BTO Research Report 292

Waterways Breeding Bird Survey: progress report for 2000–01

John H Marchant, David G Noble & L Peter Beaven

A report to the Environment Agency

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BTO, The Nunnery,
Thetford, Norfolk, IP24 2PU

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EXECUTIVE SUMMARY

1 The Waterways Breeding Bird Survey (WBBS), which is operated by BTO and funded in collaboration with the Environment Agency's R & D Programme, began in 1998. The present report covers the scheme's development during 2000–01, with emphasis on the results of the 2001 field season. Some summary data from earlier years are included for comparison. Results are given also for the BTO's long-running Waterways Bird Survey (WBS).

2 WBBS coverage in 2001 was due to be increased, as part of Phase 3 of the project. Plans for development were shelved, however, owing to a severe and widespread outbreak of Foot and Mouth Disease (FMD) across the UK in February 2001. No attempt was made to increase the sample. Existing WBBS and WBS observers were mostly unable to gain the necessary access to their sites in 2001. Only 47 WBBS surveys were conducted in 2001, compared with 172 in 2000, and 23 WBS mapping surveys, compared with 97 in 2000. Surveys that were conducted showed a changed geographical distribution, being concentrated mainly in the English Midlands and the north of Scotland.

3 Bird data obtained from WBBS in 2001 showed a preponderance of declines in estimated densities from figures calculated for 1998–2000. While in some species this will reflect real population decrease, some of the change may reflect the different-from-normal distribution of surveys, or a reduction in survey efficiency. High density figures for Feral Pigeon, Starling and House Sparrow may follow from the generally freer access in 2001 to waterways in urban areas, as opposed to the wider countryside.

4 Year-to-year population changes since 2000, as derived from both WBS and WBBS in 2001, were generally negative, probably reflecting population decrease. Reduced survey efficiency, through visits being missed or made later than usual because of FMD, may have biased 2001 counts downward, however. The clearest evidence of decline for a waterside species is for Sedge Warbler, for which five measures of 2000–01 change were all negative.

5 Mammal data were returned from 43 of the 47 WBBS stretches surveyed in 2001. There were 21 mammal species recorded, of which Rabbit and Red Fox were the most widespread, and Rabbit and Red Deer the most numerous.

6 The numbers of WBS and WBBS surveys conducted in 2001, although disappointing in showing the effects of FMD access restrictions, are an encouraging sign of continuing support from BTO volunteers for waterside bird surveys.

7 A further 250 WBBS stretches were selected randomly for coverage beginning in 2002, bringing the total number of random sites selected to 513. Details of all these sites were circulated to BTO Regional Representatives in March 2002. WBS observers were also asked to continue with both WBS and WBBS surveys on their stretches in 2002. It is anticipated that the number of WBBS stretches covered will recover to at least pre-FMD levels in 2002.

1 INTRODUCTION

1.1 The Waterways Bird Survey (WBS)

The BTO has since 1974 been conducting censuses alongside linear waters, both rivers and canals, with the aim of monitoring bird population change in these important yet vulnerable habitats throughout the United Kingdom. The Waterways Bird Survey (WBS) produces data on population changes and on the location of territories in relation to physical features of the waterway environment. These data can be used to investigate, at a variety of spatial and temporal scales, the ways in which breeding birds use river and canal habitats. The primary role of the WBS has been to record population changes among species poorly represented in the BTO's Common Birds Census (CBC). Carter (1989), Marchant *et al* (1990) and Marchant & Balmer (1994) have provided overviews of the WBS and its results.

The BTO/JNCC/RSPB Breeding Bird Survey (BBS) began in 1994 and is an ongoing programme that was designed to take over from CBC as the main way in which population changes of birds are measured in the wider countryside. After a seven-year overlap period between BBS and CBC, the CBC ceased to perform this function in 2000. WBS continues alongside BBS, supplying valuable extra data on a small number of specialist waterside bird species.

The WBS suffers the same failings for bird population monitoring as the CBC did. Sites are non-random and, because the method is labour-intensive, are relatively few in number. In addition, WBS covers only a set list of waterside bird families and species, and so provides no information on more widespread bird species as they occur in the waterside environment. These problems could be addressed by applying BBS-style methods to waterside surveys.

1.2 WBBS development in Phases 1 and 2

With this background, the BTO has been developing a Waterways Breeding Bird Survey (WBBS) since 1998, in conjunction with the Environment Agency's R & D programme. The overall aims of the project are to develop a transect method suitable for collecting breeding bird survey data from random waterway sites, and test its implementation, to

- *supplement data from the BBS with counts from rivers and canals, thus maintaining or expanding the level of bird population monitoring currently available through BBS and the BTO's long-running WBS, and satisfying the needs of organisations with specific interests in bird monitoring, such as JNCC and RSPB; and*

- *provide bird and bird–habitat data, relevant to nature conservation along waterways, that fulfil the requirements of the Environment Agency, and its sister organisations in Scotland and Northern Ireland, that have responsibilities specific to linear waters.*

Previous reports from WBBS have covered progress in Phase 1 (Marchant 1999, Marchant & Gregory 1999, Marchant *et al* 1999) and Phase 2, to the end of the 2000 breeding season (Marchant 2000, 2001, Marchant & Noble 2000, Marchant *et al* 2002).

A major innovation of WBBS is that it is designed to allow linkage to the Environment Agency's River Habitat Survey (RHS). Initial analyses of WBBS bird and RHS habitat data have been reported by Marchant & Gregory (1999) and Marchant *et al* (2002).

1.3 The scope of this report

We now report on results and developments during the period 2000-01.

It was intended that the 2001 breeding season should mark the beginning of Phase 3 of WBBS development, aimed at increasing the number of random surveys to the point where annual monitoring of waterway bird species could be attempted. In practice, this was prevented by the outbreak of Foot and Mouth Disease (FMD) in February 2001. Owing to FMD, no additional fieldwork was requested from BTO volunteers in 2001. Many were prevented from repeating previous surveys, or were able only to make one of the two survey visits, after access restrictions to their stretches were lifted in mid season. Active promotion of WBBS, with a view to increasing the sample size, was postponed until 2002.

Coverage and results obtained from the WBBS and WBS surveys in 2001 are reported here, with some summary data for earlier years included for comparison. While it has been disappointing that the scope for bird surveys was so severely limited in 2001, owing to factors beyond our control, observers were clearly keen to contribute to WBBS and WBS, where access allowed, and this is encouraging for the future development of both surveys.

Preparations made for the expansion of WBBS fieldwork in 2002 are also discussed.

2 METHODS

2.1 Methods of the Waterways Bird Survey

2.1.1 WBS fieldwork methods

WBS procedures have been described in full by Taylor (1982) and Marchant (1994). The bird census method used is territory mapping, which produces an estimate of breeding numbers and a map of breeding territories for each species, stretch and year. Details of the habitats available to the birds are also mapped. Plots are chosen by the observers themselves, under guidance from BTO staff, and are stretches typically 4–5 kilometres long that are of relatively easy access and of which at least one bank can be walked. Observers are asked to make nine visits to their site each breeding season. WBS coverage is restricted to waterside specialist birds such as grebes, ducks, geese, swans, waders, and reedbed passerines.

By 2001, the WBS had completed 28 seasons of mapping fieldwork and recorded much very valuable information on population change and relationships between birds and habitat (e.g. Rushton *et al* 1994, Marchant & Beaven 2000, Marchant 2001). Surveys continued in 2002.

2.1.2 Calculation of year-to-year population change from WBS data

The units of WBS mapping results are apparently occupied territories, whereas for WBBS and BBS they are the numbers of birds counted. Long-term monitoring from WBS data is possible for around 24 species that occur on at least 15 or so plots in each year, where number of territories can be modelled as a function of year and site. Year-to-year changes from WBS are typically presented using a chain-index method that simply pairs the year-1 and year-2 data for those plots that were surveyed in both years (e.g. Marchant & Beaven 2000, Marchant 2001). This approach is taken here in considering population change between 2000 and 2001.

Only those WBS plots where coverage was similar in 2000 and 2001 contributed to the calculations, and any individual counts that were not comparable between the two years were also excluded.

2.2 Methods of the Waterways Breeding Bird Survey

2.2.1 Selection of sites for coverage

A major innovation of WBBS is its use of random waterway sites for bird surveys. This sampling strategy allows WBBS results to be treated as representative of waterways generally, throughout the United Kingdom.

To select waterways randomly, we made a random selection of 2x2-km national grid squares, discarded those without a waterway running through them, and sought coverage of the waterway that ran through the selected square. The tetrad (2x2 km) was selected as the most appropriate grid-square size since, after a trial run, it emerged that too high a proportion of 1-km squares held no waterway. Larger squares (5x5 or 10x10 km) frequently held more than one waterway, and so raised questions about which to select from within the square. RHS reference sites have been chosen from 10-km squares, however, using the protocol of taking the stretch closest to a predetermined point within the square.

A clear definition was required of the water bodies that formed the population being sampled. The linear waters that were to be studied could have included rivers, canals, stretches that could be defined as both river and canal, and various kinds of ditches and drains. For rivers, a policy was needed on whether headwaters should be excluded and how this could be achieved, and also on whether broad or tidal stretches should be included. For the purpose of the WBBS, a waterway has been defined as any double blue line, with shaded in-fill, on the OS 1:25,000 Pathfinder map series. Single blue lines, typically minor headwaters and drainage ditches, and all non-linear water features were ignored. Enquiries with OS revealed that double blue lines with 'water stipple' are used on this scale only for features that are 6.5 metres or more wide (W. Debeugny, pers. comm.). Rivers were considered to finish at the normal tidal limit as marked as 'NTL' on the OS maps; no width limit was applied.

Stratification, for example by waterway type, RHS data, water quality, waterbird density or observer density, may be applied to WBBS in the future, either to reduce the variance of selected results or to make best use of the available manpower. No stratification of the sample was required to meet the aims of survey's initial phases.

For each selected random waterway, a map was prepared showing the boundaries of the random tetrad and the selected waterway. The waterway was picked out with a highlighter, typically for several km from the tetrad boundary, in both directions. These maps were sorted by BTO region and sent to the relevant BTO RR, whose job it was to match each site with an observer.

Start and end points within the highlighted length of waterway were not pre-set, but were left for the observer to determine with regard to:

- *the requested location;*
- *the requirement for a whole number of complete 500-metre transect sections;*
- *convenience of access;* and
- *the observer's preference for the number of sections to be covered (maximum ten).*

These concessions were designed to ensure that access problems could be overcome in the majority of cases, and a survey route set up that could be used on a long-term basis.

2.2.2 WBBS fieldwork methods

The BBS method had already proved to be enjoyable, popular with observers, and well fitted to its purpose. It was their transfer to waterways that was being tested. Modifications to BBS procedures were therefore kept to a minimum.

BBS uses a transect method in which two visits are made, termed 'early' and 'late', one in the first and one in the second half of the breeding season (BTO 1998, Gregory *et al* 1998). The transect route is divided into up to ten sections of fixed length. During each visit, all birds seen or heard are counted, section by section, in each of three distance bands from the transect line (0–25 metres, 25–100 metres, and >100 metres, summing counts from both sides of the transect line); birds seen only in flight are recorded separately.

WBBS instructions and recording forms are based heavily on those designed for BBS. Some details of the design of forms were altered in minor ways between 1998 and 2000 but, once established, the field methods of WBBS have been kept constant. Forms for 1998–2000 are each appended to the reports for those seasons (Marchant & Gregory 1999, Marchant & Noble 2000, Marchant *et al* 2001). These contain full details of fieldwork methods and recording.

The methods for WBBS differ from those of BBS in that:

- *routes within sites follow the waterway rather than a predetermined pattern based on the national grid;*
- *the sections composing each transect stretch are each 500 metres, to match RHS, not 200 metres as in BBS;*
- *transects are not fixed at 2 km, as in BBS, but are of variable length, with a maximum of 5 km (ten 500-metre sections);* and
- *habitat recording is extended from the BBS standard to allow extra information to be recorded about the waterway itself.*

Other aspects of fieldwork and analysis are identical.

As on BBS, mammals and signs of mammals were noted on each counting visit. For each species of wild mammal detected, either presence or a pair of counts (one early in the season and one late) was recorded. WBBS observers coded the main features of up to three habitat types per 500-metre section of canal, of which the first habitat was the canal itself and the other one or two were those considered by the observer to be the most important adjoining habitats. The system of habitat coding used was that devised by Crick (1992) and now used for all BTO monitoring surveys.

WBBS requires only two visits to count birds, compared to WBS's nine, and so is much quicker and simpler for observers. WBBS's transect data require relatively little processing and so there are efficiencies also for analysts. Importantly, its random sampling design ensures that the results are representative of the waterway habitat.

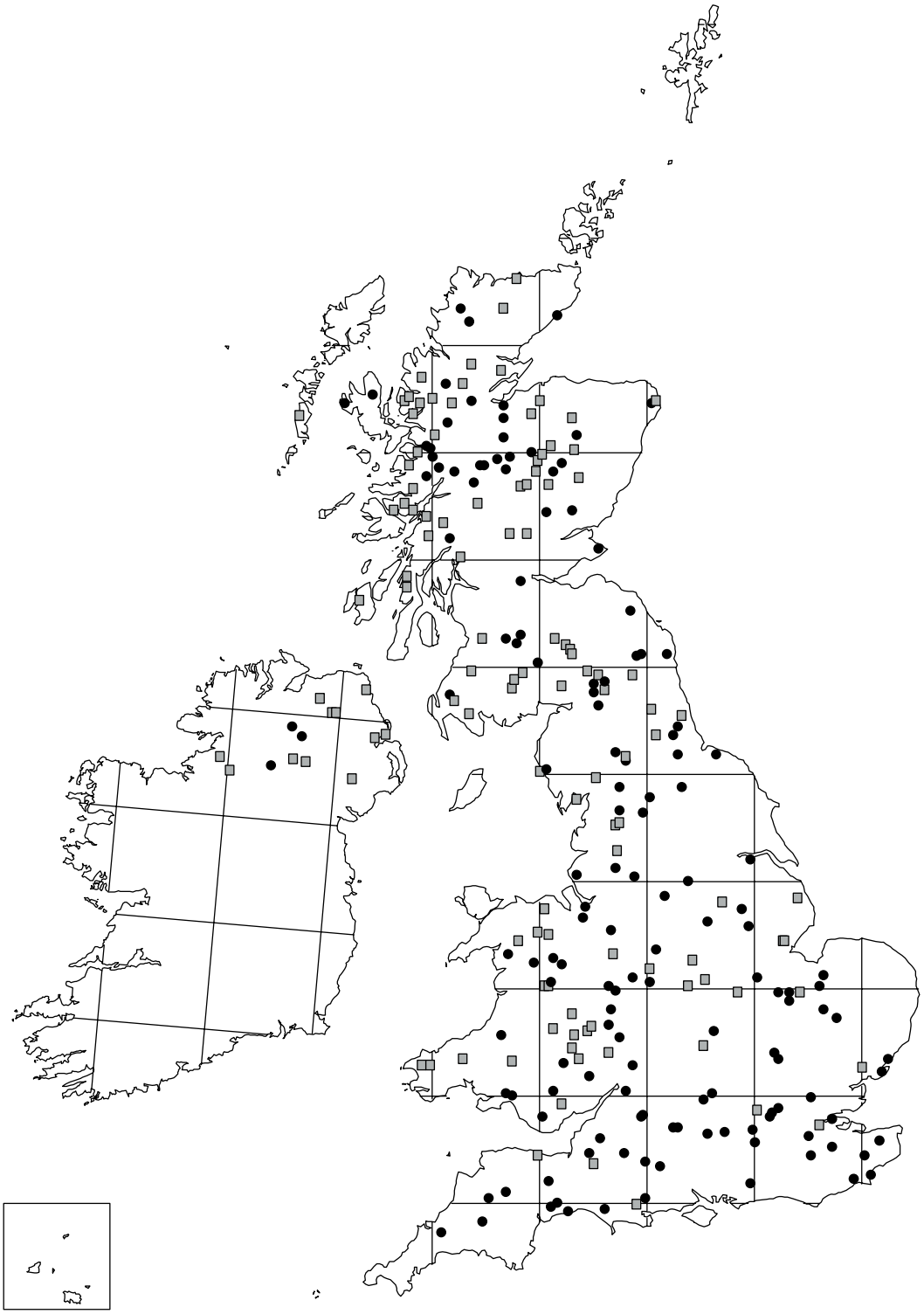
2.2.3 Application of WBBS methods in 2001

Sites designated for coverage in 2001 were the 263 sites randomly selected for Phase 2 of WBBS. These 263 random stretches represent a sample drawn from the whole of the UK (Figure 1).

Figure 1 shows the wide geographical scatter of the 263 randomly selected plots, but also the absence of stretches in some parts of the UK. The pattern of distribution follows from the area-based method of selection which, since the density of river courses in a catchment is greatest in the upper reaches, is more likely to score a hit with random tetrads that lie close to the watershed. Few stretches were selected in coastal regions and there were concentrations in some areas of higher ground, for example the Grampians, Southern Uplands and Welsh Marches. Eastern East Anglia, where river courses are few and well scattered, was not represented in the sample since, by chance, none of the tetrads selected there contained a waterway.

Within each region, each stretch was allocated a priority number (beginning at 1, i.e. top priority), which was derived from the order of the random selection. BTO Regional Representatives (RRs) then sought volunteer observers to cover as many of their selected sites as possible, beginning at priority 1 and working down the list. RRs distributed survey packs and collected completed forms for return to BTO HQ.

Figure 1. **Distribution of random WBBS stretches selected for coverage. Those surveyed at least once during 1998–2001 are shown as black spots and those not surveyed as grey squares.**



WBBS survey packs were distributed from BTO headquarters to all current WBS observers with a request to contribute to both surveys in 2001, as in 1999 and 2000.

All observers and RRs were sent guidance on fieldwork procedures in the light of the Foot and Mouth epidemic (Table 1), and referred to the BTO web site for any updated information. Few areas were unaffected by the disease or by precautionary restrictions, and fieldwork in 2001 was therefore severely limited.

Table 1. Guidance distributed to WBBS and WBS observers in spring 2001 with respect to Foot and Mouth Disease.

Where and when surveys can be carried out
1. Area descriptions given below are as described and mapped on the MAFF website www.maff.gov.uk/animalh/diseases/fmd for England and Wales. For equivalent information for Northern Ireland see www.dardni.gov.uk/footandmouth and for Scotland see www.scotland.gov.uk/agri/footandmouth
2. Do not carry out your survey if it includes any Infected Premises or falls within the 3 km radius Protection Zones surrounding Infected Premises as mapped on the appropriate website (see above).
3. Except under the circumstances covered in point 5, do not carry out your survey if it falls within an Infected Area as defined on the appropriate website (see above). Infected Areas are broad regions of the country that surround clusters of infected farms.
4. The prohibition of fieldwork in Infected Areas applies even to fieldwork that can be done from public rights of way.
5. You may carry out fieldwork in Infected Areas so long as your fieldwork is confined to urban or suburban situations and so long as it does not entail you going within 100 m of farmland.
6. Surveys can be carried out in Provisionally Free and At Risk Areas (as defined on the websites) as long as none of the other restrictions (see below) apply.
7. Do not carry out your survey if public access is denied (for example, through the closing of public footpaths) even if the region is outside an Infected Area (i.e., Provisionally Free or At Risk). These restrictions may change rapidly. However, you may use rights of way closed to the general public if you have the permission of the landowner or tenant.
8. Do not go closer than 100 m to any livestock present, even if they are separated from you by a physical boundary (fence, hedge, etc). Livestock means cows, sheep, pigs, goats and farmed deer, but not horses.
9. Only carry out your WBBS if you can complete all transect sections. Data cannot be used unless they are collected in the same way as previous years, e.g., if 9 out of 10 sections are on roads and the tenth is on a closed footpath, please cancel fieldwork for the year.
10. One visit only WBBS (i.e., just the late survey) **are** still valid. Please carry out fieldwork if access restrictions are lifted in time for the second visit, and where none of the other restrictions apply.
Getting permission: contact with farmers and other landowners
11. Getting permission is a very sensitive issue. When seeking permission, please do not do so in a way that suggests that you think it ought to be granted. Please do not even seek permission if you suspect that the farmer is unlikely to grant it. This is particularly relevant in areas with high incidences of infection (e.g., Cumbria, Devon, Dumfries and Galloway).

12. You must contact any farmers or other landowners or tenants on whose land you plan to undertake fieldwork this year, even if you previously had blanket permission to go on the land.
13. You should also ensure that neighbouring landowners and tenants have no problem with you carrying out your survey, if your route or access comes within 100m of their land.
Volunteer participation
14. Volunteers who live within 3 km of any Infected Premises (in other words – within the Protection Zone) or who have entered any Infected Premises should not undertake survey work in the countryside this season.
15. In all circumstances, do everything you can to minimise the risk of infection. Please ensure that any footwear is disinfected when moving between areas, and follow any special precautions (disinfectant mats, sprays) requested by the landowner or tenant.
16. Do not take any meat or dairy-based food or drink with you.

2.2.4 Calculation of year-to-year population change from WBBS data

This report contains estimates of population change between 2000 and 2001, derived from WBBS data for stretches covered in both years. For each year, species and stretch, a mean count was calculated by summing all the counts across 500-m sections and distance categories and dividing the total by the number of sections to give a mean value per 500-m section. The overall means of these values, across all stretches for which paired data were available for 2000 and 2001, were used to estimate year-to-year change for each species.

3 RESULTS FROM WBBS AND WBS IN 2001

3.1 Coverage achieved by WBBS in 1998–2001

The numbers of stretches surveyed are shown in Table 2. Totals for 1998-2000 may differ from those given in earlier reports where they include forms that were received well after the set deadlines. Any late data, yet to be submitted, will be included in future analyses.

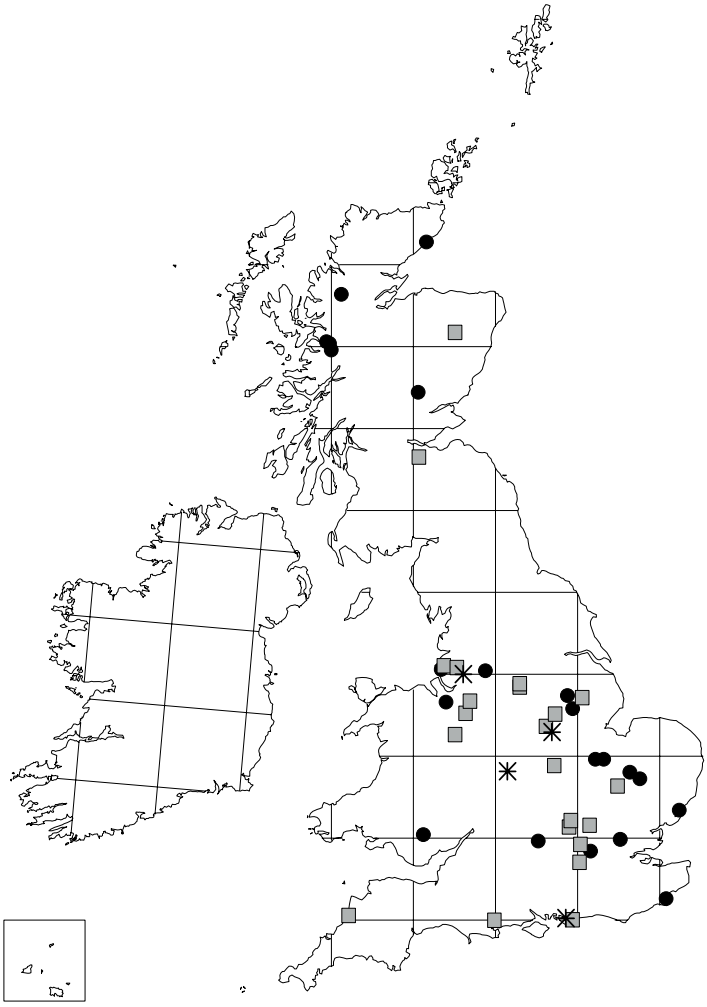
Table 2. Totals of WBBS stretches surveyed in 1998–2001.

Reason for survey	1998	1999	2000	2001	Surveyed at least once
Random stretches	107	116	106	21	146
For comparison with WBS data	15	64	61	22	77
Other non-random stretches	46	4	5	4	47
TOTAL	168	184	172	47	270

Of the 263 stretches that had been selected randomly, 107 were surveyed in 1998, 116 in 1999 and 106 in 2000 (Table 2). Only 21 of these were surveyed in 2001, two of them for the first time. In all in 2001, 47 sites were surveyed, representing only 27% of the coverage in the previous year. These were concentrated in the English Midlands and the north of Scotland, these being areas where access generally was less restricted than elsewhere (Figure 2).

A full list of stretches covered is given in Appendix 1.

Figure 2. The 47 sites at which WBBS fieldwork was conducted in 2001. Surveys at randomly chosen locations are shown as black spots, those conducted at non-random WBS plots as grey squares, and other non-random sites as asterisks.



3.2 WBBS data collection for birds

WBBS observers have been successful in recording a wide variety of bird species during their visits. Table 3 lists those recorded on at least six of the randomly selected stretches, together with their mean frequencies overall, in each year 1998–2001. WBS and other non-random sites are not included. Zero values from stretches where the species was absent are included in the means, which are therefore comparable across species. The five most abundant species recorded, across all years of the survey, were Wood Pigeon, Starling, Rook, Mallard and Wren. In 2001, the ranking was Wood Pigeon (73.3 birds per 10 km), Starling (69.4), Mallard (48.5), Feral Pigeon (42.7), and Blackbird (28.8); no figure was calculated for Rook, however. The most widespread species in 2001 on these stretches were Wren and Blackbird, followed by Wood Pigeon, Robin, Carrion Crow and Chaffinch.

Standard errors are not tabulated but were larger than the means in all cases. Differences between years in the mean figures reported for particular species result from chance effects and the effects of plot turnover as well as from population changes among the birds themselves.

Table 3. **Birds recorded on randomly selected WBBS stretches in 1998–2001. Numbers of birds per 10 km are the means from all random stretches covered, including those where the species was not found. The number of occupied stretches is also given. No figures are presented where the sample size was fewer than six plots.**

Species	Birds per 10 km (number of stretches occupied)			
	1998 (n=107)	1999 (n=116)	2000 (n=106)	2001 (n=21)
Little Grebe	1.3 (12)	1.1 (12)	0.5 (6)	.
Great Crested Grebe	0.8 (6)	1.0 (9)	.	.
Cormorant	2.4 (27)	2.7 (29)	2.8 (24)	.
Grey Heron	5.3 (63)	4.8 (71)	5.4 (69)	4.4 (12)
Mute Swan	10.4 (40)	7.4 (45)	5.8 (38)	2.8 (8)
Greylag Goose	7.0 (13)	4.7 (11)	2.5 (11)	.
Canada Goose	7.6 (35)	7.9 (27)	10.4 (28)	.
Shelduck	13.5 (10)	9.2 (10)	15.8 (10)	.
Gadwall	1.3 (7)	0.9 (6)	1.5 (8)	.
Teal	0.5 (8)	0.4 (6)	0.8 (11)	.
Mallard	42.3 (91)	43.0 (98)	47.3 (86)	48.5 (15)
Tufted Duck	7.0 (17)	4.1 (17)	3.4 (16)	4.7 (6)
Goosander	1.4 (18)	1.2 (14)	1.1 (15)	.
Sparrowhawk	0.9 (20)	0.5 (16)	0.7 (11)	.
Buzzard	2.3 (31)	2.4 (43)	2.8 (38)	.
Kestrel	1.6 (35)	1.3 (28)	1.8 (23)	.
Red Grouse	.	.	0.3 (6)	.
Red-legged Partridge	2.2 (16)	2.5 (15)	2.1 (17)	.
Grey Partridge	1.0 (12)	0.4 (9)	1.0 (12)	.
Pheasant	8.8 (59)	11.4 (68)	11.2 (63)	12.2 (12)
Moorhen	9.5 (62)	10.3 (63)	11.1 (57)	14.6 (13)
Coot	5.9 (29)	7.2 (24)	5.5 (22)	12.4 (10)
Oystercatcher	7.8 (26)	8.7 (32)	8.2 (26)	.
Lapwing	21.1 (35)	8.2 (39)	9.2 (36)	23.2 (6)
Snipe	0.8 (10)	0.6 (12)	0.6 (11)	.
Curlew	4.2 (25)	5.0 (30)	4.3 (26)	.
Redshank	1.7 (8)	1.5 (7)	2.1 (12)	.
Common Sandpiper	5.2 (34)	3.6 (30)	4.2 (35)	.
Black-headed Gull	33.0 (35)	11.4 (32)	17.1 (36)	14.9 (7)
Common Gull	4.8 (15)	4.4 (14)	13.9 (14)	.
Lesser Black-backed Gull	8.2 (22)	5.1 (28)	5.6 (25)	4.9 (7)

Herring Gull	18.7 (28)	8.2 (28)	8.9 (23)	.
Common Tern	1.0 (11)	1.1 (13)	.	.
Feral Pigeon	14.8 (23)	13.9 (21)	15.7 (24)	42.7 (6)
Stock Dove	5.4 (30)	8.4 (39)	6.3 (36)	5.0 (7)
Wood Pigeon	64.2 (89)	76.0 (94)	80.5 (90)	73.3 (16)
Collared Dove	5.4 (43)	5.8 (45)	7.5 (46)	6.5 (12)
Turtle Dove	1.2 (9)	1.9 (15)	1.4 (11)	.
Cuckoo	2.3 (41)	2.4 (37)	2.3 (43)	2.0 (6)
Little Owl	0.3 (6)	.	.	.
Tawny Owl	.	0.2 (6)	0.2 (6)	.
Swift	30.3 (61)	21.3 (59)	21.2 (54)	15.3 (9)
Kingfisher	1.9 (30)	1.6 (37)	1.7 (29)	.
Green Woodpecker	1.9 (29)	1.8 (31)	2.2 (34)	.
Great Spotted Woodpecker	2.5 (37)	1.3 (32)	1.6 (35)	.
Skylark	11.4 (56)	10.2 (54)	9.2 (51)	13.5 (12)
Sand Martin	16.3 (29)	10.7 (32)	14.7 (28)	6.2 (6)
Swallow	15.1 (73)	18.4 (87)	19.4 (79)	12.2 (15)
House Martin	14.8 (48)	18.7 (53)	16.1 (50)	8.7 (9)
Tree Pipit	0.2 (6)	0.8 (11)	0.4 (9)	.
Meadow Pipit	19.7 (38)	18.8 (42)	20.0 (41)	23.3 (6)
Yellow Wagtail	2.3 (12)	1.6 (11)	1.8 (9)	.
Grey Wagtail	3.6 (42)	5.2 (63)	5.6 (55)	2.5 (6)
Pied Wagtail	6.2 (63)	6.4 (63)	6.4 (69)	4.9 (13)
Dipper	3.3 (39)	2.8 (42)	3.2 (44)	.
Wren	37.6 (87)	43.9 (101)	45.5 (92)	27.2 (17)
Dunnock	8.1 (63)	6.8 (71)	7.4 (65)	7.2 (12)
Robin	18.1 (77)	20.1 (93)	21.8 (89)	12.6 (16)
Redstart	1.1 (11)	1.0 (12)	0.9 (13)	.
Whinchat	0.7 (11)	0.8 (11)	1.2 (11)	.
Stonechat	.	0.4 (6)	1.1 (10)	.
Wheatear	2.3 (16)	1.9 (21)	1.6 (10)	.
Blackbird	32.6 (85)	31.5 (95)	37.0 (88)	28.8 (17)
Song Thrush	10.4 (73)	10.9 (80)	11.5 (81)	6.2 (13)
Mistle Thrush	4.8 (48)	5.3 (57)	4.7 (53)	5.5 (8)
Sedge Warbler	6.6 (31)	7.4 (37)	10.0 (41)	15.5 (12)
Reed Warbler	7.4 (23)	8.8 (24)	9.2 (23)	14.7 (9)
Lesser Whitethroat	0.9 (12)	0.4 (7)	0.5 (8)	.
Whitethroat	7.6 (50)	7.7 (44)	7.7 (50)	11.5 (11)
Garden Warbler	2.7 (35)	2.7 (39)	2.3 (30)	.

Blackcap	10.8 (61)	8.7 (66)	9.2 (64)	4.7 (7)
Wood Warbler	.	.	0.5 (7)	.
Chiffchaff	8.1 (56)	4.9 (53)	6.0 (45)	.
Willow Warbler	16.0 (78)	15.4 (88)	13.9 (69)	12.6 (12)
Goldcrest	2.2 (30)	3.4 (36)	4.5 (43)	.
Spotted Flycatcher	1.4 (21)	1.6 (28)	2.2 (29)	.
Long-tailed Tit	6.7 (52)	8.2 (56)	7.7 (49)	1.9 (6)
Marsh Tit	0.5 (10)	0.5 (11)	0.7 (11)	.
Willow Tit	0.5 (9)	0.2 (6)	.	.
Coal Tit	2.5 (25)	3.4 (33)	2.4 (30)	.
Blue Tit	30.3 (84)	23.5 (91)	26.7 (85)	12.9 (13)
Great Tit	17.8 (82)	13.3 (87)	14.5 (83)	5.2 (10)
Nuthatch	0.9 (18)	1.6 (23)	1.5 (20)	.
Treecreeper	1.6 (29)	2.2 (39)	1.9 (29)	.
Jay	2.3 (27)	1.9 (32)	1.7 (29)	.
Magpie	11.0 (66)	12.1 (74)	10.5 (66)	10.6 (11)
Jackdaw	23.2 (56)	26.1 (60)	24.4 (62)	17.7 (9)
Rook	57.8 (57)	70.7 (59)	50.6 (51)	.
Carrion Crow	32.2 (88)	31.0 (92)	33.1 (86)	16.9 (16)
Hooded Crow	0.6 (8)	0.9 (12)	0.6 (9)	.
Raven	0.5 (9)	0.7 (13)	0.7 (16)	.
Starling	64.6 (65)	60.5 (72)	55.9 (73)	69.4 (14)
House Sparrow	9.9 (45)	11.0 (47)	14.1 (48)	22.8 (11)
Tree Sparrow	.	.	1.0 (6)	.
Chaffinch	38.6 (93)	39.6 (101)	41.2 (95)	22.2 (16)
Greenfinch	8.8 (58)	8.5 (61)	9.7 (58)	11.5 (13)
Goldfinch	9.3 (55)	8.4 (62)	10.0 (65)	10.0 (13)
Siskin	0.8 (10)	1.1 (10)	1.0 (11)	.
Linnet	7.0 (27)	8.8 (38)	7.1 (29)	8.3 (13)
Lesser Redpoll	0.4 (7)	.	0.3 (6)	.
Bullfinch	1.6 (24)	1.1 (22)	0.8 (17)	.
Yellowhammer	3.8 (35)	4.1 (38)	3.6 (37)	2.5 (8)
Reed Bunting	5.1 (44)	5.3 (42)	4.2 (38)	7.4 (11)
Corn Bunting	0.8 (7)	.	1.0 (7)	.

3.3 WBBS estimates of population change, 2000–01

Estimates of percentage change for 2000 and 2001, derived from WBBS stretches covered in both years, are presented in Table 4. The WBBS sample is divided into random stretches and sites surveyed because they are WBS plots.

Mean counts per 500-m stretch were multiplied by 20 and expressed as birds per 10 km, to aid comparison with Table 3. These values tend to be higher than the overall figures in Table 3, however, because the means in Table 4 are drawn only from those stretches where the species was present in at least one of the two years, rather than from all stretches, including those where the species was absent, as in Table 3. Means in Table 4 are designed to be comparable between years, within each paired sample, and not between species or between samples within species. Counts tend to be higher on stretches that were also WBS plots, perhaps because of greater observer experience or because the stretches were chosen partly for their high numbers of birds.

The random sites recorded 15 species that increased and 18 that decreased, and the WBS-related stretches recorded 13 that increased and 25 that decreased. Because the sample sizes of stretches in each group are small, the corresponding 95% confidence intervals around each estimate will be wide. Individual estimates do not correspond well between the two classes of stretches, therefore. Of the 31 species for which both estimates were calculated, for only 15 species did the estimates have the same sign. Only four of these 15 species (Swift, Song Thrush, Blackcap and Magpie) showed increases on both samples of stretches, whereas 11 species decreased on both.

Table 4. Percentage changes in population between 2000 and 2001 as estimated from WBBS data. Results from random stretches are shown separately from those from non-random stretches surveyed because they were WBS plots. No data are presented where the sample of sites providing data in both years was less than 11 (about 50% of each sample).

Species	Mean count per 10 km (random sites)		2000–01 change (random sites)	Number of paired sites (random)	Mean count per 10 km (WBS-linked sites)		2000–01 change (WBS-linked sites)	Number of paired sites (WBS-linked)
	2000	2001			2000	2001		
Grey Heron	3.8	4.6	+20.1%	16	9.2	8.8	-4.3%	14
Mute Swan	7.8	3.0	-62%	14	18.9	7.5	-60.4%	13
Mallard	50.0	51.0	+1.9%	16	84.9	69.0	-18.6%	17
Kestrel	.	.	.	.	1.3	1.5	+14.5%	11
Pheasant	15.4	12.5	-19.1%	12	5.8	6.0	+4.1%	14
Moorhen	16.2	15.3	-5.4%	14	19.0	16.2	-14.8%	15
Black-headed Gull	.	.	.	.	5.7	7.5	+31.6%	11
Wood Pigeon	80.3	76.4	-4.8%	16	92.1	82.1	-10.8%	17
Collared Dove	9.8	6.8	-31%	12	10.1	8.8	-12.7%	12
Swift	10.8	16.1	+48.6%	11	29.0	35.9	+23.8%	13
Green Woodpecker	.	.	.	.	2.3	1.9	-19.3%	11
Skylark	12.6	14.2	+13%	12	8.1	6.5	-20.5%	14
Swallow	15.8	11.4	-27.7%	16	13.1	18.6	+42.2%	17
House Martin	.	.	.	.	15.9	33.9	+113.7%	11
Pied Wagtail	6.2	3.5	-43%	18	.	.	.	.

Wren	29.3	26.5	-9.6%	16	53.8	41.6	-22.7%	17
Dunnock	5.9	7.2	+21.7%	13	13.2	8.9	-32.9%	16
Robin	11.3	11.5	+2.7%	16	21.8	19.3	-11.7%	17
Blackbird	29.5	27.7	-6.1%	17	40.5	40.1	-1.1%	17
Song Thrush	4.4	4.5	+1.1%	14	8.8	19.2	+119.6%	16
Mistle Thrush	3.3	5.2	+55.8%	12	4.6	2.7	-41.4%	12
Sedge Warbler	18.5	16.1	-13.4%	13	13.4	9.1	-32%	14
Whitethroat	12.7	11.9	-6%	11	8.5	9.0	+5.1%	16
Blackcap	3.9	4.9	+27.3%	11	9.3	10.2	+10.7%	16
Chiffchaff	.	.	.	.	7.6	8.1	+6.6%	14
Willow Warbler	7.0	6.1	-13.1%	11	6.3	10.8	+72.4%	13
Long-tailed Tit	.	.	.	.	7.9	5.1	-35.2%	12
Blue Tit	16.9	12.3	-27%	15	27.2	23.9	-12.1%	17
Great Tit	8.7	4.7	-45.8%	14	19.8	16.7	-16%	17
Magpie	10.0	11.1	+11.1%	13	14.0	19.9	+42.2%	17
Jackdaw	15.5	18.4	+18.4%	13	30.4	26.5	-12.9%	14
Rook	.	.	.	.	110.0	108.8	-1.1%	12
Carrion Crow	19.8	16.9	-14.4%	16	27.9	33.6	+20.3%	17
Starling	52.7	69.7	+32.3%	15	64.4	54.5	-15.3%	17
House Sparrow	26.1	23.6	-9.5%	14	24.9	17.0	-31.6%	14
Chaffinch	25.6	19.4	-24.4%	17	40.6	35.6	-12.3%	17
Greenfinch	9.4	10.6	+12.6%	12	13.1	12.6	-4.1%	17
Goldfinch	10.1	10.3	+2.1%	14	11.2	7.1	-36.5%	16
Linnet	10.2	7.5	-26.4%	13	.	.	.	.
Reed Bunting	6.3	7.8	+24.1%	11	6.9	6.5	-5.1%	14

3.4 Data collection for mammals

The mammal data recorded by WBBS are always likely to be minimum figures, because mammal recording was secondary to the main tasks of recording birds and habitat, and in general was not systematic. Nevertheless, since mammals are generally an under-recorded group in the UK, any monitoring data, especially from random sites, are valuable.

Across the 47 WBBS returns for 2001, mammal forms were completed and returned for 43 (91%). Mammal recording was therefore well supported by WBBS volunteers, as in 1998–2000.

In all, 21 mammal species were recorded (Table 5). Those found most frequently were diurnal species or ones that left obvious signs of presence. No mammals were recorded from two stretches, and half the sites recorded fewer than three species. Five stretches recorded 10 or more mammal species; the maximum was 11. By far the most numerous mammals seen were Rabbit and Red Deer.

Of specialist waterway mammals, Otters were found on just 2% of stretches in 2001 (15% in 1998, 11% in 1999, 13% in 2000), Water Vole on 19% (9% in 1998, 16% in 1999, 12% in 2000), and American Mink on 14% (8% in 1998, 21% in 1999 and 2000). Increases in the frequency of recording over time should not necessarily be interpreted as a population change in the species

concerned, because they will also be influenced by the observer's increasing knowledge of the stretch; decreases are more likely to be biologically significant.

Table 5. Mammals recorded on all WBBS stretches reporting mammal data in 2001 (n=43). Species are ranked by the number of stretches they occupied. The number of animals counted is the sum of early and late counts across all occupied stretches.

Species	Animals counted	Number of occupied stretches	% of stretches occupied
Rabbit	528	29	67%
Red Fox	2	22	51%
Grey Squirrel	16	21	49%
Mole	2	19	44%
Brown Hare	34	16	37%
Feral/domestic cat	17	14	33%
Shrew species	0	10	23%
Roe Deer	18	8	19%
Water Vole	2	8	19%
Hedgehog	0	8	19%
Badger	0	7	16%
American Mink	0	6	14%
Brown Rat	0	6	14%
Stoat	0	6	14%
Red Deer	509	4	9%
Weasel	1	4	9%
Muntjac Deer	0	2	5%
Fallow Deer	5	1	2%
Otter	0	1	2%
Red Squirrel	0	1	2%
Pine Marten	0	1	2%

3.5 Coverage and results from WBS in 2001

A total of 23 WBS surveys were carried out in 2001. Even allowing for the expected arrival of one or two late submissions, this compares very poorly indeed with the immediately preceding totals of 121 surveys for 1998, 105 for 1999, and 97 for 2000. Correspondence with contributors firmly identifies FMD access restrictions as the sole reason for the lack of fieldwork in most cases.

Of the 23 WBS mapping surveys for which 2001 data were available, there were comparable data from 2000 for 15 plots (Table 6). The eight plots for which comparable data were not

available comprised two plots in South Yorkshire for which the surveys in 2001 were the first since 1989; a plot in Leicestershire last surveyed in 1993; two plots where fewer than six visits were made in 2001; and three plots new to WBS, in Cornwall, Shropshire and Merseyside.

Table 6. A summary of the 15 WBS plots providing data on population change for 2000–01.

Category	No. of plots	Mean length (km)	Total length (km)
All paired plots	15	4.48	67.2
Changes since 1999–2000 comparison			
Plots gained	2	3.6	7.2
Plots lost	73	4.58	334.3
Regional distribution			
Eastern England	7	4.87	34.1
Northern England	2	3.95	7.9
Southern England	1	4.0	4.0
Western England	2	3.9	7.8
Scotland	3	4.47	13.4
Distribution by waterway type			
Canal	7	4.53	31.7
Mixed canal/river	1	6.2	6.2
Slow river	5	4.46	22.3
Fast river	2	3.5	7.0

Since the sample of plots contributing to the calculations was only around one-sixth of normal, the number of species for which population change 2000–01 could be estimated was reduced, and the precision of the estimated that could be made was much less than usual.

A further problem concerns changes in the nature of surveys that may have affected the analyses. The centre of gravity of the plots included appears to have shifted to the south and east, and towards canals (Table 6, Figure 2). This pattern may have arisen through access restrictions being less widespread in parts of eastern England, and because of the easier access to many canals (along towpaths), as opposed to rivers. Many observers made fewer WBS visits than normal, or shifted the timing of these visits towards the later part of the breeding season. This may have reduced the effectiveness of some surveys in 2001, relative to 2000, although cases where the data were obviously different in quality have been excluded as part of the normal vetting procedure. Results of the 2000–01 comparison are presented in Table 7.

Table 7. WBS estimates of population change for 2000–01, drawn from 15 plots in total for which comparable data were received for both years. No estimated are given where the number of contributing plots was less than 8.

Species	Territory total 2000	Territory total 2001	% change	Number of contributing plots
Little Grebe	2	1	.	2
Mute Swan	25	24	-4%	8
Greylag Goose	8	16	.	2
Canada Goose	55	41	.	7
Mallard	345	305	-12%	14
Tufted Duck	32	32	.	7
Goosander	3	3	.	1
Moorhen	187	175	-6%	13
Coot	169	133	-21%	9
Oystercatcher	11	13	.	4
Lapwing	32	21	.	6
Curlew	2	2	.	1
Redshank	6	6	.	1
Common Sandpiper	3	4	.	1
Kingfisher	8	7	.	6
Sand Martin	5	14	.	1
Dipper	8	8	.	3
Grey Wagtail	17	17	0%	8
Pied Wagtail	9	17	+89%	8
Sedge Warbler	143	112	-22%	12
Reed Warbler	68	69	.	6
Whitethroat	75	69	-8%	12
Reed Bunting	45	50	+11%	10

It is notable that, for most of the species for which a population change is tabulated, the change was negative. The five most numerous species recorded by WBS all decreased. The extent to which this observation may relate to changes in the pattern of census coverage is presently unclear, but may become more apparent once more years are added to the data and it becomes possible to view the 2001 season in a broader context. Meanwhile, it seems unwise to place much reliance in population changes derived from the results obtained in 2001.

4 DISCUSSION

4.1 Conclusions from fieldwork and results for 2001

The access restrictions imposed following the outbreak of FMD in February 2001, and still fully in place in most parts of the UK well into the spring, considerably reduced the number of surveys undertaken in 2001. Surveys conducted showed a changed geographical distribution, being concentrated mainly in the English Midlands and the north of Scotland. In some WBBS surveys, visits were missed or were made later than usual, and this may have tended to reduce the efficiency of bird recording. The numbers of WBS and WBBS surveys conducted in 2001, although disappointing in showing the effects of FMD access restrictions, is an encouraging sign of continuing support from BTO volunteers for waterside bird surveys.

Owing to the much smaller samples than in previous years, the changed geographical distribution of the stretches that were surveyed, and the possible reduction in survey efficiency in some cases, it is difficult to draw meaningful conclusions from the 2001 data at present. It appears, however, that many waterside species may have been scarcer in 2001 than in 1998–2000. Results of year-to-year change estimates, from random and non-random WBBS stretches and from WBS, and estimates of overall bird density from WBBS random stretches, all show a preponderance of decreasing species.

Negative percentage changes between 2000 and 2001 were recorded for three waterside bird species, Mute Swan, Moorhen and Sedge Warbler, in all three of the paired samples discussed in this report – WBS mapping surveys, random WBBS stretches and WBS-linked WBBS stretches. For Sedge Warbler, these changes were all substantial: -22%, -13% and –32% respectively (Tables 4 & 7). All three of these species also decreased between 2000 and 2001 at BBS sites, although the changes were not statistically significant (M J Raven pers comm). Constant Effort Sites, affected much less by FMD than the other schemes, provide further evidence of Sedge Warbler decline: adult abundance changed by –5% during 2000–01 (Balmer & Milne 2002).

Among species that appeared to have increased in number, the high density figures for Feral Pigeon, Starling and House Sparrow may follow from the generally freer access in 2001 to waterways in urban areas, as opposed to the wider countryside.

The significance of the 2001 results, and the true nature of population changes in that year, may become clearer once there are more years' data to consider.

4.2 Preparations for expansion of the sample in 2002–04

A further 250 WBBS stretches were selected randomly for coverage beginning in 2002, bringing the total number of random sites selected to 513. This selection was performed in exactly the same way as before (see section 2.2.1).

Details of all these sites were circulated to BTO Regional Representatives in March 2002. WBS observers were also asked to continue with both WBS and WBBS surveys on their stretches in 2002. Initial signs are that fieldwork has been well supported in 2002, despite a year's break for many regular participants. It is anticipated that the number of WBBS stretches covered will recover to at least pre-FMD levels in 2002.

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Appendix 1. Waterway stretches covered by WBBS 1998–2001, ordered by nominal 1-km grid square, together with the limiting grid references in the most recent survey, number of 500-metre sections covered in each year of coverage and the class of survey (random, WBS or other).

Nominal 1-km reference	Waterway name	Start and end grid references		Number of 500-m sections surveyed, 1998–2001			
Random sites				**98**	**99**	**00**	**01**
.H4050	Many Burns River	H381495	H504513	–	6	–	–
.H5688	Glenlark River	H574871	H592889	–	6	6	–
.H6680	Ballinderry River	unknown	unknown	–	3	–	–
NC2634	Maldie Burn	NC252352	NC239340	4	4	4	–
NC3422	River Cassley	NC344226	NC368203	6	6	–	–
ND1628	Dunbeath Water	ND163296	ND143308	–	–	–	5
NG1846	Hamra River	NG187480	NG199463	–	4	4	–
NG4454	River Romesdal	NG440543	NG460549	–	–	10	–
NG9406	Allt Coire Sgoireadail	NG952068	NG974088	–	8	8	8
NG9804	Allt Coire nan Eiricheallach	NG998032	NG993054	5	5	5	5
NH1264	Abhainn Srath Chrombuill	NH142642	NH102642	–	–	–	8
NH1428	Allt a' Choire Dhomhain	NH144269	NH156302	6	–	–	–
NH3648	Allt Cam Ban	NH362497	NH357500	2	1	1	–
NH6614	River Findhorn	NH665140	NH705170	10	10	10	–
NH6632	River Nairn	NH684349	NH674320	10	10	10	–
NH6644	River Ness (non-tidal part)	NH664444	NH642413	5	8	8	–
NH9200	Am Beanaidh	NH923039	NH917099	–	10	10	–
NJ3416	Water of Buchat	NJ323189	NJ393157	–	10	–	–
NK0446	South Ugie Water	NK015472	NK056485	–	9	–	–
NM9478	Dubh Lighe	NM966787	NM932799	–	6	9	–
NN0096	River Kingie	NN042978	NN000964	10	10	10	10
NN0686	Allt a' Cham Dhoire	NN040863	NN064873	6	–	–	–
NN1620	Allt an Stacain	NN153213	NN162218	–	4	–	–
NN2082	River Spean	NN183837	NN208814	9	9	–	–
NN3872	Allt Feith Thuill	NN400731	NN372711	3	7	7	–
NN4488	Allt Coire Ardair	NN466887	NN440883	6	6	6	–
NN4888	Allt a' Chrannaig	NN484872	NN488885	3	3	3	–
NN6094	River Spey	NN640941	NN596938	10	10	10	–
NN6884	Unnamed, feeds into aqueduct	NN687855	NN681870	3	–	–	–
NN7296	Milton Burn	NN744988	NN719956	10	10	10	–
NO0644	Buckny Burn/Lunan Burn	NO090455	NO066480	–	10	10	10
NO1282	Baddoch Burn	NO137834	NO129820	5	5	5	–
NO2090	River Dee	NO213920	NO201908	4	4	4	–
NO3046	Dean Water	NO339479	NO286459	–	7	7	–
NO5410	Kenly Water	NO538113	NO553122	4	4	–	–
NS6826	River Ayr	NS682263	NS715281	–	–	10	–

Nominal 1-km reference	Waterway name	Start and end grid references		Number of 500-m sections surveyed, 1998–2001			
NS7822	Duneaton Water	NS781226	NS814213	10	10	10	–
NS8230	Douglas Water	NS828300	NS840319	5	5	5	–
NS8280	Bonny Water	NS823803	NS793789	8	8	8	–
NS9804	Crook Burn	NS973063	NS984039	6	6	6	–
NT8452	Blackadder Water	NT857543	NT825529	10	10	–	–
NT9010	River Alwin	NT911108	NT926082	7	–	–	–
NT9412	Shank Burn	NT973153	NT952137	6	6	6	–
NU1812	River Aln	NU186138	NU215125	9	9	9	–
NX1674	Cross Water of Luce	NX180772	NX192742	10	–	–	–
NY0604	River Bleng	NY077033	NY099032	4	4	–	–
NY5076	Black Lyne	NY515784	NY496733	6	–	–	–
NY5084	Kershope Burn	NY483828	NY521848	10	10	10	–
NY5464	King Water	NY557668	NY527641	3	–	–	–
NY6086	Lewis Burn	NY631887	NY623874	–	4	4	–
NY7020	Hilton Beck	NY710200	NY719207	–	–	3	–
NY8012	River Belah	NY800124	NY819123	–	–	6	–
NZ2436	River Wear	NZ259374	NZ243361	2	4	–	–
NZ2818	River Skerne	NZ302193	NZ291207	6	6	–	–
NZ2844	River Wear	NZ284448	NZ302466	–	7	–	–
NZ6418	Skelton Beck	NZ659201	NZ668215	5	–	–	–
SD3406	Leeds & Liverpool Canal	SD365069	SD369092	–	–	6	6
SD7012	Eagley Brook	SD727123	SD712134	4	4	4	–
SD7466	River Wenning	SD746673	SD715676	8	8	8	–
SD7488	Clough River	SD764902	SD718906	–	–	10	–
SD8804	Rochdale Canal	SD885079	SD893038	10	10	10	10
SD9664	River Wharf	SE004633	SD981659	–	8	8	–
SE0278	River Cover	SE045808	SE023791	6	6	6	–
SE3288	River Swale	SE320895	SE337880	8	8	8	–
SE3800	Dove & Dearne Navigation	SE411022	SE395012	4	4	4	–
SE9620	New River Ancholme	SE972164	SE974209	–	–	9	–
SH7032	Afon Eden	SH703321	SH700328	–	–	2	–
SH9424	Afon Eiddew	SH963244	SH947250	4	4	4	–
SJ1006	Afon Banwy neu Einion	SJ107068	SJ117078	3	–	–	–
SJ1228	Afon Iwrch	SJ134266	SJ126300	7	7	7	–
SJ2022	Afon Tanat	SJ185240	SJ226240	10	10	10	–
SJ4066	Shropshire Union Canal	SJ415667	SJ399669	–	10	10	10
SJ4276	Manchester Ship Canal	SJ476777	SJ451773	5	5	5	–
SJ6402	River Severn	SJ636042	SJ673034	8	8	–	–
SJ6654	River Weaver	SJ650523	SJ662552	10	10	6	–
SJ8610	Shropshire Union Canal	SJ849142	SJ875102	10	10	10	–
SK0206	Cannock Extension Canal	SK021069	SK019045	5	–	–	–
SK0836	River Dove	SK102374	SK104346	–	–	10	–

Nominal 1-km reference	Waterway name	Start and end grid references		Number of 500-m sections surveyed, 1998–2001			
SK1686	River Noe	SK168846	SK152864	8	7	7	–
SK5662	River Maun	SK569638	SK601649	4	4	4	–
SK8874	Fossdyke Navigation	SK909749	SK880745	6	6	6	6
SK9458	River Brant	SK943600	SK940583	4	4	4	4
SN6456	Afon Teifi	SN646561	SN660569	–	5	5	–
SN6802	Lower Clydach River	SN684026	SN687045	5	5	5	–
SN7400	River Clydach	SN741010	SS738972	9	9	9	–
SO1204	Afon Rhymni	SO120059	SO138040	–	10	10	10
SO2230	Grwyne Fawr	SO229309	SO247293	–	6	–	–
SO4618	Afon Mynwy	SO477174	SO468200	–	10	10	–
SO6466	River Teme	SO629686	SO656691	7	7	7	–
SO6680	River Rea	SO662821	SO668787	9	9	9	–
SO7098	River Severn	SO722975	SJ707004	8	8	8	–
SO7454	River Teme	SO746563	SO758544	6	6	6	–
SO8004	River Frome	SO784057	SO808046	7	6	–	–
SO8628	River Severn	SO867304	SO844279	6	–	–	–
SP6002	River Thame	SP612027	SP605017	4	4	4	–
SP6260	Grand Union Canal	SP626619	SP630602	4	4	4	–
SS5204	River Lew	SS533057	SS539043	–	4	4	–
SS6810	River Taw	SS682115	SS685099	10	10	10	–
ST0280	Afon Elai	ST034824	ST039811	6	6	6	–
ST0820	River Tone	ST078203	ST084221	5	5	5	–
ST1600	River Otter	ST160012	ST170018	3	3	3	–
ST4646	River Axe	ST475475	ST452490	–	–	7	–
ST5660	River Chew	ST572617	ST584629	5	5	5	–
ST7846	River Frome	ST784462	ST787476	5	5	–	–
ST9480	River Avon	ST953800	ST960805	2	2	–	–
ST9682	River Avon	ST960831	ST977820	6	6	–	–
ST9804	River Allen	ST996040	ST990060	4	4	4	–
ST9838	River Wylye	ST948400	ST975395	–	–	5	–
SU1234	River Avon	SU127354	SU129330	6	6	6	–
SU2470	River Kennet	SU240700	SU253703	–	3	–	–
SU2870	River Kennet	SU280715	SU299710	5	5	5	–
SU5296	River Thames/Isis	SU539989	SU505971	10	10	10	10
SU5664	River Enborne	SU567648	SU557633	4	4	4	–
SU7266	River Loddon	SU743677	SU734663	4	–	4	–
SU9618	River Rother	SU961197	SU980190	–	6	6	–
SU9868	Virginia Water (outflow)	SU977686	SU987678	3	–	–	–
SX0872	River Camel	SX082742	SX065715	–	10	10	–
SX4682	River Lyd	SX478835	SX454834	5	5	5	–
SY1096	River Otter	SY112983	SY093960	7	6	6	–
SY2692	River Axe	SY262955	SY260922	5	5	5	–

Nominal 1-km reference	Waterway name	Start and end grid references		Number of 500-m sections surveyed, 1998–2001			
SY6094	River Frome	SY606960	SY617955	–	–	3	–
TF0210	River Gwash	TF040107	TF028106	–	–	2	–
TF6002	Relief Channel	TF602038	TF601032	1	1	–	–
TF6412	River Nar	TF640133	TF663136	5	5	–	–
TL1840	River Ivel	TL182402	TL184429	5	–	–	–
TL2234	River Ivel	TL222369	TL223377	2	2	2	–
TL2296	King's Dike (Drain)	TL250965	TL222965	6	6	6	6
TL3288	Forty Foot or Vermuden's Drain	TL345879	TL315880	6	6	6	–
TL3296	Twenty Foot River (Drain)	TL324969	TL352989	8	7	7	7
TL6480	Mildenhall Drain	TL655813	TL650827	3	3	3	3
TL7672	River Lark	TL731739	TL762728	7	7	7	7
TM1822	Landermere	TM489239	TM497238	2	2	–	–
TM2434	Shotley Marshes	TM245361	TM252343	4	4	4	4
TQ0056	River Wey	TQ020569	TQ033571	5	5	5	–
TQ1480	River Brent	TQ146820	TQ146810	2	2	2	–
TQ1684	Grand Union Canal	TQ182836	TQ144843	10	10	10	10
TQ2288	River Brent	TQ240885	TQ241902	5	–	–	–
TQ5062	River Darent	TQ521617	TQ527627	3	3	3	–
TQ5244	River Medway	TQ529437	TQ542437	4	4	4	–
TQ5298	River Roding	TQ547996	TQ517981	8	8	8	8
TQ7252	River Medway	TQ740539	TQ704529	9	9	9	–
TQ7278	Cliffe Fleet	TQ744782	TQ746792	4	4	4	–
TQ9222	River Rother (non-tidal part)	TQ927243	TQ923227	3	3	3	–
TR0244	Great Stour	TR038449	TR032430	4	4	–	–
TR0826	New Sewer	TR058264	TR090273	7	7	7	7
TR1658	Great Stour	TR155590	TR163598	3	3	3	–
Non-random WBS sites				**98**	**99**	**00**	**01**
NH8350	River Nairn	NH806484	NH838507	–	9	8	–
NJ5117	River Don	NJ528173	NJ496181	–	9	9	9
NS5370	Forth & Clyde Canal	NS531704	NS563690	–	–	8	–
NS8696	River Devon	NS895961	NS863961	–	10	–	–
NT0765	Linhouse Water	NT068640	NT075660	–	7	7	7
NT5434	River Tweed	NT578346	NT528348	–	–	10	–
NY3748	River Caldew	NY371487	NY382516	–	7	7	–
NY8529	River Tees	NY857295	NY889283	–	10	10	–
SD3710	Leeds & Liverpool Canal	SD375100	SD402119	–	–	–	8
SD4610	Leeds & Liverpool Canal	SD494104	SD453112	10	10	10	–
SD4617	Leeds & Liverpool Canal	SD461149	SD458193	10	10	10	–
SD5009	Leeds & Liverpool Canal	SD524093	SD494104	–	7	7	–
SD5064	River Lune	SD522648	SD482631	–	10	10	–
SD5284	Lancaster Canal	SD537831	SD520854	7	7	7	–
SD5308	Leeds & Liverpool Canal	SD540073	SD525092	–	5	5	5

Nominal 1-km reference	Waterway name	Start and end grid references		Number of 500-m sections surveyed, 1998–2001			
SD5465	River Lune	SD545653	SD558673	–	5	5	–
SD5768	Rivers Wenning & Lune	SD585684	SD558673	–	6	–	–
SD5870	River Lune	SD571684	SD591721	–	–	5	–
SD6177	River Lune	SD611790	SD609750	–	8	–	–
SD8025	River Limy	SD810237	SD807266	–	–	6	–
SE1222	River Calder/Calder & Hebble Canal	SE135228	SE128224	–	2	2	–
SE2796	River Swale	SE291965	SE257974	–	10	10	–
SE4445	River Wharfe	SE440453	SE472447	–	10	10	–
SH7220	River Mawddach	SH718193	SH735223	–	7	7	–
SJ0868	River Clwyd	SJ092659	SJ082687	–	9	10	–
SJ4070	Shropshire Union Canal	SJ394706	SJ418719	–	6	6	–
SJ5126	Shropshire Union Canal	SJ526603	SJ541603	–	–	–	3
SJ6452	Shropshire Union Canal	SJ629549	SJ638504	10	10	10	10
SJ6836	Shropshire Union Canal	SJ683347	SJ671389	–	–	9	–
SJ6967	Trent & Mersey Canal	SJ695671	SJ683689	5	5	5	5
SJ9279	Macclesfield Canal	SJ933779	SJ936814	8	8	–	–
SJ9586	Macclesfield Canal	SJ953860	SJ959880	–	5	5	–
SJ9785	Peak Forest Canal	SJ964882	SJ971859	–	5	5	–
SJ9786	River Goyt	SJ975867	SJ967883	–	5	5	–
SJ9822	Staffordshire & Worcs Canal	SJ995229	SJ971214	6	6	6	–
SK1883	River Noe	SK168846	SK204826	–	8	6	–
SK2181	River Derwent	SK205834	SK234806	–	10	10	–
SK2378	River Derwent	SK233806	SK240767	–	10	–	–
SK2476	River Derwent	SK244761	SK248727	–	8	8	–
SK3084	River Porter	SK302849	SK332857	–	–	–	8
SK3088	River Rivelin	SK322886	SK289871	–	7	7	7
SK4010	Erewash Canal	SK454471	SK469432	–	9	–	–
SK5715	River Soar	unknown	unknown	–	5	–	–
SK6236	Grantham Canal	SK639367	SK608368	8	8	8	8
SK6279	Chesterfield Canal	SK649808	SK611788	10	–	–	–
SK7351	River Trent	SK743515	SK767522	–	10	10	10
SO1024	River Usk	SO123234	SO095253	–	9	9	–
SO3780	River Clun	SO361805	SO387814	–	6	6	–
SO5112	River Monnow	SO495146	SO512122	–	10	10	–
SO5638	River Lugg	SO565372	SO556395	–	–	10	–
SO8687	Staffordshire & Worcestershire Canal	SO864855	SO862887	–	9	9	–
SO8757	Worcester & Birmingham Canal	SO865576	SO889577	5	5	5	–
SP1869	Stratford-upon-Avon Canal	SP187711	SP189671	8	8	–	–
SP4915	River Cherwell	SP484159	SP499151	–	–	10	–
SP7288	Grand Union Canal	SP727879	SP725901	10	10	10	10
SP9013	Grand Union Canal	SP933136	SP889140	–	10	10	10
SP9221	Grand Union Canal	SP929202	SP915230	8	8	8	8

Nominal 1-km reference	Waterway name	Start and end grid references		Number of 500-m sections surveyed, 1998–2001			
SS2105	Bude Canal & River Neet	SS207063	SS218038	–	–	–	6
SU4595	River Ock	SU473959	SU432963	–	10	10	–
SU9400	Alding Bourne/Lidsey Rife	SZ945999	SU958027	–	8	8	8
SX5363	River Plym	SX533637	SX569651	–	9	9	–
SX5365	River Meavy	SX527650	SX548669	–	10	10	–
SX9588	Exeter Canal	SX940894	SX963860	10	10	10	–
SY9999	River Stour	SZ004998	SY982994	–	6	6	6
TF0671	River Witham & South Delph	TF060715	TF090710	–	–	–	7
TF1721	River Glen	TF201245	TF174210	–	10	–	–
TL1210	River Ver	TL123103	TL128084	–	4	4	–
TL1515	River Lea	TL140160	TL162145	–	7	7	7
TL1550	River Ivel	TL156519	TL156508	–	5	5	–
TL3701	River Lea/Lee Navigation	TL371018	TL375026	–	10	–	–
TL4963	River Cam	TL502644	TL487621	–	6	6	6
TL8187	River Little Ouse	TL817879	TL786869	–	8	8	–
TM1150	River Gipping	TM125491	TM113527	–	10	10	–
TQ0370	River Thames	TQ044695	TQ018721	–	10	10	10
TQ0492	Grand Union Canal	TQ062940	TQ044902	10	10	10	10
TQ0558	River Wey Navigation	TQ050578	TQ055586	–	2	2	–
TQ2865	River Wandle	TQ282651	TQ261687	–	9	9	–
Other non-random sites				**98**	**99**	**00**	**01**
SD4746	Lancaster Canal	SD487452	SD486488	10	–	–	–
SD5913	Leeds & Liverpool Canal	SD596168	SD599124	10	–	–	–
SD6100	Leigh Branch Canal	SD602018	SJ630996	8	8	8	8
SD8434	Leeds & Liverpool Canal	SD843365	SD845327	10	–	–	–
SD9012	Rochdale Canal	SD947182	SD917140	10	–	–	–
SD9702	Huddersfield Narrow Canal	SD984041	SD977025	4	–	–	–
SE0225	Rochdale Canal	SE015259	SE039245	7	–	–	–
SE0612	Huddersfield Narrow Canal	SE039119	SE079139	10	–	–	–
SE1138	Leeds & Liverpool Canal	SE107399	SE125384	5	–	–	–
SE2335	Leeds & Liverpool Canal	SE222368	SE238366	5	–	–	–
SE6029	Selby Canal	SE620320	SE585290	10	–	–	–
SE6416	New Junction Canal	SE634151	SE650184	7	–	–	–
SE6518	Knottingley & Goole Canal	SE648187	SE667193	4	–	–	–
SJ3398	Leeds & Liverpool Canal	SJ350994	SJ341969	10	–	–	–
SJ3699	Leeds & Liverpool Canal	SJ387981	SJ350994	10	–	–	–
SJ5659	Shropshire Union Canal	SJ553599	SJ581588	6	–	–	–
SJ6153	Llangollen Branch Canal	SJ621551	SJ617524	6	–	–	–
SJ6386	Bridgewater Canal	SJ669871	SJ625864	10	–	–	–
SJ6575	Trent & Mersey Canal	SJ644753	SJ666759	6	–	–	–
SJ6764	Middlewich Branch Canal	SJ689658	SJ679632	6	–	–	–
SJ7992	Bridgewater Canal	SJ784912	SJ796937	6	–	–	–

Nominal 1-km reference	Waterway name	Start and end grid references		Number of 500-m sections surveyed, 1998–2001			
SJ7995	Bridgewater Canal	SJ762986	SJ799945	10	–	–	–
SJ8842	Trent & Mersey Canal	SJ881442	SJ885393	10	–	–	–
SJ9273	Macclesfield Canal	SJ930744	SJ925716	6	–	–	–
SJ9396	Peak Forest Canal	SJ935984	SJ944951	8	–	–	–
SJ9398	Ashton Canal (derelict)	SJ925976	SJ948985	6	–	–	–
SK2525	Trent & Mersey Canal	SK273274	SK238241	10	–	–	–
SK4644	Erewash Canal	SK454471	SK469431	10	–	–	–
SK4799	Sheffield & South Yorkshire Canal	SK468997	SE504001	7	–	–	–
SK6929	Grantham Canal	SK709292	SK676307	10	10	10	10
SN7305	Swansea Canal	SN752065	SN724041	6	–	–	–
SO7407	Gloucester & Sharpness Canal	SO737049	SO758093	10	–	–	–
SO8762	Droitwich Canal	SO868611	SO884627	5	–	–	–
SO9387	Dudley Canal	SO932892	SO953883	10	–	–	–
SP1581	Grand Union Canal	SP181804	SP144818	8	–	8	8
SP1996	Birmingham & Fazeley Canal	SP202984	SP186938	10	–	–	–
SP4083	Oxford Canal	SP382831	SP421822	10	–	–	–
SP6791	Grand Union Canal	SP695916	SP664927	8	–	–	–
SP8737	Grand Union Canal	SP869398	SP877372	6	–	–	–
ST0213	Grand Western Canal	ST023134	SS999131	10	–	–	–
ST3134	Bridgwater & Taunton Canal	ST301365	ST322325	10	–	–	–
ST7666	Kennet & Avon Canal	ST782657	ST755642	10	–	–	–
SU2063	Kennet & Avon Canal	SU224635	SU179618	10	–	–	–
SU8602	Chichester Canal	SU858036	SU842013	8	8	8	8
SU8953	Basingstoke Canal	SU809536	SU853527	9	–	–	–
TL8094	River Wissey	TL807945	TL774962	–	10	10	–
TQ9427	Royal Military Canal	TQ958292	TQ938248	10	–	–	–