimated that in excess of 3,500 were present in north Wales, the main influx occurring in January

(Lovegrove *et al.* 1994). The December 1981 influx was concentrated on Anglesey, where more than 500 birds were present, with small flocks elsewhere in Wales.

2.1.14.11 The English Midlands/Pennines

Pink-footed Geese regularly move between Lancashire and Norfolk, passing over a considerable number of suitable inland roost sites. Many of these offer arable and/or grassland grazing opportunities nearby. It is surprising, therefore, that inland records of Pink-footed Geese are so infrequent, and no inland site can be said to support the species with any regularity. Most bird reports for English Midland counties document passage birds, often seen high overhead during October to March, but few land, and roost counts appear to be restricted to periods of poor visibility. In Nottinghamshire, Kingsmill Reservoir (SK5159) held 150 in December 1995, Hoveringham (SK7047) held 108 in February 1984, the River Idle at Bawtry (SK7195) held 396 in January 1995, and Dunham Pools (SK8173) held 220 in December 1993. In Staffordshire, Blithfield Reservoir (SK0524) held 361 in January 1987. In Derbyshire, Carsington Reservoir (SK2451) held 220 in January 1992, and Drakelow Gravel Pit held 880 in February 1991 and 165 in January 1994. All of these records are exceptional and the geese usually move on quickly. Further north, records from Yorkshire probably involve birds moving between Lancashire and the Humber: Blackfootmoor Reservoir (SE0912) held 283 in November 1994, and Nosterfield Gravel Pits, Yorkshire, held 200 in February 1998.

There are numerous documented observations of visible migration of Pink-footed Geese from this region, particularly over the southern Pennines between the Lancashire Mosses and the Wash/Norfolk in both spring and autumn (Lancashire Bird Reports, Alan Porter pers. comm.). The favoured routes can occur over any point between the Aire Gap (SD95) and Buxton (SK07) depending on prevailing weather conditions, particularly wind, frontal activity and hill fog, with notable movements being recorded over Blackstone Edge (SD9716), Rivington Moor (SD6614), Todmorden Moor (SD8924) and Pendle Hill (SD8014). A further important route exists between the Ribble and Humber estuaries and is also used in both directions (east and west).

A more recent observation has been regular records of flocks of Pink-footed Geese migrating past Spurn Point (TA4315), particularly in the autumn. This reflects the recent increase in winter numbers in north Norfolk and probably indicates the

establishment (or re-establishment) of a more direct north-south route between Lothian/Fife and the East Anglian coast (A. Porter pers. comm.).

2.1.14.12 Cambridgeshire

Occasional records exist from before 1934, and Lack (1934) described Pink-footed Geese as regular winter visitors to the county: he described large flocks in the very north of the county, and stated that small flocks were not infrequent on the Ouse Washes. Up to the early 1950s, records were mainly on or around the Ouse Washes. From 1953, details of larger numbers are known (up to 500 on the Ouse Washes) and this situation continued with flocks of several thousand roaming the northern and central fens until, in 1963, agricultural development of the Nene Washes seems to have reduced their status. More recently, up to 150 have been recorded, but from one to 30 are seen in most years. The majority are found around the Nene Washes, with others in the general area of the Ouse Washes. Away from these two areas, the species is rare.

2.1.14.13 Gloucestershire

Pink-footed Geese formerly wintered regularly at the New Grounds, Slimbridge (SO7204). Payne-Gallwey's remarks in 1896 about large numbers seen

on the banks of the River Severn probably refer to the New Grounds, where totals of 500 to 1,200 or more were still to be seen in the 1930s. Then followed a steady decline to flocks of 50 to 130 (maximum of 400) between the late 1930s and the early 1960s. The flock formed the basis for early age counts and behavioural observations of the species carried out by Hugh Boyd and Peter Scott. The population study undertaken in the 1950s partly stemmed from observations of this flock, at the then Wildfowl Trust holding. Ringing during this period showed that the birds belonged to the Greenland/Iceland population, and their subsequent disappearance seems to have been part of a general retreat northwards of flocks wintering in England. For over 20 years they were virtually absent, but it is pleasing to report that a small wintering tradition has once again been established on this, the southernmost estuary used by Pink-footed Geese in Britain (Fig. 96).

It is remotely possible that the birds presently using the estuary originate from the Svalbard population (which winters in Belgium). No marked birds have been seen to confirm this, however. For now, assuming that the flock belongs to the Greenland/Iceland population, it seems that the attachment to preferred localities, as described by Boyd (1955), has resulted in the re-establishment of a winter tradition at this site.

Figure 93. Pink-footed Geese at Heigham Holmes, 1960/61-1999/2000: peak counts (bars) and British index (line) (circles denote years with no known data)

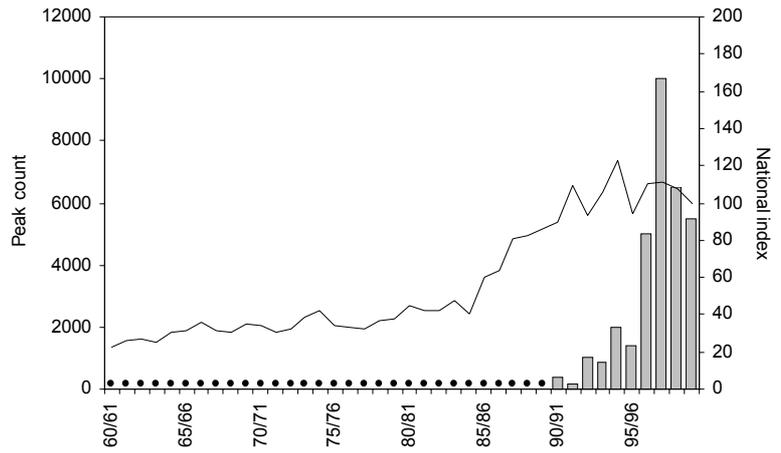


Figure 94. Pink-footed Geese at Breydon Water & Berney Marshes, 1960/61-1999/2000: peak counts (bars) and British index (line) (circles denote years with no known data)

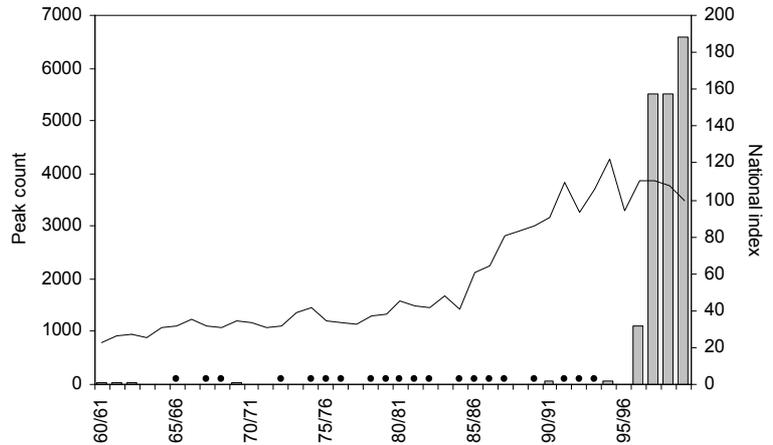


Figure 95. Pink-footed Geese at Gibraltar Point, 1960/61-1999/2000: peak counts (bars) and British index (line) (circles denote years with no known data)

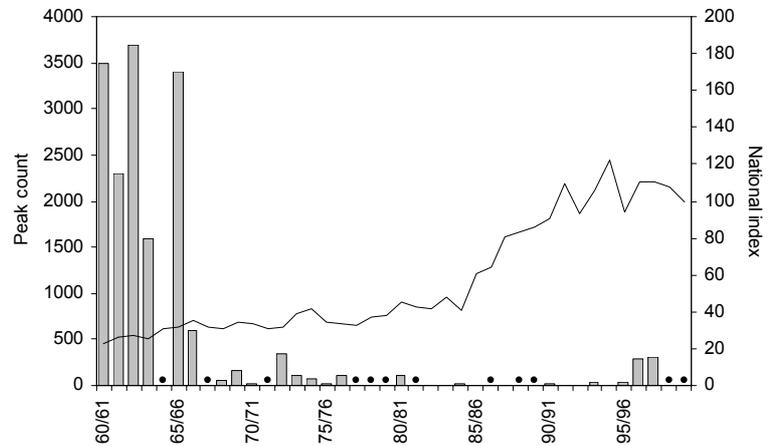
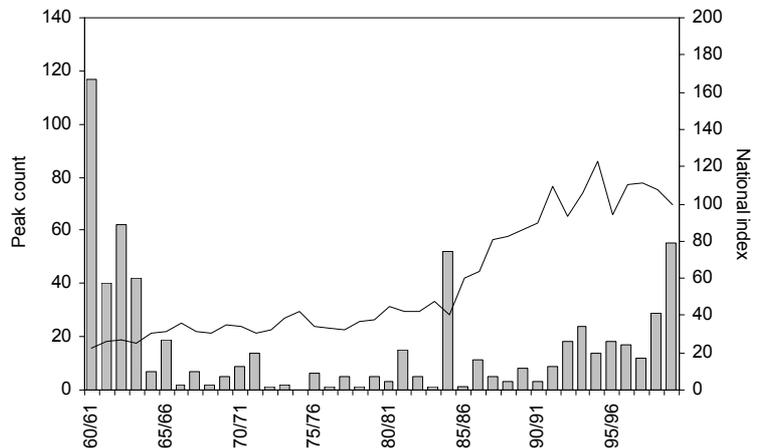


Figure 96. Pink-footed Geese at Slimbridge, Severn Estuary, 1960/61-1999/2000: peak counts (bars) and British index (line) (circles denote years with no known data)



3 FUTURE MONITORING AND DATA NEEDS

The counting of Pink-footed Geese has been conducted annually since 1960, and the continuation of this census is currently secured. Recent modelling has shown this census to be an accurate way of estimating abundance in this population (Frederiksen *et al.* in press), although some methodological improvements are desirable (see 3.1). Other monitoring activities, however, are carried out less often and with less regularity, particularly those based upon ringing. Currently, funding for continued ringing is not available, yet as population parameters change over time there is an important need for a long-term commitment to the collection of data using ringing (see Kershaw *et al.* 2001 for further detail).

There is a clear need to develop integrated population monitoring of Greenland/Iceland Pink-footed Geese. With these fundamental requirements in mind, a workshop on grey geese was held in Iceland in 2001, attended by specialists from Iceland, Britain and other countries. Current knowledge of the status and monitoring of Greenland/Iceland Pink-footed Geese, as well as the Iceland population of Greylag Goose, was reviewed and the effectiveness of current research and monitoring activity to provide essential data and information for the conservation management of these geese was assessed.

A series of recommendations was made and those relevant to Pink-footed Geese are summarised below (see Frederiksen 2001 for further details), along with some other issues not considered at that time.

3.1 Counts and surveys

1. Current monitoring activities in Britain should be maintained and co-ordination of the UK autumn census at an international level with annual inputs from Iceland developed.
2. A survey of stratified sample squares in the UK should be planned and implemented, with the aim of generating a comprehensive autumn total that includes numbers on small wetlands, not regularly included in the current census.
3. Further, and thereafter regular, midwinter and spring censuses are needed in order to maintain an understanding of site importance during these periods.

3.2 Age ratios

1. There is a need to review the statistical basis of age ratio estimation with respect to within-flock sampling, geographical sampling and seasonal timing and implement the recommendations. In particular, there is a need to understand better the relationship between age ratios in the field, in the hunting bag, and in the ringing catch samples.
2. There may be a need for greater formal geographical stratification of age ratio estimates throughout the present winter range.
3. A stratified sampling procedure for assessing age ratios in Iceland in August should be developed and implemented.
4. More detailed regular information on breeding success (numbers of pairs attempting to breed and brood size at or around fledging) would aid refinement of population models. The logistic difficulties of collecting such data are, however, significant.
5. Collection of wing sample data from hunting bags in the UK would be desirable and collection of such data should be continued in Iceland.

3.3 Ringing

1. Ringing activity plays an important role in monitoring and should be continued annually on this basis.
2. A greater geographic spread of ringing activity within UK and possibly Iceland is desirable.
3. In using ringing for monitoring purposes, there is a need to review optimal numbers (and distribution) of different age classes of geese ringed and then seek to implement these targets in a regular programme that complements other methods of monitoring population dynamics.
4. Important insights into population dynamic processes can be gained from the collection of additional information from future resightings of marked geese. There is a need for dialogue with observers to encourage such data collection (e.g. of family relationships).
5. There is a specific need to collect data that will help assess the numbers of individuals recruiting into the breeding population. Collection of such data on the breeding grounds in Iceland should be encouraged.

6. In order to aid the analysis of survival from resighting data, observers in the UK should be encouraged to focus effort during specific periods. These are October and March for Pink-footed Goose. It is important, however, to maintain the collection of observations outside these periods for other purposes.

3.4 Bag statistics

1. The continuation of all aspects of the Icelandic hunting bag monitoring system is essential, including wing surveys. Further, independent clarification of the accuracy of the methods employed is needed.
2. The value of the hunting bag data collected in Iceland is high. Given obligations under the African-Eurasian Waterbird Agreement to report harvest statistics for hunted waterbirds, the UK Government is urged to investigate the best statistical means to collect similar data. The commitment to this made by the Scottish Executive (Scottish Executive 2000), and the recent development of monitoring trials are seen as a positive step towards a comprehensive harvest monitoring system in the UK.

3.5 Management issues

1. The rapid population increase of the 1980s and early 1990s appears to have slowed and numbers now appear to have stabilised. In the context of this changing situation it is essential that existing monitoring activity be continued in order to provide necessary surveillance of status.
2. There is an urgent need in Britain to quantify the distribution and scale of alleged agricultural damage.

3.6 Future collaboration

1. The world range of this population of Pink-footed Goose is restricted to three countries: Greenland, Iceland and Britain. This would considerably aid the development of a flyway conservation plan for the population to guide national and international conservation and management actions, since it would involve relatively few governments and organisations.
2. Co-ordination and co-operation between Iceland and the UK on the conservation management of shared migratory goose populations should, therefore, continue to be furthered both at governmental and technical levels.

4 ACKNOWLEDGEMENTS

This report could not have been possible without the steadfast support of hundreds of goose counters who brave the elements during the coldest months of the year. Counting often necessitates having to be at the roost site an hour or so before dawn and, especially in the north of Scotland, adverse weather and ground conditions often have to be negotiated. We only hope that the easier task of turning the counts into words does justice to the thousands of hours undertaken in the field.

The relatively uncomplicated task of collating the information was undertaken at WWT from the 1950s by Hugh Boyd, then Malcolm Ogilvie, David Salmon, Peter Cranswick, Carl Mitchell and currently by Richard Hearn. However, where errors in the compilation or summarising of data have occurred, these are entirely ours.

The following contributors have helped to make the summarising of the 30,000 Pink-footed Goose counts currently lodged at WWT Slimbridge into a written report a much easier task: Mike Bell, David Boertmann, Hugh Boyd, Ivan Brockway, Allan Brown, Peter Cranswick, Paul Fisher, Derek Forshaw, Tony Fox, Rick Goater, Peter Gordon, Frank Mawby, Malcolm Ogilvie, David Patterson, Ian Patterson, Paul Shimmings, Arnór Sigfússon, and David Stroud.

This work has been partly financed by the Joint Nature Conservation Committee and our thanks go to David Stroud, a goose enthusiast himself and supporter of the goose monitoring programme.

Additional comments on individual sites have been provided by Paul Brooks, Paul Collin, Les Hatton, John Kemp, Alan Porter, A. Shepherd and the late Michael Seago. Æver Petersen provided useful information on the protection status, habitat use and agricultural conflict of Pinkfeet in Iceland and John Harradine improved the text concerning hunting in Britain. Thanks also to Helen Baker, Peter Cranswick and Ian Patterson for comments that allowed improvements to be made to earlier drafts.

Design and layout was undertaken by Stuart Pegler and Paul Marshall with assistance from Nancy Robb.

Finally, it has been a pleasure to share many hours talking, watching, counting and catching Pink-footed Geese with the following: Alan Lauder, Iain Munro, Marjorie Ness, Robert Rae, Raymond & Judy Duncan, Alan Leitch, Bob Swann, Simon Foster, Ian Stenhouse, Steve Cooper, Richard Hesketh, Janet Kear, John Turner, Chris Tomlinson, Luke Tomlinson, Andy Wooldridge, Pete Bullen, Charlie Liggett, Helen Gummer, Graham Clarkson, Gordon Wright, Myrfyn Owen, Pat Wisniewski, Dick Lambert, Andy Stewart, Dave Hodges, J. Taylor, Dave Fletcher, Katherine Fletcher and Olafur Einarsson. Apologies to anyone inadvertently missed.

The authors have made every effort to include all known data in this review. Given, however, that a number of unpublished reports and databases may have been overlooked, we urge readers to submit new and additional data to the authors, especially where there are apparent gaps in our datasets.

5 REFERENCES

- Andrews, I.J. 1986. *The Birds of the Lothians*. Scottish Ornithologist's Club.
- Baxter, E.V. & Rintoul, L.J. 1953. *The Birds of Scotland*. Oliver & Boyd.
- Beer, J.V. & Boyd, H. 1962. Weights of Pink-footed Geese in autumn. *Bird Study* 9: 91-99.
- Bell, M.V. 1988. Feeding behaviour of wintering Pink-footed and Greylag Geese in North-east Scotland. *Wildfowl* 39: 43-53.
- Bell, M.V. & Newton, S.F. 1995. The status and distribution of wintering Pink-footed and Greylag Geese in east central Scotland. *Scottish Birds* 18: 24-50.
- Bell, M.V., Dunbar, J. & Parkin, J. 1988. Numbers of wintering Pink-footed and Greylag Geese in north-east Scotland 1950-1986. *Scottish Birds* 15: 49-60.
- Bell, M.C., Mitchell, C.R., Fox, A.D. & Stewart, A. 1995. *Survival estimates of Pink-footed Geese Anser brachyrhynchus: 1987-1993*. Report to Joint Nature Conservation Committee. The Wildfowl & Wetlands Trust, Slimbridge. 32 pp.
- Bell, M.V., Newton, A.V. & Newton, S.F. 1998. Roost selection by Pink-footed *Anser brachyrhynchus* and Greylag *A. anser* Geese in east central Scotland. *Wildfowl* 48: 40-51.
- Berry, J. 1939. *The status and distribution of wild geese and wild duck in Scotland, International Wildfowl Inquiry Vol II*. Cambridge, the University Press.
- Boertmann, D. 1991. Distribution and numbers of moulting non-breeding geese in North-east Greenland. *Dansk Orn. Foren. Tidsskr.* 85, 77-88.
- Boertmann, D. 1994. An annotated checklist to the birds of Greenland. *Meddelelser om Grønland, Bioscience* 38: 1-63.
- Boertmann, D. 2000. Greenland. Pp. 187-204 in Heath, M.F. & Evans, M.I. (eds.) *Important Bird Areas in Europe: Priority sites for conservation. Volume 1: Northern Europe*. Cambridge, UK: BirdLife International (BirdLife Conservation Series No. 8).
- Booth, C., Cuthbert, M. and Reynolds, P. 1984. *The Birds of Orkney*. The Orkney Press, Kirkwall.
- Born, E.W. 1983. *Havpattedyr og havfugle i Scoresby Sund. Fangst og forekomst 1983*. Report by Danbiu Aps., Copenhagen.
- Boyd, H. 1953. Notes on field counts of age-group ratios and brood-size. *Wildfowl* 5: 14-19.
- Boyd, H. 1955. The role of tradition in determining the winter distribution of Pink-footed Geese in Britain. *Wildfowl Trust Annual Report* 7: 99-106.
- Boyd, H. 1956. Statistics of the British population of the Pink-footed Goose. *Journal of Animal Ecology* 25: 253-273.
- Boyd, H. 1999. Pink-footed Geese *Anser brachyrhynchus* on the Moorfoot Hills, Scotland, in spring 1952-1981. *Wildfowl* 49: 27-35.
- Boyd, H. & Ogilvie, M.A. 1969. Changes in the British-wintering population of the Pink-footed Goose from 1950 to 1957. *Wildfowl* 20: 33-46.
- Boyd, H. & Scott, P. 1955. The British population of the Pink-footed Goose, its numbers and losses. *Wildfowl Trust Annual Report* 7: 99-106.
- Brotherston, W. 1964. The numbers and behaviour of geese in the Lothians and Berwickshire. *Wildfowl* 15: 57-70.
- Brown, A.W. 1996. *Pink-footed and Greylag Geese in Fife – 1995/96*. Unpublished report.
- Brown, A.W. 1997. *Pink-footed and Greylag Geese in Fife – 1996/97*. Unpublished report.
- Brown, A.W. 1998. *Counts of Pink-footed and Greylag Geese in Fife in winter 1997/98*. Unpublished report.
- Brown, A.W. 1999. *Counts of Pink-footed and Greylag Geese in Fife in winter 1998/99*. Unpublished report.
- Brown, A.W. 2000. *Counts of Pink-footed and Greylag Geese in Fife in winter 1999/2000*. Unpublished report.
- Brown, A.W. & Brown, L.M. 1992. Development of an internationally important Pink-footed Goose roost at West Water Reservoir, Borders Region, 1966-1990. *Scottish Birds* 16: 260-268.

- Burnham, K.P. 1993. A theory for combined analysis of ring recovery and recapture data. Pp. 199-213 in Lebreton, J.-D. & North, P.M. (eds.) *Marked individuals in the study of bird populations*. Birkhäuser Verlag, Basel.
- Christensen, N.H. 1967. Moulting migration of Pink-footed Geese (*Anser fabalis brachyrhynchus*) from Iceland to Greenland. *Dansk Orn. Foren. Tidsskr.* 61: 55-66.
- Colhoun, K. 2001. *The Irish Wetland Bird Survey 1998-99; Results from the fifth winter of the Irish Wetland Bird Survey*. BWI/NPW/WWT, Dublin.
- Corbet, G.B. 1998. *The Nature of Fife*. Scottish Cultural Press.
- Cramp, S. & Simmons K.E.L. (eds.) 1977. *Handbook of the Birds of Europe, the Middle East and North Africa: The Birds of the Western Palearctic. Volume 1, Ostrich to Ducks*. OUP, Oxford.
- Cranswick, P. 1992. *Distribution of Pink-footed and Greylag Geese in south-east Scotland, especially in relation to disturbance*. WWT report to NCCS. Slimbridge, 85 pp.
- Dix, T.J. 1991. *Outer Hebrides Bird Report 1989 and 1990*. Outer Hebrides Ornithologists' Group, Uist Community Press, 116 pp.
- Einarsson, Á. 1983. Heiðagæsavarpíð í Grafarlöndum eystri. *Blíki* 2: 2-9.
- Einarsson, Ó. 2000. Iceland. Pp. 341-363 in Heath, M.F. & Evans, M.I. (eds.) *Important Bird Areas in Europe: Priority sites for conservation. Volume 1: Northern Europe*. Cambridge, UK: BirdLife International (BirdLife Conservation Series No. 8).
- Elder, W.H. 1955. The relation of age and sex to the weights of Pink-footed and Greylag Geese. *Wildfowl Trust Annual Report* 7: 127-132.
- Forshaw, W.D. 1983. Numbers, distribution and behaviour of Pink-footed Geese in Lancashire. *Wildfowl* 34: 64-76.
- Forshaw, W.D. 1996. *Report on wild geese and swans in Lancashire, 1995/96*. Unpublished report.
- Forshaw, W.D. 1997. *Report on wild geese and swans in Lancashire, 1996/97*. Unpublished report.
- Forshaw, W.D. 1998. *Report on wild geese and swans in Lancashire, 1997/98*. Unpublished report.
- Forshaw, W.D. 1999. *Report on wild geese and swans in Lancashire, 1998/99*. Unpublished report.
- Forshaw, W.D. 2000. *Report on wild geese and swans in Lancashire, 1999/2000*. Unpublished report.
- Fox, A.D. 1993. Pre-nesting feeding selectivity of pink-footed geese *Anser brachyrhynchus* in artificial grassland. *Ibis* 135: 417-422.
- Fox, A.D., Boyd, H. & Warren, S.M. 1992. The phenology of spring pre-nesting feeding in Iceland-nesting geese. *Ecography* 15: 289-295.
- Fox, A.D., Einarsson, Ó., Hilmarsson, J.Ó., Boyd, H. & Mitchell, C. 2000. Viðdvöl heiðagæsa á Suðurlandi að vori. *Blíki* 20:11-20.
- Fox, A.D., Gitay, H., Owen, M., Salmon, D.G. & Ogilvie, M.A. 1989. Population dynamics of Icelandic-nesting Geese, 1960-1987. *Ornis Scandinavica* 20: 289-297.
- Fox, A.D., Mitchell, C., Stewart, A., Fletcher, J.D., Turner, J.V.N., Boyd, H., Salmon, D.G., Haines, W.G. & Tomlinson, C. 1994a. Winter movements and site-fidelity of Pink-footed Geese *Anser brachyrhynchus* ringed in Britain, with particular emphasis on those marked in Lancashire. *Bird Study* 41: 221-234.
- Fox, A.D., Norriss, D.W., Stroud D.A. & Wilson H. J. 1994b. *Greenland White-fronted Geese in Ireland and Britain, 1982/83-1993/94 – the first twelve years of international conservation monitoring*. Greenland White-fronted Goose Study Research Report No. 8.
- Fox, A.D., Oakshott, J. & Turner, J.V.N. 1987. *Expedition Firebird 1987, Pink-footed Goose Research in north-east Iceland July/August 1987*. Wildfowl Trust, Slimbridge.
- Frederiksen, M. 2001. *Icelandic-British workshop on grey geese, Hvanneyri, Iceland, 28-30 September 2001: Proceedings and recommendations*. Náttúrufræðistofnun Íslands, Reykjavík, 17 pp.
- Frederiksen, M. 2003. Indirect estimation of the number of migratory Greylag and Pink-footed Geese shot in Britain. *Wildfowl* 53: 27-34.
- Frederiksen, M., Hearn, R.D., Mitchell, C., Sigfússon, A.P., Swann, R.L. & Fox, A.D. in press. The size and dynamics of Icelandic-breeding goose populations: a reassessment of the evidence. *Journal of Applied Ecology*.

- Freme, S.W.P. 1955. The discovery of Pink-footed Geese nesting in Iceland, 1929. *Wildfowl Trust Annual Report* 7: 139-145.
- Garðarsson, A. 1976. Stofnstærð og framleiðsla heiðagæsar *Anser brachyrhynchus* í Þjórsárverum 1971-1974. Pp. 33-64 In: *Þjórsárver: Framleiðsla gróðurs og heiðagæsar*. Orkustofnun, Reykjavík.
- Gill, J. 1994. *Habitat Choice and Distribution of Wintering Pink-footed Geese Anser brachyrhynchus*. D.Phil, University of East Anglia.
- Gill, J.A., Watkinson, A.R. & Sutherland, W.J. 1996. The impact of sugar beet farming practice on wintering Pink-footed Geese *Anser brachyrhynchus* populations. *Biological Conservation* 76: 95-100.
- Giroux, J.-F. 1991. Roost site fidelity of Pink-footed Geese *Anser brachyrhynchus* in north-east Scotland. *Bird Study* 38: 112-117.
- Giroux, J.-F. & Patterson, I.J. 1995. Daily movements and habitat use by radio-tagged Pink-footed Geese *Anser brachyrhynchus* wintering in north-east Scotland. *Wildfowl* 46: 31-44.
- Gitay, H., Fox, A.D. & Boyd, H. 1990. Analysis of historical pink-footed goose ringing – recovery data. *The Ring* 13: 103-112.
- Greenhalgh, M.E. 1976. *Wildfowl of the Ribble Estuary*. WAGBI, Chester.
- Gregory, R.D., Wilkinson, N.I., Noble, D.G., Robinson, J.A., Brown, A.F., Hughes, J., Proctor, D.A., Gibbons, D.W. & Galbraith, C.A. 2002. The population status of birds in the United Kingdom, Channel Islands and Isle of Man: an analysis of conservation concern 2002-2007. *British Birds* 95: 410-450.
- Harradine, J. 1983. Sport shooting in the United Kingdom: some facts and figures. In: Leeuwenberg, F. & Hepburn, I. (Eds.) *Proceedings of the Second Meeting of the Working Group on Game Statistics*. International Union of Game Biologists, Zoetermeer.
- Hearn, R. & Mitchell, C. 1995. *Goose distribution and feeding around Loch Leven NNR*. Report to Scottish Natural Heritage. WWT, Slimbridge.
- Hearn, R.D. & Mitchell, C. 2004. *Greylag Goose Anser anser (Iceland population) in Britain and Ireland 1960/61 – 1999/2000*. Waterbird Review Series, The Wildfowl & Wetlands Trust/Joint Nature Conservation Committee, Slimbridge.
- Hearn, R., Mitchell, C., Munro, I. & Ness, M. 1996. *The feeding distribution of Pink-footed Geese at Loch Leven NNR in winter 1995/96*. Report to Scottish Natural Heritage. WWT, Slimbridge.
- Heath, M.F. & Evans, M.I. Eds. 2000. *Important Bird Areas in Europe: Priority sites for conservation. Volume 1: Northern Europe*. Cambridge, UK: BirdLife International (BirdLife Conservation Series No. 8).
- Inglis, I.R. 1977. The breeding behaviour of the Pink-footed Goose: behavioural correlates of nesting success. *Animal Behaviour* 25: 747-764.
- Jepsen, P.U., Søgaard, B., Ragborg, A.-G. & Møller, H.S. 1993. *Danish Report 1993 on the Ramsar Convention: Denmark and Greenland*. Ministry of the Environment, Copenhagen.
- Kear, J. 1963. *Wildfowl and Agriculture*. In: Atkinson-Willes, G.L. *Wildfowl in Great Britain*. HMSO, St Albans.
- Kear, J. 1970. The experimental assessment of goose damage to agricultural crops. *Biological Conservation* 2: 206-212.
- Keller, V. 1991. The effects of disturbance from roads on the distribution of feeding sites by geese (*Anser brachyrhynchus*, *A. anser*) wintering in north-east Scotland. *Ardea* 79: 229-232.
- Keller, V.E., Gallo-Orsi, U., Patterson, I.J. & Naef-Daenzer, B. 1998. Feeding areas used by individual Pink-footed Geese *Anser brachyrhynchus* around the Loch of Strathbeg, North-east Scotland. *Wildfowl* 48: 52-64.
- Kershaw, M. & Cranswick, P.A. 2003. Numbers of wintering waterbirds in Great Britain, 1994/1995 – 1998/1999: I. Wildfowl and selected waterbirds. *Biological Conservation* 111: 91-104.
- Kershaw, M., Hearn, R.D. & Cranswick, P.A. 2001. The role of ringing in integrated population monitoring of Anatidae in the United Kingdom. *Ardea* 89: 209-220.
- Kirby, J.S. 1995. Winter population estimates for selected waterfowl species in Britain. *Biological Conservation* 73: 189-198.
- Kirby, J.S. & Cranswick, P.A. 1991. *The 1990 National Census of Pink-footed and Greylag Geese in Britain*. WWT Report, Slimbridge.

- Kirby, J.S., Owen, M. & Rowcliffe, J.M. 1999. *Geese and their Interactions with Agriculture and the Environment*. Wetlands Advisory Service Limited.
- Lack, D. 1934. *Birds of Cambridgeshire*. Cambridge Bird Club, Cambridge.
- Lack, P. 1986. *The Atlas of Wintering Birds in Britain and Ireland*. Poyser, London.
- Lambeck, R.H.D. 1990. The applicability of age ratio and brood size counts in population dynamic studies of the brent goose *Branta b. bernicla*. *Ardea* 78: 414-425.
- Lebret, T. 1948. Waarnemingen over leeftijdsgroepen bij Kolganzen, *Anser a. albifrons* (Scop.). *Ardea* 36: 198-200.
- Lovegrove, R., Williams, G. & Williams, I. 1994. *Birds in Wales*. T. & A.D. Poyser, London.
- Madge, S. & Burn, H. 1988. *Wildfowl: an identification guide to the ducks, geese and swans of the world*. Christopher Helm, London.
- Madsen, J. 1984. Study of the possible impact of oil exploration on goose populations in Jameson Land, East Greenland. *Norsk Polarinst. Skr.* 181: 141-151.
- Madsen, J. 1985. Impact of disturbance on field utilization of Pink footed Geese in West Jutland, Denmark. *Biological Conservation* 33: 53-63.
- Madsen, J., Boertmann, D. & Mortensen, C.E. 1984. The significance of Jameson Land, East Greenland as moulting and breeding area for geese: results of censuses 1982-84. *Dansk Orn. Foren. Tidsskr.* 78: 121-131.
- Madsen, J., Cracknell, G. & Fox, A.D. (eds.) 1999. *Goose populations of the Western Palearctic. A review of status and distribution*. Wetlands International Publ. No. 48, Wetlands International, Wageningen, The Netherlands. National Environmental Research Institute, Rønde, Denmark, 344 pp.
- Madsen, J. & Mortensen, C.E. 1987. Habitat exploitation and interspecific competition of moulting geese in East Greenland. *Ibis* 129: 25-44.
- Marr, B.A.E., Reaney, J., Truckle, W.H. & Wiseman, E.J. 1959. Spring migration (1959) at the Butt of Lewis. *Bird Migration* 1: 75-81.
- Mawby, F. 1995. *Goose counts on the Solway Estuary 1994-95*. English Nature Report.
- McGilvray, J., McRory, E., Perman, R. & Stewart, W.J. 1990. *The Economic Impact of Sporting Shooting in Scotland*. Fraser of Allander Institute, University of Strathclyde.
- Meltofte, H. 1976. Ornithological observations from the Scoresby Sund area, North-east Greenland 1974. *Dansk Orn. Foren. Tidsskr.* 70: 107-122.
- Mitchell, C. 1995. *Midwinter and spring counts of Pink-footed and Greylag Geese in Britain, 1995*. Report to Scottish Natural Heritage. WWT, Slimbridge.
- Mitchell, C. 1996. *The 1995 national census of Pink-footed and Greylag Geese in Britain*. Report to JNCC. WWT, Slimbridge.
- Mosbech, A. & Glahder, C. 1991. Assessment of the impact of helicopter disturbance on moulting Pink-footed Geese *Anser brachyrhynchus* and Barnacle Geese *Branta leucopsis* in Jameson Land, Greenland. *Ardea* 79: 233-238.
- Newton, I. & Campbell, C. 1973. Feeding of geese on farmland in east-central Scotland. *Journal of Applied Ecology* 10: 781-801.
- Newton, I., Thom, V.M. & Brotherston, W. 1973. Behaviour and distribution of wild geese in south-east Scotland. *Wildfowl* 24: 111-121.
- Newton, S., Bell, M.V., Brown, A.W. & Murray, R. 1990. Pink-footed Goose numbers at arrival sites in eastern and central Scotland. *Scottish Birds* 16: 35-36.
- Ogilvie, M.A. & Boyd, H. 1976. The numbers of Pink-footed and Greylag Geese wintering in Britain, observations 1969-1975 and predictions 1976-1980. *Wildfowl* 27: 63-75.
- Owen, M. 1976. Factors affecting the distribution of geese in the British Isles. *Wildfowl* 27: 143-147.
- Owen, M. 1980. *Wild Geese of the world*. Batsford, London.
- Owen, M., Atkinson-Willes, G.L. & Salmon, D.G. 1986. *Wildfowl in Great Britain. 2nd Edition*. University Press, Cambridge.
- Pashby, P. 1992. The Humber Wildfowl Refuge: an experiment in wildfowl conservation. *The Naturalist* 117: 81-98.
- Patterson, I.J. 1991. Conflict between geese and agriculture: does goose grazing cause damage to crops? *Ardea* 79: 179-186.

- Patterson, I.J., Abdul-Jalil, S. & East, M.L. 1989. Damage to winter cereals by Greylag and Pink-footed Geese in north-east Scotland. *Journal of Applied Ecology* 26: 879-895.
- Pettifor, R., Rowcliffe, J.M. & Mudge, G.P. 1997. *Population viability analysis of Icelandic/Greenlandic Pink-footed Geese*. WWT report to SNH, 91 pp.
- Pollitt, M.S., Hall, C., Holloway, S.J., Hearn, R.D., Marshall, P.E., Musgrove, A.J., Robinson, J.A. & Cranswick, P.A. 2003. *The Wetland Bird Survey 2000-01: Wildfowl and Wader Counts*. BTO/WWT/RSPB/JNCC, Slimbridge.
- Pope, J. 1995. *Where the Wild Goose Flies*. Ginn, Bucks.
- Ramsar 1999. *Strategic Framework for the List of Wetlands of International Importance*. Ramsar Bureau, Gland, Switzerland.
- Rayment, M., Sankey, S. & Sheddon, C. 1998. *Geese and Local Economies in Scotland*. Report to the National Goose Forum. RSPB/BASC, 34 pp.
- Reynolds, N. & Harradine, J. 1994. *Grey Goose Shooting Kill & Duck Recruitment*. BASC Report to WWT, 55 pp.
- Reynolds, N. & Harradine, J. 1996. *Grey Goose Shooting Kill & Duck Recruitment*. BASC Report to WWT, 55 pp.
- Rose, P.M. & Scott, D.A. 1997. *Waterfowl Population Estimates. Second edition*. IWRB Special Publication 44.
- Scott, D.A. & Rose P.M. 1996. *Atlas of Anatidae Populations in Africa and Western Eurasia*. Wetlands International Publication No. 44. Wetlands International, Wageningen, The Netherlands.
- Scott, P., Fisher, J. & Guðmundsson, F. 1953. The Severn Wildfowl Trust Expedition to Central Iceland, 1951. *Wildfowl Trust Annual Report* 5: 79-115.
- Scott, P., Boyd, H. & Sladen, W.J.L. 1955. The Wildfowl Trust's second expedition to Central Iceland, 1953. *Wildfowl Trust Annual Report* 7: 63-98.
- Scottish Executive 2000. *Policy Report and Recommendations of the National Goose Forum*. Scottish Executive, Edinburgh.
- Scottish Office 1996. *Wild Geese and Agriculture in Scotland: a discussion paper*. Scottish Office, Edinburgh.
- Scottish Natural Heritage. 2003. *Monitoring of goose use of the refuges in the Loch of Strathbeg Goose Management Scheme, 2003*. SNH Report, 67 pp.
- Sigfússon, A. 1996. A new system of goose hunting bag reporting from Iceland. *Wetlands International Goose Specialist Group Bulletin* 8: 9-11.
- Skarphéðinsson, K.H. 1983. Fuglalíf í Hvannalindum. *Bliki* 1: 2-11.
- Skarphéðinsson, K.H. in press. The moulting of non-breeding Pink-footed Geese in Iceland. *Bliki*.
- Skarphéðinsson, K.H. & Guðmundsson, G.A. 1990. Fuglalíf í Skógum, Skagafirði, og nágrenni, 1987. *Bliki* 9: 49-66.
- Smout, A.-M. 1986. *The Birds of Fife*. John Donald, Edinburgh.
- Snow, D.W. & Perrins, C.M. 1998. *The Birds of the Western Palearctic Concise Edition*. Oxford University Press, Oxford.
- Stenhouse, I.J. 1993. *Grey geese in the Moray Firth*. Report to SNH. WWT, Slimbridge, 59 pp.
- Stenhouse, I.J. & Mitchell, C. 1994. *Monitoring of winter Greylag and Pink-footed Goose populations in Scotland, 1993-94*. WWT Report, 45 pp.
- Stevenson 1866-90. *The Birds of Norfolk. Vol 1-3*. John van Bruce & Gurney & Jackson, London.
- Stroud, D.A., Chambers, D., Cook, S., Buxton, N., Fraser, B., Clement, P., Lewis, I. McLean, I. Baker, H. & Whitehead, S. 2001. *The UK SPA network: its scope and content*. JNCC, Peterborough.
- Taylor, M, Seago, M, Allard, P & Dorling, D. 2000. *The Birds of Norfolk*. Pica Press, Sussex.
- Tucker, G.M. & Heath, M.F. 1994. *Birds in Europe: their Conservation Status*. BirdLife International, Cambridge, UK (BirdLife Conservation Series No. 3).
- van Impe, J. 1978. La rupture de la cohésion familiale chez l'Oie Rieuse, *Anser albifrons albifrons*, dans les quartiers d'hivernage. *Le Gerfaut/De Giervalk* 68: 651-679.

Watkins-Pitchford, D.J. 1939. *Manka, The Sky Gypsy*. Methuen & Co. Ltd, London.

Watkinson, A.R. & Sutherland, W.J. 1996. The impact of sugar beet farming practice on wintering Pink-footed Geese *Anser brachyrhynchus* populations. *Biological Conservation* 76: 95-100

Wetlands International. 2002. *Waterbird Population Estimates – Third Edition*. Wetlands International Global Series No. 12. Wageningen, The Netherlands.

Wright, G. & Boyd, H. 1983. Numbers, age and sex of Greylag and Pink-footed Geese shot at Loch Leven National Nature Reserve, 1966-1981. *Wildfowl* 34: 163-167.