



# Generation of the headline indicator of wild bird populations

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# **GENERATION OF THE HEADLINE INDICATOR OF WILD BIRD POPULATIONS**

A joint report by BTO & RSPB

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## EXECUTIVE SUMMARY

- 1 This brief report outlines the data sources and methods used to produce the headline indicator of wild bird populations outlined in the DETR document '*Sustainability Counts*' (Anon 1998). The indicator was produced by RSPB, BTO and DETR and is one of 13 designed to show trends in a variety of factors affecting the quality of life in the UK.
- 2 A complete copy of the wild bird indicator data set for 1970-97 is now held by RSPB, BTO and DETR.
- 3 Data were drawn from a number of sources, including the Common Birds Census, Waterways Bird Survey, Rare Breeding Birds Panel, seabird monitoring, Wetland Bird Survey, other surveys, and atlases of distribution. These covered 219 of about 229 species that had nested in the UK during 1970-97.
- 4 After interpolating or extrapolating missing data, the final data set contained real or estimated data for 94% of all species-year combinations. Data for very rare species were removed prior to analysis.
- 5 Across-species indicators were calculated from the geometric means of population indices across relevant species groups. Headline indicators summarised the trends of 139 species.
- 6 A clear decline is evident among farmland birds; this is of considerable conservation concern in itself and, since birds are good indicators of the general health of the countryside as wildlife habitat, a sign of wider environmental degradation.
- 7 Annual updating of the indicator can be carried out each summer; plans for this are presented. Distributional data will become increasingly outdated and the indicators project highlights the need for repeat breeding bird atlas work in the relatively near future.
- 8 Future developments of the wild bird indicator could include the introduction of more habitat subdivisions, or of region-specific indicators. Non-breeding bird populations could also be added, although birds of the wider UK countryside are not currently monitored outside the breeding season.



## 1 INTRODUCTION

There is a long history of ornithological monitoring in the UK (e.g. Marchant *et al.* 1990), largely based on fieldwork by volunteers, that is co-ordinated by NGOs with the financial support of government (mainly via JNCC). There is now a system of Integrated Population Monitoring, in which data on survival and reproduction are brought together with those on numbers; this provides not only a means for detecting when populations fail to attain (or maintain) the target levels considered to be desirable, and of drawing such failures to the attention of conservation authorities, but also an understanding of the causes of the failures, allowing natural and man-made problems to be distinguished, further research on the problems to be well focussed, and advice on remedial action to be provided (Greenwood *et al.* 1993).

As part of this process, BTO regularly makes available to conservation practitioners a general report on the status and population trends of British birds (Crick *et al.* 1998) and it and other bodies produce a variety of more specialised annual reports. In addition, information is made available through a variety of means to the public, both to provide feedback to the volunteers who conduct so much of the basic fieldwork and to ensure that the population at large is informed about the issues. Decisions that have to be made about action to be taken to deal with conservation problems may have consequences reaching far beyond wildlife - reform of the Common Agricultural Policy is a clear example. At least in a democracy, it is therefore important that the population at large should be well informed.

These activities in the ornithological world intersect with government's wishes and intentions to set targets for its own performance and that of the wider public service in various fields, to monitor achievement against targets, and to report that monitoring to the public. The publication of the 'headline' indicators of sustainable development (Anon 1998) was an important milestone on the road of providing such information. In the discussions leading to that publication, there was widespread support from consultees (as well as from government) for the inclusion of an indicator of the nation's biodiversity resource, which was seen as an important element in people's quality of life.

There are reasons concerned with the ecology of birds (and our depth of knowledge about it) that make birds good indicators of the general health of the countryside as wildlife habitat (Furness *et al.* 1993); even more importantly, monitoring of birds is very significantly better developed than that of any other group of animals or plants. This is why the wild bird indicator was chosen as one of the 13 'headline' indicators.

The wild bird indicator was produced by RSPB, BTO and DETR. The purpose of this brief report is to document the way in which it was calculated and to discuss how it can be updated and improved. The report as submitted to DETR is supplemented by a disk containing the complete 1970-97 data set, which is now held by all three organisations. The contents of the disk are listed in Appendix 1.





## 2 SOURCES OF DATA

The index covers the period 1970-97 and is based solely on breeding bird populations. Data on non-breeding bird populations were available, but were not incorporated into the index. A total of about 229 species bred in the UK during 1970-97 (where breeding was defined as 'laid eggs that were presumed to be fertile'). These species, along with their associated categories and other information, are listed in Appendix 2. Data were available for 219 species. These data came from a wide variety of sources, which are listed in Table 1 along with the numbers of species for which each data source was ultimately used. The sources of data used for each species are shown in Appendix 2.

**Table 1. Sources of data for the indicator.**

Data source	Partners	No. species	Units used
ATLAS	BTO/SOC/IWC	42	10-km squares occupied in UK
CBC	BTO/JNCC	69	CBC index 1970-97
WBS	BTO/JNCC	4	WBS index 1974-96
RBBP	BB/JNCC/RSPB/BTO	51	mostly max total pairs 1973-95
RBBP/SURVEY	RBBP/RSPB/EN	4	mostly max total pairs 1973-95
SCR	JNCC/Seabird Group	9	pairs
SCR/SURVEY	SCR/RSPB/SNH	3	AOT or pairs
SCR/SMP	JNCC/RSPB/SOTEAG	4	mostly Thompson index
SURVEY	RSPB/JNCC/BTO/+	14	various
OTHER	BTO/RSPB/SNH/WWT/+	9	various
OTHER/SMP		2	various
OTHER/SURVEY		1	breeding pairs
WEBS	WWT/BTO/JNCC/RSPB	6	WeBS index, 1970/71-1996/97
GAME BAG	GCT	1	bag per 100 hectares
NONE		10	

### Notes:

- Data sources: acronyms are explained in the text.
- Partners: **BTO** British Trust for Ornithology; **SOC** Scottish Ornithologists' Club; **IWC** Irish Wildbird Conservancy (now BirdWatch Ireland); **JNCC** Joint Nature Conservation Committee (on behalf of English Nature, Scottish Natural Heritage and the Countryside Council for Wales, and also on behalf of the Environment and Heritage Service in Northern Ireland); **BB** *British Birds*; **RSPB** Royal Society for the Protection of Birds; **EN** English Nature; **SNH** Scottish Natural Heritage; **SOTEAG** Shetland Oil Terminal Environmental Advisory Group; **WWT** Wildfowl & Wetlands Trust; **GCT** Game Conservancy Trust; **+** various other sources.
- Units: **AOT** = apparently occupied territories.

Wherever possible an annual measure of population size was sought for the period 1970-97 (either an absolute measure, such as counts of pairs, or a relative one, such as an index of percentage change).

Wherever a population or range estimate was collected from a survey spanning several years, the value was allocated to the mid year or years of the range of survey years. For example, values from the 1968-72 atlas were allocated to 1970, while data from the SCR collected during 1985-87 were allocated to 1986.

A comprehensive list of references to these various sources of data is appended (Appendix 3).

## **2.1 Common Birds Census (CBC) and Waterways Bird Survey (WBS)**

CBC and WBS are long-running mapping surveys of breeding birds (Marchant *et al.* 1990, Crick *et al.* 1998). CBC covers mainly farmland and woodland habitats, and WBS is a survey of linear waters.

The most frequently used data were those from the CBC. Mountford indices were calculated for each year for 69 species with the mean index for each species across all years set at unity. The data were generated using data from all CBC plot types, i.e. farmland, woodland and other habitats ('special'). CBC indices were not calculated for species for which more than half the year-to-year changes recorded were based on fewer than twenty plots. For example, Common Snipe data were available for the 28-year period 1970-97 but were not used because, of those 28 years, 17 annual estimates of change were based on data from fewer than 20 plots.

CBC data were available for most species for the period 1970-97, although for House Sparrow they were only available for 1975-96. Due to complications arising through the sparseness of the data, no index could be produced for House Martin.

Data from the Waterways Bird Survey (WBS) were used for only four species; Common Kingfisher, White-throated Dipper, Common Sandpiper and Grey Wagtail. Although CBC data were available for the Grey Wagtail, the representation of sites in the WBS was much greater. The same exclusion/inclusion criteria used for the CBC were adopted for the WBS. Most WBS data were for the period 1974-96, though Grey Wagtail data covered 1974-97.

## **2.2 Rare Breeding Birds Panel (RBBP)**

RBBP is a collaborative body that collects records of rare breeding birds in the UK for monitoring purposes and publishes annual summaries (e.g. Ogilvie *et al.* 1999).

Information on annual population sizes of more than fifty rare breeding bird species was available from the reports of the RBBP. The RBBP reports give several population figures for each species. In general the lowest estimate is based on proven breeding pairs, while the highest is the maximum total number of pairs reported. Since breeding is difficult to prove for many species, the latter value has been used in most cases; for most species this is more likely to reflect the true breeding population.

The run of RBBP data covers the period 1973-95, but with three kinds of exceptions:

- First, RBBP began to include a few species (e.g. Common Quail) in their reports only some years after the instigation of the scheme.
- Second, for some species (e.g. Common Goldeneye) the Panel ceased to report national populations during the time period.
- Third, occasional years of data have been missed for some species (e.g. Snow Bunting, Black Redstart and Marsh Warbler).

For a few species, such as Cirl Bunting or Dartford Warbler, data from the Panel are enhanced by full national surveys at decadal intervals. These are listed as RBBP/SURVEY in Table 1 and Appendix 2. For some species, population sizes for 1996 and 1997 were known but not yet reported by RBBP (e.g. Great Bittern and Red Kite). For others, e.g. Roseate Tern, better sources of data are available.

For several RBBP species, the population during the period 1970-72 was known to be zero, even though RBBP did not start monitoring until 1973. In most cases this information was available from the breeding atlases (e.g. Sharrock (1976) for Hoopoe in 1970) or from Batten *et al.* (1990). It is likely that, for some of these species (e.g. Little Gull and Red-necked Grebe), that summering individuals were present, even though there were no breeding pairs.

### 2.3 Seabird monitoring

Seabirds are monitored by two separate, but closely linked schemes (Thompson *et al.* 1998):

- the Seabird Colony Register (SCR), a complete census of British and Irish seabirds every 15 years (with past surveys in 1969-70 and 1985-87); and
- a Seabird Monitoring Programme (SMP) in which seabird populations have been counted at a sample of plots throughout Britain and Ireland since 1986.

For most seabirds therefore, population sizes are known for the two complete censuses, and trends are known for a number from 1986 onwards. Unfortunately, truly national post-1986 trends are available for only a small number of species (there are many regional trends). For Common Guillemot, Northern Fulmar and Sandwich Tern, a chain index (termed the Thompson index after its developer) was produced for 1986 onwards, with 1986 set to a value of 100. To allow this to be extrapolated back to 1970 (see below) the population size estimated from the SCR in 1985-87 was set to an index value of 100, and the index value for 1970 calculated from the population size then. For example, there were 290,000 pairs of Northern Fulmar in GB in 1970, and 539,000 pairs in GB in 1985; the 1985 index was set to 100, and so the 1970 index was calculated as 53.8. These species are listed as SCR/SMP in Table 1 and Appendix 2.

Better annual trend data were available for Little and Roseate Terns, while for some species (e.g. skuas) full national surveys have been undertaken since 1985-87. Such species are listed as SCR/SURVEY in Table 1 and Appendix 2.

## **2.4 Wetland Bird Survey (WeBS)**

The annual reports of WeBS (e.g. Cranswick *et al.* 1997) contain data from monthly counts of wildfowl and waders on both coastal and inland wetlands.

For a small number of waterfowl, the best data on annual breeding population levels are available from WeBS. Although the WeBS trend monitors mainly the non-breeding population, it can be taken also as the breeding trend for sedentary species, i.e. those whose UK non-breeding population is made up solely of UK breeding birds. Such species included Mute Swan and Ruddy Duck. Although year-to-year variations in numbers will also be related to productivity in the previous breeding season, these effects are small compared to the overall trend. WeBS produces indices for winter months which span the end of one year and the beginning of the next. The winter 1970/71 index was taken as the value for the 1970 breeding season, 1971/72 taken as 1971, *etc*; this option seemed to make the most sense. The indices were generated using the Underhill method (Underhill 1989), with 1970 set to an index of 100.

## **2.5 Single-species surveys**

A number of species, though not monitored annually, are monitored intermittently on longer time scales - most commonly every five or ten years at a national scale. In recent years much of this has been undertaken within the Statutory Conservation Agencies/RSPB annual breeding birds scheme (SCARABBS), although other organisations, notably BTO, have also been involved. Such species are listed as SURVEY in Table 1 and Appendix 2.

## **2.6 Other population monitoring**

Information on trends for a variety of other species was extracted from the scientific literature (OTHER) and, for Red Grouse, game bags were used as the best index of the species population trend. Although game bags could have been used for additional species, those for other grouse are too dependent on shooting effort and those for waders (e.g. Eurasian Woodcock and Common Snipe) really refer more to winter populations.

## **2.7 Distributional data**

For 19% of species (42 out of the total of 219) there were no data on population change during the time period. For these species there was no option but to use changes in range, rather than population, over a twenty-year period. These data were obtained by comparing the results of the breeding atlases of 1968-72 (Sharrock 1976) and 1988-91 (Gibbons *et al.* 1993). Data on population trends (rather than changes in range) were always used wherever available, even if they were for a shorter time period than that spanned by the atlases (e.g. Red-throated and Black-throated Divers).

The Breeding Bird Survey (BTO/JNCC/RSPB) will monitor some of these less common species in the future, but the BBS began only in 1994 and has not yet been running long enough for data from this scheme to have been included in this indicator.

### 3 DEALING WITH MISSING VALUES

Ideally, a measure of population (or range) would have been obtained for all 229 species for each of the 28 years, 1970-97. In practice this was not possible, and there were many missing species-year values. These missing values were either of data which have never existed or which had been collected but not reported at the time of the analysis. Wherever possible these missing values were estimated by interpolation or extrapolation.

#### 3.1 Interpolation

To interpolate missing values for years in-between two years for which counts were available ( $yr_1$  and  $yr_n$ ) a constant annual rate of change ( $a$ ) was assumed, with  $a$  calculated as:

$$a = (\text{value}_n / \text{value}_1)^{1/(n-1)}$$

where  $\text{value}_n$  = value (e.g. population size or index) in  $yr_n$  and  $\text{value}_1$  = value in  $yr_1$  (i.e. the most recent year for which the value was known).

Knowing  $a$  and  $\text{value}_1$  it was possible to estimate the values for  $yr_2$ ,  $yr_3$ ,  $yr_4$  etc up to  $yr_{n-1}$ .

For species with several intermittent surveys,  $a$  was estimated for each intervening time period separately. Thus, for example, Peregrine Falcon was surveyed in 1971, 1981 and 1991, and the interpolated values for 1972-80 were based on the value of  $a$  calculated from  $yr_1 = 1971$  and  $yr_n = 1981$ , and so on.

#### 3.2 Extrapolation

Where necessary, missing values were extrapolated either forwards or backwards, based on the species' trend over the previous or following period. No data were extrapolated (forwards or backwards) over periods of more than seven years. This period is almost certainly too long, and was chosen to ensure that changes in range over the period 1970 to 1990 from atlas data could be extrapolated to 1997. Such long extrapolations are unsustainable in the long term.

Extrapolations were either from intermittent surveys or annual monitoring data. The method of extrapolation was subtly different for these two sorts of data. An explanation of forward extrapolation is given here, but the principle is the same for backward extrapolation.

For intermittent surveys, the interpolation formula (above) was used for forward extrapolation beyond the last survey. Where there were several intermittent surveys, the most contemporary value of  $a$  was used. Thus, for Peregrine Falcon for example, the values extrapolated for 1992-97 were based on the value of  $a$  calculated for the period 1981-91.

The most obvious example of needing to extrapolate a set of annual monitoring data into the future was for the RBBP data. These were available mostly for the period 1973-95, and had not at the time been reported for 1996 or 1997. Similarly some CBC, WBS and WeBS data were not available for 1997. The manner in which these missing values were extrapolated was similar to the forward extrapolation from intermittent surveys, but with  $a$  calculated from

the mean of the first and last three years of data in the monitoring string. For species that started breeding during the period 1973-95 (e.g. Purple Sandpiper which first bred in 1978), the first year was taken as the first year of breeding.

One drawback with this approach is that it assumes a linear change from the beginning to the end of the data string, and this was not always justified (e.g. Common Scoter and Red-necked Phalarope). More sophisticated approaches could be considered. Annual monitoring data were only rarely extrapolated forwards by more than two years (e.g. data for Ruff were extrapolated for 1995-97 and for Bearded Tit for 1994-97).

### 3.3 Summary of data availability and geographical scope

Data were sought for 229 species, each for 28 years, representing a total of 6,412 species-year combinations. A total of 3,937 (61.4%) real values were available and a further 2,087 (32.5%) values were interpolated or extrapolated. No values were available or could be estimated for the remaining 388 (6.1%) of species-year combinations.

The geographical scope of the data for each species is summarised in Table 2. In most cases (86%), the data represent change in population or range for the UK as a whole. The reason for this is that most of the major schemes (such as CBC and RBBP) cover the whole UK. In practice, however, some of these schemes might not yield trends which are an unbiased representation of UK trends, largely because they lack a formal sampling design. Data for half of the remaining species are representative of Britain rather than UK; thus for example the WeBS trends used for a few wildfowl are indices for GB not UK. The remaining species' data are drawn from yet more restricted geographical areas. However, in all of these cases, the bulk of the UK population for that species lies within the areas monitored. Thus, for example, for five species of seabird it is the UK coastal population that is monitored, even though a small part of the population nests inland.

**Table 2. Geographical scope of the species data.**

Geographical scope	No. species	Notes
UK	188	e.g. CBC, WBS and RBBP data
GB	16	e.g. WeBS wildfowl indices
UK coast	5	only coastal part of seabird populations monitored
Northern Isles	3	Great and Arctic Skuas, Arctic Tern
Shetland only	2	Whimbrel and Red-throated Diver
Other	5	various

## **4 CALCULATION OF THE INDEX**

### **4.1 Removal of very rare species from the index**

Extremely rare species could markedly affect any index in which all species received equal weighting. Thus, for example, a change in population from two pairs to one pair of Eurasian Wryneck, a very rare species in the UK, could have the same effect on an index as a 50% crash in the population of an abundant species such as the Sky Lark. Species-specific weightings, based for example on population size or conservation status, would introduce subjectivity and complexity and make interpretation of any final indicator difficult. Thus, instead of using weightings, 23 species whose maximum annual population size in the (mostly) RBBP run of data was 20 pairs or less (e.g. Montagu's Harrier and Fieldfare) were removed prior to calculation of the indicator. In practice, most of these species would have fallen out at a later stage of the analysis anyway (section 4.2.1).

### **4.2 Generation of the across-species index**

The index was generated by calculating an average index of population trend taken across all species (or various groupings). It is not sensible to do this by taking arithmetic means of the indices across species. The reason for this is best explained by example. Of two species, one doubles in number (so that its index rises from 1.0 to 2.0) and the other halves in number (so its index falls from 1.0 to 0.5). Intuitively, these two changes should cancel each other out, with a doubling precisely balancing a halving. However, the simple mean of their final indices is 1.25, which suggests that the average trend was rising. This is plainly misleading.

The solution is to take the geometric mean of the indices, which in this simple example is the square root of their product ( $2.0 \times 0.5$ , of which the square root is 1.0). This is a sensible overall measure. The geometric mean is necessary because of the skewed nature of the distribution of a simple index value; population increases can be infinite, but population decreases can be no more than 100%.

#### **4.2.1 Setting the data to a base year**

It is not possible to combine species trends measured in different units (e.g. pairs or indices), often with different index base years. It was thus necessary to convert each species' trend values to a standard base year.

The base year (at which all species indices are set to a value of 1.0 or 100%) could be the first year, the last year or indeed any year. It would be odd, however, to have 'any year' as the base year, although one candidate for this would be the year with the most data (1988). However, the choice of such a base year would be hard to justify. The first year in the index (1970) was therefore chosen as the base year. One drawback of this is that it can give the misleading impression that the 1970 value is also some kind of target to be regained, particularly with an index that declines from its initial value.

The index for a given species in year  $x$  was calculated as:

$$\text{value}_x / \text{value}_{1970}$$

It is possible to calculate this index only for species with data for 1970. This inevitably excluded some species from the index. Such species were of two sorts - those which were present but for which there were no 1970 data (e.g. Red-throated Diver and Golden Eagle) and those which did not breed in 1970. With one exception (Mediterranean Gull), none of the species which did not breed in 1970 ever held more than 20 breeding pairs in any subsequent year, so most of these species had already been excluded (section 4.1). Species excluded purely because there were no data for 1970 are listed in part D of Appendix 2.

#### 4.2.2 Groupings of species prior to index calculation

Prior to generating any across-species indices, each species was classified in three separate ways: by native/introduced status, by habitat and by abundance class. These classifications allowed the calculation of across-species indices for different groupings.

##### *Native/introduced status*

Each species was categorised as native or introduced/feral following the definitions used by Gibbons *et al.* (1993; see footnote to Table 10, p. 476 and footnote to Table 13, p. 479). Species classed as non-native are those in part C of Appendix 2 and those in part B and marked 'in' in the Status column. For Greylag Goose, which has both a native and an introduced population, separate trends were calculated and used in the appropriate groupings. Re-introduced species (Western Capercaillie, White-tailed Eagle and Red Kite) were treated as native. The first half of the Red Kite's rising trend occurred in the wild population in Wales prior to the re-introduction programme in England and Scotland; in the event, neither White-tailed Eagle nor Red Kite appeared in the headline indicator because their populations were below 500 pairs.

##### *Habitat classification*

Each species was allocated to one of seven habitat categories, as shown in Appendix 2. These categories were: **CO** coastal, **FA** farmland, **WO** woodland, **LW** wetland, **UR** urban, **UP** upland, and **NC** not classified. This classification follows that of the *New Atlas* (Gibbons *et al.* 1993, p. 479), part of which was taken from Ratcliffe (1990, for uplands) and part from Fuller (1994, for woodland). All the farmland and woodland classifications agree with those of Fuller *et al.* (1995). Twenty additional species were newly allocated to their preferred habitat because they were too rare or had too restricted a distribution to have been categorised in the *New Atlas*, or did not breed during 1988-91.

##### *Abundance categories*

Each species was classified as either rare (fewer than 500 breeding pairs in UK) or not rare (more than 500 breeding pairs). Rare species are listed in part B of Appendix 2. Information on population size was taken from Stone *et al.* (1997). For a few species it was necessary to convert the unit in which population size was reported (e.g. adults or individuals) to pairs. This was done in an identical manner to that used for the BirdLife Data Annex (Heath *et al.*



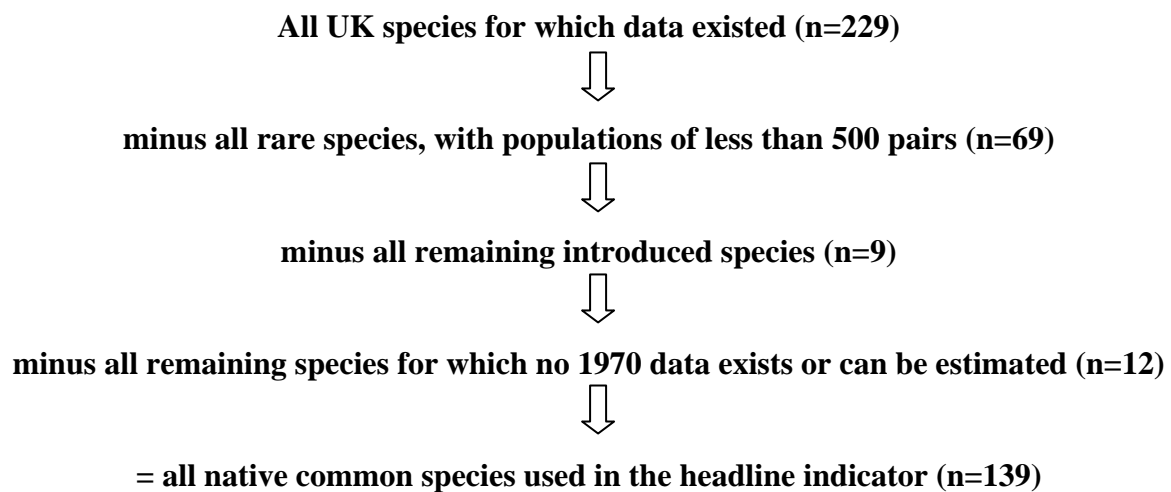
in prep). The data of Stone *et al.* (1997) were always used, even though for a few species more up-to-date data were available. This made sense for two reasons. First, these authors present a published and agreed set of population estimates. Second, most estimates are for the early to mid 1990s and it seemed better to have all estimates referring to a similar time, rather than updating some but not others.

### 4.2.3 Calculating across-species indices

In total, annual population indices (both real and estimated values) were available for 186 species for the period 1970-97. As outlined above, across-species indices were constructed for a variety of species groupings using the geometric means of the relevant species' trend series (each based on 1970 = 1) to form the overall index.

Of the 186 species with annual data, 14 were of introduced (including feral) origin. Among the 172 species classed as native, 33 had populations of less than 500 pairs; these species were excluded from the final indicator because it was believed that their trends were not representative of the countryside generally, many having increased as a result of direct conservation action or as a function of their recent colonisation.

The final headline indicator as it appeared in Anon (1998) was based on trends of 139 more common species. The procedure by which these species were selected from the total breeding bird fauna of the UK was as follows:





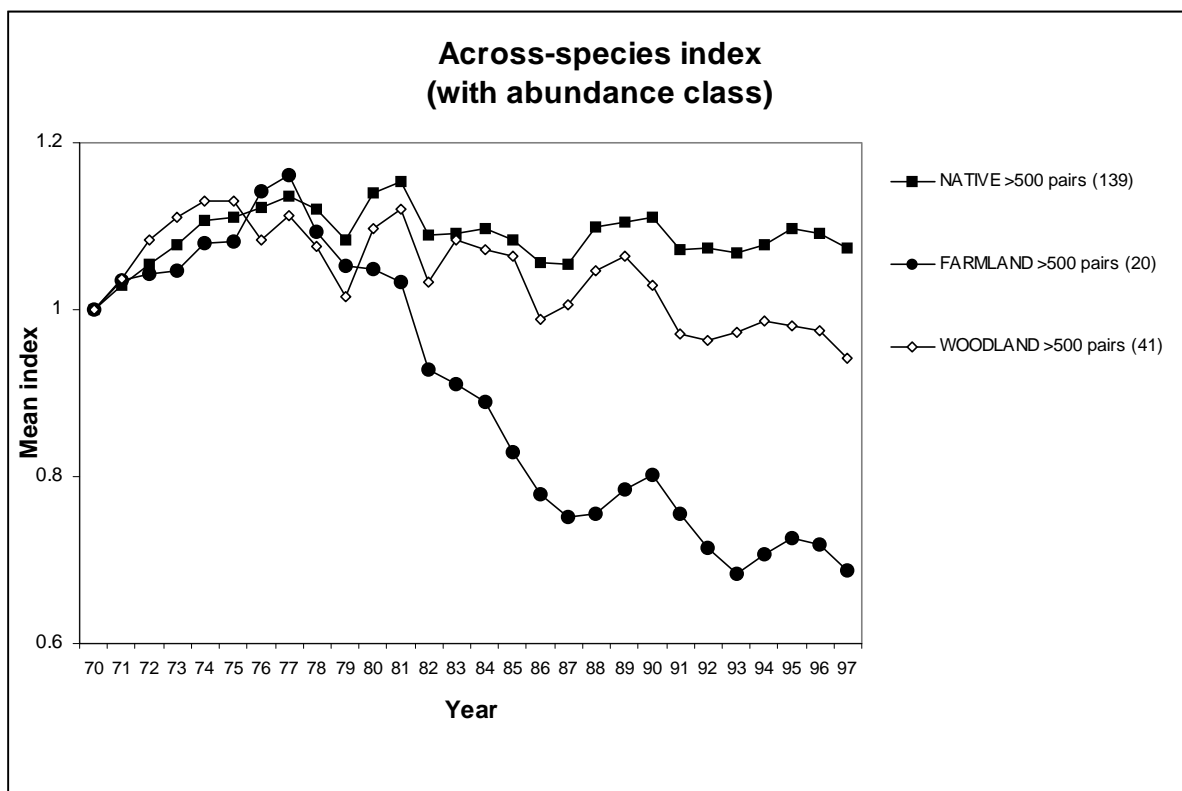
## 5 RESULTS AND DISCUSSION

### 5.1 Indicators of wild bird populations, 1970-97

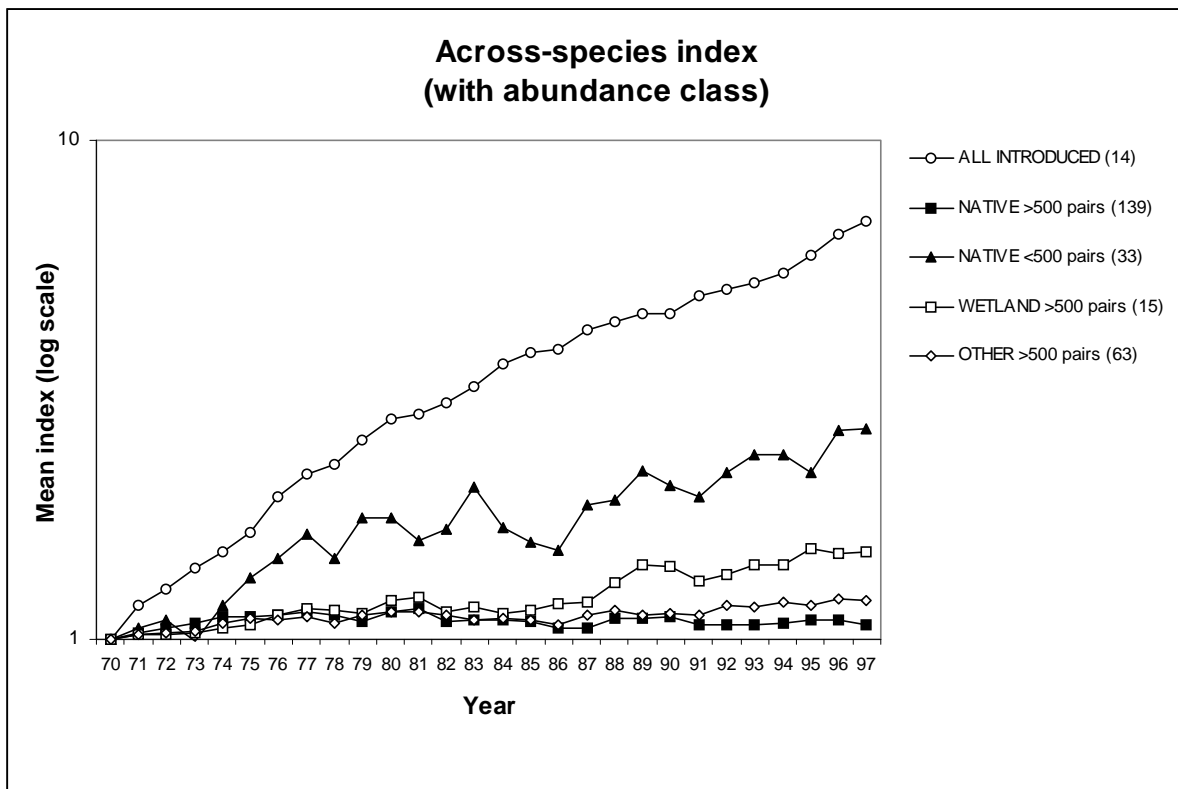
The final headline indicator was based on trends of 139 species, with indices produced for all 139 combined and also separately for farmland and woodland subsets. These three lines are shown in Figure 1. Ideally the y-axis should be plotted on a log scale so that a doubling and a halving in population size carry equal visual weight in the indicator. This was not done because of the problems of explaining log scales to the public.

Farmland and woodland account for about 85% of the UK land surface and are home to many of the UK's most abundant species. Declines of species in these habitats are thus a sign of general environmental degradation.

Figure 1. The headline indicator (from Anon 1998).



**Figure 2. Indices of various groupings.**



**Figure 3. Comparison of generalist and specialist species of farmland and woodland. The species included in each subset are indicated in Appendix 2A.**

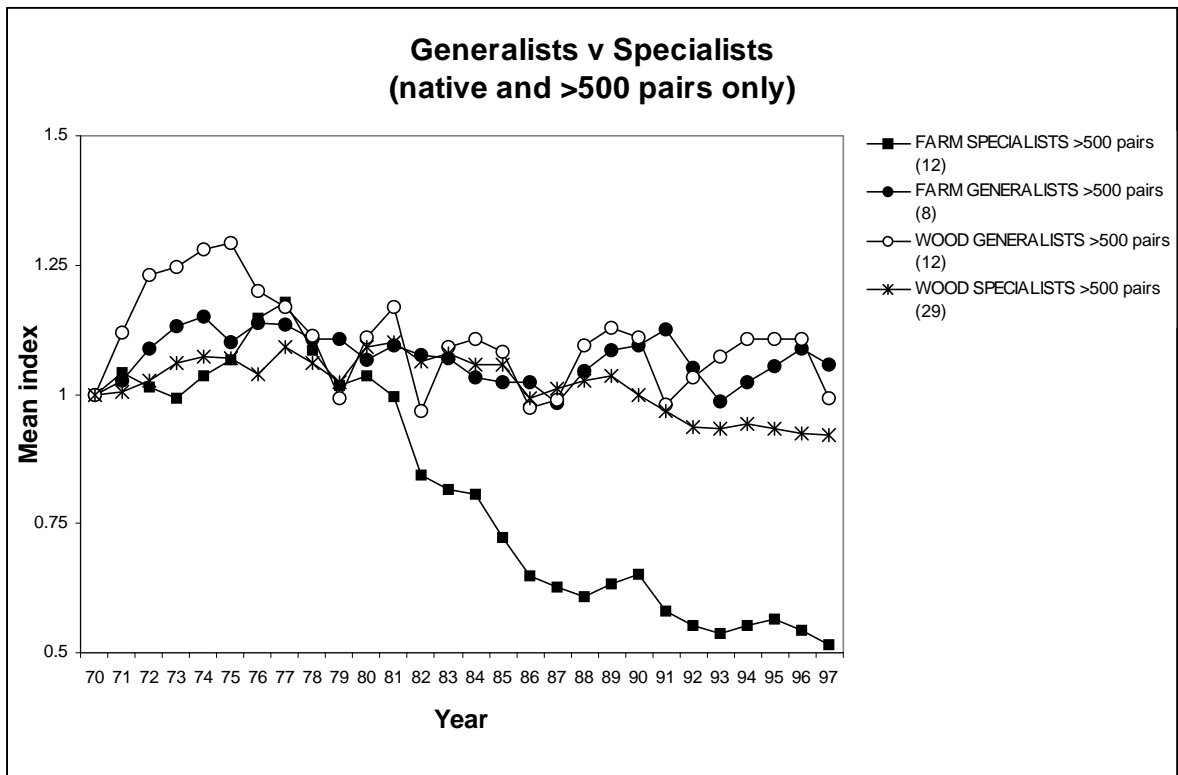


Figure 2 shows indices of various other groupings. Populations of introduced species have increased very substantially, rising by over 150 per cent between 1970 and 1997. A log scale has been used for this graph to allow this trend to be plotted alongside the other groups. Populations of some other groups of species, most notably wetland birds, increased during 1970-97, as did rare species for reasons already discussed. The main headline indicator is also shown for comparison.

The striking conclusion that it is birds of farmland that are of greatest conservation concern is amplified by the trends in Figure 3, which show that farmland specialists are strongly in decline, while birds of farmland that are not entirely dependent on that habitat have shown little overall change. Species treated as generalists are marked 'gn' in Appendix 2A, and specialists 'sp'.

## 5.2 Annual updating of the indicators

Annual updating of the indicators can best be carried out as soon as the most important elements of the relevant data are available. The CBC results are produced annually each spring. RBBP reporting is also annual, generally in the spring but two or three seasons in arrears. The indicators can thus be updated annually each summer.

The updating of the headline indicator will involve:

- 1 calculation, using the appropriate statistical models, of population trends for species covered by the BTO's Common Birds Census and Waterways Bird Survey (a large proportion of the trend data within the indicator comes from the CBC);
- 2 collation of the most recent data from the Rare Breeding Birds Panel (while this is not crucial, as these data were ultimately excluded from the headline index, they will be collated for the sake of completeness);
- 3 collation of the most recent data from Seabird Monitoring;
- 4 collation of the most recent relevant data from the Wetland Bird Survey;
- 5 collation of the most recent data from single-species surveys;
- 6 collation of data from other population monitoring schemes;
- 7 review of the distributional information. The most recent national breeding atlas data were collected in 1988-91 (Gibbons *et al.* 1993). Future re-calculation of the indicator will encounter more difficult problems of extrapolation from atlas data which, until a repeat distribution atlas is compiled, will become increasingly outdated. It would be helpful to investigate the influence of atlas distributional data on the final indicator. This may help to highlight how quickly a new repeat breeding distribution atlas needs to be begun.

It is proposed that in future BTO will be responsible for item 1 and for providing the indices to RSPB. BTO will also be responsible for collating data from relevant single-species

schemes which it runs (e.g. Heronries Census). RSPB will be responsible for items 2-7 and for the production of the headline indicator and explanatory text, in discussion with DETR.

A standard timetable for this work would be:

- population data to be analysed and assembled in July;
- RSPB to receive the necessary indices from BTO by the end of August;
- the wild bird indicator, with breakdowns for habitats and commonness, to be developed in August and September;
- the headline indicator to be produced by the start of October.

### **5.3 Future developments**

The principle by which the species have been divided into farmland, woodland and wetland categories in this analysis could be extended to cover some additional habitat groupings, such as seabirds or birds of reservoirs. Subdivision of habitats must be considered carefully, however, to ensure that the additional habitat categories have a sufficiently large sample of species to give meaningful results.

Similarly, the data could be subdivided regionally, to cover separately for example the four main UK countries. This would require more development work than adding more habitat-based indicators, because each data source would be required to supply separate data for each region. Regional indices from CBC and WBS are simple to calculate, however, and would not present any problem. In the event, data from Wales and Northern Ireland may be too sparse to allow them to be treated separately. Regional division within England may be possible, owing to the much larger monitoring samples in that country.

It will be important to use the same methods for region-specific or habitat-specific indicators as for the headline indicator, so that essentially they are partitions of the headline trend. This will allow direct comparisons between trends for different regions or habitats.

A further development that has been mooted is the incorporation of data for non-breeding bird populations. This would be highly desirable because of the high conservation importance of many of the UK's winter bird populations, particularly waders and wildfowl. Winter monitoring is carried out for these wetland birds on estuaries and inland waters, and also for garden birds, but not currently for birds of the wider countryside.

## **ACKNOWLEDGEMENTS**

The data from which the wild bird indicator is drawn have been collected in many cases by volunteer ornithologists too numerous to name, to whom a major acknowledgement is due. The authors are grateful to DETR for funding this project and for the collaboration of John Custance. JNCC, in the person of Paul Rose, also assisted during the planning stages. David Noble, Jeremy Greenwood and Nigel Clark provided helpful comments on earlier drafts of this report, and Samantha Rider and Sophie Foulger gave secretarial and technical support.





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## APPENDIX 1 SPREADSHEETS CREATED

The following files have been created to hold the data assembled for this project. A copy of these files has been submitted to DETR for their internal use.

**bto.zip**  
**pkunzip.exe**

When unzipped, e.g. using *pkunzip.exe*, *bto.zip* contains two Excel files:

**breeding.xls**  
**breedap5.xls**

*Breeding.xls* contains four worksheets:

**5yinc&dec**  
**lnbase70**  
**targets**  
**data**

*Breedap5.xls* contains two worksheets:

**summary data**  
**graph**

### Notes:

- Edited extracts from *lnbase70* appear as Appendix 2.
- The graph worksheet from *breedap5.xls* contains the graphs reproduced in this report as Figures 1-3.



## APPENDIX 2 SUMMARY OF DATA GATHERED, BY SPECIES

### A: Species included in the headline indicator (n=139)

Species	Data set (units)	No. years (real data/total)	Habitat	Notes
Little Grebe	ATLAS (occ. 10-km squares)	3/28	LW	WBS & CBC samples too small
Great Crested Grebe	SURVEY (individuals)	4/28	LW	1965 (Prestit & Mills 1966), 1975 (Hughes <i>et al.</i> 1979), 1988-91 (New Atlas tetrad counts)
Fulmar	SCR/SMP (Thompson index, 1986-97)	13/28	CO	1985 GB estimate (Stone <i>et al.</i> 1997) tied to index of 100, and 1970 index calculated from it (290,000 in 1970; Lloyd <i>et al.</i> 1991)
Gannet	SCR/SMP (no. of occupied nests/sites)	5/28	CO	1994-95 estimate from Stone <i>et al.</i> (1997); 1984-85 and 1969-70 from table in Gibbons <i>et al.</i> (1993)
Cormorant	SCR (pairs)	2/24	CO	1969-70 estimate from Lloyd <i>et al.</i> (1991); 1985-87 estimate from Stone <i>et al.</i> (1997)
Shag	SCR (pairs)	2/24	CO	1969-70 estimate from Lloyd <i>et al.</i> (1991); 1985-87 estimate from Stone <i>et al.</i> (1997)
Grey Heron	OTHER (app. occ. nests)	28/28	LW	From BTO Heronries Census
Mute Swan	WeBS index 1970/71 96/97	27/28	LW	Have assumed WeBS index reliably reflects breeding season trend; GB population is discrete (Scott & Rose 1996); CBC trend very variable; see also Eltringham (1963), Ogilvie (1981, 1986)
Greylag Goose (Hebridean)	SURVEY (individuals, post-breeding)	4/24	UP	All figures from Paterson (1987); 1970 figure is maximum of range given for the 1960s
Shelduck	OTHER (adults, (pre) breeding)	4/28	CO	1970 estimate from Yarker & Atkinson-Willes (1972); 1986 Owen <i>et al.</i> (1986); 1988-91 New Atlas tetrad counts (Gibbons <i>et al.</i> 1993)
Gadwall	OTHER (pairs)	3/28	LW	Data from Fox (1988) and Fox in Gibbons <i>et al.</i> (1993); 1970 estimate is from Sharrock (1976) and agrees well with Fox (1988)

Species	Data set (units)	No. years (real data/total)	Habitat	Notes
Teal	ATLAS (occ. 10-km squares)	3/28	UP	
Mallard	CBC index 1970 97	28/28	LW	
Shoveler	ATLAS (occ. 10-km squares)	3/28	LW	
Tufted Duck	ATLAS (occ. 10-km squares)	3/28	LW	
Eider	OTHER (breeding females)	3/27	CO	Data from Baillie (in Gibbons <i>et al.</i> 1993); assume 31/32 of the British & Irish population is in Britain
Red-breasted Merganser	WeBS index 1970/71 96/97	27/28	UP	Have assumed WeBS index reliably reflects breeding season trend; Owen <i>et al.</i> (1986) state that most wintering birds are breeders; see also Gregory <i>et al.</i> (1997)
Goosander	WeBS index 1970/71 96/97	27/28	UP	Have assumed WeBS index reliably reflects breeding season trend; Owen <i>et al.</i> (1986) state that most wintering birds are breeders; see also Gregory <i>et al.</i> (1997)
Hen Harrier	ATLAS (occ. 10-km squares)	3/28	UP	National survey in 1988/89 (Bibby & Etheridge 1993), but no prior survey for comparison
Sparrowhawk	CBC index 1970 97	28/28	WO sp	
Buzzard	CBC index 1970 97	28/28	UP	
Kestrel	CBC index 1970 97	28/28	FA gn	
Peregrine	SURVEY (pairs occupying territories)	3/28	UP	1991 & 1981 data from Crick & Ratcliffe (1995); 1971 data by calculation and from Crick <i>et al.</i> (1987); see also Ratcliffe (1972)
Red Grouse	GCT (bag/100ha)	24/28	UP	1970-89 data read from fig 9.5 in Tapper (1992); 1990-93 from Game Conservancy (1994)
Ptarmigan	ATLAS (occ. 10-km squares)	3/28	UP	
Black Grouse	ATLAS (occ. 10-km squares)	3/28	UP	Other data sets are too short and/or too regional; game bag suffers from moratorium in recent decades
Capercaillie	ATLAS (occ. 10-km squares)	3/28	WO sp	Game bag suffers from moratorium in recent decades
Grey Partridge	CBC index 1970 97	28/28	FA sp	

Species	Data set (units)	No. years (real data/total)	Habitat	Notes
Water Rail	ATLAS (occ. 10-km squares)	3/28	LW	
Moorhen	CBC index 1970 97	28/28	LW	
Coot	CBC index 1970 97	28/28	LW	
Oystercatcher	ATLAS (occ. 10-km squares)	3/28	NC	WBS sample too small
Little Ringed Plover	SURVEY ((summering) pairs)	4/28	LW	1973 (Parrinder & Parrinder 1975) & 1984 (Parrinder 1989); 1988-91 estimate (Gibbons <i>et al.</i> 1993) assumes same densities as in 1984
Ringed Plover	ATLAS (occ. 10-km squares)	3/28	CO	1973/74 and 1984 surveys of UK exist (Prater 1976, 1989), but 1973/74 estimates are considered unrealistically low
Dotterel	ATLAS (occ. 10-km squares)	3/28	UP	National survey undertaken in 1987-88 (Galbraith <i>et al.</i> 1993), but no other survey for comparison
Golden Plover	ATLAS (occ. 10-km squares)	3/28	UP	
Lapwing	CBC index 1970 97	28/28	FA sp	
Snipe	ATLAS (occ. 10-km squares)	3/28	UP	CBC sample too small
Woodcock	CBC index 1970 97	28/28	WO sp	
Whimbrel	SURVEY (pairs)	4/28	UP	1982-86 & 1989-94 figures from Dore <i>et al.</i> (1996); 1970 figure from Sharrock (1976), agrees well with population growth documented by Richardson (1990)
Curlew	CBC index 1970 97	28/28	UP	
Redshank	ATLAS (occ. 10-km squares)	3/28	NC	WBS & CBC samples too small
Greenshank	ATLAS (occ. 10-km squares)	3/28	UP	National survey in 1995 (Hancock <i>et al.</i> 1997), but no earlier survey for comparison
Common Sandpiper	WBS index 1974 96	23/28	UP	

Species	Data set (units)	No. years (real data/total)	Habitat	Notes
Arctic Skua	SCR/SURVEY (app. occupied territories)	3/28	UP	Orkney & Shetland hold most; 1970 & 1985-87 from Lloyd <i>et al.</i> (1991); 1992 from Meek <i>et al.</i> (1994) & Sears <i>et al.</i> (1995); 1985-87 data for Orkney based on extrapolation from 1982 data
Great Skua	SCR/SURVEY (app. occupied territories)	3/28	UP	Orkney & Shetland hold most; 1970 & 1985-87 from Lloyd <i>et al.</i> (1991); 1992 Meek <i>et al.</i> (1994) & Sears <i>et al.</i> (1995); Orkney data for 1985-87 extrapolated from 1982 data
Black-headed Gull	SCR (pairs)	2/24	NC	Data from Lloyd <i>et al.</i> (1991); inland figures very poor (especially for 1969-70); coast holds ca 45% of population (Lloyd <i>et al.</i> 1991)
Common Gull	SCR (pairs)	2/24	NC	Data from Lloyd <i>et al.</i> (1991); inland figures not available; coast holds ca 22% of population (Lloyd <i>et al.</i> 1991)
Lesser Black-backed Gull	SCR (pairs)	2/24	CO	Data from Lloyd <i>et al.</i> (1991); coast holds ca 76% of population (Lloyd <i>et al.</i> 1991)
Herring Gull	SCR (pairs)	2/24	CO	Data from Lloyd <i>et al.</i> (1991); coast holds ca 91% of population (Lloyd <i>et al.</i> 1991)
Great Black-backed Gull	SCR (pairs)	2/24	CO	Data from Lloyd <i>et al.</i> (1991); coast holds virtually entire population
Kittiwake	SCR (pairs)	2/24	CO	Data from Lloyd <i>et al.</i> (1991).
Sandwich Tern	SCR/SMP (Thompson index)	12/28	CO	Thompson index generated for 1986-96; 1970 index generated from population estimates from Lloyd <i>et al.</i> (1991)
Common Tern	SCR (pairs)	2/24	NC	
Arctic Tern	SCR/SURVEY (pairs)	4/28	CO	85% of British & Irish population breeds in Orkney & Shetland; 1980, 89 & 94 data from Brindley <i>et al.</i> (in prep) and Avery <i>et al.</i> (1993); 1970 from Lloyd <i>et al.</i> (1991), probably underestimate
Little Tern	OTHER/SMP (Sears & Thompson index)	28/28	CO	1970-86 index from Sears & Avery (1993); 1987-97 supplied by Kate Thompson; indices linked at 1986



Species	Data set (units)	No. years (real data/total)	Habitat	Notes
Guillemot	SCR/SMP (Thompson index)	12/28	CO	1986-97 data from Thompson index; 1970 value is based on Lloyd <i>et al.</i> (1991), mainly for GB.
Stock Dove	CBC index 1970 97	28/28	FA sp	
Woodpigeon	CBC index 1970 97	28/28	FA gn	
Collared Dove	CBC index 1970 97	28/28	UR	
Turtle Dove	CBC index 1970 97	28/28	FA sp	
Cuckoo	CBC index 1970 97	28/28	NC	
Barn Owl	ATLAS (occ. 10-km squares)	3/28	FA gn	Results of recent survey not yet released
Tawny Owl	CBC index 1970 97	28/28	WO gn	
Long-eared Owl	ATLAS (occ. 10-km squares)	3/28	WO sp	
Short-eared Owl	ATLAS (occ. 10-km squares)	3/28	UP	
Swift	ATLAS (occ. 10-km squares)	3/28	UR	
Kingfisher	WBS index 1974 96	23/28	LW	
Green Woodpecker	CBC index 1970 97	28/28	WO sp	
Great Spotted Woodpecker	CBC index 1970 97	28/28	WO sp	
Lesser Spotted Woodpecker	CBC index 1970 97	28/28	WO sp	
Woodlark	RBBP/SURVEY 1973 95 (occupied territories/max pairs)	17/28	NC	1970, 75, 81, 83 & 86 data from Sitters <i>et al.</i> (1996); 1997 data from Wotton & Gillings (in press); rest from RBBP
Skylark	CBC index 1970 97	28/28	FA sp	
Sand Martin	ATLAS (occ. 10-km squares)	3/28	NC	WBS sample too small
Swallow	CBC index 1970 97	28/28	NC	
Tree Pipit	CBC index 1970 97	28/28	WO sp	

Species	Data set (units)	No. years (real data/total)	Habitat	Notes
Meadow Pipit	CBC index 1970-97	28/28	UP	
Rock Pipit	ATLAS (occ. 10-km squares)	3/28	CO	
Yellow Wagtail	CBC index 1970-97	28/28	FA gn	
Grey Wagtail	WBS index 1974-97	24/28	UP	
Pied Wagtail	CBC index 1970-97	28/28	NC	
Dipper	WBS index 1974-96	23/28	UP	
Wren	CBC index 1970-97	28/28	WO gn	
Dunnock	CBC index 1970-97	28/28	WO gn	
Robin	CBC index 1970-97	28/28	WO gn	
Nightingale	ATLAS (occ. 10-km squares)	3/28	WO sp	
Redstart	CBC index 1970-97	28/28	WO sp	
Whinchat	ATLAS (occ. 10-km squares)	3/28	UP	
Stonechat	ATLAS (occ. 10-km squares)	3/28	NC	
Wheatear	ATLAS (occ. 10-km squares)	3/28	UP	
Ring Ouzel	ATLAS (occ. 10-km squares)	3/28	UP	
Blackbird	CBC index 1970-97	28/28	WO gn	
Song Thrush	CBC index 1970-97	28/28	WO gn	
Mistle Thrush	CBC index 1970-97	28/28	NC	
Grasshopper Warbler	ATLAS (occ. 10-km squares)	3/28	NC	CBC sample too small
Sedge Warbler	CBC index 1970-97	28/28	LW	
Reed Warbler	CBC index 1970-97	28/28	LW	
Dartford Warbler	RBBP/SURVEY 1973-95 (max total pairs)	26/28	NC	Data from Gibbons & Wotton (1996) for 1970-94, though much overlap with RBBP
Lesser Whitethroat	CBC index 1970-97	28/28	WO gn	

Species	Data set (units)	No. years (real data/total)	Habitat	Notes
Whitethroat	CBC index 1970-97	28/28	FA sp	
Garden Warbler	CBC index 1970-97	28/28	WO sp	
Blackcap	CBC index 1970-97	28/28	WO sp	
Wood Warbler	ATLAS (occ. 10-km squares)	3/28	WO sp	CBC sample too small; national survey in 1984-85 (Bibby 1989), but no prior/repeat survey for comparison
Chiffchaff	CBC index 1970-97	28/28	WO sp	
Willow Warbler	CBC index 1970-97	28/28	WO sp	
Goldcrest	CBC index 1970-97	28/28	WO sp	
Spotted Flycatcher	CBC index 1970-97	28/28	WO sp	
Pied Flycatcher	ATLAS (occ. 10-km squares)	3/28	WO sp	
Long-tailed Tit	CBC index 1970-97	28/28	WO gn	
Marsh Tit	CBC index 1970-97	28/28	WO sp	
Willow Tit	CBC index 1970-97	28/28	WO sp	
Crested Tit	ATLAS (occ. 10-km squares)	3/28	WO sp	
Coal Tit	CBC index 1970-97	28/28	WO sp	
Blue Tit	CBC index 1970-97	28/28	WO gn	
Great Tit	CBC index 1970-97	28/28	WO gn	
Nuthatch	CBC index 1970-97	28/28	WO sp	
Treecreeper	CBC index 1970-97	28/28	WO sp	
Jay	CBC index 1970-97	28/28	WO sp	
Magpie	CBC index 1970-97	28/28	NC	
Jackdaw	CBC index 1970-97	28/28	FA gn	
Rook	SURVEY (nests)	2/28	FA gn	1975 data from Sage & Vernon (1978); 1996 from Marchant & Gregory (1999); CBC index of nests for 1986-97 not used
Carrion Crow	CBC index 1970-97	28/28	NC	

Species	Data set (units)	No. years (real data/total)	Habitat	Notes
Raven	ATLAS (occ. 10-km squares)	3/28	UP	
Starling	CBC index 1970 97	28/28	FA sp	
House Sparrow	CBC index 1975 96	22/28	UR	
Tree Sparrow	CBC index 1970 97	28/28	FA sp	
Chaffinch	CBC index 1970 97	28/28	WO gn	
Greenfinch	CBC index 1970 97	28/28	FA gn	
Goldfinch	CBC index 1970 97	28/28	FA sp	
Siskin	ATLAS (occ. 10-km squares)	3/28	WO sp	
Linnet	CBC index 1970 97	28/28	FA sp	
Twite	ATLAS (occ. 10-km squares)	3/28	UP	
Redpoll	CBC index 1970 97	28/28	WO sp	
Crossbill	ATLAS (occ. 10-km squares)	3/28	WO sp	Data are for GB only and include Scottish Crossbill
Bullfinch	CBC index 1970 97	28/28	WO gn	
Hawfinch	ATLAS (occ. 10-km squares)	3/28	WO sp	
Yellowhammer	CBC index 1970 97	28/28	FA sp	
Reed Bunting	CBC index 1970 97	28/28	FA gn	
Corn Bunting	CBC index 1970 97	28/28	FA sp	

**B: Species excluded because their populations were less than 500 pairs (n=69)**

Species	Data set (units)	No. years (real data/total)	Habitat & status	Notes
Black-throated Diver	SURVEY (summering territories)	2/20	UP	1985 (Campbell & Talbot 1987); 1994 (Bainbridge <i>et al.</i> , RSPB unpubl); counts compared, with Campbell's correction both years
Red-necked Grebe	RBBP 1973 95 (max total pairs)	26/28	LW	
Slavonian Grebe	RBBP 1973 95 (max total pairs)	23/28	LW	see also Anon (1996b)
Black-necked Grebe	RBBP 1973 95 (max total pairs)	23/28	LW	
Bittern	RBBP 1976 95 (booming males)	23/28	LW	1996 & 1997 from Weaver (RSPB unpubl, Bittern Monitoring Reports); 1972 estimate from Day & Wilson (1978)
Little Egret	OTHER (app. occ. nests)	28/28	CO	From Lock & Cook (1998)
Whooper Swan	RBBP 1978 95 (max total wild pairs)	26/28	UP	Donald (in Gibbons <i>et al.</i> 1993) states they did not breed 1948-77, so zeros added for 1970-77
Barnacle Goose	ATLAS (occ. 10-km squares)	3/28	LW in	817 adults in UK in 1991 (Delany 1993); no earlier estimate
Egyptian Goose	SURVEY (individuals)	3/28	LW in	1963 estimate is mean from Atkinson-Willes (1963); 1981-83 estimate (birds) from Lack (1986); 1991 estimate (adults only) from Delany (1993); see also Sutherland & Allport (1991)
Wigeon	ATLAS (occ. 10-km squares)	3/28	UP	Number of squares in 1988-91 probably a slight overestimate owing to inclusion of birds summering but not breeding
Pintail	RBBP 1973 95 (max total pairs)	23/28	LW	
Garganey	RBBP 1980 95 (max total pairs)	15/25	LW	
Red-crested Pochard	OTHER (individuals)	26/28	LW in	Cotswold Water Park only (main UK site); 1970-89 from Baatsen (1990); 1990-92 from Wiltshire Bird Report ( <i>Hobby</i> ); rest from 1995/96 WeBS; some query over east & west sites within CWP
Pochard	RBBP 1986 95 (max total pairs)	10/18	LW	
Scaup	RBBP 1973 95 (max total pairs)	23/28	UP	
Common Scoter	RBBP 1973 95 (max total pairs)	23/28	UP	1995 estimate is from Underhill <i>et al.</i> (1998)

Species	Data set (units)	No. years (real data/total)	Habitat	Notes
Goldeneye	RBBP 1973 92 (max total pairs)	20/28	LW	
Honey Buzzard	RBBP 1973 95 (max total pairs)	23/28	WO	
Red Kite	RBBP 1973 95 (total pairs)	27/28	UP	1970-72 figures from Davis & Newton (1981); 1997 from RSPB SAP; NB complications of breeding v territorial pairs; see also Newton <i>et al.</i> (1994), Anon (1997a), Evans <i>et al.</i> (1997)
White-tailed Eagle	OTHER (no. home ranges with pairs or trios)	28/28	CO	Data for 1982-92 from Green <i>et al.</i> (1996); for 1993-97 from Sea Eagle Project Newsletter (Anon 1997b); zero pairs before 1982; see also Halley (1998)
Marsh Harrier	RBBP 1973 95 (breeding females)	24/28	LW	1971, 1983-90 & 1995 figures from Underhill-Day (1998); others post-1973 from RBBP; 1986 & 1989 figures exclude renests
Montagu's Harrier	RBBP 1973 95 (max total pairs)	23/28	FA	
Goshawk	RBBP 1973 95 (max total pairs)	23/28	WO	
Golden Eagle	SURVEY (pairs)	3/23	UP	1982-83 data from Dennis <i>et al.</i> (1984); 1992 from Green (1996); see also Everett (1971a), Halley (1998)
Osprey	RBBP 1973 95 (total pairs)	26/28	LW	1970-72 data from graph on p. 117 in Gibbons <i>et al.</i> (1993)
Hobby	RBBP 1973 95 (max total pairs)	23/28	FA	see also Parr (1994)
Quail	RBBP 1986 95 (max total pairs)	10/19	FA	
Lady Amherst's Pheasant	OTHER (tetrads in Bedfordshire)	3/28	WO in	A high proportion of population is in Bedfordshire; data from Dazley & Trodd (1994)
Spotted Crake	RBBP 1973 95 (singing males)	23/28	LW	
Corncrake	SURVEY (singing males)	8/28	FA	1978/79, 1988 & 1993 figures from Green (1995); subsequent figures from 1996 Corncrake Newsletter (Anon 1996a); 1997 data from RSPB ends-report; 1994-97 figures cover core of range only
Crane	RBBP 1973 95 (pairs)	26/28	LW	Did not breed 1970-72; hence zero values
Black-winged Stilt	RBBP 1973 95 (pairs)	26/28	LW	Did not breed 1970-72 (Gibbons <i>et al.</i> 1993); hence zero values
Avocet	RBBP 1973 95 (confirmed prs)	23/28	CO	

Species	Data set (units)	No. years (real data/total)	Habitat	Notes
Stone-curlew	RBBP 1973 95 (max total pairs)	25/28	FA	1996-97 figures from RSPB SAP (proven breeding pairs) may be low compared to earlier RBBP data; see also Anon (1997c)
Temminck's Stint	RBBP 1973 95 (max total pairs)	26/28	UP	Breeding first proven in 1971 (Headlam 1972), hence zero for 1970; 1971 & 1972 figures inferred from Gibbons <i>et al.</i> (1993)
Purple Sandpiper	RBBP 1973 95 (max total pairs)	26/28	UP	Did not breed until 1978 (Dennis 1983), hence zeros for 1970-72
Ruff	RBBP 1973 94 (max. no. nesting females)	23/28	NC	Up to 1993 number of females was quoted, but from 1994 number of leks; difficult to stitch together
Black-tailed Godwit	RBBP 1973 95 (max total pairs)	23/28	NC	
Wood Sandpiper	RBBP 1973 95 (max total pairs)	23/28	UP	
Red-necked Phalarope	OTHER (males, 1976-96)	22/28	UP	Data for 1976-96 from graph in O'Brien <i>et al.</i> (1997); 1970 data (number of pairs) from Everett (1971b)
Mediterranean Gull	RBBP 1973 95 (max total pairs)	26/28	CO	Bred 1968 then not until 1976; hence zeros for 1970-72
Little Gull	RBBP 1973 95 (max total pairs)	26/26	LW	
Roseate Tern	OTHER/SMP (pairs)	28/28	CO	Data for 1970-92 from Avery <i>et al.</i> (1995); 1993-97 from Thompson <i>et al.</i> (1998)
Rose-ringed Parakeet	ATLAS (occ. 10-km squares)	3/28	UR in	
Snowy Owl	RBBP 1973 95 (breeding females)	28/28	UP	
Hoopoe	RBBP 1973 95 (max total pairs)	25/26	NC	
Wryneck	RBBP 1973 95 (max total pairs)	23/28	WO	
Shorelark	RBBP 1973 95 (max total pairs)	26/26	UP	1970-72 figure inferred from Batten <i>et al.</i> (1990)
Bluethroat	RBBP 1973 95 (max total pairs)	26/28	NC	Believed no breeding season records 1970-72 (Batten <i>et al.</i> 1990)
Black Redstart	RBBP 1973 95 (max total pairs)	14/28	UR	Some missing years in RBBP run
Fieldfare	RBBP 1973 95 (max total pairs)	23/28	WO	

Species	Data set (units)	No. years (real data/total)	Habitat	Notes
Redwing	RBBP 1973 95 (max total pairs)	23/28	WO	
Cetti's Warbler	RBBP/SURVEY 1973 95 (max total pairs)	27/28	LW	Survey data from Wotton <i>et al.</i> (1998)
Savi's Warbler	RBBP 1973 95 (max total pairs)	23/28	LW	
Marsh Warbler	RBBP 1973 95 (max total pairs)	20/28	LW	Some missing years in RBBP run
Icterine Warbler	RBBP 1973 95 (pairs)	26/26	NC	None recorded in breeding season 1970-72; hence zeros
Firecrest	RBBP 1973 95 (max total pairs)	23/28	WO	
Bearded Tit	OTHER/SURVEY (breeding pairs)	23/28	LW	Data from Campbell <i>et al.</i> (1996), corrected for uncounted top sites; data cover Britain & Ireland, but Irish population is tiny
Golden Oriole	RBBP 1973 95 (max total pairs)	23/28	WO	
Red-backed Shrike	RBBP 1973 95 (max total pairs)	23/28	NC	
Chough	SURVEY (breeding pairs)	2/23	CO	1982 data from Bullock <i>et al.</i> (1983); 1992 Stone <i>et al.</i> (1997)
Brambling	RBBP 1973 95 (max total pairs)	23/28	WO	
Serin	RBBP 1973 95 (max total pairs)	23/25	NC	
Scottish Crossbill	NONE	0/0	WO	
Parrot Crossbill	RBBP 1973 95 (max total pairs)	26/28	WO	Did not breed during 1970-72; hence zeros
Common Rosefinch	RBBP 1973 95 (max total pairs)	26/28	NC	
Lapland Bunting	RBBP 1973 95 (max total pairs)	23/28	UP	
Snow Bunting	RBBP 1973 95 (max total pairs)	22/28	UP	Some missing years in RBBP run
Cirl Bunting	RBBP/SURVEY 1982 95 (max total pairs)	16/28	FA	1997 figure from RSPB ends-report (unpublished); 1970, 1982 & 1989 figures from Evans (1992); other data from RBBP



**C: Additional species excluded because they were introduced or feral (n=9)**

<b>Species</b>	<b>Data set (units)</b>	<b>No. years (real data/total)</b>	<b>Habitat</b>	<b>Notes</b>
Greylag Goose (introduced)	WeBS index 1970/71 96/97	27/28	LW	Have assumed WeBS index reliably reflects breeding season trend; see also Owen & Salmon (1988)
Canada Goose	WeBS index 1970/71 96/97	27/28	LW	Have assumed WeBS index reliably reflects breeding season trend
Mandarin Duck	ATLAS (occ. 10-km squares)	3/28	LW	
Ruddy Duck	WeBS index 1970/71 96/97	27/28	LW	Have assumed WeBS index reliably reflects breeding season trend
Red-legged Partridge	CBC index 1970 97	28/28	FA	
Pheasant	CBC index 1970 97	28/28	WO	
Golden Pheasant	ATLAS (occ. 10-km squares)	3/28	WO	
Feral Pigeon	ATLAS (occ. 10-km squares)	3/28	UR	These data are for Rock Dove and Feral Pigeon combined
Little Owl	CBC index 1970 97	28/28	FA	

**D: Additional species excluded owing to lack of real or imputed 1970 data (n=12)**

Species	Data set (units)	No. years (real data/total)	Habitat	Notes
Red-throated Diver	SURVEY (breeding pairs)	2/22	UP	1983 data from Gomersall <i>et al.</i> (1984); 1994 from Gibbons <i>et al.</i> (1997); only comparison that can be made is for Shetland; numbers are corrected for birds missed
Manx Shearwater	NONE	0/0	CO	
Storm Petrel	NONE	0/0	CO	
Leach's Petrel	NONE	0/0	CO	
Merlin	SURVEY (breeding pairs)	4/22	UP	1983-84 estimate is mean of counts in Bibby & Nattrass (1986); 1993-94 figure is from Rebecca & Bainbridge (1998)
Dunlin	NONE	0/0	UP	Atlas change figures based on all records are probably overestimates owing to inclusion of birds summering but not breeding; that based on breeding records is probably too low
Razorbill	NONE	0/0	CO	1985-87 data are available but comparison with 1969-70 considered unreliable (see Thompson <i>et al.</i> 1998, Table 1.1)
Black Guillemot	NONE	0/0	CO	1985-87 data are available but comparison with 1969-70 considered unreliable (see Thompson <i>et al.</i> 1998, Table 1.1)
Puffin	NONE	0/0	CO	1985-87 data are available but comparison with 1969-70 considered unreliable (see Thompson <i>et al.</i> 1998, Table 1.1)
Rock Dove	NONE	0/0	CO	
Nightjar	SURVEY (singing males)	2/24	NC	1981 data from Gribble (1983); 1992 from Morris <i>et al.</i> (1994)
House Martin	NONE	0/0	UR	Sparse CBC data led to problem generating the index, even when period of years was restricted

### APPENDIX 3 REFERENCES CONSULTED FOR BIRD POPULATION DATA

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