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**Waterways Breeding Bird Survey:
progress report for 1998–99**

John H Marchant & David G Noble

A report to the Environment Agency

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

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EXECUTIVE SUMMARY

- 1 To fulfil its statutory duties for wildlife conservation, the Environment Agency requires good-quality information on the distribution and numbers of breeding birds along waterways, and on how bird populations relate to the habitat available.
- 2 The BTO has monitored the numbers and distribution of breeding birds along linear waters since 1974 through its Waterways Bird Survey (WBS), which uses intensive mapping to count and plot birds' breeding territories. WBS data, however, cover relatively few sites and have not been as valuable as expected to the Environment Agency and other bodies concerned with nature conservation along waterways.
- 3 A new national programme, the BTO/JNCC/RSPB Breeding Bird Survey (BBS), was introduced in 1994 with the aim of taking over the monitoring role of the BTO's long-running Common Birds Census (CBC), which covers mainly farmland and woodland, and perhaps that of WBS too. While this new scheme has been highly successful, earlier investigations had suggested that BBS would produce fewer data than WBS for monitoring specialist waterway birds: in particular, monitoring of Kingfisher, Dipper, Common Sandpiper, Little Grebe, Sand Martin, Grey Wagtail, Mute Swan, and Reed Warbler would be of lower quality.
- 4 With this background, the BTO began pilot work for the Waterways Breeding Bird Survey in 1998. Work in 1998 demonstrated that the method devised for WBBS was popular with observers and provided data that would be suitable for either a long-term national monitoring scheme or for short-term site surveys. Links were demonstrated with RHS. The first year's pilot work identified topics requiring further study.
- 5 New work on WBBS has been funded by the Environment Agency for 1999 and 2000 (Phase 2). The main aims have been to investigate the power of WBBS for monitoring population change and to collect data to help refine the links between WBBS bird counts and RHS habitat variables.
- 6 In 1999, the first season of Phase 2, 170 WBBS surveys were conducted in total by BTO volunteers, including 106 randomly selected stretches and 62 stretches on which a WBS mapping survey was also carried out (with three stretches common to both samples) and five for which coverage had not been requested. There were 101 surveys that were repeated from 1998. The 170 surveys comprised 1168 500-metre sections. Overall, 158 bird and 25 mammal species were recorded on WBBS stretches in 1999.
- 7 Assuming a similar level of volunteer input in 2000, it is expected that there will be a sufficient amount of data to meet the aims of Phase 2 with regard to bird population monitoring. For comparison of bird counts with habitat, it is important that RHS data are made available from as many as possible of the WBBS's randomly selected stretches by the end of October 2000.
- 8 Further WBBS fieldwork is planned for 2001–03, including expansion of population monitoring and a detailed analysis of relationships between RHS variables and breeding bird numbers.

1 INTRODUCTION

1.1 The Waterways Bird Survey

It was in 1974 that the BTO began 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). Overviews of the WBS and its results have been provided by Carter (1989), Marchant *et al.* (1990) and Marchant & Balmer (1994).

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 4½–5 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 annually. Only a restricted list of bird species, incorporating all waterside specialists such as grebes, ducks, geese, swans, waders, and reedbed passerines, is included in the survey.

By 1999, the WBS had completed 26 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 *et al.* 1999b).

To fulfil their statutory duties for wildlife conservation, the Environment Agency requires good-quality information on the distribution and numbers of breeding birds along waterways, and on how bird populations relate to the habitat available. WBS, however, has not been as useful as expected to the Agency and the bodies that preceded it. Relatively few sites have been covered, and the survey has proved quite time-consuming for BTO staff (although less so in recent years because territory totals are calculated by the volunteers themselves). In particular, it is not geared to the Agency's River Habitat Survey (RHS) that now underpins most assessments of conservation value on waterways throughout the UK. WBS receives no dedicated funding, and its future is uncertain.

1.2 More recent developments in monitoring breeding birds

The major development in monitoring breeding birds since the start of WBS has been the introduction of the Breeding Bird Survey (BBS) in 1994 (e.g. BTO 1998, Gregory *et al.* 1998). The main aims of the BBS are:

- *To provide information on year-to-year and longer-term changes in population levels for a wide range of breeding birds across a variety of habitats throughout the UK. Knowing to what extent bird populations are increasing or decreasing is fundamental to bird conservation. Monitoring birds has the added advantage that they act as valuable indicators to the health of the countryside.*

- *To promote a greater understanding of the population biology of birds and in particular to focus on factors responsible for declines. The BBS is a key component of the BTO's Integrated Population Monitoring Programme.*
- *To promote bird conservation through the involvement of large numbers of volunteers in survey work in the UK.*

In this new scheme, volunteer BBS observers make two counting visits per breeding season to standardised transect routes through 1-km squares selected randomly from the national grid. Repeat surveys give information on population change between years. Over 2300 squares were surveyed in 1999. Compared with mapping surveys, there are substantial improvements in the efficiency of data processing, input and analysis. The BBS method has proved popular and enjoyable for volunteers, and is now well established as an ongoing monitoring scheme.

As from 2001, BBS is set to take over from CBC the task of monitoring the large-scale population changes of the more abundant and widespread breeding bird species in the UK. This will bring improvements in the representativeness of the results and an increase in the range of species that can be monitored. For birds that are waterways specialists, however, and indexed currently by WBS, our preliminary studies have shown that BBS alone cannot be a full replacement for the WBS's monitoring function. Marchant *et al.* (1996) concluded that, if BBS were to be the sole replacement for WBS:

- *the precision of monitoring would be generally lower for BBS than for WBS and fewer waterbird species would therefore be monitored;*
- *there would not be an adequate way of distinguishing population changes of waterbirds along waterways from those occurring in other wetland habitats;*
- *the scale of monitoring would be too crude to provide adequate monitoring results at regional or catchment levels.*

Species that would be monitored less well by BBS than WBS are listed in Table 1. By their nature, targeted surveys of waterways are more efficient at detecting birds that specialise in linear features, such as Kingfisher and Dipper, than the area-based (kilometre-square) sampling units of BBS.

A priority of the Environment Agency is to link bird surveys to its River Habitat Survey (Raven *et al.* 1997), and thus increase the power of its assessments of waterway conservation value. Since RHS itself is a transect, this would be best achieved by transect methods of bird censusing, employed where possible in parallel with RHS sections (Marchant *et al.* 1996, Langston *et al.* 1997). These authors suggested that WBS could be modified to meet this objective by remodelling it to use transect methods like those of BBS, and demonstrated that field methods along waterways could be switched successfully from territory mapping to line transects that could be much more efficient.

Table 1. Species that would be monitored with greater precision by WBS at its current level than by the projected annual sample of 3000 BBS squares. Species are ordered from greatest to least difference. Source: Marchant *et al.* (1996).

**Kingfisher
Goosander
Dipper
Common Sandpiper
Little Grebe
Sand Martin
Grey Wagtail
Mute Swan
Reed Warbler**

All the aims of monitoring breeding birds along waterways could be met by a scheme that both:

- *supplemented BBS data with counts from rivers and canals, thus maintaining or expanding the level of bird population monitoring currently available through BBS and WBS and satisfying the needs of organisations with specific interests in bird monitoring, such as JNCC and RSPB; and*
- *provided bird and bird-habitat data, relevant to nature conservation along waterways, that would fulfil the requirements of the Environment Agency, and its sister organisations in Scotland and Northern Ireland, that have responsibilities specific to linear waters.*

Supplementing BBS, in which sites are selected randomly to ensure that the sample is fully representative of bird habitats in the UK, would require the introduction of random selection of sites to waterways bird censusing.

1.3 The launch of the Waterways Breeding Bird Survey (Phase 1)

In pursuit of these ideals, the BTO, with financial support from the Environment Agency and from several water companies, launched the Waterways Breeding Bird Survey (WBBS) as a pilot scheme in 1998. Specific aims of the pilot scheme were to test:

- *methods of random selection of waterway stretches;*
- *to what extent random coverage of waterway stretches can be achieved;*
- *what modifications are required to BBS methods when used along waterways; and*
- *whether the data collected by BBS-style methods would be sufficient to meet the aims of an ongoing national survey.*

To meet the last of these objectives, it was estimated that coverage of about 100 WBBS stretches would provide sufficient data, at least for the single season of investigation planned for 1998.

Minimal modifications were made to the BBS transect method, aside from directing observers to cover waterways. The survey required two counting visits during the breeding season during which all birds seen or heard were recorded. Transect sections were each 500 metres, to match RHS section lengths. Separate totals of birds seen or heard were produced for each section and

for three distance categories plus an 'in-flight' category. Mammal data were also collected. The WBBS has considerable benefits over the existing WBS in the relative simplicity of the methods, and in the efficient use of observers' and analysts' time.

The survey received a very positive response from volunteer organisers and counters, and all aspects of the pilot survey worked extremely well (Marchant & Gregory 1999). A total of 103 stretches of waterway comprising 600 500-metre sections were surveyed in the 1998 pilot survey, in time for inclusion in the report, in line with our target figure. Subsequently, data have been received from a further four randomly selected stretches, making 107 in all (Table 2). Although only 53% of the 201 selected stretches were actually surveyed, those covered were widely distributed within Britain, and approximated to a random sample.

A further element to the 1998 WBBS pilot work was introduced at the request of the Environment Agency, who required new data on comparative breeding bird numbers on canals with and without a close season for coarse angling. A further 61 canal stretches, selected specifically to investigate the possible effects on breeding bird numbers of a close season for coarse angling, were also surveyed in 1998 using WBBS methods (Table 2); the results of this study were reported separately (Marchant *et al.* 1999a). These plots were selected by hand, with a view to creating a comparable sample of sites with and without a close season. Stretches of canal that had already been selected randomly for coverage were included in this second sample too; five stretches were common to both samples (Table 2).

Some stretches in both samples were existing WBS plots. This arose by chance in three cases, as the random sampling picked out sites already being studied by WBS observers, and by design in the sample picked for the fishing-season study. In total, 18 stretches were also surveyed by the WBS mapping method in 1998.

The pilot survey demonstrated that WBBS can collect extensive data for waterbirds, for other bird species, for mammals and for waterside habitats. Survey volunteers recorded a total of 149 bird species, including valuable samples of all the expected waterbirds. Mammal recording was carried out on 93 stretches and a total of 24 mammal species were found, showing the potential of WBBS for recording wildlife other than birds.

Table 2. Totals of WBBS stretches surveyed in 1998.

Reason for WBBS survey	Number of stretches	Number of 500-metre sections
Random stretches (not in canal sample)	102	589
Extra canal stretches (for fishing-season study)	61	503
Stretches in both random and canal samples	5	39
Stretches also surveyed by WBS mapping	18	154
Total canal stretches for fishing-season study	66	542
Total random stretches	107	628
TOTAL	168	1131

In the pilot survey, waterbirds were located on considerably higher proportions of WBBS stretches than BBS squares, confirming the value of specialised waterside transects in supplementing BBS monitoring. Further conclusions of the pilot work in 1998 were as follows (Marchant & Gregory 1999, Marchant *et al.* 1999a).

- *Working together, BBS and WBBS would provide more precise and more representative data on waterbird population changes than are currently available through WBS and CBC.*
- *As well as supplementing overall population monitoring, WBBS would provide broad-scale bird population trends that are specific to the waterway habitat and are fully representative of waterways nationally; this would cover a wider range of bird species than are presently monitored by the mapping WBS. WBBS could provide information on bird population trends not just nationally but at smaller scales such as regions and catchments; such data would be of value to the Agency and to other bodies with duties to manage and conserve waterways.*
- *Developing a transect bird census method for waterways alongside WBS mapping would provide an alternative standard method for one-off or short-term surveys, for example for site appraisal before or after management operations.*
- *Initial work showed that there were promising links between WBBS and RHS data (Table 3). This result was based on RHS surveys from the hand-selected canal stretches, however, and not on a random sample.*

Table 3. Highly significant correlations between waterbird numbers and RHS features in WBBS 500-metre sections of canal (from Marchant *et al.* 1999a).

	Direction of	Species providing highly significant correlations
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RHS feature	correlation	(P<0.001) between count data and RHS feature
Water width:	+ve	Sedge Warbler, Shelduck, Shoveler, Cetti's Warbler, Water Rail, Reed Warbler, Redshank, Curlew
	-ve	Moorhen
Emergent reeds:	+ve	Reed Warbler, Cetti's Warbler, Reed Bunting
Emergent herbs:	+ve	Little Grebe
Bankside trees:	+ve	Moorhen
Banktop herbs:	+ve	Sedge Warbler, Cetti's Warbler
Improved grass:	+ve	Yellow Wagtail, Reed Bunting
Tilled land:	+ve	Reed Warbler
Urban/suburban:	+ve	Mallard
	-ve	Reed Bunting

Several elements of WBBS requiring further fieldwork were identified by the work in 1998 and plans were laid to address them during the 1999 and 2000 breeding seasons.

1.4 Aims of WBBS in 1999–2000 (Phase 2)

Repeat WBBS surveys allow the results to be investigated not only within but also between years. Continuation of WBBS for a second and a third breeding season in Phase 2 therefore adds a new dimension to the pilot surveys.

The main aims of the continuation of pilot work for a further two years have been:

- *to investigate the power of WBBS for measuring population change, in comparison with the monitoring results of WBS and BBS; and*
- *to make a more thorough investigation of the links between WBBS counts and RHS habitat data, using a large random selection of waterway stretches.*

To these ends, two sets of BTO observers have been encouraged to participate in WBBS in 1999 and 2000. First, the BTO's regional organisers have been asked to find observers to cover a random set of stretches that includes all those surveyed in 1998 and a few more. Second, all observers who currently contribute to the mapping WBS have been asked also to provide a set of WBBS counts for their stretch. Repeat coverage was not requested for the 61 hand-selected canal stretches that were surveyed in 1998 but which did not form part of the random or WBS samples.

In addition, the Environment Agency is arranging RHS coverage by accredited surveyors for as many as possible of the randomly selected stretches that have been surveyed for WBBS in any of the years 1998–2000.

By the end of Phase 2, we expect to have a large sample of random WBBS stretches covered for two or three successive seasons. These will provide two sets of estimates of year-to-year population change, and information on the precision of these estimates, that can be compared with the data provided independently by WBS and BBS. WBS observers using both methods on their plots will provide special insight into the WBS–WBBS comparison. Information on the precision of population change estimates provided by WBBS will enable assessments to be made of how many WBBS stretches would need to be surveyed each year to detect given levels of bird population change.

The Agency and BTO have planned for there to be both RHS and WBBS data, even if only for one year, for a high proportion of the random stretches. Directly comparable data from these two surveys, and more sophisticated modelling techniques applied to their analysis, should allow WBBS to reach its full potential for waterway management, and test the value of RHS as a predictor of breeding bird numbers.

The eventual aims of linking RHS and WBBS data are provisionally as follows (S.J. Ormerod, pers. comm.):

- *to enable the development of models, applicable throughout the UK, that predict the presence and absence of river birds from RHS data;*
- *to illustrate the value of modelling the distribution of river birds to their use as biological indicators;*
- *to use this example to demonstrate a robust, generic protocol for presence–absence modelling that will be transportable to other river organisms such as plants, invertebrates, fish and mammals; and*
- *to use this example to demonstrate a robust, appropriate and transportable protocol for testing model accuracy in presence–absence prediction.*

Much of the detailed analytical work will, however, fall beyond the scope of the present project.

2 METHODS OF THE WATERWAYS BREEDING BIRD SURVEY

2.1 Selection of plots for coverage

An ideal way of selecting lengths of a linear feature, such as waterways, would be from a complete catalogue that was either fully digitised or contained grid references of reference points at regular intervals. Complete surveys of waterways have been undertaken in some Agency regions, and computerised catalogues created such as the Anglian Region's Rivers Environmental Database (REDs), but there has been no national coordination of such work. Digitised data on map features including waterways are held by the Ordnance Survey (OS), but this database has been too expensive for any conservation-related body to obtain. As yet, therefore, there is no complete national list of waterway sections that is available for our use.

In the absence of linearly-based data to work from, an alternative approach was taken of making a random selection of national grid squares, discarding those without a waterway running through them, and seeking coverage of the waterway stretch inside or adjacent to 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 pilot, a waterway was defined as any double blue line, with shaded in-fill, on the OS 1:25,000 Pathfinder map series. Single blue lines, typically 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 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 the pilot survey.

2.2 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.

Some details of the design of forms were altered in minor ways between 1998 and 1999 but, once established, the field methods of WBBS have been kept constant.

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 for 1998, which were based heavily on those designed for BBS, are appended to the previous report (Marchant & Gregory 1999). Forms distributed for the 1999 season, which are identical except in minor detail, are in Appendix 1. These contain full details of fieldwork methods and recording.

The pilot WBBS differed from BBS in that:

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

Other aspects of fieldwork and analysis were identical.

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.

2.3 Application of WBBS methods in 1998 (Phase 1)

Owing to the short notice we were able to give them of the start of WBBS, the BTO's Regional Representatives (RRs) were asked whether they felt able to organise the survey in their regions. A small number of tetrads with waterways were rejected from the sample because they lay in regions where the RR had asked not to be involved. This procedure would not be used if WBBS developed into a major scheme; in that case all RRs would be expected to participate.

From 651 tetrads investigated, 201 contained a waterway and were selected for survey. This size of sample was selected to make allowance for the problems RRs would face in finding observers and for the requirement for about 100 stretches to be covered. RRs were informed of the selected squares at the end of February 1998 and, for each tetrad, sent an A4 map at 1:25,000, centred on the tetrad, with the full length of double-line waterway highlighted as suitable for coverage. Highlighted waterways ("stretches") were the major sample units of the WBBS, equivalent to the sample squares of BBS.

Within each region, each stretch was allocated a priority number (beginning at 1, i.e. top priority), that derived from the order of the random selection. RRs then sought volunteer observers to cover as many of their selected sites as possible, beginning at priority 1 and working down the list.

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).*

2.4 Application of WBBS methods in 1999 (Phase 2)

The 201 random stretches selected for survey in 1998 were kept in the sample, and supplemented with a further 63 taken from the same random selection. Many had been excluded from the 1998 sample only because no regional organiser had been available, but in 1999 the sample included stretches from all the BTO's UK regions. The 264 random stretches therefore represent a sample of the whole of the UK (Figure 1).

RRs were asked to find observers to cover these sites in both 1999 and 2000 and to distribute packs of survey forms. Coverage of additional sites was not requested.

WBBS survey packs were distributed from BTO headquarters to all current WBS observers, around 130 in total, with a request to contribute to both surveys in 1999 and 2000.

2.5 Methods of data analysis

WBBS data for each species and 500-metre section consisted of two counts (from one visit early in the season and one late), each divisible into four 'distance' categories (the three distance bands, and birds in flight).

Mean counts per unit length for each species were calculated as follows. First, counts were summed across all four distance categories. Second, a mean count was calculated across the sections that constituted each stretch; for each species and stretch, this produced two estimates of bird density (number per 500 metres), one for the early and one for the late visit. This step was necessary because bird counts on adjacent 500-metre sections could not be taken as independent estimates of bird numbers. Third, the lower of these figures was discarded and the higher figure was multiplied by 20 to convert the units to birds per 10 km. Finally, the resulting figures were averaged across all plots.

To estimate densities in the 0–25m distance band, the procedure was repeated but omitting birds recorded beyond 25 metres from the transect line or as in flight.

Calculating mean densities across all stretches, whether or not the species was present there, gives density figures that are directly comparable between species. Mean densities on occupied stretches were not calculated but will be higher, especially for species that are distributed patchily.

3 RESULTS FROM WBBS IN 1999

3.1 Coverage achieved by WBBS in 1998–99

The numbers of stretches covered in 1999 are not necessarily fully known, since some observers may not have submitted their forms in time to be included in this analysis. This report lists four additional sites for 1998 that were received late. The figures that follow for 1999 may therefore be incomplete, although any late data not yet received will be included in future analyses. It is likely, however, that only a handful of surveys remain to be returned to the BTO.

Of the 263 stretches that were randomly selected, 107 were surveyed in 1998 (Table 2), 106 in 1999 (Table 4), 84 in both years (Table 4), and 139 (53%) in one or other of the years. This is close to the coverage rate of about 50% that was anticipated at the start of the survey. Efforts will be made to increase the numbers of plots surveyed further in 2000.

WBS observers responded at a similar rate. Final totals of WBS coverage in 1999 are not yet available. However, 62 WBS plots contributed WBBS data and this is expected to be about half the number of WBS plots receiving mapping coverage in 1999.

In all, 101 of the 170 stretches covered in 1999 were repeat surveys (Table 4). There were 84 random and 17 WBS stretches that provided data on population change between the first two seasons. The number of repeat surveys is likely to increase considerably, especially for the WBS stretches, after the 2000 season.

Table 4. Totals of WBBS stretches surveyed in 1999.

Reason for WBBS survey	Surveyed in both 1998 and 1999		Total 1999 surveys	
	Number of stretches	Number of 500-metre sections	Number of stretches	Number of 500-metre sections
Total random stretches	84	506	106	662
Total WBS stretches	17	144	62	491
Random stretches also covered by WBS (i.e. in both samples)	3	29	3	29
Other non-random stretches (volunteered)	3	26	5	44
TOTAL	101	647	170	1168

There was little change in the total numbers of stretches covered in 1998 and 1999, but substantial turnover in the stretches surveyed (Table 5). Those canal stretches included in the

sample for the sole reason of studying the impact on birds of a close season for coarse angling were all dropped in 1999, and replaced in the sample by WBS stretches.

There was also turnover within the random sample, however. At most, 23 random stretches surveyed in 1998 were not covered in 1999, although this figure may be reduced by data that are submitted late. Equally, the 22 random stretches newly covered in 1999 can be regarded as a minimum figure.

Table 5. WBBS stretches lost from and added to the sample in 1999.

Reason for WBBS survey	Surveyed in 1998 only		Coverage new in 1999	
	Number of stretches	Number of 500-metre sections	Number of stretches	Number of 500-metre sections
Canal stretches (for fishing-season study)	45	367	0	0
Random stretches	23	124	22	156
WBS stretches	1	10	45	347
Other non-random stretches (volunteered)	0	0	2	18
TOTAL	67	486	69	521

Figure 1 shows the wide geographical scatter of the 263 randomly selected plots, but also the absence of cover 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.

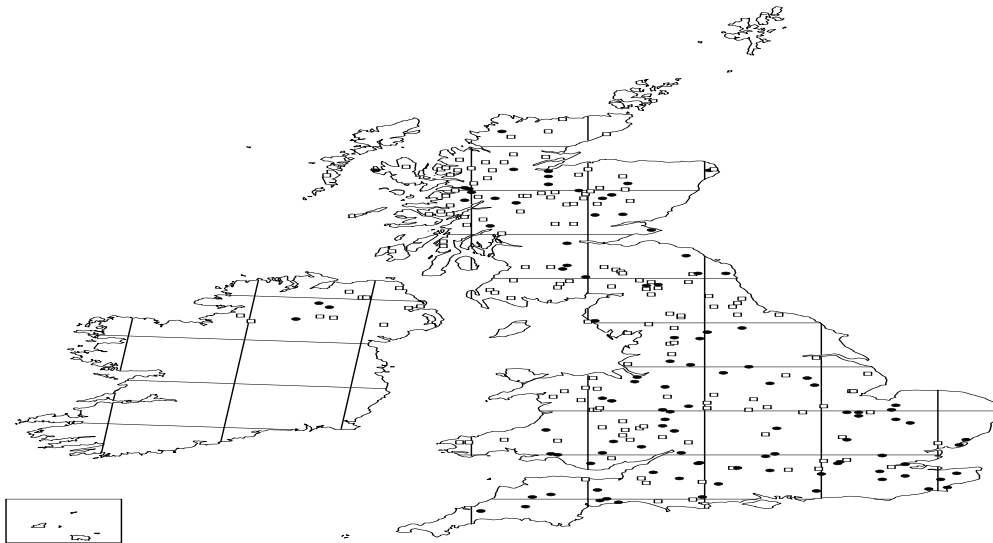
Figure 1 shows that few stretches were selected in coastal regions and that there were concentrations in some areas of higher ground, for example the Grampians, Southern Uplands and Welsh Marches. Eastern East Anglia, where river courses are few and well scattered, was not represented in the sample since none of the tetrads selected there contained a waterway.

That only 51% of the selected stretches were covered gives room for some subjectivity in plot selection, if observers' choice of stretches to cover were related to habitat or to bird distribution. There is no evidence, however, that this was likely to be the case. Clumping of stretches covered, within the sample selected, was more likely to stem from:

- *regional variation in the number of observers available to participate; and*
- *regional variation in the accessibility of waterways.*

A full list of stretches covered in 1999 is given in Appendix 2.

Figure 1. Distribution of random WBBS stretches in 1999. Those surveyed in 1999 are shown as black circles and those not surveyed as open squares.



3.2 Data collection for birds

In 1999, WBBS again collected a large amount of data for waterside specialist birds. Grey Wagtail was especially widespread, being recorded from 54% of random sites; Dipper was recorded from 38%, Kingfisher from 32%, and Common Sandpiper from 25% (Table 6). Comparative figures from 1998 are also tabulated (from Marchant & Gregory 1999) but, since there has been substantial turnover in the sample, the comparison does not necessarily reflect population change.

Table 6. Proportions of random WBBS stretches occupied by waterbird species in 1998 (n=103) and 1999 (n=106). Species listed are those indexed by the Waterways Bird Survey in 1998 (Marchant *et al.* 1999b).

Species	% of random WBBS stretches occupied in 1998	% of random WBBS stretches occupied in 1999	No. of random WBBS stretches occupied in 1999
Little Grebe	11%	10%	11
Mute Swan	37%	42%	44
Greylag Goose	12%	9%	10
Canada Goose	34%	25%	26
Mallard	85%	87%	92
Tufted Duck	16%	15%	16
Goosander	16%	11%	12
Moorhen	59%	55%	58

Coot	27%	22%	23
Oystercatcher	23%	26%	28
Lapwing	32%	35%	37
Curlew	23%	24%	25
Redshank	7%	5%	5
Common Sandpiper	31%	25%	27
Kingfisher	29%	32%	34
Sand Martin	26%	27%	29
Yellow Wagtail	12%	9%	10
Grey Wagtail	41%	54%	57
Pied Wagtail	60%	56%	59
Dipper	36%	38%	40
Sedge Warbler	29%	35%	37
Reed Warbler	21%	22%	23
Whitethroat	49%	40%	42
Reed Bunting	41%	37%	39

As in 1998, a wide variety of bird species were recorded by WBBS observers in 1999. Table 7 lists those recorded on at least 5% of the randomly selected stretches, together with their mean densities overall and within the 25-metre band of each transect. The most widespread species on these stretches were Wren (89%), Mallard and Chaffinch (87%), and Wood Pigeon and Blackbird (85%); the five most abundant species recorded were Wood Pigeon, Rook, Starling, Wren and Mallard.

Lucky observers recorded sightings of Night Heron, Honey Buzzard and Little Gull.

3.3 Collection of habitat data

Each WBBS return is accompanied by a habitat form, of which an example is included in Appendix 1. This records the name of the waterway and also the start and end grid references. Basic habitat details are recorded for each 500-metre section, using the standard BTO codes.

There are no plans to analyse the BTO habitat data as part of the present project, given that the much more detailed RHS data are expected to be available. The BTO habitat data would be valuable in the absence of RHS data for WBBS sites, and may provide a better description than RHS data of land-use in the surrounding floodplain.

3.4 Collection of data for mammals

The mammal data recorded by WBBS are likely to be underestimates, because mammal recording was secondary to the main tasks of recording birds and habitat, and in general was not systematic. The recording form is included in Appendix 1.

Across the 170 WBBS returns for 1999, mammal forms were completed and returned for 159 (94%). Mammal recording was therefore well supported by WBBS volunteers, as in 1998.

No mammals were recorded from nine stretches, and half the sites recorded fewer than three species. Twelve stretches recorded more than ten mammal species; the maximum was 14. In all, 25 species were recorded (Table 8). The mammal species found most frequently were diurnal species or ones that left obvious signs of presence. Of specialist waterway mammals, Otters were found on 11% of stretches (15% in 1998), Water Vole on 16% (9% in 1998), and American Mink on 21% (8% in 1998).

Table 7. Birds recorded on random WBBS stretches in 1999 (n=106). Species occurring on less than 5% of plots are omitted. Means and standard errors of bird counts are given across all stretches covered, together with the percentage of the stretches that were occupied.

Species	Birds per 10km (total)	Birds per 10km (in 0–25m distance band)	Percentage of stretches occupied
Little Grebe	1.1 ± 0.4	0.9 ± 0.4	10%
Great Crested Grebe	1.1 ± 0.6	0.9 ± 0.6	8%
Cormorant	2.9 ± 0.6	0.6 ± 0.3	26%
Grey Heron	5.0 ± 0.7	2.5 ± 0.5	63%
Mute Swan	7.7 ± 1.5	5.2 ± 1.1	42%
Greylag Goose	5.2 ± 2.5	0.3 ± 0.3	9%
Canada Goose	7.1 ± 1.9	2.4 ± 0.8	25%
Shelduck	10.1 ± 5.9	2.4 ± 2.0	9%
Gadwall	1.0 ± 0.5	0.6 ± 0.3	6%
Teal	0.5 ± 0.2	0.3 ± 0.2	6%
Mallard	43.1 ± 5.7	33.2 ± 4.9	87%
Tufted Duck	4.3 ± 1.6	3.1 ± 1.4	15%
Goosander	1.1 ± 0.4	0.7 ± 0.3	11%
Sparrowhawk	0.5 ± 0.1	0	15%
Buzzard	2.4 ± 0.4	0.4 ± 0.1	38%
Kestrel	1.3 ± 0.3	0.2 ± 0.1	25%
Red-legged Partridge	2.6 ± 1.2	0.5 ± 0.2	13%
Grey Partridge	0.4 ± 0.1	0.1 ± 0.1	8%
Pheasant	11.9 ± 2.2	2.6 ± 0.6	59%
Moorhen	10.5 ± 1.7	8.7 ± 1.4	55%
Coot	7.6 ± 2.5	6.8 ± 2.4	22%
Oystercatcher	7.9 ± 2.1	3.1 ± 0.8	26%
Lapwing	8.3 ± 2.0	1.1 ± 0.5	35%
Snipe	0.5 ± 0.2	0.2 ± 0.1	8%
Curlew	5.1 ± 1.2	0.3 ± 0.2	24%
Common Sandpiper	3.3 ± 0.7	3.0 ± 0.7	25%
Black-headed Gull	10.9 ± 3.6	2.1 ± 1.3	29%
Common Gull	4.5 ± 1.9	1.8 ± 1.2	11%
Lesser Black-backed Gull	5.5 ± 1.6	0.1 ± 0.1	24%

Herring Gull	8.6 ± 3.0	0.6 ± 0.3	25%
Common Tern	1.2 ± 0.4	0	12%
Feral Pigeon	15.1 ± 6.5	12.0 ± 6.0	19%
Stock Dove	9.2 ± 4.6	1.6 ± 0.6	36%
Wood Pigeon	81.2 ± 18.1	17.1 ± 2.2	85%
Collared Dove	6.2 ± 1.3	2.1 ± 0.7	42%
Turtle Dove	2.1 ± 0.7	0.7 ± 0.4	14%
Cuckoo	2.5 ± 0.5	0.3 ± 0.1	32%
Swift	19.3 ± 4.5	0.6 ± 0.5	52%
Kingfisher	1.6 ± 0.3	1.1 ± 0.2	32%
Green Woodpecker	1.9 ± 0.4	0.3 ± 0.1	29%
Great Spotted Woodpecker	1.4 ± 0.3	0.7 ± 0.2	29%
Skylark	10.3 ± 2.0	1.2 ± 0.4	46%
Sand Martin	11.5 ± 3.3	3.4 ± 2.0	27%
Swallow	18.5 ± 2.8	3.3 ± 0.8	76%
House Martin	19.4 ± 4.0	1.9 ± 0.7	48%
Tree Pipit	0.6 ± 0.2	0.3 ± 0.2	8%
Meadow Pipit	17.1 ± 3.9	8.8 ± 2.5	34%
Yellow Wagtail	1.7 ± 0.7	0.8 ± 0.3	9%
Grey Wagtail	5.2 ± 0.7	4.3 ± 0.6	54%
Pied Wagtail	6.6 ± 1.1	4.3 ± 0.8	56%
Dipper	3.0 ± 0.5	2.6 ± 0.5	38%
Wren	45.2 ± 4.0	28.4 ± 3.0	89%
Duncock	7.2 ± 0.8	4.8 ± 0.7	64%
Robin	20.8 ± 2.0	13.3 ± 1.5	82%
Redstart	0.8 ± 0.3	0.4 ± 0.2	9%
Whinchat	0.6 ± 0.3	0.5 ± 0.2	8%
Wheatear	1.9 ± 0.6	0.7 ± 0.2	18%
Blackbird	33.3 ± 2.9	18.1 ± 2.0	85%
Song Thrush	10.9 ± 1.4	4.4 ± 0.7	70%
Mistle Thrush	5.5 ± 0.8	2.6 ± 0.5	50%
Sedge Warbler	8.0 ± 1.7	6.3 ± 1.4	35%
Reed Warbler	9.5 ± 2.7	8.1 ± 2.3	22%
Lesser Whitethroat	0.5 ± 0.2	0.1 ± 0.1	7%
Whitethroat	7.7 ± 1.5	4.7 ± 1.2	40%

Garden Warbler	2.9 ± 0.6	1.9 ± 0.4	35%
Blackcap	9.1 ± 1.3	5.2 ± 0.9	58%
Chiffchaff	5.3 ± 0.8	2.4 ± 0.5	48%
Willow Warbler	15.4 ± 2.0	6.9 ± 1.0	75%
Goldcrest	3.5 ± 0.9	2.3 ± 0.5	31%
Spotted Flycatcher	1.7 ± 0.3	1.5 ± 0.3	25%
Long-tailed Tit	8.7 ± 1.7	7.7 ± 1.7	50%
Marsh Tit	0.6 ± 0.3	0.4 ± 0.2	10%
Willow Tit	0.2 ± 0.1	0.1 ± 0.1	6%
Coal Tit	3.4 ± 1.2	2.1 ± 0.8	28%
Blue Tit	23.9 ± 2.2	17.6 ± 1.9	79%
Great Tit	13.7 ± 1.4	9.3 ± 1.1	76%
Nuthatch	1.7 ± 0.4	1.0 ± 0.3	21%
Treecreeper	2.3 ± 0.4	1.9 ± 0.4	36%
Jay	2.0 ± 0.4	0.7 ± 0.2	28%
Magpie	12.7 ± 1.6	5.1 ± 0.9	66%
Jackdaw	26.8 ± 6.2	3.6 ± 1.0	53%
Rook	76.5 ± 22.4	1.4 ± 0.6	53%
Carrion Crow	32.8 ± 3.9	5.8 ± 0.9	81%
Hooded Crow	0.9 ± 0.3	0	9%
Raven	0.8 ± 0.3	0.1 ± 0.1	11%
Starling	64.8 ± 12.6	11.0 ± 2.1	64%
House Sparrow	11.9 ± 2.2	6.9 ± 1.6	43%
Chaffinch	40.1 ± 3.6	22.0 ± 2.2	87%
Greenfinch	9.2 ± 1.5	5.0 ± 1.0	57%
Goldfinch	8.6 ± 1.4	4.3 ± 0.8	57%
Siskin	1.0 ± 0.4	0.6 ± 0.3	8%
Linnet	9.4 ± 2.7	2.7 ± 1.0	34%
Bullfinch	1.1 ± 0.3	1.0 ± 0.3	19%
Yellowhammer	4.1 ± 0.8	1.8 ± 0.5	34%
Reed Bunting	5.6 ± 1.0	3.4 ± 0.7	37%

Table 8. Mammals recorded on random WBBS stretches in 1999 (n=25). Species are ranked by the proportion of stretches they occupied. The number of animals counted is the sum of early and late counts across all occupied stretches.

Species	Animals counted	No. occupied stretches	% of stretches occupied
Rabbit	1892	114	72%
Mole	21	88	55%
Red Fox	15	67	42%
Grey Squirrel	102	71	45%
Brown Hare	76	51	32%
Roe Deer	31	35	22%
shrew species	12	34	21%
American Mink	4	33	21%
Hedgehog	2	33	21%
Stoat	6	32	20%
Badger	1	31	19%
Brown Rat	9	30	19%
Water Vole	17	26	16%
Otter	5	18	11%
Weasel	1	17	11%
Red Deer	348	16	10%
Muntjac Deer	1	11	7%
Red Squirrel	3	7	4%
Mountain Hare	9	4	3%
Fallow Deer	11	2	1%
Bank Vole	0 (signs only)	2	1%
Pine Marten	0 (signs only)	2	1%
Feral Goat	3	1	1%
House Mouse	1	1	1%
Wood Mouse	0 (signs only)	1	1%

4 DISCUSSION

4.1 Progress in 1998–99

Pilot work for WBBS in 1998 has already defined a standard method for the collection of breeding bird information from 500-metre sections of waterway, equivalent to RHS sections, and has demonstrated that RHS is useful as a predictor of breeding bird distribution and numbers. It has also shown that WBBS is popular with volunteer observers and could form the basis of an ongoing monitoring method for breeding birds in this habitat.

Progress in 1999 has been satisfactory. Effort was switched successfully from the canal sample, which was no longer needed, to the new requirement for WBBS data that corresponded to WBS mapping survey plots. Around 20% of randomly chosen sites covered in 1998 apparently dropped out of the sample in 1999, although this proportion will be reduced by any repeat surveys submitted late. A similar number of randomly chosen sites were surveyed for the first time in 1999, so that the overall sample size in 1999 was little changed.

Numbers of birds recorded per unit waterway length were broadly similar overall to those recorded in 1998 (Table 7; Marchant & Gregory 1999). Differences in mean figures between 1998 and 1999 may relate to population change between these two years, or may stem from turnover in the sample of stretches surveyed.

Despite the degree of turnover in the sample, the number of repeat surveys in 1998–99 is already sufficient for an initial investigation of the power of WBBS for monitoring population change. This analysis awaits the completion of Phase 2 and will be made alongside that for 1999–2000.

4.2 Outlook for completion of Phase 2

Observers have received some preliminary feedback on the work in 1998–99 and have been alerted to the need for repeat surveys in 2000 (Marchant 2000). Instructions and recording forms have been overhauled and newly printed for the 2000 season and will be distributed to RRs and WBS observers in early April.

There is no indication that volunteer support in 2000 will not be at a similar level to previous years. All but a handful of surveys in 2000 are likely to be repeats of 1999 work. It is expected therefore that the number of repeat surveys will be considerably higher for the 1999–2000 comparison than for 1998–99, and that the aims of WBBS in this regard will be fully met.

The success of the second main aim of Phase 2 is dependent on the Agency's success in completing RHS surveys on WBBS 500-metre sections in the 1999 and 2000 summer seasons. The BTO was supplied with a copy of the River Habitat Survey database (Version 3.1, Oct 1999) in March 2000. As yet, however, there is no key to link these to particular WBBS sections and we are unable to assess how many WBBS sections had already been surveyed for RHS by the end of 1999. A further sample of WBBS stretches is scheduled to be added to the RHS database, preferably incorporating a key to identify the WBBS reference, by the end of October 2000.

If the final sample of matched RHS and WBBS data is too small, it may not be possible during Phase 2 to make more than a preliminary investigation of the power of RHS for predicting bird distributions.

4.3 Further work

Plans are in hand for Environment Agency support for WBBS to continue for a further three years, with the provisional aims of monitoring population changes over the six-year period 1998–2003 and increasing further the sample of sections covered by both WBBS and RHS.

It is proposed that detailed modelling work assessing links between WBBS and RHS data should be carried out as a PhD project under the joint supervision of the BTO, Cardiff University and the Environment Agency.

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The BTO's work relies heavily on volunteers. It is gratifying that, in a period when BBS grew and CBC and WBS continued to be well supported, BTO volunteers also found time to survey such a large sample of WBBS plots. We are very grateful to all observers who have contributed WBBS data, and to the BTO's Regional Representatives and others who assisted with finding volunteers and forwarding paperwork.

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Appendix 1. WBBS 1999: recording forms and instructions.

This appendix contains the following sheets as distributed to WBBS observers in 1999:

- *General information*(1 page)
- *WBBS instructions* (8 pages)
- *Field recording sheet*..... (4 pages)
- *Count summary sheet*..... (4 pages)
- *Habitat recording form*..... (2 pages)
- *Mammal count summary sheet* (2 pages)

Field recording and count summary sheets were presented as single double-sided A3 sheets, folded to A4.

Appendix 2. Stretches covered by WBBS in 1999, ordered by nominal 1-km grid square, together with the limiting grid references, number of 500-metre sections covered and the total number of bird species recorded.

Randomly selected sites

.H4050	Many Burns River.....	H381495	.H504513	6	24
.H5688	Glenlark River.....	H574871	.H592889	6	25
.H6680	Ballinderry River.....			3	20
NC2634	Maldie Burn.....	NC252352	NC239340	4	12
NG1846	Hamra River.....	NG187480	NG199463	4	23
NG9406	Allt Coire Sgoireadail.....	NG952068	NG974088	8	25
NG9804	Allt Coire nan Eiricheallach..	NG998032	NG993054	5	6
NH3648	Allt Cam Ban.....			1	6
NH6614	River Findhorn.....	NH665140	NH705170	10	25
NH6632	River Nairn.....	NH684349	NH674320	10	52
NH6644	River Ness (non-tidal part)...	NH664444	NH642413	8	37
NH9200	Am Beanaidh.....	NH923039	NN917999	9	12
NJ3416	Water of Buchat.....	NJ323189	NJ393157	10	41
NK0446	South Ugie Water.....	NK015472	NK056485	9	33
NM9478	Dubh Lighe.....	NM966787	NM941791	6	40
NN0096	River Kingie.....	NN042978	NN000964	10	15
NN1620	Allt an Stacain.....	NN153213	NN162218	4	4
NN2082	River Spean.....	NN183837	NN208814	8	14
NN3872	Allt Feith Thuill.....	NN400731	NN372711	7	5
NO0644	Buckny Burn/Lunan Burn.....	NO090455	NO060480	10	24
NO1282	Baddoch Burn.....	NO137834	NO129820	5	21
NO2090	River Dee.....	NO213920	NO201908	4	18
NO3046	Dean Water.....	NO340479	NO287458	7	56
NO5410	Kenly Water.....	NO538113	NO553122	4	26
NS7822	Duneaton Water.....	NS781226	NS814213	10	20
NS8230	Douglas Water.....	NS828300	NS840319	5	27
NS8280	Bonny Water.....	NS823803	NS793789	8	49
NS9804	Crook Burn.....	NS973063	NS984039	6	23
NT8452	Blackadder Water.....	NT857543	NT825529	10	41
NT9412	Shank Burn.....	NT973153	NT952137	6	30
NU1812	River Aln.....	NU186138	NU215125	9	45
NY0604	River Bleng.....	NY077033	NY099032	4	37
NY5084	Kershope Burn.....	NY483828	NY521848	10	22
NY6086	Lewis Burn.....	NY631887	NY623874	4	18
SD7012	Eagley Brook.....	SD727123	SD712134	4	31
SD7466	River Wenning.....	SD746673	SD715676	8	49
SD8804	Rochdale Canal.....	SD885079	SD893038	10	37
SD9664	River Wharf.....	SE004633	SD981659	8	47
SE0278	River Cover.....	SE045808	SE023791	6	40
SE3288	River Swale.....	SE320895	SE337880	8	40
SE3800	Dove & Dearne Navigation.....	SE411022	SE395012	4	44
SJ1228	Afon Iwrch.....	SJ134266	SJ126300	7	37
SJ2022	Afon Tanat.....	SJ185240	SJ226240	10	49
SJ4066	Shropshire Union Canal.....	SJ415667	SJ399669	10	32
SJ4276	Manchester Ship Canal.....	SJ476777	SJ451773	5	57
SJ6402	River Severn.....	SJ636042	SJ673034	8	44
SJ6654	River Weaver.....	SJ650523	SJ662552	10	43
SK1686	River Noe.....	SK168846	SK152864	7	41
SK5662	River Maun.....	SK569638	SK601649	4	37
SK8874	Fosdyke Navigation.....	SK909740	SK880745	6	38
SK9458	River Brant.....	SK943600	SK940588	4	40

SN6456	Afon Teifi.....	SN646561	SN660569	5	35
SN6802	Lower Clydach River.....	SN684026	SN687045	5	35
SN7400	River Clydach.....	SN741010	SS738972	9	33
SO1204	Afon Rhywni.....	SO120059	SO138040	10	26
SO2230	Grwyne Fawr.....	SO229309	SO247293	6	13
SO4618	Afon Mynwy.....	SO477174	SO468200	10	50
SO6466	River Teme.....	SO629686	SO656691	7	50
SO6680	River Rea.....	SO662821	SO668787	9	50
SO7098	River Severn.....	SO722975	SJ707004	8	48
SO7454	River Teme.....	SO746563	SO758544	6	54
SO8004	River Frome.....	SO784057	SO808046	6	46
SP6002	River Thames.....	SP612027	SP605017	4	33
SP6260	Grand Union Canal.....	SP626619	SP630602	4	36
SS5204	River Lew.....	SS533057	SS539043	4	36
SS6810	River Taw.....	SS682115	SS685099	7	35
ST0280	Afon Elai.....	ST034824	ST039811	6	49
ST0820	River Tone.....	ST078203	ST084221	5	45
ST1600	River Otter.....	ST160012	ST170018	3	31
ST5660	River Chew.....	ST572617	ST584629	5	36
ST7846	River Frome.....	ST784462	ST787476	5	37
ST9480	River Avon.....	ST953800	ST960805	2	29
ST9682	River Avon.....	ST960831	ST977820	6	40
ST9804	River Allen.....	ST996040	ST990060	4	45
SU1234	River Avon.....	SU127354	SU129330	6	44
SU2870	River Kennet.....	SU280715	SU299710	5	31
SU5296	River Thames/Isis.....	SU539989	SU505971	10	51
SU5664	River Enborne.....	SU557633	SU567648	4	26
SU9618	River Rother.....	SU961197	SU980190	6	52
SX0872	River Camel.....	SX082742	SX065715	10	25
SX4682	River Lyd.....	SX478835	SX454834	5	45
SY1096	River Otter.....	SY112983	SY093960	6	45
SY2692	River Axe.....	SY262955	SY260922	5	34
TF6002	Relief Channel.....	TF602038	TF601032	1	31
TF6412	River Nar.....	TF640133	TF663136	5	44
TL2234	River Ivel.....	TL222369	TL223377	2	34
TL2296	King's Dike (Drain).....	TL250965	TL222963	6	39
TL3288	Forty Foot or Vermuden's Drain.....	TL345879	TL315880	6	43
TL3296	Twenty Foot River (Drain).....	TL324969	TL352989	7	41
TL6480	Mildenhall Drain.....	TL655813	TL650827	3	27
TL7672	River Lark.....	TL731739	TL762728	7	67
TM1822	Landermere.....	TM489239	TM497238	2	21
TM2434	Shotley Marshes.....	TM245361	TM252343	4	49
TQ0056	River Wey.....	TQ020569	TQ033571	5	47
TQ1480	River Brent.....	TQ146820	TQ146810	2	28
TQ5062	River Darent.....	TQ521617	TQ527627	3	38
TQ5244	River Medway.....	TQ529437	TQ542437	4	31
TQ5298	River Roding.....	TQ547996	TQ517981	8	42
TQ7278	Cliffe Fleet.....	TQ744782	TQ746792	4	38
TQ9222	River Rother (non-tidal part).....	TQ937243	TQ933227	3	50
TR0244	Great Stour.....	TR038449	TR032430	4	53
TR0826	New Sewer.....	TR058264	TR090273	7	46
TR1658	Great Stour.....	TR155590	TR163598	3	44

Random selected, and also a WBS site

SJ8610	Shropshire Union Canal.....	SJ849142	SJ875102	10	28
TQ1684	Grand Union Canal.....	TQ182836	TQ144843	10	41
TQ7252	River Medway.....	TQ740539	TQ704529	9	52

Other WBS sites

NH8350	River Nairn	NH806484	NH838507	9	39
NS8696	River Devon	NS895961	NS863961	10	51
NY3748	River Caldw	NY371487	NY382516	7	46
NY8529	River Tees	NY857295	NY889283	10	37
SD4610	Leeds & Liverpool Canal	SD494104	SD453112	10	50
SD4617	Leeds & Liverpool Canal	SD461149	SD458193	10	50
SD5009	Leeds & Liverpool Canal	SD524093	SD494104	7	31
SD5064	River Lune	SD522648	SD482631	10	51
SD5284	Lancaster Canal	SD537831	SD520854	7	38
SD5308	Leeds & Liverpool Canal	SD540073	SD525092	5	49
SD5465	River Lune	SD545653	SD558673	5	57
SD6177	River Lune	SD611790	SD609750	8	45
SE1222	R Calder/Calder & Hebble Canal	SE135228	SE128224	2	27
SE2796	River Swale	SE291965	SE257974	10	57
SE4445	River Wharfe	SE440453	SE472447	10	53
SH7220	River Mawddach	SH718193	SH735223	7	18
SJ0868	River Clwyd	SJ092659	SJ082687	9	56
SJ4070	Shropshire Union Canal	SJ394706	SJ418719	6	47
SJ6452	Shropshire Union Canal	SJ629549	SJ638504	10	52
SJ6967	Trent & Mersey Canal	SJ695671	SJ683689	5	39
SJ9279	Macclesfield Canal	SJ933779	SJ936814	8	39
SJ9586	Macclesfield Canal	SJ953860	SJ959880	5	33
SJ9785	Peak Forest Canal	SJ964882	SJ971859	5	36
SJ9786	River Goyt	SJ975867	SJ967883	5	36
SJ9822	Staffordshire & Worcs Canal	SJ995229	SJ971214	6	43
SK2181	River Derwent	SK205834	SK234806	10	47
SK2378	River Derwent	SK233806	SK240767	10	26
SK2476	River Derwent	SK244761	SK248727	8	62
SK3088	River Rivelin	SK322886	SK289871	7	32
SK4010	Erewash Canal	SK454471	SK469432	9	49
SK5715	River Soar			5	11
SK6236	Grantham Canal	SK639367	SK608368	8	51
SK7351	River Trent	SK743515	SK767522	10	50
SO1024	River Usk	SO123234	SO095253	9	55
SO3780	River Clun	SO361805	SO387814	6	34
SO5112	River Monnow	SO495146	SO512122	10	31
SO8687	Staffordshire & Worcs Canal	SO864855	SO862887	9	44
SO8757	Worcester & Birmingham Canal	SO865576	SO889577	5	32
SP1869	Stratford-upon-Avon Canal	SP187711	SP189671	8	35
SP7288	Grand Union Canal	SP727879	SP725901	10	38
SP9013	Grand Union Canal	SP933136	SP889140	10	59
SP9221	Grand Union Canal	SP929202	SP915230	8	41
SU4595	River Ock	SU473959	SU432963	10	49
SU9400	Alding Bourne/Lidsey Rife	SZ945999	SU958027	8	42
SX5363	River Plym	SX533637	SX569651	9	46
SX5365	River Meavy	SX527650	SX548669	10	46
SX9588	Exeter Canal	SX940894	SX963860	10	52
SY9999	River Stour	SZ004998	SY982994	6	49
TF1721	River Glen	TF201245	TF174210	10	58
TL1210	River Ver	TL123103	TL128084	4	38
TL1515	River Lea	TL140160	TL162145	7	61
TL1550	River Ivel	TL156519	TL156508	5	67
TL3701	River Lea/Lee Navigation	TL371018	TL375026	10	47
TL4963	River Cam	TL502644	TL487621	6	44
TL8187	River Little Ouse	TL817879	TL786869	8	49
TQ0370	River Thames	TQ044695	TQ018721	10	31

TQ0492	Grand Union Canal.....	TQ062940	TQ044902	10	56
TQ0558	River Wey Navigation.....	TQ050578	TQ055586	2	23
TQ2865	River Wandle.....	TQ282651	TQ261687	9	34

Voluntary sites

SD6100	Leigh Branch Canal.....	SD602018	SJ630996	8	64
SK1883	River Noe.....	SK168846	SK204826	8	26
SK6929	Grantham Canal.....	SK676307	SK709292	10	42
SU8602	Chichester Canal.....	SU858036	SU842013	8	50
TF8094	River Wissey.....	TF807945	TF774962	10	54