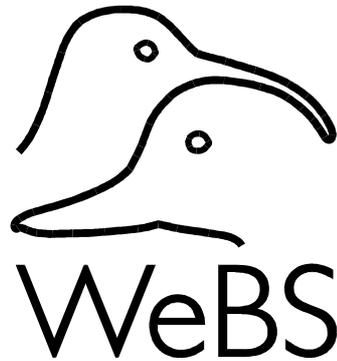


Waterbirds in the UK 2005/06

The Wetland Bird Survey

Andy Musgrove, Mark Collier, Alex Banks,
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Cover: Whooper Swans and Pink-footed Geese by James McCallum. James McCallum is a wildlife artist living and working in North Norfolk. He is best known for his watercolour paintings and sketches of natural history, particularly birds, made outdoors from life at the time of watching. Many of James' paintings are reproduced in a series of books, the latest, '*Arctic Flight*', is a collection of sketches and painting from trips to northern and Arctic regions. For more details of James' work visit www.jamesmccallum.co.uk.

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This report is provided free to all WeBS counters and those who participate in the other national waterbird surveys, none of whom receive financial reward for their invaluable work. Further feedback is provided to counters through the annual WeBS Newsletter. For further information please contact the WeBS Office at the BTO.

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This book represents the twenty-fifth report of the Wetland Bird Survey and comprises information from WeBS and complementary national and local surveys, *e.g.* goose censuses. It is entirely dependent on the many thousands of dedicated volunteer ornithologists who supply the data and to whom we are extremely grateful. The Local Organisers who coordinate these counts deserve special thanks for their contribution.

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The WETLAND BIRD SURVEY

Organised and funded by

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OTHER NATIONAL WATERBIRD SURVEYS

Details of and contacts for many of the other waterbird surveys used in this report, and of forthcoming surveys, can be obtained via the web sites of the four WeBS partner organisations.

ERRATUM TO 2004/05 REPORT

Please note the following corrections to data presented in the 2004/05 WeBS annual report:

p142 The 2000/01 peak counts of 268 Black-tailed Godwit on the Ouse Washes was from a supplementary daytime count and should have been indicated by a method 13.

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Summary

The Wetland Bird Survey and Waterbirds in the UK

The Wetland Bird Survey (WeBS) is a joint scheme of the British Trust for Ornithology (BTO), the Wildfowl & Wetlands Trust (WWT), Royal Society for the Protection of Birds (RSPB) and Joint Nature Conservation Committee (JNCC) to monitor non-breeding waterbirds in the UK. The principal aims of the scheme are to identify population sizes, to determine trends in numbers and distribution, and to identify important sites for waterbirds. WeBS Core Counts are made annually at around 2,000 wetland sites of all habitats; estuaries and large still waters predominate. Monthly coordinated counts are made mostly by volunteers, principally from September to March, with fewer observations during summer months. Data from other sources, *e.g.* roost counts of grey geese, are included in this report where relevant.

This report presents total numbers counted for all species in the most recent year in Great Britain and Northern Ireland. Annual indices are provided for the more numerous species, as are monthly indices showing relative abundance during the winter.

Species accounts provide yearly maxima for all sites supporting internationally and nationally important numbers. Sites with changed status are highlighted and significant counts are discussed. Counts are placed in an international context where possible, and relevant research is summarised. Waterbird totals are provided for all sites meeting criteria for international importance and species occurring in internationally important numbers on each are identified.

WeBS Low Tide Counts are made on selected estuaries to determine the distribution of birds during low tide and to identify important feeding areas that may not be recognised during Core Counts, which are made mostly at high tide. A summary of results for these estuaries, and distribution maps for selected species, are provided.

Waterbird totals recorded by the Irish Wetland Bird Survey, a similar scheme operating in the Republic of Ireland, are also included.

The 2005/06 year

This report summarises counts during 2005/06 and previous years (since 1960 for wildfowl, 1969 for waders and the early 1980s or 1990s for other species). During 2005/06, WeBS counters covered 3,750 count sectors at around 2,100 count sites, during the crucial 'winter' period of September to March. At least 1,500 were counted in any one of these months and almost 1,150 were covered continually throughout this period. This, again, represents a fantastic effort all around and a huge thank you must go to all those involved.

In Britain, wintering numbers of both Bewick's and Whooper Swans showed a convincing increase during 2005/06 with the Whooper Swan index reaching its highest ever. The British index for Mute Swan also reached record levels, however, numbers in Northern Ireland fell to their lowest ever recorded.

The number of Pink-footed Geese fell slightly, although remain at a high level. Following the long-term decline in the number of European White-fronted Geese wintering in Britain numbers in 2005/06 remained at a similar level to that of the previous year. Greenland White-fronted Geese also showed further signs of decline, although the national index was similar to that of 2004/05. Unlike European Whitefronts, this decline has been observed across the entire population and is thought to be linked to poor breeding success.

Icelandic Greylag Geese wintered in similar numbers to the past few years. An increase in Greenland Barnacle Geese was noted at several key sites including at the principal site, Islay. There was a slight decline in Svalbard Barnacle Geese, which was attributed to lower numbers at the key site, Solway Estuary. Numbers of Dark-bellied Brent Geese rose for the second year running with increases witnessed at several of the key sites. Peak numbers of East Canadian High Arctic Light-bellied Brent Geese were similar to the previous few years, whilst numbers of Svalbard Light-bellied Brent Geese was almost double that of the previous year, albeit similar to figures two-years hence. As usual the majority of birds wintered on Lindisfarne, numbers at which were the third highest ever recorded during WeBS.

Shelduck remained at a similar level to 2004/05 in Britain and continued to show an increase in Northern Ireland. The Wigeon index rose to its highest ever level in Britain; however, the Northern Ireland wintering population continues to fall. Numbers of wintering Gadwall also reached their highest-ever level in Britain, whilst numbers in Northern Ireland were still low. As usual Teal numbers were subject to a high level of fluctuation, although this species too was recorded in highest ever numbers. Following a long-term decline the numbers of Mallard appear to be stable having reached record low levels in both Britain and Northern Ireland in 2004/05. Pintail numbers in both Britain and Northern Ireland have risen sharply since the beginning of the millennium and continue to do so. Shoveler too reached a new high level in the index in Britain whilst numbers in Northern Ireland remained low.

The recent dramatic decline of some diving duck species in Northern Ireland appeared to be abating with some signs of a revival, whilst Scaup continued to increase, peaking at their highest ever level. Numbers of these three species have been less erratic in Britain with a slight decline for Pochard, a continued rise for Tufted Duck and little change for Scaup. Eider numbers in Britain rose slightly following a recent decline, whereas the long term increase in Northern Ireland continued. The wintering population of Goldeneye in the UK remained low, though both the British and Northern Ireland indices appeared relatively stable following recent declines. Both Red-breasted Merganser and Goosander numbers fell slightly although numbers for the latter remain relatively stable.

Counted maxima for Red-throated Diver increased on those of 2004/05, while those for Black-throated and Great Northern Divers were at their highest levels ever. The British trend for Little Grebe continues to show a steady increase, whilst the trend for Great Crested Grebes is stable. Little Egret again continued to expand its population and range, particularly in the west. In Britain both Moorhen and Coot numbers continue to remain relatively stable. However, Coot

numbers in Northern Ireland remained low despite notable increases at Loughs Neagh and Beg and Upper Lough Erne.

Oystercatcher numbers remained fairly stable, though the index did show a slight decrease with peak counts at many sites below average. Avocets have shown a steady increase over the past 15 years though the British index dropped slightly for the second consecutive year. Numbers of wintering Golden Plover continued to increase in both Britain and Northern Ireland, reaching a new peak in Britain, whilst Lapwing numbers also rose in Britain and remained stable in Northern Ireland. Ringed Plover numbers rose slightly in Britain and also rose more markedly in Northern Ireland. Conversely, Grey Plover have continued to decline in Britain, though Northern Ireland did see a small increase. Although the British Knot index showed a slight decline numbers on the key site, The Wash, were the highest for over twelve years. Wintering numbers of Dunlin continued to decline. There were mixed fortunes for the two godwit species, with a continued fall in Bar-tailed Godwit numbers yet a rise in Black-tailed Godwits to such an extent that the peak monthly count for Black-tailed Godwit outnumbered that of Bar-tailed for the first time. Both Redshank and Greenshank showed a slight decrease in Britain, whilst Curlew and Turnstone numbers remained similar to the past few years. Turnstone numbers in Northern Ireland have shown a rise during the past few years.

Declines were again recorded in most of the main gull species, the exception being Great Black-backed Gull, where the maximum count rose by almost 23% on the previous year. Kittiwake numbers too were higher than for 2004/05, with the maximum being more than doubled. Summed maxima of Little Tern and Arctic Tern were higher than in the previous year. However, Sandwich Tern and Common Tern numbers were lower than in 2005/06. As with all gulls and terns the optional coverage of these groups during WeBS counts means that numbers recorded will largely be dependent on coverage across sites.

Introduction

The UK is of outstanding international importance for waterbirds. Lying on some of the major flyways for Arctic-nesting species, large numbers of waterbirds are attracted, especially during winter, by the relatively mild climate and extensive areas of wetland, notably estuaries. The UK thus has both moral and legal obligations to conserve both these waterbirds and the wetlands upon which they depend.

As a signatory to a number of international conservation conventions, and as a member of the EU, the UK is bound by international law. In particular, the 'Ramsar' Convention on Wetlands of International Importance especially as Waterfowl Habitat, the EC Birds Directive and the EU Habitats and Species Directive, between them, require the UK to identify important examples of wetland and other habitats and sites important for birds and designate them for protection. Implicit in these obligations is the need for regular monitoring to identify and monitor such sites. These instruments also lay particular significance on the need to conserve migratory populations, and consequently most of the waterbird populations in the UK.

The UK has ratified the Agreement on the Conservation of African-Eurasian Migratory Waterbirds (AEWA) of the 'Bonn' Convention on the Conservation of Migratory Species of Wild Animals. AEWA entered into force in 1999. It is a specific Agreement requiring nations to take coordinated measures to conserve migratory waterbirds given their particular vulnerability due to their migration over long distances and their dependence on networks that are decreasing in extent and becoming degraded through non-sustainable human activities. Article three of the Agreement requires, among other things, that sites and habitats for migratory waterbirds are identified, protected and managed appropriately, that parties initiate or support research into the ecology of these species, and exchange information and results. Explicit in this Agreement is that adequate monitoring programmes are set in place to fulfil these objectives and the Action Plan to the Agreement specifically requires that nations endeavour to monitor waterbird populations.

AIMS AND OBJECTIVES OF WeBS

The Wetland Bird Survey (WeBS) aims to monitor all non-breeding waterbirds in the UK to provide the principal data on which the conservation of their populations and wetland habitats is based. To this end, WeBS has three main objectives:

- to assess the size of non-breeding waterbird populations in the UK;
- to assess trends in their numbers and distribution; and
- to assess the importance of individual sites for waterbirds.

These results also form the basis for informed decision-making by conservation bodies, planners and developers and contribute to the sustainable and wise use and management of wetlands and their dependent waterbirds. The data and the WeBS report also fulfil some of the objectives of the Conventions and Directives listed above. WeBS also provides UK data to Wetlands International to assist their function to coordinate and report upon waterbird monitoring at an international scale.

Structure and organisation of WeBS

WeBS is a partnership scheme of the British Trust for Ornithology (BTO), Wildfowl & Wetlands Trust (WWT), Royal Society for the Protection of Birds (RSPB) and the Joint Nature Conservation Committee (JNCC), the last on behalf of Natural England (NE), Scottish Natural Heritage (SNH) and the Countryside Council for Wales (CCW), and the Environment and Heritage Service in Northern Ireland (EHS).

WeBS continues the traditions of two, long-running count schemes which formed the mainstay of UK waterbird monitoring since 1947 (Cranswick *et al.* 1997). WeBS Core Counts are made at a wide variety of wetlands throughout the UK. Synchronised counts are conducted once per month, particularly from September to March, to fulfil all three main objectives. In addition, WeBS Low Tide Counts are undertaken on selected estuaries with the aim of identifying key areas used during the low tide period, principally by feeding birds; areas not otherwise noted for

their importance by Core Counts which are normally conducted at high tide.

The success and growth of these count schemes accurately reflects the enthusiasm and dedication of the several thousands of volunteer ornithologists who participate. It is largely due to their efforts that waterbird monitoring in the UK is held in such international high regard.

Aim of this report

This report presents syntheses of data collected between July 2005 and June 2006 (see *The WeBS Year*), and in previous years, in line with the WeBS objectives. Data from other national and local waterbird monitoring schemes, notably annual goose censuses, are included where WeBS data alone are insufficient to fulfil this aim, so that the report provides a single, comprehensive source of information on waterbird status and distribution in the UK. All nationally and internationally important sites for which data exist are listed.

WEATHER IN 2005/06

This summary of UK weather is drawn from the Meteorological Office web site at www.metoffice.gov.uk. Bracketed figures following the month refer to the Core Count priority date for the month in question. Arctic breeding conditions for birds that winter in the UK are summarised from information collated by Soloviev & Tomkovich at the web site www.arcticbirds.ru.

United Kingdom

Mean monthly temperatures during **July** (24) were above average for the time of year. Levels of rainfall were below average in Scotland and Northern Ireland but above the norm in England and Wales.

Temperatures remained above average throughout **August** (21). The amount of rain was below average throughout most of the country except for in East Anglia and parts of western and northern Scotland, which experienced above average rainfall.

East Anglia and northern Scotland remained wet and temperatures were generally above average for most of the country with some areas experiencing their warmest **September** (18) for over five years. For much of southern England and parts of Wales September was the ninth out of the past 11 months in which

rainfall was below average. For these areas 2005 was the driest year since 1973.

October (16) brought mild conditions across the whole of the UK, in spite of this northeast England and southeast Scotland experienced lower than average sunshine. October was wetter than usual with many areas receiving rainfall double the monthly average.

November (6) began mild but became cold in the second half of the month. Sunshine levels were above average with some areas documenting record levels of sunshine. Rainfall was close to average except in the south and east of England, which remained dry.

A cold **December** (4) throughout many parts of southern England, however, temperatures were above average in much of Scotland and Northern Ireland. In general most of the country was drier and sunnier than expected for the time of year.

January (15) was the driest since 1997 for England, Wales and Northern Ireland. Temperatures were close to average for the southern half of the UK but above average in the north of Scotland.

During **February** (12) southwest England experienced cold conditions, while temperatures were above average in Scotland. Southeast England and East Anglia were wetter than average and Northern Ireland remained drier.

March (12) was predominantly cold throughout much of the UK. Average temperatures in Scotland were lower in March than in the three preceding months; the first time that this has been recorded for 30 years. Rainfall varied between regions and some areas experienced twice the monthly average.

April (9) saw temperatures return to nearer average in Scotland and Northern Ireland, with those in England and Wales being slightly above average. Northwest Scotland was predominantly wet while southeast England remained dry. Sunshine was above average throughout most of the UK, particularly eastern Scotland.

May (14) was very wet throughout most of the UK; some parts of England and Wales received double the monthly average. East Anglia was particularly warm.

June (11) was warm, dry and sunny for most of the UK. Temperatures were above average and rainfall below average.

Table 1. The percentage of inland count units (lakes, reservoirs, gravel pits, rivers and canals) in the UK with any ice and with 75% or more of their surface covered by ice during WeBS counts in winter 2005/06 (England divided by a line drawn roughly between the Humber and the Mersey Estuaries).

Region	Ice	S	O	N	D	J	F	M
Northern Ireland	>0%	0	0	0	0	0	0	0
	>74%	0	0	0	0	0	0	0
Scotland	>0%	0	0	2	3	6	6	7
	>74%	0	0	2	1	5	4	5
N England	>0%	0	0	0	2	4	5	4
	>74%	0	0	0	<1	<1	3	0
S England	>0%	0	0	0	<1	1	7	2
	>74%	0	0	0	<1	<1	2	<1
Wales	>0%	0	0	1	0	0	4	1
	>74%	0	0	1	0	0	2	0

Arctic Breeding Conditions 2005

Spring temperatures were above average throughout Fennoscandia, arctic Russia,

Greenland and eastern Canada. Indications of phenology pointed towards an early spring in Greenland and across most of arctic Russia, while perceptions were that the season was later in Fennoscandia. Summer temperatures remained above average in eastern Greenland, Fennoscandia and western arctic Russia, south through from the Yamal Peninsula. However, there was considerable local variation between summer temperatures at sites in Fennoscandia and western arctic Russia with temperatures at many sites being warmer than average and at nearby sites colder than average. Temperatures on the Novaya Zemlya archipelago, west through the Taimyr Peninsula and west through arctic Russia were below average. Rodent abundance was low in Greenland, Fennoscandia and arctic Russia east from the Yamal Peninsula. Higher abundances were recorded from the northern Yamal west through the Taimyr Peninsula.

Waterbirds in the UK

SURVEY METHODS

The main source of data for this report is the WeBS scheme, providing regular monthly counts for most waterbird species at the majority of the UK's important wetlands. In order to fulfil the WeBS objectives, however, data from a number of additional schemes are included in this report. In particular, a number of species groups necessitate different counting methodologies in order to monitor numbers adequately, notably most geese and seaducks, and the results of other national and local schemes for these species are routinely included.

The methods for these survey types are outlined below and more detail can be found in Gilbert *et al.* (1998). It should be noted that site definition is likely to vary between these surveys (see *Interpretation of Waterbird Counts*).

WeBS Core Counts

WeBS Core Counts are made using so-called 'look-see' methodology (Bibby *et al.* 2000), whereby the observer, familiar with the species involved, surveys the whole of a predefined area. Counts are made at all wetland habitats, including lakes, lochs/loughs, ponds, reservoirs, gravel pits, rivers, freshwater marshes, canals, sections of open coast and estuaries. Numbers of all waterbird species, as defined by Wetlands International (Rose & Scott 1997), are recorded. In the UK, this includes swans, geese, ducks, divers, grebes, cormorants, herons, Spoonbill, rails, cranes, waders and Kingfisher. Counts of gulls and terns are optional.

In line with the recommendations of Vinicombe *et al.* (1993), records of all species recorded by WeBS, including escapes, have been published to contribute to the proper assessment of naturalised populations and escaped birds. Following Holmes & Stroud (1995), non-native species, which have become established are termed 'naturalised'. These species are categorised according to the process by which they became established: naturalised feral (domesticated species gone wild); naturalised introduction (introduced by man); naturalised re-establishment (species re-

established in an area of former occurrence); or naturalised establishment (a species which occurs, but does not breed naturally, *e.g.* potentially Barnacle Goose in southern England). With the exception of vagrants, all other non-native species have been classed as 'escapes'. The native range is given in the species account for naturalised species, escapes and vagrants.

Most waterbirds are readily visible. Secretive species, such as snipes, are generally under-recorded. No allowance is made for these habits by the observer and only birds seen or heard are recorded. The species affected by such biases are well known and the problems of interpretation are highlighted individually in the Species accounts. Most species and many subspecies are readily identifiable during the counts. Categories may be used, *e.g.* unidentified scoter species, where it is not possible to be confident of identification, *e.g.* under poor light conditions.

Species present in relatively small numbers or dispersed widely may be counted singly. The number of birds in large flocks is generally estimated by mentally dividing the birds into groups, which may vary from five to 1,000 depending on the size of the flock, and counting the number of groups. Notebooks and tally counters may be used to aid counts.

Counts are made once per month, ideally on predetermined 'priority dates'. This enables counts across the whole country to be synchronised, thus reducing the likelihood of birds being double counted or missed. Such synchronisation is imperative at large sites, which are divided into sectors, each of which can be practicably counted by a single person in a reasonable amount of time. Local Organisers ensure coordination in these cases due to the high possibility of local movements affecting count totals. The priority dates are pre-selected with a view to optimising tidal conditions for counters covering coastal sites at high tide on a Sunday (see *Coverage*). The dates used for individual sites may vary due to differences in the tidal regime around the country. Coordination within a site takes priority over national synchronisation.

Counts suspected to be gross underestimates of the true number of non-secretive species

present are specifically noted, *e.g.* a large flock of roosting waders only partially counted before being flushed by a predator, or a distant flock of seaduck in heavy swell. These counts may then be treated differently when calculating site totals (see *Analysis*).

Data are input by a professional data input company. Data are keyed twice by different people and discrepancies identified by computer for correction. Any particularly unusual counts are checked by the National Organisers and are confirmed with the counters if necessary.

WeBS Low Tide Counts

This survey aims to assess numbers of waterbirds present during low tide on estuaries, primarily to assess the distribution of feeding birds at that time (Musgrove *et al.* 2003; see the section *Low Tide Counts* for a full explanation of methods).

This survey occasionally provides higher counts for individual sites than Core Counts, for example, where birds feed on one estuary but roost on another. These data are validated before being used for site assessment against 1% thresholds.

Supplementary daytime and roost counts

Supplementary counts are made at some sites where WeBS counts are known to under-represent the true value of the site. In particular, some species occur in much larger sites when using the site as a nighttime roost, *e.g.* geese, Goosander and gulls, that are not present during WeBS daytime counts. Some sites are also counted more frequently than once monthly by some observers.

Supplementary counts are collected by counters familiar with the site for WeBS survey, thus employing the same site definition and, for daytime counts, the same counting methods, and are submitted on standardised recording forms adapted from those used for WeBS Core Counts.

Goose roost censuses

Many geese (*Anser and Branta spp*) spend daylight hours in agricultural landscapes, and are therefore missed during counts at wetlands by WeBS. These species are usually best counted as they fly to or from their roost sites at dawn or dusk since these are generally discrete wetlands and birds often follow

traditional flight lines approaching or leaving the site. Even in half-light, birds can generally be counted with relative ease against the sky, although they may not be specifically identifiable at mixed species roosts.

In order to produce population estimates, counts are synchronised nationally for particular species (see *National totals* below), though normally only one or two such counts are made each year. The priority count dates are determined according to the state of the moon, since large numbers of geese may remain on fields during moonlit nights. Additional counts are made by some observers, particularly during times of high turnover when large numbers may occur for just a few days.

In some areas, where roost sites are poorly known or difficult to access, counts of birds in fields are made during the daytime. As with WeBS Core Counts, the accuracy of the count is noted.

Additional counts

Additional, *ad hoc*, data are also sought for important sites not otherwise covered by regular monitoring, particularly open coast sections in Scotland, whilst the results of periodic, coordinated surveys - such as the non-estuarine coastal waterbird survey (NEWS), International Greenland Barnacle Goose Census and International Whooper & Bewick's Swan Census - are included where the data collected are compatible with the presentation formats used in this report.

The accuracy of counts of waterbirds on the sea is particularly dependent on prevailing weather conditions at the time of or directly preceding the count. Birds are often distant from land, and wind or rain can cause considerable difficulty with identifying and counting birds. Wind not only causes telescope shake, but even a moderate swell at sites without high vantage points can hamper counts considerably. The need to count other waterbirds in 'terrestrial' habitats at the site often precludes the time required for an accurate assessment of seaducks. Many sites may be best covered using aerial surveys, though this technique has been little used in the UK historically. Consequently, the best counts of most divers, grebes and seaduck at open coast and many estuarine sites are made simply when conditions allow; only rarely will

such conditions occur by chance during WeBS counts. Synchronisation between different sites may be difficult or impossible to achieve, and thus coordination of most counts to date has occurred at a regional or site level, *e.g.* within the Moray Firth and within North Cardigan Bay.

The extensive use of aerial survey methods in nearshore marine waters in recent years means that data are available for a number of sites. However, the boundaries of such sites frequently do not correspond to those counted for WeBS Core Counts, and indeed the area surveyed from the air can vary between years. As a result, such aerial surveys are now tabulated separately within the relevant species accounts. These surveys employ a 'distance sampling' methodology (see Buckland *et al.* 2001, 2004), whereby only a proportion of birds is counted, and the missed proportion estimated by statistical means. Some published reports from these surveys provide only the counted number, whilst others include the calculated estimates also (which often have relatively wide confidence intervals).

Some data are provided directly by individuals (for example, reserve wardens), often undertaking counts for site survey purposes, but whose data are not formally published in a report.

A significant point is that these additional data are taken from published sources, from surveys with the specific aim of monitoring waterbirds, and where methods have been published - or where data have been collected by known individuals, usually undertaking site-based surveys, and are provided directly for use in *Waterbirds in the UK*. Casual records and data from, *e.g.* county bird reports, where the methods and/or site boundaries used are not documented, are not included. Reports and data for important sites from surveys that the authors know to have taken place in recent years are actively sought for inclusion in this report, but it is likely that other sources of suitable data are overlooked. The inclusion of additional data for some species and sites does not, thus, indicate that the tables in the Species accounts include all such suitable data.

Irish Wetland Bird Survey

The Irish Wetland Bird Survey (I-WeBS) monitors non-breeding waterbirds in the



Republic of Ireland (Crowe 2005). I-WeBS was launched in 1994 as a joint partnership between BirdWatch Ireland, National Parks and Wildlife Service of Dúchas, The Heritage Service of the Department of Environment and Local Government (Ireland), and WWT, with additional funding and support from the Heritage Council and WWF UK (World Wide Fund for Nature). I-WeBS is complementary to and compatible with the UK scheme. The main methodological difference from UK-WeBS is that counts are made only between September and March, inclusive.

Productivity monitoring

Changes in numbers of waterbirds counted in the UK between years are likely to result from a number of factors, including coverage and weather, particularly for European and Russian breeding species which may winter further east or west within Europe according to the severity of the winter. Genuine changes in population size will, however, result from differences in recruitment and mortality between years.

For several species of swans and geese, young of the year can be readily identified in the field and a measure of productivity can be obtained by recording the number of young birds in sampled flocks, expressed as a percentage of the total number of birds aged. Experienced fieldworkers, by observing the behaviour of and relationship between individuals in a flock, can record brood sizes as the number of young birds associating with, usually, two adults.

ANALYSIS AND PRESENTATION

In fulfilment of the WeBS objectives, results are presented in a number of different sections. An outline of the analyses undertaken for each is given here; further details can be provided upon request. A number of limitations of the data or these analytical techniques necessitate caution when interpreting the results presented in this report (see *Interpretation of Waterbird Counts*).

Count accuracy and completeness

Counts at individual sites may be hampered by poor conditions, or parts of the site may not be covered. This may result in counts missing a significant proportion of one or more species.

It is important to flag such counts since using them at face value would under-represent the importance of the site and give misleading results, *e.g.* when used for trend calculations and assessment of site importance.

Counts at sites - and at individual sectors of large sites that are counted using a series of sub-divisions (known as 'complex sites') - are flagged as 'OK' or 'Low' by the counter, where 'Low' indicates that the counter feels a significant proportion of the birds present at the time of the count may have been missed, *e.g.* because all of the site or sector was not visited, or because a large flock of birds flew before counts were complete. Such assessments may be provided for individual species, or for all species present.

Similarly, at complex sites, one or more sectors may be missed in a particular month, again rendering the total count for the site incomplete to a greater or lesser degree for one or more species.

For single sector sites, counts are assessed as incomplete based on the 'OK/Low' information provided by the counter. For complex sites, an algorithm is used to assess whether missed sectors and/or 'Low' counts in some sectors constitute an incomplete count at the site level. The mean count of each sector is calculated based on 'OK' counts from a window extending a month either side of the month of the count in question, and using earlier or subsequent years, such that within this window the 15 nearest counts are used to make the assessment. The total count for the site in any one month is considered incomplete if the sectors for which the count is missing or 'Low' in that month tend to hold, on the basis of their mean values, more than 25% of the sum of all sector means. The assessment is made on a species-by-species basis, recognising the fact that species distribution is not uniform across a site that and a missed sector may be particularly important for some species but not for others.

Completeness assessments are made for all WeBS Core Counts, and for most goose roost counts (which, as single-sector sites, are made on the basis of the 'OK/Low' assessment provided by the counter).

Because the completeness calculation for complex sites is based on a moving window of counts, and the use of different parts of the site by species may change, the addition of new

data each year may result in counts flagged in previous *Waterbirds in the UK* (prior to 2004/05 published as *Wildfowl and Wader Counts*) as complete now being considered incomplete, and *vice versa*.

Counts are not flagged as 'Low' if a large number of the birds present is routinely missed, *e.g.* because they are cryptic, secretive, or hide in reeds - such as Snipe, Teal and Water Rail. 'Low' indicates that a significant proportion of the birds that could reasonably be expected to be counted under normal conditions was considered to have been missed. Similarly, many counts of waterbirds on the sea may be undercounts. Indeed, if the distribution of a flock stretches beyond the limits of visibility, the counter - as with birds hidden in reeds - can never know with confidence whether the count included all birds present. Counts flagged as incomplete are treated differently in trend analysis and site importance assessments.

The WeBS Year

Different waterbird species occur in the UK at different times of year. Most occur in largest numbers during winter, some are residents with numbers boosted during winter, while others occur primarily as passage migrants or even just as summer visitors.

Although WeBS counts concentrate primarily on winter months, survey is made year-round. Accordingly, different 12-month periods are used to define a year to report upon different species, in particular, to define the 'annual' maximum and to identify the peak 'annual' count for assessing site importance.

For most species, the year is defined as July to June, inclusive. Thus, for species present in largest numbers during winter, counts during autumn passage and spring passage the following calendar year are logically associated with the intervening winter. For species present as summer visitors - notably terns, Garganey and Little Ringed Plover - the calendar year is used to derive national and site maxima. The different format used for column headings (*e.g.* 05/06 or 2005) in the 'header' and tables in each species account identify whether a 'winter' or calendar year has been used.

Note that national totals (reported in Tables 3 and 4) present data for the period July 2005 to June 2006.

National totals and annual maxima

Total numbers of waterbirds recorded by WeBS and other schemes are presented (within Tables 3 and 4 and within individual species accounts). It is very important to appreciate that these national totals are not population estimates, as WeBS does not cover 100% of the population of any species. The totals are presented separately for Great Britain (including the Isle of Man but excluding the Channel Islands) and Northern Ireland in recognition of the different legislation that applies to each. Separate totals for England, Scotland, Wales, and the Channel Islands can be obtained from the BTO upon request. The count nearest the monthly priority date or, alternatively, the count coordinated with nearby sites if there is considered to be significant interchange, is chosen for use in this report if several accurate counts are available for the same month. A count from any date is used if it is the only one available.

Totals from different count methods are mostly not combined to produce national totals because the lack of synchronisation may result in errors, *e.g.* birds counted at roost by one method may be effectively double counted during the WeBS count at a different site in that month. Total counts from several national goose surveys are, however, used instead of WeBS Core Counts where the census total provides a better estimate of the total numbers, as follows:

- Pink-footed and Icelandic Greylag Geese in October, November and December;
- Greenland White-fronted Goose in December and March;
- Greenland Barnacle Geese in November and March;
- NW Scotland Greylag Geese in August and February;
- Canadian Light-bellied Brent Geese in October.

Additionally, counts of Svalbard Barnacle Geese from North Cumbria and Dumfries & Galloway are replaced by Solway-wide dedicated counts between October and March. Finally, the maximum British totals for both Bewick's and Whooper Swan do include roost counts from the Ouse and Nene Washes and Martin Mere in place of Core Counts at this site, given the particular concentration of these species feeding around and roosting at this site.

Counts from other site or regional-based surveys, for example of seaducks, are not included in national totals. Where a census total replaces standard Core Count data these are indicated by '*'.

Some of the goose populations are identified according to location (from research into movements of marked birds) as they cannot be separated in the field by appearance alone. In such cases, a standard region of the UK is used each year to assign individual birds to particular populations and thus to derive national totals. For full details please contact BTO but broadly, the breakdown is as follows:

- NW Scotland Greylag Goose - Inner and Outer Hebrides plus Southwest Highland.
- Icelandic Greylag Goose - all other areas of Scotland plus Northumberland and North Cumbria.
- Re-established Greylag Goose - other areas.
- Greenland Barnacle Goose - Scottish west coast plus Shetland and Orkney.
- Svalbard Barnacle Goose - other Scottish regions plus Northumberland and North Cumbria.
- Naturalised Barnacle Goose - other areas.
- Canadian Light-bellied Brent Goose - Northern Ireland, Wales, western and northern Scotland, Cornwall, Devon and Channel Islands.
- Svalbard Light-bellied Brent Goose - other areas.

(Note that the separate populations overlap to some extent, and some birds are thus likely to be mis-assigned using these areas. This is particularly so in the case of Greylag Goose and future surveys are planned to help rectify this issue).

Data from counts at all sites are used, irrespective of whether they are considered complete or not. Numbers presented in this report are not rounded. National and site totals calculated as the sum of counts from several sectors or sites may imply a false sense of accuracy if different methods for recording numbers have been used, *e.g.* 1,000 birds estimated on one sector and a count of seven individuals on another is presented as 1,007. It is safe to assume that any large count includes a proportion of estimated birds. Reproducing the submitted counts in this way is, however, deemed the most appropriate means of presentation and avoids the summation of 'rounding error'.

In the accounts of some scarcer species, including many escaped or introduced species, summed site maxima - calculated by summing the highest count at each site, irrespective of the month in which it occurred - have also been quoted. For some species, particularly more numerous ones, this is likely to result in double counting where birds have moved between sites.

Annual indices

Because the same sites are not necessarily covered by WeBS on every month in every year, relative changes in waterbird numbers cannot be determined simply by comparing the total number of birds counted each year (Tables 3 and 4). This issue is addressed by using indexing techniques that have been developed to track relative changes in numbers from incomplete data.

In summary, for occasions when a particular site has not been visited, an expected count for each species is calculated (imputed) based on the pattern of counts across months, years and other sites. This effectively means that a complete set of counts are available for all years and all months for a sample of sites. Only sites that have a good overall level of coverage are used (at least 50% of possible visits undertaken) and the underlying assumption is that the pattern of change in numbers across these sites (the index) is representative of the pattern of change in numbers at the country level (see *Interpretation of Waterbird Counts* below). Annual index values are expressed relative to the most recent year, which takes an arbitrary value of 100.

The 'Underhill index' was specifically developed for waterbird populations (see Underhill 1989, Prÿs-Jones *et al.* 1994, Underhill & Prÿs-Jones 1994 and Kirby *et al.* 1995 for a full explanation of this indexing process and its application for WeBS data). This report uses Generalized Additive Models (GAMs; Hastie & Tibshirani 1990) to fit both index values and a smoothed trend to the WeBS count data (see Maclean *et al.* 2005 for a full explanation of this process and its application for WeBS data) whilst retaining elements from the Underhill method that allows the assessment of whether or not counts flagged as incomplete should be treated as missing data. The generated smoothed trends

are less influenced by years of abnormally high or low numbers and sampling 'noise' than are the raw index values. This makes them especially useful when assessing changes through time (*e.g.* WeBS Alerts; Maclean *et al.* 2005). Following recent development work undertaken by WeBS, winter indices for waders are for the first time based on data from the months of November to March inclusive while those for other species additionally include September and October. Exceptions are made for the indices for Icelandic Greylag Goose, Pink-footed Goose, Greenland White-fronted Goose and Svalbard Barnacle Goose, for which annual census data are preferentially used to generate indices. Previously, the months used for indexing were assigned in a species-specific manner following established recommendations (Underhill & Prys-Jones 1994 and Kirby *et al.* 1995). The new approach, in addition to improving the robustness of the indices to changes in the timing of arrivals and departures with climate change and increasing comparability between species, brings WeBS indexing into line with other WeBS methodologies, specifically reporting of Alerts and computation of five-year mean of peaks.

Not all species are included in the indexing process. Gulls and terns are excluded because counting of these species is optional. Species that occur substantially on habitat not well monitored by WeBS (*e.g.* Moorhen and Snipe) are excluded as are species that occur at sites sporadically and/or in small numbers (*e.g.* Bean Goose and Smew).

The periods of years for which indices are calculated have been revised slightly in the light of recent analyses. Data for wildfowl continue to be presented for the period 1966/67 to the present. Data from 1974/75 onwards have been used for waders as a high proportion of counts before this winter were imputed. For species added later to the scheme, (*i.e.* Great Crested Grebe and Coot in 1982/83, Little Grebe in 1985/86, Cormorant in 1986/87 and gulls, terns, divers, rare grebes and other species from 1993/94), data from the first two years following their inclusion have been omitted from indices, as initial take-up by counters appears not to have been complete, resulting in apparent sharp increases in numbers during this time. For similar reasons

the first two years of data have been excluded from Northern Ireland indices.

Index values, where calculated, are graphed within each account. The underlying trend, where calculated, is shown using a broken line. The actual index values used to produce the graphs in this report can be obtained on request from the British Trust for Ornithology (see *Contacts*).

Monthly indices

The abundance of different waterbird species varies during the winter due to a number of factors, most notably the timing of their movements along the flyway, whilst severe weather, particularly on the continent, may also affect numbers in the UK. However, due to differences in site coverage between months, such patterns cannot be reliably detected using count totals. Consequently, an index is calculated for each month to reflect changes in relative abundance during the season.

The imputing process used to derive missing data for generating annual trends also allows monthly indices to be calculated across the same suite of sites. This reveals patterns of seasonality for the species considered. These are presented as graphs in the species accounts, giving the value for the most recent winter and the average value and range over the five preceding winters. Monthly graphs are not presented for the goose species for which annual indices are based on censuses as data for these are available for a limited number of months only.

Broad differences in the monthly values between species reflect their status in the UK. Resident species, or those with large UK breeding populations, *e.g.* some grebes and Mallard, are present in large numbers early in the winter. Declines through the winter result in part from mortality of first year birds, but also birds returning to remote or small breeding sites that are not covered by WeBS. The majority of UK waterbirds either occur solely as winter visitors, or have small breeding populations that are swelled by winter immigrants, with peak abundance generally occurring in mid winter.

The vast majority of the wintering populations of many wader species are found on estuaries, and, since coverage of this habitat is relatively complete and more or less

constant throughout winter, meaningful comparisons of total monthly counts can be made for many species.

Site importance

Criteria for assessing the international importance of wetlands have been agreed by the Contracting Parties to the Ramsar Convention on Wetlands of International Importance (Ramsar Convention Bureau 1988). Under criterion 6, a wetland is considered internationally important if it regularly supports 1% of the individuals in a population of one species or subspecies of waterbird, whilst any site regularly supporting 20,000 or more waterbirds qualifies under criterion 5. Similar criteria have been adopted for identification of SPAs under the EC Birds Directive in the UK legislation. A wetland in Britain is considered nationally important if it regularly holds 1% or more of the estimated British numbers of one species or subspecies of waterbird, and in Northern Ireland, important in an all-Ireland context if it holds 1% or more of the all-Ireland estimate. More detailed information about SPAs and Ramsar sites in the UK can be accessed via the JNCC website at <http://www.jncc.gov.uk/page-4>. There are currently 251 SPAs and 146 Ramsar sites in the UK.

Population estimates are revised once every three years, in keeping with internationally agreed timetables (Rose & Stroud 1994). International estimates used in this report follow recent revisions of international populations (Wetlands International 2006) and of estimates for Great Britain (Kershaw & Cranswick 2003, Rehfisch *et al.* 2003). The relevant 1% thresholds are given in Appendix 1, and are also listed at the start of each individual species account. (It should be noted that the estimates and thresholds for some species or populations which should be the same at an international and national level because all birds are found in Britain, *e.g.* for Pink-footed Goose, differ slightly because of the rounding conventions applied. In most species accounts, these differences have been rationalised and only one or other of the estimates used).

For some species (*e.g.* Lapwing) no national thresholds are available and arbitrary levels have been used to compile the table of sites, the chosen level being given in the sub-

heading of the table. Passage thresholds, applied to counts of some wader species in Great Britain, are also listed.

'National threshold' is used as a generic term to imply the 1% British threshold for sites in Great Britain, and the all-Ireland threshold for sites in Northern Ireland. Similarly, the term 'national importance' implies sites in Great Britain and in Northern Ireland that meet the respective thresholds.

Tables in the Species accounts rank the principal sites for each species according to the mean of annual maxima for the last five years (the five-year peak mean), in line with recommendations of the Ramsar Convention, and identify those meeting national and international qualifying levels (see also *Interpretation of Waterbird Counts*). For each site, the maximum count in each of the five most recent years, the month of occurrence of the peak in the most recent year, and the five-year peak mean are given. Incomplete counts are bracketed.

In accounts for most wildfowl, divers, grebes, Cormorant, herons, gulls, terns and Kingfisher, annual maxima are derived from any month in the appropriate 12-month period (see *The WeBS Year*). Average maxima for sites listed in the wader accounts that are based on a 'winter' year are calculated using data from only the winter period, November to March. Data from other sources, often involving different methods, e.g. goose roost censuses, are used where these provide better, i.e. larger, counts for individual sites. The source of all counts, if not derived from WeBS Core Counts, is indicated using a superscripted number after the count (a list of sources is given at the beginning of the accounts).

In the first instance, five-year peak means are calculated using only complete counts; incomplete counts are not used if they depress the mean count. Incomplete counts are, however, included in the calculation of the mean if they raise the value of the mean. Where all annual maxima are incomplete, the five-year peak mean is the highest of these individual counts. Averages enclosed by brackets are based solely on incomplete counts.

Sites are selected for presentation using a strict interpretation of the 1% threshold (for convenience, sites in the Channel Islands and Isle of Man are identified using 1% thresholds

for Great Britain and included under the Great Britain section of the tables). For some species with very small national populations, and consequently very low 1% thresholds, an arbitrary, higher level has been chosen for the inclusion of sites. Where no thresholds are given, e.g. for introduced species, and where no or very few sites in the UK reach the relevant national qualifying levels, an arbitrary threshold has been chosen to select a list of sites for this report. These adopted thresholds are given in the sub-headings of the table. A blank line has been inserted in the table to separate sites that qualify as nationally important from those with five-year peak mean counts of less than 50 birds.

All sites that held numbers exceeding the relevant national threshold (or adopted qualifying level) in the most recent year, but with five-year peak means below this value, are listed separately. This serves to highlight important sites worthy of continued close attention.

For a number of wader species, where different thresholds exist for passage periods, the peak count during this period and month of occurrence are also listed. This list includes all those sites with counts above the relevant threshold, even if already listed in the main part of the table by virtue of the five-year winter peak mean attaining the national threshold.

Where the importance of a site has changed since the previous *Waterbirds in the UK* (prior to 2004/05 published as *Wildfowl and Wader Counts*) as a result of the data collected since then - i.e. it has become nationally or internationally important but was not following the previous year, or it has changed from international to national importance or *vice versa* - this is indicated in the table to the right of the five-year peak mean. Sites with elevated status have a black triangle pointing up (▲) to the right of the average, whilst those with lowered status are indicated using a triangle pointing down (▼). Sites for which the average fell below the threshold for national importance following 2003/04 are listed at the end of the table.

It should be noted that a site may appear to have been flagged erroneously as having elevated status if the most recent count was below the relevant threshold. However, a particularly low count six years previously will

have depressed the mean in the previous report. The converse may be true for sites with lowered status and thus, in exceptional circumstances, a site may be listed in the relevant sections of the table as both no longer being of national importance yet also with a peak count in the most recent year exceeding the national threshold.

WeBS Alerts

WeBS Alerts have been developed to provide a standardised method of measuring and reporting on changes in wintering waterbird numbers at different temporal and spatial scales using WeBS data. Generalized Additive Models (GAMs) are used to fit smoothed trends to annual population indices (changes in population size calculated using these smoothed values are less susceptible to the effects of short-term fluctuations in population size or to errors when sampling than are results produced using raw data plots). Alerts are triggered for populations that have undergone major declines, and are intended to help identify where research into causes of decline may be needed and inform conservation management.

Proportional changes in the smoothed index value of a population over short- (5-year), medium- (10-year) and long- (25-year) term time frames are categorised according to their magnitude and direction. Population declines of between 25% and 50% trigger Medium Alerts and declines of greater than 50% trigger High Alerts. Increases of 33% and 100% (values chosen to be those necessary to return a population to its former size following declines of 25% and 50% respectively) are also identified, albeit that these are rarely of conservation concern.

National Alerts are generated for species (or specific populations of a species) using data from across the WeBS site network, for Great Britain and the constituent countries of the UK (Maclean *et al.* 2005). These Alerts provide some context for understanding finer scale changes in numbers. Alerts are calculated only for native species for which WeBS annual indices are calculated. Alerts are not available for some species over long time periods because there were only relatively recently included in WeBS Core Counts. Full results from the latest Alerts report are available for download from

<http://www.bto.org/webs/alerts/alerts/index.htm>.

Principal sites

In addition to the assessment of sites against 1% thresholds in Species accounts, sites are identified for their importance in terms of overall waterbird numbers in the section *Principal Sites*. The peak count at each site is calculated by summing the individual species maxima during the season, irrespective of the month in which they occurred, or whether counts were complete or not. Data from all sources used for site assessment within the species accounts are used here, including wader numbers during passage periods. Non-native introduced or escaped species (*i.e.* those not in BOURC category A) are not included in these totals.

Counts made using methodologies that employ different site definitions to those used by WeBS (*e.g.* seaducks on the Moray Firth) are not incorporated into the calculations. Such sites are, however, listed at the end of the table.

INTERPRETATION OF WATERBIRD COUNTS

Caution is always necessary in the interpretation and application of waterbird counts given the limitations of these data. This is especially true of the summary form, which, by necessity, is used in this report. A primary aim here remains the rapid feedback of key results to the many participants in the WeBS scheme. More detailed information on how to make use of the data for research or site assessment purposes can be obtained from the British Trust for Ornithology (see *Contacts*).

Whilst the manner of presentation is consistent within this report, information collated by WeBS and other surveys can be held or used in a variety of ways. Data may also be summarised and analysed differently depending on the requirements of the user. Consequently, calculations used to interpret data and their presentation may vary between this and other publications, and indeed between organisations or individual users. The terminology used by different organisations may not always highlight these differences. This particularly applies to summary data. Such variations do not detract from the value of each different method, but offer greater

choice to users according to the different questions being addressed. This should always be borne in mind when using data presented here.

For ease of reference, the caveats provided below are broadly categorised according to the presentation of results for each of the key objectives of WeBS. Several points, however, are general in nature and apply to a broad range of uses of the data.

National totals

The majority of count data are collected between September and March, when most species of waterbird are present in the UK in highest numbers. Data are collected during other months and have been presented where relevant. Caution is urged, however, regarding their interpretation both due to the relative sparsity of counts from this period and the different count effort for different sites. Data are presented for the months July to June inclusive (see *The WeBS Year*), matching the period for which data are provided *en masse* by counters.

A number of systematic biases of WeBS or other count methodology must be borne in mind when considering the data. Coverage of estuarine habitats and large, standing waters by WeBS is good or excellent. Consequently, counted totals of those species which occur wholly or primarily on these habitats during winter will approach a census. Those species dispersed widely over rivers, non-estuarine coast or small inland waters are, however, likely to be considerably under-represented, as will secretive or cryptic species, such as snipes, or those which occur on non-wetlands, *e.g.* grassland plovers. Species which occur in large numbers during passage are also likely to be under-represented, not only because of poorer coverage at this time, but due to the high turnover of birds in a short period. Furthermore, since counts of gulls and terns are optional, national totals are likely to be considerable underestimates of the number using the WeBS network of sites. Only for a handful of species, primarily geese, can count totals be considered as a census.

One instance of possible over-estimation may occur if using summed site maxima as a guide to the total number of scarcer species. For species with mobile flocks in an area well covered by WeBS, *e.g.* Snow Goose in

southeast England, it is likely that a degree of double counting will occur, particularly if birds move between sites at different times of the year.

The publication of records of vagrants in this report does not imply acceptance by the British Birds Rarities Committee (*e.g.* Fraser *et al.* 2007).

Annual indices

For most species, the long-term trends in index values can be used to assess changes in overall wintering numbers with confidence. However, the comments above concerning the differential coverage of different habitats remain important. For some species, a substantial proportion of wintering birds occur away from those sites monitored by the WeBS Core Count scheme or use these sites at certain times of day that make them unlike to be encountered by WeBS counters. Consequently, this incomplete coverage needs to be borne in mind when interpreting the indices for some species. The proportion of some of these species being monitored by the WeBS Core Count scheme can be quantified and biases understood by comparison to other surveys. For example, from the Non-estuarine Coastal Waterbird Survey (NEWS) it is known that WeBS Core Counts monitor between one quarter and one half of wintering Ringed Plover, Purple Sandpiper, Sanderling and Turnstone and that the indices and trends reported will be biased towards changes occurring on estuaries. Similarly, trends reported for seaduck and grassland plovers will be biased towards changes occurring within estuaries although in these species the proportion of overall numbers monitored by WeBS Core counts is less well understood. In the case of winter swans, although the sites on which they occur are generally well monitored by WeBS Core counts they are mainly used as roost sites by the birds and therefore changes in the birds' daily routine with weather or local feeding opportunities may have considerable influence on whether they are present during the WeBS count and thus affect the reported indices and trends.

Indices and trends for Pink-footed Goose, Greenland White-fronted Goose, Icelandic Greylag Goose and Svalbard Barnacle Goose can be considered to be especially representative of national patterns. The

numbers of these species are not well monitored by monthly WeBS Core Counts but rather are preferentially monitored by the annual coordinated censuses that cover the majority of British wintering birds. Indices for strictly or principally estuarine species (*e.g.* Wigeon and Knot) can also be considered especially representative as over 90% of British estuaries, including all major sites, are counted each month between September and March. Similarly, species that occur principally on larger inland waterbodies (*e.g.* Pochard and Goldeneye) are well monitored by WeBS Core Counts although the proportion of the numbers not being monitored is largely unquantified. For these species the indices and trends reported can be considered representative of the national pattern. For more widespread species (*e.g.* Mallard, Tufted Duck and Curlew) a large proportion of birds occur at small inland sites and habitats not well monitored by WeBS Core Counts. The selection of such sites follows no formal sampling pattern and therefore it is unclear as to whether these wetlands are a representative sample of the country as a whole.

Because short-term fluctuations provide a less rigorous indication of population changes, care should be taken in their interpretation. The underlying trend, denoted by the smoothed line in the annual index graphs, will give a better overall impression of trends for species with marked inter-annual variation, although it should be noted that unusually high or low index values in the most recent year will have a disproportionate effect on the trend at that point.

Caution should be used in interpreting figures for species that only occur in small numbers. Thus, numbers tend to fluctuate more widely for many species in Northern Ireland, largely as a result of the smaller numbers of birds involved but also, being at the western most limit of their range, due to variable use being made of Ireland by wintering waterbirds.

It should be borne in mind that the imputed values, used in place of missing and incomplete counts, are calculated anew each year, as in the completeness calculation for 'complex sites' which may cause the same count to change from complete to incomplete or *vice versa* with the addition of a new year's data. Because the index formula uses data from all years, each new year's counts will slightly

alter the site, month and year factors. In turn, the assessment of missing counts may differ slightly and, as a result, the index values produced each year are likely to differ from those published in the previous *Waterbirds in the UK* (prior to 2004/05 published as *Wildfowl and Wader Counts*). Additionally, data submitted too late for inclusion are subsequently added to the dataset. The indices published here represent an improvement on previous figures as the additional year's data allow calculation of the site, month and year factors with greater confidence.

Monthly indices

As for annual indices, the reduced numbers of both sites and birds in Northern Ireland result in a greater degree of fluctuation in numbers used in the analyses of data from the province.

Site definition

To compare count data from year to year requires that the individual sites - in terms of the area surveyed - remain the same. The boundary of many wetlands are readily defined by the extent of habitat (*e.g.* for reservoirs and gravel pits), but are less obvious for other sites (*e.g.* some large estuaries) and here count boundaries have often been defined over time by a number of factors to a greater or lesser degree, including the distribution of birds at the time of the count, known movements of birds from roost to feeding areas, the extent of habitat, and even ease of access.

Sites are defined for a variety of purposes, and the precise boundary of sites describing ostensibly the same wetland may differ accordingly. For example, the boundaries used to define a large lake may differ for its definition as a wetland (based on habitat), as a waterbird count area (some birds may use adjacent non-wetland habitat), and as a statutorily designated site for nature conservation (which may be constrained by the need to follow boundaries easily demarcated in planning and legal terms). It should be recognised that the boundary of a site for counting may even differ between different waterbird surveys, particularly where different methodologies are employed, *e.g.* the 'Forth Estuary' comprises one large site for WeBS Core Counts, a slightly different area for Low Tide Counts, and two roost sites for Pink-footed Geese.

Data from different waterbird surveys have been used for assessment of site importance in this report if collected for ostensibly the same site, and are unlikely to cause significant discrepancies in the vast majority of cases (though see *Site importance*).

Particular caution is urged, however, in noting that, owing to possible boundary differences, totals given for WeBS or other sites in this report are not necessarily the same as totals for designated statutory sites (ASSIs/SSSIs, SPAs or Ramsar Sites) having the same or similar names.

It should also be borne in mind that whilst discrete wetlands may represent obvious sites for waterbirds, there is no strict definition of a site as an ecological unit for birds. Thus, some wetlands may provide all needs - feeding, loafing and roosting areas - for some species, but a 'site' for other species may comprise a variety of disparate areas, not all of which are counted for WeBS. Similarly, for some habitats, particularly linear areas such as rivers and rocky coasts, and marine areas, the definition of a site as used by waterbirds is not readily discerned without extensive survey or research that is usually beyond the scope of WeBS or other similar surveys. The definitions of such sites may thus evolve, and therefore change between *Waterbirds in the UK* (prior to 2004/05 published as *Wildfowl and Wader Counts*). Further, the number of birds recorded by WeBS at particular sites should not be taken to indicate the total number of birds in that local area.

In some cases, for example where feeding geese are recorded by daytime WeBS Core Counts over large sites, and again at discrete roosts within or adjacent to that same site, data are presented for both sites in the table of key sites given the very different nature or extent of the sites and often number of birds, even though the same birds will be counted at both.

Site importance

Sites are selected for presentation in this report using a strict interpretation of the 1% threshold. It should be noted, however that where 1% of the national population is less than 50 birds, 50 is normally used as a minimum qualifying threshold for the designation of sites of national importance. It should also be noted that the 'qualifying levels' used for introduced species are used

purely as a guide for presentation of sites in this report and do not infer any conservation importance for the species or the sites concerned since protected sites would not be identified for these non-native birds.

It is necessary to bear in mind the distinction between sites that regularly hold wintering populations of national or international importance and those which may happen to exceed the appropriate qualifying levels only in occasional winters. This follows the Ramsar Convention, which states that key sites must be identified on the basis of demonstrated regular use (calculated as the mean winter maxima from the last five seasons for most species in this report), otherwise a large number of sites might qualify as a consequence of irregular visitation by one-off large numbers of waterbirds. However, the Convention also indicates that provisional assessments may be made on the basis of a minimum of three years' data. These rules of thumb are applied to SPAs and national assessments also. Sites with just one or two years' data are also included in the tables if the mean exceeds the relevant threshold for completeness but this does not, as such, imply qualification. This caveat applies also to sites that are counted in more than two years but, because one or more of the peak counts are incomplete, whose means surpass the 1% threshold based on counts from only one or two years.

Nevertheless, sites which irregularly support nationally or internationally important numbers may be extremely important at certain times, *e.g.* when the UK population is high, during the main migratory periods, or during cold weather, when they may act as refuges for birds away from traditionally used sites. For this reason also, the ranking of sites according to the total numbers of birds they support (particularly in *Principal Sites*) should not be taken as a rank order of the conservation importance of these sites, since certain sites, perhaps low down in terms of their total 'average' numbers, may nevertheless be of critical importance to certain species or populations at particular times.

Peak counts derived from a number of visits to a particular site in a given season will reflect more accurately the relative importance of the site for the species than do single visits. It is important to bear this in mind since, despite

considerable improvements in coverage, data for a few sites presented in this report derive from single counts in some years. Similarly, in assessing the importance of a site, peak counts from several winters should ideally be used, as the peak count made in any one year may be unreliable due to gaps in coverage and disturbance- or weather-induced effects. The short-term movement of birds between closely adjacent sites may lead to altered assessments of a site's apparent importance for a particular species. More frequent counts than the once-monthly WeBS visits are necessary to assess more accurately the rapid turnover of waterbird populations that occurs during migration or cold weather movements.

It should also be borne in mind that because a count is considered complete for WeBS, it does not imply that it fully represents the importance of the site. A site of importance for a wintering species may have been counted only in autumn or spring, and thus while a valid complete count is available for that year, it under-represents the importance of the site for that species. This problem is overcome to some extent by the selection of counts from a limited winter window for wader species, although this will also tend to underestimation of the mean if it excludes large counts at other times of year. A similar issue arises for counts derived from different survey methods. For example, many sites important as gull roosts are identified on the basis of evening roost counts. Valid and complete counts may have been made by WeBS Core Counts during daytime over the course of a particular winter but, if no roost counts were made, the mean will be depressed by the much lower Core Count in that year. Thus, when counts appear to fluctuate greatly between years at individual sites on the basis of data from different sources - particularly for geese and gulls in the absence of roost counts, and for seabirds in the absence of dedicated survey - the five-year means and apparent trends over time should be viewed with caution.

Caution is also urged regarding the use of Low Tide Count data in site assessment. Whilst this survey serves to highlight the importance of some estuaries for feeding birds that, because they roost on other sites, are missed by Core Counts, the objectives of Low Tide Counts do not require strict synchronisation across the site and this may

result in double counting of birds on some occasions. It should also be noted that count completeness assessments are not made for Low Tide Count totals at complex sites, and any undercounts from this scheme are not flagged in the tables, leading to under-estimation of the site's importance.

This list of potential sources of error in counting wetland birds, though not exhaustive, suggests that the net effect tends towards under- rather than over-estimation of numbers and provides justification for the use of maximum counts for the assessment of site importance or the size of a population. Factors causing under-estimation are normally constant at a given site in a given month, so that while under-estimates may occur, comparisons between sites and years remain valid.

It should be recognised that, in presenting sites supporting nationally or internationally important numbers of birds, this report provides just one means of identifying important sites and does not provide a definitive statement on the conservation value of individual sites for waterbirds, let alone other conservation interests. The national thresholds have been chosen to provide a reasonable amount of information in the context of this report only. Thus, for example, many sites of regional importance or those of importance because of the assemblage of species present are not included here. European Directives and conservation Conventions stress the need for a holistic approach to effect successful conservation, and lay great importance on maintaining the distribution and range of species, in addition to the conservation of networks of individual key sites.

For the above reasons of poor coverage, geographically or temporally, outlined above, it should be recognised that lists of sites supporting internationally and nationally important numbers of birds are limited by the availability of WeBS and other survey data. Whilst the counter network is likely to cover the vast majority of important sites, others may be missed and therefore will not be listed in the tables due to lack of appropriate data.

Some counts in this report differ from those presented previously; this results from the submission of late data and corrections, and in some cases, the use of different count seasons

or changes to site structures. Additionally, some sites may have been omitted from tables previously due to oversight. It is likely that small changes will continue as definitions of sites are revised, in the light of new information from counters. Most changes are minor, but comment is made in the text where they are significant.

Note that sites listed under 'Sites no longer meeting table qualifying levels' represent those that would have been noted of national importance based on the preceding five years (*i.e.* 2000/01 to 2004/05) but which, following the 2005/06 counts, no longer met the relevant threshold. It is not an exhaustive list of sites, which at any time in the past have been of national or all-Ireland importance.

COVERAGE

WeBS Core Counts

Coordinated, synchronous counts are advocated to prevent double counting or birds being missed. Consequently, priority dates are recommended nationally. Due to differences in tidal regimes around the country, counts at a few estuaries were made on other dates to match the most suitable conditions. Weather and counter availability also result in some counts being made on alternative dates.

Table 2. WeBS Core Count priority dates in 2005/06

24 July	15 January
21 August	12 February
18 September	12 March
16 October	09 April
06 November	14 May
04 December	11 June

Standard Core Counts were received from 2,109 sites of all habitats for the period July 2005 to June 2006, comprising 3,801 count sectors (the sub-divisions of large sites for which separate counts are provided).

WeBS and I-WeBS coverage in 2005/06 is shown in Figure 1. The location of each count sector is shown using only its central grid reference. The grid reference of principal WeBS count sites mentioned in the Principal Sites table (Table 6.) are given in Table A2. in Appendix 2. and are shown in Figure A1. in Appendix 2.

As ever, areas with few wetlands (*e.g.* inland Essex/Suffolk) or small human populations (*e.g.* much of Scotland) are

apparent on the map as areas with little coverage. Northwest Scotland is usually poorly covered, although in 2005/06 this area was covered by surveys by the RAF Ornithological Society, which are reported upon in this report. Northern Ireland remains relatively uncovered aware from the major sites and further volunteers from here, or indeed anywhere in the UK, are always welcome.

Goose censuses

In 2005/06, supplementary counts of Bean Geese were submitted by the Bean Goose Action Group (Slamannan Plateau) (Maciver 2006) and the RSPB (Middle Yare Marshes). National surveys of Pink-footed and Icelandic Greylag Geese (the Icelandic-breeding Goose Census) were undertaken at roosts in October, November and December 2005 (Rowell 2006). A census of the Northwest Scotland Greylag Goose population on the Uists was made in August 2005 and February 2006 (Uist Greylag Goose Management Committee), and counts of this population at other key sites (*e.g.* Tiree) were timed to coincide with these counts. Censuses of Greenland White-fronted Geese were carried out in autumn 2005 and spring 2006 by the Greenland White-fronted Goose Study (Fox & Francis 2006). Greenland Barnacle Geese were counted regularly by SNH and others on Islay and other key locations whilst the Svalbard Barnacle Geese on the Solway were counted regularly by WWT staff and volunteers. Data were also provided by the International Light-bellied Brent Goose census.

Seaduck surveys

Coastal counts of seaduck, divers and grebes were received from several sites. Aerial and/or shore-based counts from Aberdeen Bay, Outer Hebrides, Coll/Tiree/Mull, Moray/Dornoch Firths, Scapa Flow/Tankerness, Sound of Gigha & outer West Loch Tarbert, and the Firth of Clyde were provided by JNCC (Söhle *et al.* 2006). Continuing surveys of the Moray Firth were carried out between November 2005 and January 2006 (RSPB Scotland/Talisman Energy (UK) Ltd). Monthly aerial and/or land-based counts of Common Scoter in Carmarthen Bay were carried out between September 2005 and February 2006 (Banks *et al.* 2007). Results from aerial monitoring of Common Scoter and Red-

throated Diver were provided by WWT. Continuing counts of key sites around Shetland were provided by SOTEAG (Heubeck and Mellor 2007). Continuing survey of the Eiders

of the wider Firth of Clyde area were carried out in September 2005 (Waltho *pers. comm.*).



Figure 1. Position of all locations counted for standard WeBS and I-WeBS counts between July 2005 and June 2006.