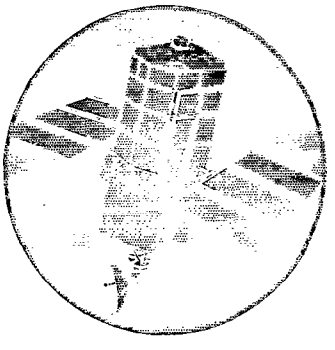
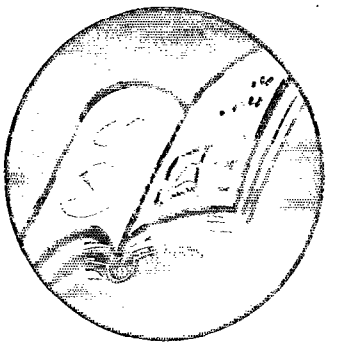
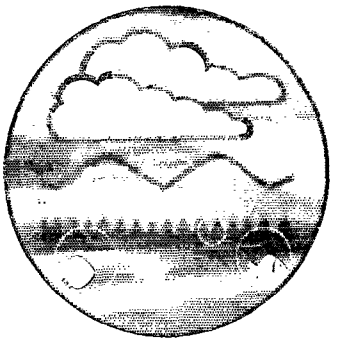
Waterways Breeding Bird Survey Pilot Survey 1998: Adaptation of BBS Census Methods to Rivers and Canals

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Waterways Breeding Bird Survey Pilot Survey 1998: Adaption of BBS Census Methods to Rivers and Canals

R&D Technical Report W205

J H Marchant & R D Gregory

Research Contractor:
British Trust for Ornithology

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Statement of use
This report will be of use to the Environment Agency and other bodies concerned with nature conservation along waterways. The Waterways Breeding Birds Survey (WBBS) can collect useful data linked to the River Habitat Survey (RHS). This document details the methods and findings of the initial trials.

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EXECUTIVE SUMMARY

In order to fulfill their statutory duties for wildlife conservation, the Environment Agency and its sister organisations require good-quality information on the distribution and numbers of breeding birds along waterways, and on how bird populations relate to the habitat available.

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.

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.

Changing the methods of long-term waterways bird censusing from WBS mapping to a BBS-style transect, and incorporating random selection of plots, would maximise the value of waterways bird censuses for nature conservation, especially if future data collection were compatible with the Environment Agency's River Habitat Survey (RHS).

With this background, the BTO launched the Waterways Breeding Bird Survey (WBBS) as a pilot scheme in 1998. A sample of 201 stretches of waterway was selected randomly, with the aim of achieving coverage by volunteers of at least 100 stretches. 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. 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. In all, 103 stretches of waterway comprising 600 500-metre sections were surveyed in the 1998 pilot survey, in line with our target figure. Stretches covered were widely distributed within Britain and approximated to a random sample. A further 61 canal plots, selected to investigate the possible effects on breeding bird numbers of a close season for coarse angling, were also surveyed in 1998 using WBBS methods; this study has been reported separately.

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.

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. Working together, BBS and WBBS would provide more precise and more representative data on waterbird population change 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 has shown that there are promising links between WBBS and RHS data. More data collection is needed, however, and more sophisticated modelling techniques need to be applied to their analysis, before WBBS reaches its full potential for waterway management.

Elements of WBBS requiring further pilot fieldwork have been identified and will be addressed during the 1999 and 2000 breeding seasons. The Agency is asked to consider collecting a further set of RHS data, concurrently, this time on randomly selected WBBS stretches, so that links between the two sets of data can be investigated on a wider range of waterway types.

KEYWORDS

Breeding Birds Survey; Waterways Bird Survey; Census; Ornithology; Rivers; Canals; Population; Conservation.

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 reed-bed passerines, is included in the survey.

Today, the WBS has completed 25 seasons of mapping fieldwork and recorded much very valuable information on population change and relationships between birds and habitat (*eg* Rushton *et al.* 1994).

In order to fulfill their statutory duties for wildlife conservation, the Environment Agency and its sister organisations require 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 these bodies. Relatively few sites have been covered, and the survey has proved quite time-consuming for BTO staff (although less so now 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 Subsequent 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 (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 2000 squares were surveyed in 1998. 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.

BBS is in the process of taking 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. Goosander is not yet monitored by WBS, but its population expansion has brought it to the threshold level for indexing.

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. Data are from 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.

In pursuit of these ideals, the BTO 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;*
- *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.

A further element to the 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. This study has been reported elsewhere (Marchant *et al.* 1999).

2 METHODS OF THE PILOT 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 in the public domain.

In the absence of linear 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 many 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, 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 infill, 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.

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 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, ie 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 preset, 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).*

2.2 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.

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 is divided into up to ten sections. 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, which were based heavily on those designed for BBS, are appended to this report (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 Methods of 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 not widespread.

3 RESULTS

3.1 Coverage achieved

Of the 201 stretches that were randomly selected, just over half (103) were covered. Four further surveys that arrived too late for inclusion in the analyses, and one for which the forms were completed incorrectly, are treated as not covered. The distributions of WBBS random stretches covered and not covered are shown in Figure 1.

Figure 1 shows the wide geographical scatter of selected plots, but also the absence of cover in some parts of the UK. The rather clumped pattern of stretches that were selected follows partly from the non-participation of a small number of RRs, for example in Northern Ireland, Aberdeenshire and Sussex, in that no stretches were selected from their regions.

The pattern of distribution also follows from the area-based method of selection, which, since the number 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 Norfolk and Suffolk, where river courses are few and well scattered, were 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 was 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.*

Strict adherence to the priority rankings would have helped to maintain the random nature of the sample even where not all the stretches were covered. The results provided little evidence, however, that priority was an important determinant of whether a selected stretch received coverage (Table 2). Despite these limitations, **the sample of stretches that were covered can reasonably be considered to be representative of waterways in participating regions.**

Stretches that were covered, together with the number of 500-metre sections in each, are listed in Appendix 2. In all, exactly 600 500-metre sections were covered. The mean number of 500-metre transect sections per stretch was 5.83 (standard deviation 2.40, range 2-10).

It was clear from the maps returned by observers that not all sections were 500 metres long, as had been requested. Where possible, conspicuous errors were corrected, for example by amalgamating half-length sections, before the stage of data input. Assuming that the mean section length was as requested, the mean WBBS transect length was 2.9 km and, overall, the pilot survey covered 300 km of waterway.

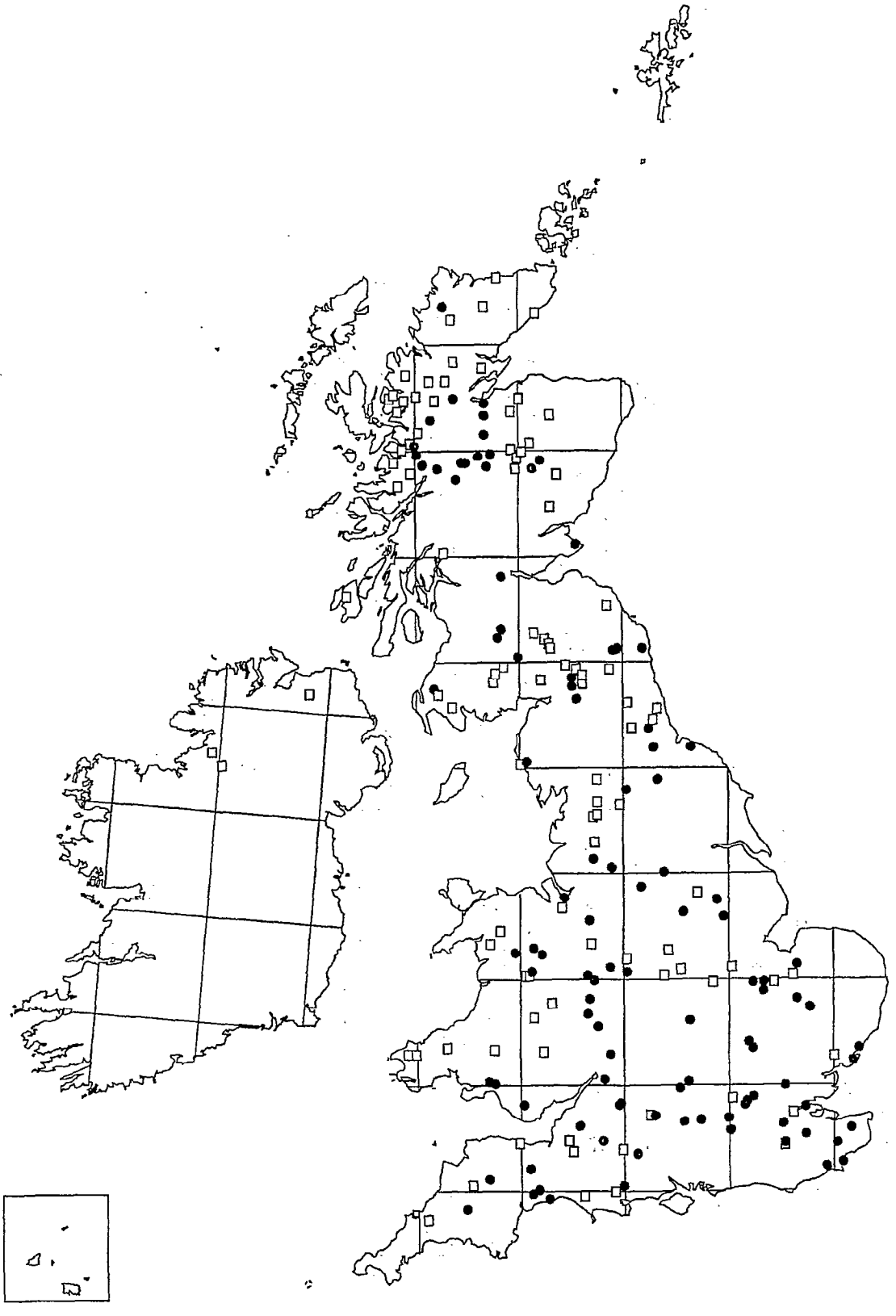

Figure 1. Coverage of randomly selected WBBS stretches in 1998. Closed circles represent sites covered and open squares those selected but not covered.

Table 2. Proportions of sites covered in relation to their priority ranking.

Priority ranking	No. stretches selected	No. stretches covered	% covered
1	69	41	59%
2	45	21	47%
3	27	11	41%
4	19	11	58%
5	11	5	45%
6 and below	30	14	47%

3.2 Data collection for birds

WBBS observers recorded 149 species on the random stretches, including escaped or introduced Black Swan, Barnacle Goose, Bar-headed Goose, Muscovy Duck and Peacock. Among the rarest species recorded were Little Gull, Wood Sandpiper, Quail, Stone-curlew and Woodlark. Osprey and Avocet were each recorded on two plots. Grasshopper Warbler (one plot) and Lesser Spotted Woodpecker (two plots) were surprisingly rare.

Numbers of species recorded on each stretch are listed in Appendix 2. The largest number of species on any one stretch was 61 on 3½ km of the River Lark in Suffolk (surveyed by JHM); by contrast, on 1½ km of mountain stream in Inverness-shire the only birds found were seven Meadow Pipits and a Merlin. The mean number of species per stretch was 35.3 (standard deviation 13.2). These figures compare with 46 spaces for species on each count summary form (Appendix 1).

For species occurring on more than 5% of stretches, the proportion of sites occupied, and the mean densities overall and in the 0-25m distance category, are shown in Appendix 3. The most abundant species overall were Wood Pigeon, Starling, Rook, Mallard, Chaffinch and Wren. Within 25 metres of the waterway, the most abundant waterbirds were Mallard, Moorhen, Reed Warbler, Mute Swan and Sedge Warbler. The following species occurred on at least three-quarters of stretches surveyed: Chaffinch (88%), Mallard (85%), Wood Pigeon, Wren, Carrion Crow, Blackbird, Blue Tit and Great Tit.

Results of WBBS for waterside bird species are shown in Table 3, alongside comparative data from the Breeding Bird Survey in 1997 (from Gregory *et al.* 1998). 1997 BBS data were used because 1998 data were unavailable at the time of writing. In every case except Whitethroat, where the percentages were the same, species were found on a substantially higher proportion of WBBS stretches than BBS squares. The ratio of WBBS proportion to BBS proportion was highest for the most specialised waterways species, such as Dipper and Kingfisher, and least for Whitethroat which shows no special attachment to waterside habitats. It should be remembered that BBS transects are each 2 km, and are therefore shorter than the mean WBBS transect length of 2.9 km; the extra length of WBBS transects will tend to increase the apparent differences from BBS.

Table 3. Proportions of WBBS and BBS sites occupied by waterbird species. Species tabulated are those that are currently indexed by the Waterways Bird Survey. BBS data are from Gregory *et al.* (1998).

Species	No. occupied WBBS stretches	% WBBS stretches occupied in 1998	% BBS squares occupied in 1997
Little Grebe	11	11%	2%
Mute Swan	38	37%	8%
Mallard	88	85%	43%
Tufted Duck	16	16%	6%
Moorhen	61	59%	22%
Coot	28	27%	8%
Oystercatcher	24	23%	12%
Lapwing	33	32%	26%
Curlew	24	23%	21%
Redshank	7	7%	3%
Common Sandpiper	32	31%	4%
Kingfisher	30	29%	2%
Sand Martin	27	26%	5%
Yellow Wagtail	12	12%	8%
Grey Wagtail	42	41%	6%
Pied Wagtail	62	60%	44%
Dipper	37	36%	2%
Sedge Warbler	30	29%	12%
Reed Warbler	22	21%	4%
Whitethroat	50	49%	49%
Reed Bunting	42	41%	16%

Drawing on the data presented in Table 3, the species for which directing BBS effort along waterways would apparently provide the greatest benefit, in terms of transects occupied, are:

Dipper, Kingfisher, Common Sandpiper, Grey Wagtail, Little Grebe, Sand Martin, Reed Warbler and Mute Swan.

All are species identified in earlier assessments as likely to require supplementary monitoring over and above the standard BBS (see Table 1).

3.3 Collection of habitat data

Although the BTO habitat coding system is complex, there was little evidence that observers found difficulty in completing the forms. Guidance as to the meaning of some terms and for which codes to give priority were given on the WBBS habitat recording form (Appendix 1). Extra guidance was requested by one observer over the distinctions between eutrophic, oligotrophic and dystrophic waters and marl.

Only two observers failed to return a habitat form. For these stretches, first habitats (only) were assigned to each transect section by us, from information received from the observer or gleaned from the OS map.

The distribution of major habitat types among waterway sections is shown in Table 4. Streams and rivers formed 86% of the sample, and canals 14%. There is a discrepancy between the random selection procedure, which excluded waterways less than 6.5 metres wide according to the OS criteria, and the description by observers of 16% of sections as being 5 metres wide or less; it is likely, however, that observers recorded water width rather than a bankfull width, and that this accounted for most or all of the discrepancy. Farmland was the most frequent type recorded as the second and third habitat, with grassland predominating over tilled land. Woodland was the second most frequent second habitat type, and for third habitats the second most used coding was for human sites, particularly rural, including buildings, gardens, roads and parks.

Within each of the tabled categories were two further levels of subcategories. These would enable quite detailed comparisons of bird numbers and habitat, although the scope for this in the pilot survey was limited by the size of the sample. WBBS habitat data are less detailed than RHS data; also, since there is space for observers to record only three habitat types, WBBS data may omit habitats that are considered by observers to be of lower priority for recording.

3.4 Collection of data for mammals

From the 103 random WBBS stretches that were covered in 1998, observers for all but ten completed and returned their forms for recording detectable mammals (see example in Appendix 1). Five of the 93 forms were nil returns, indicating that no mammals or signs of mammals had been observed. Of the remaining 88 stretches, 57% recorded three or fewer mammal species, with a modal value of two (25% of stretches). Eight stretches recorded more than ten mammal species; the maximum was 14 species.

Table 5 lists the species of mammals found, ranked by the proportion of stretches on which they were located. All such estimates of proportion of stretches occupied 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 mammals found most frequently were diurnal species or ones that left obvious signs of presence. Of specialist waterway mammals, Otter was found on 15% of stretches, Water Vole on 9% and American Mink on 8%.

Table 4. **Summary of habitat data recorded for WBBS 500-metre sections in 1998. Codes are from the BTO habitat coding system (Crick 1992). Only the most frequently recorded habitat subcategories are shown; those recorded on less than 5% of both second and third habitats are excluded.**

Habitat code and description		% of first habitats (n=600)	% of second habitats (n=585)	% of third habitats (n=420)
G	**WATER BODIES (freshwater)**	**100%**	**0.3%**	**1.2%**
G6	stream (less than 3m wide)	13%		
G7	river (more than 3m wide)	73%		
G9	small canal (2-5m wide)	3%		
G10	large canal (more than 5m wide)	11%		
A	**WOODLAND**		**18%**	**18%**
A1	broadleaved		12%	10%
B	**SCRUBLAND**		**2%**	**4%**
C	**SEMINATURAL GRASS/MARSH**		**13%**	**10%**
C2	grass moor (unenclosed)		7%	2%
D	**HEATHLAND AND BOGS**		**7%**	**9%**
E	**FARMLAND**		**49%**	**31%**
E1	apparently improved grassland		18%	9%
E2	apparently unimproved grassland		13%	5%
E3	mixed grass/tilled land		7%	6%
E4	tilled land		11%	10%
F	**HUMAN SITES**		**10%**	**23%**
F2	suburban		7%	6%
F3	rural		3%	15%
H	**COASTAL**		**1%**	**1%**
I	**INLAND ROCK**		**0%**	**2%**

Table 5. **Mammals recorded on WBBS random stretches in 1998 (n=93). 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	1547	60	65%
Mole	10	37	40%
Red Fox	13	36	39%
Grey Squirrel	107	34	37%
Brown Hare	102	30	32%
Roe Deer	23	22	24%
shrew species	13	18	19%
Badger	1	17	18%
Otter	8	14	15%
Stoat	1	13	14%
Hedgehog	1	13	14%
Red Deer	299	12	13%
Brown Rat	3	11	12%
Weasel	1	11	12%
Mountain Hare	42	8	9%
Water Vole	3	8	9%
American Mink	3	7	8%
Muntjac Deer	1	5	5%
Red Squirrel	3	4	4%
Fallow Deer	2	4	4%
Feral Goat	14	1	1%
Pipistrelle Bat	0 (signs only)	1	1%
Long-eared Bat	0 (signs only)	1	1%
Pine Marten	0 (signs only)	1	1%

4 DISCUSSION

4.1 Success of the pilot scheme

4.1.1 Random selection of plots

No suitable national database of waterway stretches was available from which to make a random selection. Ideally, such a database would be linked to information that could be used to stratify a random sample. The alternative approach of selecting waterways from random grid-squares worked successfully but the scope for stratification was limited and none was attempted in the pilot survey. Stratification by observer density within sampling regions, as adopted by the BBS, could usefully be explored in the future.

An effect of the selection method and the lack of stratification, for example by river width or altitude, was that most stretches of river selected were close to the headwaters. This followed from the density of watercourses being higher close to watersheds than towards the coast. Whether this feature of the sample was important would depend on the aims of the survey. If the aims were different from those of the pilot WBBS, for example if the survey were to concentrate on lowland species or those preferring broader rivers, then it would be inappropriate to use the current method of selecting stretches unless a suitable stratification was applied.

Partly as a result of the short notice given to RRs and observers of the start of the pilot survey, a substantial proportion (49%) of the sample stretches were not covered. This may be linked more to lack of observers in some regions and to problems of obtaining access than to observer choice based on bird numbers. To maintain the randomness of a future full survey, however, it would be important to increase the percentage of stretches covered. This could be achieved by:

- *maintaining and increasing the momentum generated by the first pilot survey, by means of feedback of news and results to existing and potential WBBS observers;*
- *ensuring lead-in times of at least six months to any new phases of the survey;*
- *employing a stratification by observer density, as in BBS, by which more stretches would be selected in areas where observers are available to cover them;*
- *offering help in obtaining access permissions in difficult cases.*

It is unlikely that the coverage rate of 70% of selected squares achieved by BBS could be matched by WBBS. In comparison with BBS transects, transects alongside rivers are more likely to be subject to restrictions on access. Riverside gardens and private fisheries are two particular problems observers might face. Alternative transect routes, avoiding areas where access has been refused, are often used in BBS squares but would be inappropriate for WBBS surveys if they involved a substantial deviation from the watercourse. The proportion of WBBS stretches that are "uncoverable" is thus likely always to be higher than that of BBS squares.

4.1.2 Field methodology

Observers appear to have taken very well to BBS-style transect methods for waterbird surveys. WBBS differs from BBS in covering an intrinsically interesting bird habitat; observers appear to have enjoyed this and also the greater freedom to choose the starting point and length of their transect. Observers reported no difficulty following BBS-style transects along canals, where towpaths provided easy access directly alongside the waterway. On rivers, some found that minor diversions away from the riverbank were necessary or that the length of the stretch that could be covered was limited by access restrictions.

In future WBBS surveys, consideration should be given to the following:

- *agreeing section boundaries with observers, to standardise more precisely on 500 metres as the section length; and*

- *giving observers more guidance about habitat recording.*

In conclusion, however, the pilot survey has demonstrated that the BBS census methods as adapted for the pilot WBBS can be applied successfully in a random sample of waterway stretches and can produce valuable data on birds, mammals and habitat.

4.2 Value of WBBS to the work of the Environment Agency

4.2.1 Population monitoring

The Environment Agency has a statutory duty to promote the conservation of flora and fauna dependent on the aquatic environment. To meet this duty, data on broad-scale bird population trends are necessary in order to provide background information to population changes detected during catchment or site-based studies, for example before and after operational works (Marchant *et al.* 1996, Langston *et al.* 1997).

The advantage of WBBS over both BBS and WBS is that it would provide broad-scale bird population trends that are specific to the waterway habitat and drawn from a fully representative sample. The pilot survey has demonstrated that WBBS methods could fulfil these objectives.

If a long-running WBBS were set up with 400 stretches covered each year, the results of the pilot suggest that a monitoring sample of 100 or more occupied plots would be available for 60 species (from Appendix 3). These include all but three of the species listed as targets in Table 1; more WBBS plots (up to 900 annually in the case of Little Grebe) would be needed to find 100 occupied stretches for Little Grebe, Goosander and Reed Warbler. We estimate that a sample size of 100 or more occupied stretches is required to monitor population trends precisely, although it is possible that sample sizes between 50 and 100 still provide adequate monitoring (Field & Gregory 1999). The efficiency of WBBS in covering specific target waterbird species could be improved by stratifying the sample by habitat type.

For species providing large samples of occupied WBBS stretches, populations could be monitored not just nationally but also regionally and at the scale of larger catchments.

The population trend data provided by WBBS would be of value to JNCC, RSPB, and other supporters of the BBS, and to the Agency and other bodies with both conservation and management duties along waterways. WBBS would extend the range of species currently monitored by BBS and, for species already covered, extend the range of habitats from which data were drawn.

4.2.2 Site appraisal

The pilot survey has established that WBBS is a workable method that, with relatively little fieldwork effort, can provide bird counts that link to the Agency's RHS. In addition, there are encouraging signs that WBBS observers can collect valuable mammal data that would also be directly relevant to site appraisal along waterways. Alongside a full-scale long-running national WBBS programme, the WBBS method can become an accepted standard for short-term or one-off waterbird surveys.

Where data on waterbirds are required as part of a pre- or post-project appraisal on a short stretch of waterway, it is likely that a WBS-style mapping census would be more appropriate than a WBBS transect because of the more complete and more detailed information it would give on waterbird territory location (Marchant *et al.* 1996). While WBS would require nine survey visits in a season, it would produce maps of breeding territories for each species; WBBS needs just two visits but simply provides bird counts by 500-metre section of waterway. Where time constraints preclude WBS mapping, the WBBS method would be an appropriate alternative.

A key question for the Environment Agency and others collecting RHS data is whether they are of value in predicting the distribution of birds and other wildlife not included in the survey itself. If RHS turned out to be only poorly related to the real distributions of wildlife species and communities, then its value for nature conservation would be seriously undermined. If WBBS bird counts are strongly linked to RHS data, then a joint WBBS/RHS database could be used to model bird distribution on waterways on a catchment, regional or national scale, and to predict how bird numbers might change in response to proposed management works. The ability to predict breeding bird populations, based on RHS habitat measures, would be of great value to the Agency and other bodies with duties to manage waterways and conserve their wildlife.

As part of the report investigating the effects on canal birds of a closed season for coarse angling (Marchant *et al.* 1999), we examined correlations between selected RHS variables and WBBS bird counts in 500-metre sections. The results confirmed, as already indicated in other recent studies (*eg* Buckton & Ormerod 1997, Brewin *et al.* 1998), that RHS factors correlate well with bird numbers. The strongest correlations are listed in Table 6. A substantial number of less significant correlations were also found. While there are some surprises in the results, they make good sense biologically and fit well with what we already know about the ecology of each species. Another function of the WBBS pilot work in 1998 has been therefore to demonstrate the power of WBBS and RHS in concert and add to the growing evidence that RHS results are useful indicators of biodiversity.

It should be noted, however, that the correlative approach adopted was only preliminary and that a full analysis of this aspect of the data was not part of the project. No allowance was made in this analysis for the non-independence of transect sections. Water width, in particular, was likely to be very similar across all sections within a WBBS canal stretch; auto-correlation of this kind is likely to have exaggerated the significance of the correlations.

Nevertheless, that so many links were found between RHS and WBBS data, despite the preliminary nature of the analysis, is encouraging for further investigation of this topic. Ideally, such an investigation should be based on a representative sample of waterways, including rivers, and use more sophisticated bird-habitat modelling techniques as developed by Buckton & Ormerod (1997) and Brewin *et al.* (1998), perhaps at the catchment level. The Agency should pursue this work, for example by funding a PhD studentship.

Table 6. Highly significant correlations between waterbird numbers and RHS features in WBBS 500-metre sections of canal (from Marchant *et al.* 1999).

RHS feature	Direction of correlation	Species providing highly significant correlations (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

4.3 Future development of WBBS

Information that is needed as part of the further development of WBBS includes:

- *the potential for volunteers to carry out repeat surveys on stretches covered previously;*
- *the potential for expansion of the survey to random stretches not previously covered;*
- *the potential for current WBS observers to contribute data to both WBS and WBBS;*
- *estimates of the precision of year-to-year monitoring by WBBS methods;*
- *a comparison of population change data between WBBS and WBS; and*
- *development of a modelling approach to WBBS and RHS data, including the collection of new RHS data for randomly selected waterways.*

The R&D project in collaboration with the Environment Agency will run until the year 2001. The BTO plans that, in 1999, as many as possible of the random stretches covered in 1998 will be resurveyed, and that extra stretches will be added to the sample. Also, WBS observers will be encouraged to contribute to both WBS and WBBS. An examination of paired WBBS counts for 1998 and 1999 will give the first estimates of the precision of monitoring obtainable by WBBS. The sample of 1998-99 data for WBS and WBBS in parallel should allow the first comparisons of estimates of year-to-year population change from the two surveys. The success of a second year of WBBS surveys would confirm its potential as a long-running survey.

The Environment Agency is asked to consider the value of commissioning RHS fieldwork on the random sample of WBBS stretches during 1999, to provide a large random sample of comparative WBBS and RHS data for future detailed analysis and modelling. This would be used to clarify to what extent the two sets of data are linked.

ACKNOWLEDGEMENTS

The launch of WBBS was funded in collaboration with the Environment Agency's R&D programme. We also acknowledge the financial support of Anglian Water, British Waterways, Severn Trent Water, Thames Water and Welsh Water. BBS is funded jointly by the BTO, JNCC (on behalf of English Nature, Scottish Natural Heritage, the Countryside Council for Wales and the Environment and Heritage Service in Northern Ireland), and the RSPB.

The BTO's work relies heavily on volunteers. It is gratifying that, in a year when BBS grew and CBC and WBS continued to be well supported, BTO volunteers also found time to survey over a hundred random 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.

We acknowledge the help of the following Environment Agency staff during the course of this project: Geraldine Daly, Dr Paul Raven, Martin Smalls, Adrian Taylor, Andrew Heaton and Alastair Driver. Dr Steve Ormerod also provided valuable advice and guidance. Thanks are due to Andy Tomczynski and Tony Dearsley (Thames Water), Geoff Nickolds (Severn Trent Water), Viv Phillips (British Waterways), Andy Brown (Anglian Water) and Phil Morgan (Dŵr Cymru Welsh Water) for providing text from their organisations endorsing this work. At BTO HQ, Dr Nick Carter, Peter Beaven, Sam Rider, Karl Evans, Fiona Sanderson, Vivien Hiom and Jane Wells assisted at various stages of the project. Host Data Services Ltd of Watford input the bulk of the WBBS data from the observers' field sheets.

Endorsements:

Dŵr Cymru Welsh Water has been pleased to support the BTO Waterways Breeding Bird Survey. As a Company dedicated to good environmental practice and creating a better, cleaner environment for our customers and wildlife we recognise the importance of our role in maintaining and improving waterways for birds. They provide a valuable habitat for our wildlife and we are committed to improving biodiversity through partnership with other bodies. **Dŵr Cymru/Welsh Water**

British Waterways manages and cares for over 2000 miles of Britain's canals and rivers. Through the organisation's own Environmental Code of Practice all aspects of British Waterways' work from routine management to large-scale development are planned to maintain and where possible improve available habitats for wildlife. Good stewardship of the natural heritage of the waterways depends on good-quality information about the wildlife present. Support for the Waterways Breeding Bird Survey is in recognition of the value of such surveys in our work. **British Waterways**

We at Severn Trent Water are delighted to support the Waterways Breeding Bird Survey. Since we are soon to launch our Company Biodiversity Action Plan we are well aware of the need to monitor the populations of birds around our waterways. The data that the survey provides are essential in helping to set the priorities for future habitat improvements, building further upon the improvement in water quality which our massive investment programme has already brought about. **Severn Trent Water**

We are very pleased to sponsor the BTO in the development of a new survey methodology for the monitoring of breeding birds on waterways. I believe it will make a significant contribution to biodiversity monitoring and our understanding of the ecological benefits of improved river quality and the impact of water resource development and management. We work actively to improve the quality and flow of rivers, having invested around £950 million since 1989 at our sewage treatment works to ensure the waste water returned to the environment is of the highest quality.

Dr Peter Spillett, Environment and Quality Manager, **Thames Water**

Anglian Water is pleased to have been involved with the Waterways Breeding Bird Survey during 1998. As a company Anglian Water is committed to protecting the ecological assets that are an integral part of our business. A major aspect of our involvement in protecting and enhancing the UK's biodiversity is through species monitoring and research on our own sites. This involvement varies from participation in the BTO/British Sugar Business Sites Challenge to the development of our own index to monitor the biodiversity value of individual sites. Our interaction with the environment, in particular with riverine habitats, extends much further than our own site boundaries and so the surveys that the BTO are carrying out are of great interest. The additional information that is gained from these surveys will contribute to the overall understanding of the effectiveness of our operational environmental improvements in the riverine environment. **Anglian Water**

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APPENDIX 1. WBBS pilot 1998: recording forms and instructions.

This appendix contains the following sheets as distributed to WBBS observers in 1998:

- *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.

WATERWAYS BREEDING BIRD SURVEY:
PILOT 1998

British Trust for Ornithology

General information

Why a Waterways Breeding Bird Survey?

The Waterways Bird Survey (WBS) has run since 1974, with BTO volunteers using territory mapping to assess population changes of selected riverside birds along rivers and canals. It was a BTO initiative and for most of its life it has received limited outside financial support.

In the meantime, the National Rivers Authority (which had statutory responsibility for nature conservation along waterways), and the Environment Agency (EA) which has replaced it, have been carrying out their own bird surveys, having found that WBS did not meet their specific requirements.

The need has now been identified by EA for linking bird surveys to its River Habitat Survey. Modifying WBS to meet these objectives would require remodelling the scheme along the lines of the Breeding Bird Survey. Eventually, a Waterways BBS might become an extension of the Breeding Bird Survey (BBS) itself.

Initial tests in 1996 highlighted the need for ongoing surveys of waterbirds in this habitat, and suggested that methods could be switched successfully from territory mapping to line transects. Based on this work, EA has now funded a single-year pilot survey of BBS-style methods on randomly selected waterways throughout the UK. They have also funded a study of the effects of fishing close-seasons on canals on bird populations, which has been integrated with the WBBS pilot.

The long-running WBS, using its territory-mapping methods, will continue as normal in 1998.

Aims of the pilot survey

This year's single-season pilot WBBS will show: whether the methods of plot selection have been successful; the likely success of a full survey; the accessibility of randomly selected sites; the value of recording in distance bands; and the practicality of bird, habitat and mammal recording by the new methods.

Organisation of the pilot WBBS

The contract for this new work arrived at the Nunnery on 4 February. Despite the short notice we are able to give, we are hoping for an enthusiastic response from Regional Organisers and from potential observers!

Regional Organisers have been appointed and asked to match plots with potential observers. The "plots" in this case are just over 200 lengths of river and canal. Most stretches are tied loosely to a randomly selected tetrad (2x2-km square) of the British and Irish national grids; in addition, a number of extra canal stretches have been chosen, to meet the additional requirement for studying the effects of fishing close seasons on the species and numbers of breeding birds. Where WBBS waterways overlap with existing WBS plots, we are contacting WBS observers direct, to ask whether they can contribute to both surveys.

The observer may choose the upstream and downstream limits of the survey, provided that a whole number of 500-metre units are covered (the River Habitat Survey uses this size of survey unit.) Up to 10 such units may be covered, i.e. 5 km. Where possible, the part of the waterway that runs through the selected tetrad should be included in the survey. Procedures will follow those of BBS, and recording forms (field sheets, summary sheets, habitat and mammal forms) are essentially the same. Please refer to instructions and recording forms for more information.

Ideally, we need every selected waterway to be surveyed. If you have agreed to survey a stretch but for any reason can't do it, please let your RO or me know this **before mid April** and say why (e.g. access denied, too remote, dangerous terrain), unless your reasons are personal. Please ensure that you understand what to do and that you report back quickly if you run into problems or need help. Some staff time may be available to fill gaps in coverage along canals, in particular, provided we are alerted in time.

John Marchant (WBBS National Organiser)
BTO, The Nunnery, Thetford, Norfolk, 24 Feb 1998

WATERWAYS BREEDING BIRD SURVEY: PILOT 1998

INSTRUCTIONS

British Trust for Ornithology

BACKGROUND

- The aims of the WBBS pilot survey are to assess the value of the transect census methodology of the BTO/JNCC/RSPB Breeding Bird Survey (BBS) as applied to surveys of birds along rivers and canals. The methods and all recording forms are based heavily on the BBS equivalents.
- This year's pilot WBBS incorporates a sample of canal stretches that have been selected especially to investigate whether fishing close seasons are likely to affect the populations of breeding birds.

Like BBS, the pilot WBBS survey is designed to be a quick, simple and, most importantly, an enjoyable birdwatching exercise. Most stretches of waterway to be covered are tied to randomly selected tetrads 2x2-kilometre (km) squares of the National Grid; in addition, a small number of canal stretches have been selected non-randomly for the extra purpose of comparing bird numbers between canals with and without fishing close seasons. Only around 200 stretches have been selected in total for this pilot survey, and it is important that some level of coverage is achieved for as many of these as possible. The minimum coverage for any selected waterway would be a single 500-metre unit, but ideally up to ten such units could be covered (5 km).

Observers make just three visits to their waterway stretches, the first to check access and record habitat types, and the second and third to record birds.

The main aims of the BBS, to which the pilot WBBS is closely related, are:

1. 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.
2. 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.
3. To promote bird conservation through the involvement of large numbers of volunteers in survey work in the UK.

The pilot WBBS differs from BBS in that:

1. The transects run along rivers and canals, rather than being matched to straight lines through grid squares.

TIPS TO VOLUNTEERS:

1. **Record all birds seen or heard. Birds at any distance beyond 100 metres to the side of your transect line (the midline of the waterway) should be recorded in the third distance category.**
2. **Ensure that only the number of birds recorded is written in each box on the count summary forms. Additional information (such as +, ♀ or ♂) complicates the forms and should be avoided.**
3. **Record habitat details, as described on the Habitat Recording Form. Even if you are able to fill in only the first two columns on the habitat form, this is still extremely useful.**
4. **Birds can be listed in any order on the Count Summary Sheet.**

Fieldworkers sho[illegible]ot put themselves in a position which could place them, or others, in danger. The Trust does not t[illegible]y responsibility or liability for any actions and subsequent consequences from the activities of field[illegible]ers.

2. Count sections are each 500 metres (BBS 200 metres). This is because the Environment Agency's River Habitat Survey, to which WBBS may eventually be linked, uses this larger size of unit.

The pilot WBBS differs from the long-established (and ongoing) Waterways Bird Survey (WBS) in that:

1. BBS-style transect methods are used, rather than territory-mapping.
2. Stretches are selected randomly.
3. All species of birds are included (not just riparian species as in WBS).

EQUIPMENT AND FORMS

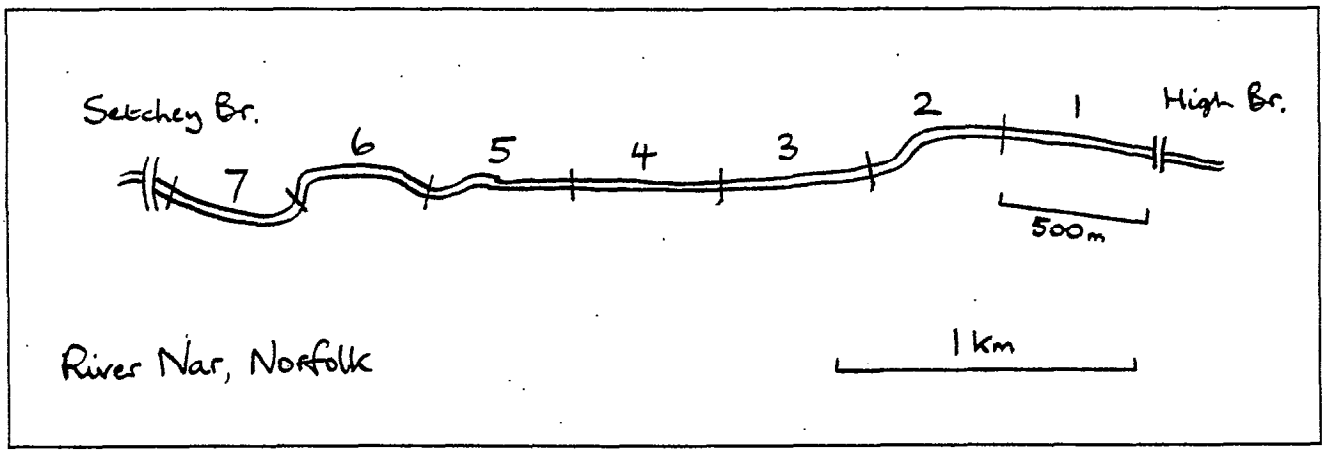
If you have volunteered to take part in the Pilot Waterways Breeding Bird Survey (WBBS), either your BTO Regional Organiser (RO) or the BTO Census Unit will have provided you with a copy of the Pathfinder Ordnance Survey (OS) map of the relevant part of the selected waterway we would like you to survey. The map is labelled with the grid reference of the bottom-left 1-km square of the selected tetrad and the name of the waterway to be covered (which are to be copied to your recording forms), and with the nominal tetrad. We hope the photocopied map will provide enough information for you to reach the site and do your fieldwork, but you may wish to obtain the OS Pathfinder map itself (the map number is on the label).

You should have received a map, this set of instructions, a general information sheet (blue), a habitat recording form (green), a mammal count summary sheet (pink), two field recording sheets, two count summary sheets and two "letters of introduction" for each waterway stretch you have agreed to cover.

FINDING A ROUTE

The waterway to be surveyed is highlighted on your map. The start and end points of the stretch are for the observer to determine, but both should be on the map that has been provided. Ideally, the stretch should contain that part of the waterway that passes through the selected tetrad. The boundaries of the tetrad are marked on the map. The length of the stretch should be a whole number of 500-metre units (min 1, max 10). Your transect line should be as close as possible to the edge of the waterway. Measure out and mark the 500-metre sections on your map before you start, and carry the map with you in the field.

In choosing your stretch, you will need to bear in mind any physical difficulties in walking it, and the need to obtain permission to enter private land. A letter of introduction has been provided for you to use when approaching landowners. In the example below, seven 500-metre sections are surveyed, i.e. 3½ kilometres in total.



In cases where survey work proves impossible, for example because it is physically impossible to visit or access permissions are not granted, please report this to your RO. It is **very important** not to reject stretches on the grounds that they appear uninteresting - stretches containing few species are just as valuable as squares with many species. **If circumstances prevent you from completing your fieldwork, please let us know urgently, in case another observer can be found to take over. This is especially important for canals, where a limited amount of staff fieldwork time is available.**

SUMMARY OF FIELDWORK

1.	March - April	Reconnaissance visit to set up or check census route and complete habitat recording form.
2.	Early April - mid-May	Complete 'early' transect count.
3.	Mid-May - late June	Complete 'late' transect count.
4.	July - August	Return data to Regional Organisers or directly to the BTO Census Unit if there is no acting organiser.

N.B. The fieldwork should begin and end later in more northerly parts of the UK.

WHEN TO VISIT

The main part of the breeding season, roughly between 1st April and 30th June, in the lowlands of southern Britain, should be divided into two counting periods (early season visit = April to mid-May; late season visit = mid-May to late June) and one visit should be made in each half. **Visits should be at least 4 weeks apart.** The first should coincide with the main activity period of the resident breeding birds in an area, while the second should take place after the arrival of the latest migrant breeding birds. Where local conditions dictate, for example, at higher altitudes and further north, visits should be shifted later in the season.

Counts should be made during the morning, beginning ideally between 6am and 7am, and no later than 9am. Please try to keep the starting times and dates of counts similar within a breeding season (and across years), preferably to within half-an-hour. Counts will be more productive the earlier you are able to start. Starting times can be shifted to begin later in more remote and less accessible areas.

WEATHER

Please do not attempt to census birds in conditions of heavy rain, poor visibility or strong wind. Please record weather conditions in the boxes provided on the forms which describe cloud cover, rain, wind speed, and visibility. Choose one number (1-3) from each of the four headings below and enter these in the box provided on the field and summary sheets.

Cloud cover	Rain	Wind	Visibility
0 - 33% = 1	None = 1	Calm = 1	Good = 1
33 - 66% = 2	Drizzle = 2	Light = 2	Moderate = 2
66 - 100% = 3	Showers = 3	Breezy = 3	Poor = 3

COUNTY CODES

Observers are asked to use the official county code to indicate where the census was carried out (which is not necessarily their home county). All UK codes start with GB followed by two letters, so for example Norfolk is GBNK. A full list of county codes is given in Appendix 1.

RECORDING BIRDS

Please record all the birds you encounter as you walk alongside the waterway. Do not record birds that are behind you as you begin a census nor any beyond the end of the stretch.

From your chosen starting point begin to walk your route at a slow and methodical pace. We recommend that you pause briefly to listen for bird songs and scan for birds flying overhead. Please remember to note the starting and finishing times of your visit (using a 24-hour clock, eg 0630, six-thirty in the morning, 1300, one o'clock in the afternoon). Record all the birds you see and hear on the field recording sheets in the appropriate transect sections 1-10 and in the appropriate distance category (see below). The recording boxes on the field sheet are divided into sections for convenience. Please don't worry about birds at the boundary of two sections: record them in whichever section seems more appropriate, but not in both. Try not to record the same individual bird twice. So for example a Mistle Thrush that can be heard singing from several transect stretches, or a Mute Swan swimming on ahead of the observer, should be recorded just once, in the section where it was first detected.

We would strongly encourage observers to use the standard BTO species codes (see Appendix 2). Please familiarise yourself with the most likely codes before you go into the field. If a species is not listed in Appendix 2 please give the full common name. There is no need to record the activity or sex of the birds you encounter although you may wish to do so. Please distinguish juvenile birds recorded from adults in those species where this is possible (e.g. B.juv, juvenile Blackbird) because juveniles should be excluded from the summary sheets. Please include any escaped birds on transects, and any feral waterfowl, whether or not the species is on the official UK list.

On both field and summary sheets, birds should be noted in the appropriate distance category. Put each bird into one of the following four categories, when they were first noted:

1. within 25 metres either side of the line;
2. between 25 and 100 metres either side of the line;
3. more than 100 metres either side of the line (at any distance); or
F. birds in flight only (at any distance).

Please note that distances are measured perpendicular (i.e. at right angles) to the transect line. A bird seen 200m ahead of the observer but close to the transect line should be recorded in category 1. We recommend that observers measure out distance categories (25m and 100m) using a combination of a tape measure and pacing to familiarise themselves with these before fieldwork begins. Category F relates to those birds seen only in flight. Draw an arrow through the species' two-letter code (e.g. ↗BZ↘) to indicate that a bird is in flight. If a bird is seen to take off or land it should be recorded in the appropriate distance category (1-3) at that position. **N.B. Skylarks in display flight should be recorded in the relevant distance category.**

COUNT SUMMARIES

Please complete the summary sheets (one for each field recording sheet) as soon as possible after each field visit and preferably on the same day. The form summarises the information so that it can be analysed. Simply transfer the number of individual birds (**excluding juveniles**) that were recorded in each section of the transect, 1-10, on each visit, in each distance band. Print the two-letter species codes in the appropriate boxes (and remember to add a **full stop** for single letter codes, e.g. B. = Blackbird). Where you did fewer than ten transect sections, leave the remaining boxes blank.

You may find it helpful to cross through species registrations on the field recording sheet as you transfer this information to the summaries (see page 5). This reduces the chance of duplicating or missing records. **Each volunteer is assigned an observer code (Obs. code) by BTO Census Unit when we receive the completed forms - please leave this box blank.**

If you have difficulty distinguishing adult and young birds simply estimate, to the best of your ability, how many adults were present. We appreciate that mixed-aged flocks of crows or Starlings, for example, will present problems later in the season and ask that you observe and record with great care. Colonial nesters should be entered in the box provided (see below).

COLONIAL NESTING BIRDS

Birds nesting in dense colonies (Rook, Sand Martin and gulls) will not be censused adequately using the standard method and we ask observers to count or estimate the number of nests in any colonies of these species that are visible from the transect line. Colony counts should be conducted separately from the transects and **only** for those species listed above.

EXAMPLE FIELD AND SUMMARY SHEETS

Example of completed field recording sheet

Please do not write in the shaded boxes. PLEASE USE BLOCK CAPITALS

Obs. code	_ _ _ _	Observer name	Mr/~~Mrs/Ms~~ J.H. MARCHANT	Address	BTO THE NUNNERY THETFORD NORFOLK IP24 2PU
1-km square reference (eg SK0212)			T M 1 1 8 5		
County code (eg GBSY)			G B N K		
Visit date (DD:MM:YY) (eg 08:05:98)			0 5 : 0 5 : 9 8	Tel. No:	01842 750050

Early or late season visit (E/L)	E	Weather (1,2 or 3)	Cloud 2	Rain 1	Wind 1	Visibility 2	
	Start time (HH:MM)	0 7 : 1 2	Finish time	0 8 : 3 3			

Recording birds in the field

100m 25m 100m

3	2	1	2	3
S	CH	MA ↑ 2MH	7MA →	

1

Transferring counts onto summary sheets

100m 25m 100m

3	2	1	2	3
S	CH	~~MA~~ ↑ 2MH	~~7MA~~ →	

1

Example of count summary sheet

Two-letter species code and species name	Distance category	Number of birds recorded on each transect section									
		1	2	3	4	5	6	7	8	9	10
MA MALLARD	1	3		2	12						
	2							2			
	3										
	F	7									

HABITAT RECORDING

Habitat recording will be essential to WBBS because it allows changes in bird numbers to be related to changes in habitat available to them. Habitat forms must be completed using the coding scheme which is common to a range of BTO projects. This is shown on the back of the green form and can be used without specialist knowledge. We advise that habitat details are recorded on your reconnaissance visit or following a count. Please do not record birds and habitat at the same time.

Habitat should be recorded separately for each of the 500-metre transect sections in your stretch. Please record what you feel to be the most appropriate codes for each section. Codes allow you to describe both the habitat of the waterway itself, termed the **first** habitat on the form, and that of the surrounding area (second and third habitats). In many cases two habitat types will have equal importance in the area surrounding the waterway, and the order in which they are entered does not matter. For each habitat, choose one habitat code from each of levels 1 and 2, and up to two codes from levels 3 and 4. Please complete as much detail as you feel able: the first two levels for each habitat are the most important.

The example below describes a river running through an area of arable farmland. In both 500-metre sections, the river itself is over 3 metres wide, is known to be fished, has light boat traffic, is oligotrophic (see habitat form), and is slow-running. Transect section 1 comprises tilled land with a hedgerow without trees, an active farmyard, and autumn-sown cereal growing. There is no third habitat and so this is left blank. Transect section 2 is a similar area also containing woodland. The first and second habitat codes are the same as for section 1 and the third habitat codes are for the woodland, i.e. coniferous, young plantation with low disturbance, moderate shrub layer and sparse field layer. If there is no appropriate code in levels 3 or 4 please put a dash ('-') in that column.

Transect section	First habitat (the waterway itself)				Second habitat (surroundings)				Third habitat (surroundings)				Comments
	Levels:				Levels:				Levels:				
	1	2	3	4	1	2	3	4	1	2	3	4	
1	G	7	3 10	2 5	E	4	2 6	7 -					10 = occasional pleasure-boats
2	G	7	3 10	2 5	E	4	2 6	7 -	A	2	5 8	2 6	

RETURN OF DATA

Please return completed forms to your RO by the end of August - earlier if possible. Forms returned for each waterway stretch should comprise: a map of your waterway stretch, with transect section numbers marked; one green habitat recording form; two field recording sheets; two count summaries; and the mammal recording form.

The WBBS Pilot is being organised by BTO on behalf of the Environment Agency and other bodies. Many thanks for helping with this important project and enjoy your censusing!

If you have any queries about the pilot WBBS please contact either your BTO Regional Organiser or:

The Census Unit, BTO, National Centre for Ornithology, The Nunnery, Thetford, Norfolk IP24 2PU

Tel: (01842) 750050 Fax: (01842) 750030

APPENDIX 1. COUNTY CODES

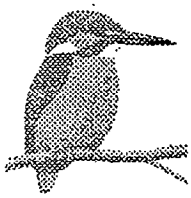
Always fill in the county on recording and summary sheets using the four-letter code from the list below.

England	
Avon	GBAV
Bedford	GBBD
Berkshire	GBBK
Buckinghamshire	GBBC
Cambridgeshire	GBCA
Cheshire	GBCH
Cleveland	GBCV
Cornwall (excl Scilly)	GBCO
Cumbria	GBCU
Derbyshire	GBDB
Devon	GBDV
Dorset	GBDO
Durham	GBDU
Essex	GBES
Gloucestershire	GBGL
Hampshire	GBHA
Hereford & Worcs	GBHF
Hertfordshire	GBHT
Humberside	GBHU
Isle of Wight	GBIW
Kent	GBKE
Lancashire	GBLA
Leicestershire	GBLE
Lincolnshire	GBLI
London (Greater)	GBLO
Manchester (Greater)	GBMA
Merseyside	GBME
Norfolk	GBNK
Northamptonshire	GBNH
Northumberland	GBNL
North Yorkshire	GBNY
Nottinghamshire	GBNT
Oxfordshire	GBOX
Shropshire	GBSA
Scilly Isles	GBSI
South Yorkshire	GBSY
Staffordshire	GBST
Somerset	GBSO
Suffolk	GBSK
Surrey	GBSR
Sussex (West & East)	GBSX
Tyne & Wear	GBTY
Warwickshire	GBWK
West Midlands	GBWM
West Yorkshire	GBWY
Wiltshire	GBWT
Isle of Man	
Isle of Man	GBIM
Scotland	
Borders Region	GBBR
Central Region	GBCR
Dumfries & Galloway Region	GBDR
Fair Isle	GBFI
Fife Region	GBFR
Grampian Region	GBGR
Highland Region	GBHR
Lothian Region	GBLR
Orkney	GBOR
Shetland (excl Fair Isle)	GBSH
Strathclyde Region	GBSC
Tayside Region	GBTR
Western Isles	GBWI
Wales	
Anglesey	GBAN
Clwyd	GBCW
Dyfed	GBDY
Glamorgan (all)	GBGM
Gwent	GBGT
Gwynedd	GBGD
Powys	GBPO
Northern Ireland	
Antrim	GBUN
Armagh	GBUR
Down	GBUD
Fermanagh	GBUF
Londonderry	GBUL
Tyrone	GBUT
Channel Islands	
Alderney	CIAL
Guernsey	CIGU
Herm	CIHE
Jersey	CIJE
Sark	CISA

APPENDIX 2. BTO SPECIES CODES

AC	Arctic Skua
AE	Arctic Tern
AV	Avocet
BY	Barnacle Goose
BO	Barn Owl
BA	Bar-tailed Godwit
BR	Bearded Tit
BS	Berwick's Swan
BI	Bittern
BK	Black Grouse
BH	Black-headed Gull
BW	Black-tailed Godwit
BV	Black-throated Diver
BX	Black Redstart
B.	Blackbird
BC	Blackcap
TY	Black Guillemot
BN	Black-necked Grebe
BJ	Black Tern
BU	Bluethroat
BT	Blue Tit
BL	Brambling
BG	Brent Goose
BF	Bullfinch
BZ	Buzzard
C.	Carrion Crow
CG	Canada Goose
CP	Capercaillie
CW	Cetti's Warbler
CH	Chaffinch
CC	Chiffchaff
CF	Chough
CL	Cirl Bunting
CT	Coal Tit
CD	Collared Dove
CM	Common Gull
CS	Common Sandpiper
CX	Common Scoter
CN	Common Tern
CE	Corncrake
CO	Coot
CA	Cormorant
CB	Corn Bunting
CI	Crested Tit
CR	Crossbill
CK	Cuckoo
CU	Curlew
DW	Dartford Warbler
DI	Dipper
DO	Dotterel
DN	Dunlin
D.	Dunnock
EG	Egyptian Goose
E.	Eider
FP	Feral Pigeon
FF	Fieldfare
FC	Firecrest
F.	Fulmar
GA	Gadwall
GX	Gannet
GW	Garden Warbler
GY	Garganey
GC	Goldcrest
EA	Golden Eagle
OL	Golden Oriole
GF	Golden Pheasant
GP	Golden Plover
GN	Goldeneye
GO	Goldfinch
GD	Goosander
GI	Goshawk
GH	Grasshopper Warbler
GB	Great B.b. Gull
GG	Great Crested Grebe
ND	Great Northern Diver
GS	Great Spotted Woodpecker
NX	Great Skua
GT	Great Tit
GE	Green Sandpiper
G.	Green Woodpecker
GR	Greenfinch
GK	Greenshank
H.	Grey Heron
GJ	Greylag Goose
P.	Grey Partridge
GV	Grey Plover
GL	Grey Wagtail
GU	Guillemot
HF	Hawfinch
HH	Hen Harrier
HG	Herring Gull
HY	Hobby
HZ	Honey Buzzard
HC	Hooded Crow
HP	Hoopoe
HM	House Martin
HS	House Sparrow
JD	Jackdaw
J.	Jay
K.	Kestrel
KF	Kingfisher
KI	Kittiwake
KN	Knot
LM	Lady Amherst's Pheasant
LA	Lapland Bunting
L.	Lapwing
TL	Leach's Petrel
LB	Lesser B.b. Gull
LS	Lesser Sp. Woodpecker
LW	Lesser Whitethroat
LI	Linnet
ET	Little Egret
LG	Little Grebe
LU	Little Gull
LO	Little Owl
LP	Little Ringed Plover
AF	Little Tern
LE	Long-eared Owl
LT	Long-tailed Tit
MG	Magpie
MA	Mallard
MN	Mandarin
MX	Manx Shearwater
MR	Marsh Harrier
MT	Marsh Tit
MW	Marsh Warbler
MP	Meadow Pipit
MU	Mediterranean Gull
ML	Merlin
M.	Mistle Thrush
MH	Moorhen
MO	Montagu's Harrier
MS	Mute Swan
N.	Nightingale
NJ	Nightjar
NH	Nuthatch
OP	Osprey
OC	Oystercatcher
PE	Peregrine
PH	Pheasant
PF	Pied Flycatcher
PW	Pied Wagtail
PG	Pink-footed Goose
PT	Pintail
PO	Pochard
PM	Ptarmigan
PU	Puffin
PS	Purple Sandpiper
Q.	Quail
RN	Raven
RA	Razorbill
RG	Red Grouse
ED	Red-backed Shrike
RM	Red-breasted Merganser
RQ	Red-crested Pochard
FV	Red-footed Falcon
KT	Red Kite
RL	Red-legged Partridge
NK	Red-necked Phalarope
RH	Red-throated Diver
LR	Redpoll
RK	Redshank
RT	Redstart
RE	Redwing
RB	Reed Bunting
RW	Reed Warbler
RZ	Ring Ousel
RI	Ring-necked Parakeet
RP	Ringed Plover
R.	Robin
DV	Rock Dove
RC	Rock Pipit
RO	Rook
RS	Roseate Tern
RY	Ruddy Duck
RU	Ruff
SS	Sanderling
SM	Sand Martin
TE	Sandwich Tern
VI	Savi's Warbler
SQ	Scarlet Rosefinch
SP	Scaup
CY	Scottish Crossbill
SW	Sedge Warbler
NS	Serin
SA	Shag
SU	Shelduck
SX	Shorelark
SE	Short-eared Owl
SV	Shoveler
SK	Siskin
S.	Skylark
SZ	Slavonian Grebe
SN	Snipe
SB	Snow Bunting
ST	Song Thrush
SH	Sparrowhawk
AK	Spotted Crake
SF	Spotted Flycatcher
SG	Starling
SD	Stock Dove
SC	Stonechat
TN	Stone-curlew
TM	Storm Petrel
SL	Swallow
SI	Swift
TO	Tawny Owl
T.	Teal
TK	Temminck's Stint
TP	Tree Pipit
TS	Tree Sparrow
TC	Treecreeper
TU	Tufted Duck
TT	Turnstone
TD	Turtle Dove
TW	Twite
WA	Water Rail
W.	Wheatear
WM	Whimbrel
WC	Whinchat
WG	White-fronted Goose
WH	Whitethroat
WS	Whooper Swan
WN	Wigeon
WT	Willow Tit
WW	Willow Warbler
WO	Wood Warbler
WK	Woodcock
WL	Woodlark
WP	Woodpigeon
OD	Wood Sandpiper
WR	Wren
WY	Wryneck
YW	Yellow Wagtail
Y.	Yellowhammer

*** Please return to BTO HQ ***



WATERWAYS BREEDING BIRD SURVEY: PILOT 1998

British Trust for Ornithology

FIELD RECORDING SHEET

Please do not write in the shaded boxes. PLEASE USE BLOCK CAPITALS

Obs. code		Observer name	Mr/Mrs/Ms			Address	
1-km square reference (eg SK1898) ***							
County code (eg GBSY)							
Visit date (DD:MM:YY) (eg 02:05:98)						Tel. No:	
Early or late visit (E/L)			Weather (1,2 or 3)	Cloud	Rain	Wind	Visibility
	Start time (HH:MM)			Finish time			

*** Please enter reference of bottom-left 1-km square in the selected tetrad (as given on the label on the map for the stretch).

Distance categories:

1. 0-25 metres from the transect line (ie line along middle of waterway)
2. 25-100 metres from the transect line
3. more than 100 metres from the transect line
F. birds in flight only (at any distance) [record on sheets using an arrow, eg ←BZ→]

NB Record singing Skylarks in the distance category, not as in flight. Record breeding colonies that are visible from your route (Rooks, Sand Martins and gulls) and estimate the number of nests.

*[On this form, numbered stretches are each **500 metres** long; boxes are not drawn to scale]*

100m 25m 25m 100m

3	2	1	2	3
		↑		

1 START

Distance category:

100m 25m 25m 100m

3	2	1	2	3
		↑		

2

100m 25m 25m 100m

3	2	1	2	3
		↑		

4

100m 25m 25m 100m

3	2	1	2	3
		↑		

6

100m 25m 25m 100m

3	2	1	2	3
		↑		

3

100m 25m 25m 100m

3	2	1	2	3
		↑		

5

Please record finish time __:__

100m 25m 25m 100m

3	2	1	2	3

8

100m 25m END 25m 100m

3	2	1	2	3

10

100m 25m 25m 100m

3	2	1	2	3

7

100m 25m 25m 100m

3	2	1	2	3

9

BTO SPECIES CODES

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HG	Herring Gull
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RL	Red-legged Partridge
NK	Red-necked Phalarope
RH	Red-throated Diver
LR	Redpoll
RK	Redshank
RT	Redstart
RE	Redwing
RB	Reed Bunting
RW	Reed Warbler
RZ	Ring Ousel
RI	Ring-necked Parakeet
RP	Ringed Plover
R.	Robin
DV	Rock Dove
RC	Rock Pipit
RO	Rook
RS	Roseate Tern
RY	Ruddy Duck
RU	Ruff
SM	Sand Martin
SS	Sanderling
TE	Sandwich Tern
VI	Savi's Warbler
SQ	Scarlet Rosefinch
SP	Scaup
CY	Scottish Crossbill
SW	Sedge Warbler
NS	Serin
SA	Shag
SU	Shelduck
SX	Shorelark
SE	Short-eared Owl
SV	Shoveler
SK	Siskin
S.	Skylark
SZ	Slavonian Grebe
SN	Snipe
SB	Snow Bunting
ST	Song Thrush
SH	Sparrowhawk
AK	Spotted Crake
SF	Spotted Flycatcher
SG	Starling
SD	Stock Dove
SC	Stonechat
TN	Stone-curlew
TM	Storm Petrel
SL	Swallow
SI	Swift
TO	Tawny Owl
T.	Teal
TK	Temminck's Stint
TP	Tree Pipit
TS	Tree Sparrow
TC	Treecreeper
TU	Tufted Duck
TT	Turnstone
TD	Turtle Dove
TW	Twite
WA	Water Rail
W.	Wheatear
WM	Whimbrel
WC	Whinchat
WG	White-fronted Goose
WH	Whitethroat
WS	Whooper Swan
WN	Wigeon
WT	Willow Tit
WW	Willow Warbler
WO	Wood Warbler
WK	Woodcock
WL	Woodlark
WP	Woodpigeon
OD	Wood Sandpiper
WR	Wren
WY	Wryneck
YW	Yellow Wagtail
Y.	Yellowhammer

WATERWAYS BREEDING BIRD SURVEY: PILOT 1998

COUNT SUMMARY SHEET

British Trust for Ornithology

Please do not write in the shaded boxes. PLEASE USE BLOCK CAPITALS

Obs. code		Observer name	Mr/Mrs/Ms
1-km square reference (eg SK0212)			
County code (eg GBSY)			
Visit date (DD:MM:YY) (eg 08:05:98)			
Early or late visit (E/L)		Weather (1, 2 or 3)	Cloud / Rain / Wind / Visibility
Start time (HH:MM)		Finish time	

Address

Tel. No:

Two-letter species code and species name	Distance category	Number of birds recorded on each transect section									
		1	2	3	4	5	6	7	8	9	10
	1										
	2										
	3										
	F										
	1										
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Only insert number in boxes (no +, ♂, ♀ please)

Two-letter species code and species name	Distance category	Number of birds recorded on each transect section									
		1	2	3	4	5	6	7	8	9	10
— —	1										
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Please record colony counts in the box at the end of this form

Two-letter species code and species name	Distance category	Number of birds recorded on each transect section									
		1	2	3	4	5	6	7	8	9	10
— —	1										
	2										
	3										
	F										
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Please record colony counts in the box at the end of this form

Two-letter species code and species name	Distance category	Number of birds recorded on each transect section									
		1	2	3	4	5	6	7	8	9	10
__ __	1										
	2										
	3										
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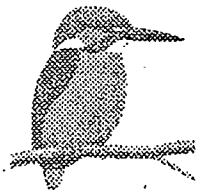
Two-letter species code and species name	Date of count (DD:MM:YY) (eg 29.04.1998)	Best estimate of number of active nests (=pairs)
R O Rook	__ __ : __ __ : 19 __ __	
S M Sand Martin	__ __ : __ __ : 19 __ __	
__ __ ..... Gull	__ __ : __ __ : 19 __ __	
__ __	__ __ : __ __ : 19 __ __	



WATERWAYS BREEDING BIRD SURVEY: PILOT 1998

HABITAT RECORDING FORM

British Trust for Ornithology

Please do not write in the shaded boxes

PLEASE USE BLOCK CAPITALS

Obs. code.	_ _ _ _	Observer name	Mr/Mrs/Ms	Year	19 _ _
1-km square OS reference ***	_ _ _ _ _ _	County code (eg GBNK)	_ _ _ _		
Waterway name ***					
Full 2-letter 6-figure grid reference for upstream limit of stretch surveyed	_ _ _ _ _ _ _ _				
Full 2-letter 6-figure grid reference for downstream limit of stretch surveyed	_ _ _ _ _ _ _ _				

Transect section	First habitat (the waterway itself)				Second habitat (surroundings)				Third habitat (surroundings)				Comments
	Levels:				Levels:				Levels:				
	1	2	3	4	1	2	3	4	1	2	3	4	
1													
2													
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9													
10													

*** Please copy bottom-left 1-km square, and waterway name, from the label on the base-map.

For each 500-metre section of your WBBS plot, please record details of the waterway itself ("First habitat") and for up to two main surrounding or adjacent habitat types. Each box should contain either one letter (A to J) or one number (1 to 15). The full list of BTO habitat codes is given overleaf. We are especially keen to know more about how fishing and other disturbance might affect birds.

We also need a sketch map of the waterway stretch you survey. Please return the map that was sent to you, or a copy, marked up to show the start and end of the stretch and the divisions between the 500-metre sections. Please mark section numbers, to match those used on field and summary sheets.

Recording the "First habitat":

Levels 1 & 2: Only G6 & G7 (streams/rivers) and G9 & G10 (small/large canals) should apply. Use average figures to decide the appropriate width category for each section.

Level 3: Use up to two codes per section; give priority to coding fishing and other disturbance, and use other codes only where space allows. Boat traffic includes both pleasure-boats (motorised) and industrial craft. Record canoeing, rowing, sailing and sports boating under water sports (2), and use comments column to specify which are present.

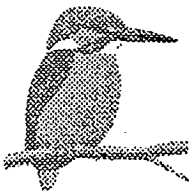
Level 4: Use up to two codes per section. Give priority to codes for water quality and speed of flow. Eutrophic water (1) has green algae profusely in suspension; an oligotrophic water (2) has less growth of vascular plants than a marl (4); dystrophic water (3) has almost no green water-plants apparent. Use 6 (fast-running) where water surface is not smooth (riffles etc), but ignore isolated weirs etc in otherwise slow stretches. Use 7 (dredged) where river course has been altered in the past, and for canals and rivers where there is evidence of recent dredging.

BTO HABITAT CODING SCHEME

LEVEL 1	LEVEL 2	LEVEL 3	LEVEL 4*
A WOODLAND	1 Broadleaved 2 Coniferous 3 Mixed (10% of each) 4 Broadleaved water-logged 5 Coniferous water-logged 6 Mixed water-logged	1 Mixed-aged or semi-natural 2 Coppice with standards 3 Coppice without standards 4 Mature plantation (taller than 10m, with closed canopy) 5 Young plantation (5-10m, open canopy) 6 Parkland (scattered trees and grassy areas) 7 High-medium disturbance from people 8 Low disturbance	1 Dense shrub layer 2 Moderate shrub layer 3 Sparse shrub layer 4 Dense field layer 5 Moderate field layer 6 Sparse field layer 7 Grazed (moderate to heavy) 8 Lightly grazed 9 Dead wood present 10 Dead wood absent
B SCRUBLAND (or young woodland <5m tall)	1 Regenerating natural or semi-natural woodland 2 Downland (chalk) 3 Heath scrub 4 Young coppice 5 New plantation 6 Clear-felled woodland, with or without new saplings 7 Other	1 Broadleaved 2 Coniferous 3 Mixed (10% of each) 4 Broadleaved swamp scrub 5 Coniferous swamp scrub 6 Mixed swamp scrub 7 High-medium disturbance from people 8 Low disturbance	1 Predominantly tall (3-5m) 2 Predominantly low (1-3m) 3 Dense shrub layer 4 Moderate shrub layer 5 Sparse shrub layer 6 Extensive bracken 7 Dense field layer 8 Moderate field layer 9 Sparse field layer 10 Grazed (moderate to heavy)
C SEMI-NATURAL GRASSLAND /MARSH	1 Chalk downland 2 Grass moor (unenclosed) 3 Grass moor mixed with heather (unenclosed) 4 Machair 5 Other dry grassland 6 Water-meadow/ grazing marsh 7 Reed swamp 8 Other open marsh 9 Saltmarsh	1 Hedgerow with trees 2 Hedgerow without trees 3 Tree-line without hedge 4 Other field boundary (wall, ditch, etc.) 5 Isolated group of 1-10 trees 6 No field boundary 7 Montane 8 High-medium disturbance from people 9 Low disturbance	1 Ungrazed 2 Cattle 3 Sheep 4 Horses 5 Rabbits 6 Deer 7 Other grazers 8 Extensive bracken 9 Hay
D HEATHLAND AND BOGS	1 Dry heath 2 Wet heath 3 Mixed heath 4 Bog 5 Breckland 6 Drained bog	1 Montane 2 Raised bog 3 Valley/ basin bog 4 Blanket bog 5 Heath mixed with rough grass 6 Heath without grass 7 Heath with extensive bracken 8 Undetermined bog 9 Isolated group of 1-10 trees 10 High-medium disturbance from people 11 Low disturbance	1 Ungrazed 2 Cattle 3 Sheep 4 Horses 5 Rabbits 6 Deer 7 Other grazers 8 Ploughed 9 Burned 10 Planted with saplings less than 0.5m tall

LEVEL 1	LEVEL 2	LEVEL 3	LEVEL 4
E FARMLAND	1 Improved grassland 2 Unimproved grassland 3 Mixed grass/ tilled land 4 Tilled land 5 Orchard 6 Other farming	1 Hedgerow with trees 2 Hedgerow without trees 3 Tree-line without hedge 4 Other field boundary (wall, ditch, etc.) 5 Isolated group of trees 6 Farmyard (active)	1 Ungrazed 2 Cattle 3 Sheep 4 Horses 5 Other stock 6 Bare earth/plough 7 Autumn cereal 8 Spring cereal 9 Root crops (specify) 10 Other crops (specify) 11 Oil seed rape 12 Other brassicas (specify) 13 Stubble (clean) 14 Stubble (weedy) 15 Unsown/Fallow
F HUMAN SITES	1 Urban 2 Suburban 3 Rural	1 Building 2 Gardens 3 Municipal parks/ mown grass/ golf courses/ recreational areas 4 Sewage works "urban" 5 Near road (within 50m) 6 Near active railway line (within 50m) 7 Other 8 Rubbish tip	1 Industrial 2 Residential 3 Well-wooded 4 Not well-wooded 5 Area of large gardens 6 Area of medium gardens 7 Area of small gardens 8 Many shrubs 9 Few shrubs 10 Disused
G WATER BODIES (freshwater)	1 Pond (less than 50m²) 2 Small water-body (50-450m²) 3 Lake/unlined reservoir 4 Lined reservoir 5 Gravel pit, sand pit, etc 6 Stream (less than 3m wide) 7 River (more than 3m wide) 8 Ditch with water (less than 2m wide) 9 Small canal (2-5m wide) 10 Large canal (more than 5m wide)	1 Undisturbed/ disused 2 Water sports (sailing etc) 3 Angling (coarse or game) 4 Coarse angling 5 Game fishing 6 Industrial activity 7 Sewage processing 'rural' 8 Other disturbance (specify) 9 Small island 10 Boat traffic relatively light 11 Boat traffic medium to heavy	1 Eutrophic (green water) 2 Oligotrophic (clear water, few weeds) 3 Dystrophic (black water) 4 Marl (clear water, large water-weeds) 5 Slow-medium running 6 Fast-running 7 Dredged 8 Undredged 9 Banks cleared 10 Banks vegetated
H COASTAL	1 Marine - open shore 2 Marine shore - inlet/cove/ loch 3 Estuarine 4 Brackish lagoon 5 Open sea	1 Mud or silt 2 Sand 3 Shingle 4 Rocky 5 Fully vegetated 6 Sparse/medium vegetation 7 Inter-tidal 8 Below low-water mark	1 Cliff vertical/ steeply sloping 2 Dune 3 Flat/gentlysloping 4 Small island 5 Spit 6 Dune slack 7 Sloping ground 8 Undisturbed 9 Disturbed 7 Sloping ground 8 Undisturbed 9 Disturbed
I INLAND ROCK	1 Cliff 2 Scree/boulder slope 3 Limestone pavement 4 Other rock outcrop 5 Quarry 6 Mine/spoil/ slag heap 7 Cave	1 Active 2 Disused 3 Montane 4 Non-montane 5 High disturbance from climbers/ walkers etc. 6 Medium disturbance 7 Low disturbance	1 Bare rock 2 Low vegetation present (mosses, liverworts, etc) 3 Grasses present 4 Scrub present
J MISCELLANEOUS			

* *Shrub layer* comprises woody plants less than 5m tall. *Field layer* comprises herbaceous, non-woody plants.



WATERWAYS BREEDING BIRD SURVEY: PILOT 1998

MAMMAL COUNT SUMMARY SHEET

British Trust for Ornithology

Details of how to record mammals are given overleaf. While birds are naturally the focus of breeding bird surveys, there is a great deal to be gained by noting additional useful information as we carry out our survey work. In comparison with birds, relatively little is known about the status of mammal populations in the UK. Any information we are able to collect will add greatly to our knowledge. Mammal recording began on a trial basis for the Breeding Bird Survey in 1995, and this form (like other WBBS forms) follows the format currently used for that scheme. We would welcome any comments you might have on it, particularly how you feel it could be improved.

Please do not write in the shaded boxes **PLEASE USE BLOCK CAPITALS**

Obs. code	_ _ _ _	Obs. name	Mr/Mrs/Ms	Year	19 _ _
1-km square OS reference ***	_ _ _ _ _ _	County code (eg GBNK)	_ _ _ _		

If you saw no evidence of mammals, please indicate a nil return by entering "N" in this box → —

SPECIES		Numbers counted on transect		Known to be present within area surveyed (enter '1')	SPECIES		Numbers counted on transect		Known to be present within area surveyed (enter '1')
		Early visit	Late visit				Early visit	Late visit	
Brown Hare	01				Brown Rat	14			
Mountain/Irish Hare	02				Badger	15			
Rabbit	03				Stoat	16			
Red Squirrel	04				Weasel	17			
Grey Squirrel	05				Water Vole	43			
Red Fox	06				American Mink	57			
Red Deer	07				Otter	58			
Roe Deer	08								
Fallow Deer	09								
Muntjac Deer	10								
Hedgehog	11								
shrew species	12								
Mole	13								

Comments

*** Please enter reference of bottom-left 1-km square in the selected tetrad (as given on the label on the map for the stretch).

NB **If a species of mammal was recorded on just the early or the late visit, please enter a zero in the remaining box. Double zeros are not needed.**

Please return your completed Mammal Count Summary Sheet, along with your other WBBS Pilot forms, to your Regional Organiser at the end of the field season.

How to record mammals

Live mammals should be counted as you carry out your line transects. If a mammal was known to be **present**, but not seen on your transect counts, please enter a '1' in the box provided. For example, a species may have been seen on a reconnaissance visit to your square or you may have noticed obvious signs of its presence during fieldwork. Write the species' names in full and the numbers counted on the **Field Recording Sheets** (in the same way you record two-letter species codes for birds). **There is no need to make special visits to count mammals and recording can be combined with bird recording with little extra work.** Mammals are not recorded in distance bands. If you come across groups of animals please make your best estimate of the numbers.

In many cases presence may be revealed by tracks or signs. In this case you should place a '1' in the third column and detail your observations in the Comments section. If you didn't see any mammals, or signs of mammals, just complete the **top three rows** of this form and return it to your Regional Organiser with your other records. Negative returns are just as valuable.

Counts of Mammals should be transferred from the Field Recording Sheets onto this form. There is just one summary sheet for mammals. For each species, total the number of animals counted from all ten transect stretches for the early and late visits separately, and enter these in the appropriate boxes. There is also space provided to record additional species.

Background information

Compared with birds, population trends of mammals have been relatively under-recorded. This reflects both the interest that exists in birds and the difficulties in taking a census of mammals. Birds are usually relatively easy to observe, they are mostly diurnal, and many advertise their presence in the breeding season with distinctive songs. In comparison, mammals are usually difficult to observe, many are nocturnal or crepuscular, and they are generally unobtrusive in their habits. Historically, there has been just one national atlas of mammals and three different national atlases of birds.

The number of wild breeding mammals in Britain is only around 50, while there are over two hundred species of breeding birds. It is interesting to note that while only a small number of birds are non-natives (around 10%), a high proportion of our mammals are non-natives (around 35%) e.g. Rabbit, Grey Squirrel, Fallow Deer and Muntjac Deer. Populations of mammals in Britain have probably altered much more than those of birds over the last few hundred years, yet these changes are poorly documented. We hope that the introduction of mammal recording will help, in a small way, to improve our knowledge of the distribution and population trends of some of our commoner mammals.

If you are interested in mammals and would like more information we suggest the following books:

The Handbook of British Mammals (1991) Editors G.B. Corbet & S. Harris. 3rd edition, Blackwell Scientific Publications.

Mammals of Britain and Europe (1993) D. Macdonald & P. Barrett. Collins Field Guide, HarperCollins Publishers.

If you have any queries about mammal recording please do not hesitate to contact:

The Census Unit, BTO,
National Centre for Ornithology, The Nunnery,
Thetford, Norfolk, IP24 2PU
Tel: (01842) 750050 Fax: (01842) 750030

APPENDIX 2. Randomly chosen stretches covered by WBBS in 1998, ordered by 10-km grid square and tetrad letter, together with the number of 500-metre sections covered and the total number of bird species recorded.

Tetrad	Waterway name	Type (see key in Table 4)	Upstream & downstream grid references	No. sect-ions	No. bird spp.
NC23S	Maldie Burn	River	NC252352 - NC239340	4	9
NG90X	Allt Coire nan Eiricheallach	Stream	NG998032 - NG993054	5	7
NH12P	Allt a' Choire Dhomhain	Stream	NH144269 - NH156302	6	11
NH34U	Allt Cam Bàn	Stream	NH355501 - NH363498	2	4
NH61S	River Findhorn	River	NH665140 - NH705170	10	24
NH63R	River Nairn	River	NH674320 - NH684349	10	53
NH64S	River Ness (non-tidal part)	River	NH646428 - NH664443	5	40
NN08T	Allt a' Chàm Dhoire	Stream	NN040863 - NN064873	6	8
NN09D	River Kingie	River	NN000964 - NN042978	10	19
NN28B	River Spean	River	NN208814 - NN183837	9	21
NN37W	Allt Feith Thuill	River	NN402732 - NN380722	3	3
NN48P	Allt Coire Ardair	Stream	NN440883 - NN466888	6	17
NN48Z	Allt a' Chrannaig	Stream	NN488885 - NN484873	3	27
NN68X	Unnamed, feeds into aqueduct	Stream	NN687855 - NN681870	3	2
NN69C	River Spey	River	NN597939 - NN639940	10	48
NN79I	Milton Burn	River	NN719956 - NN744988	10	34
NO18G	Baddoch Burn	Stream/river	NO137834 - NO129820	5	22
NO29A	River Dee	River	NO201908 - NO213920	4	21
NO51K	Kenly Water	River	NO538113 - NO553122	4	18
NS72W	Duneaton Water	River	NS781226 - NS814213	10	24
NS83F	Douglas Water	River	NS828300 - NS840319	5	31
NS88F	Bonny Water	River	NS793789 - NS823803	8	53
NS90X	Crook Burn	Stream	NS984039 - NS973063	6	23
NT91A	River Alwin	Stream	NT911108 - NT926082	7	28
NT91L	Shank Burn	Stream	NT955137 - NT973153	6	30
NU11W	River Aln	River	NU186138 - NU215124	9	48
NX17S	Cross Water of Luce	Stream	NX180772 - NX192742	10	20
NY00S	River Bleng	River	NY077033 - NY099032	4	32
NY56M	King Water	River	NY557668 - NY527641	3	46
NY57D	Black Lyne	River	NY515784 - NY496733	6	48
NY58C	Kershope Burn	River	NY521848 - NY483828	8	12
NZ21Z	River Skerne	River	NZ302193 - NZ291207	6	37
NZ23N	River Wear	River	NZ243361 - NZ259374	2	47
NZ61P	Skelton Beck	Stream	NZ659201 - NZ668215	5	34

SD71B	Eagley Brook	River	SD712134 - SD727123	4	29
SD80X	Rochdale Canal	Large canal	SD885079 - SD893038	10	39
SE07J	River Cover	River	SE023791 - SE045808	6	42
SE30V	Dove & Dearne Navigation	Stream/small canal	SE411022 - SE395012	4	43
SE38J	River Swale	River	SE320895 - SE337880	8	44
SH92M	Afon Eiddew	River/stream	SH946250 - SH964244	4	34
SJ10D	Afon Banwy neu Einion	River	SJ107068 - SJ117078	3	21
SJ12J	Afon Iwrch	River/stream	SJ126300 - SJ134266	7	24
SJ22B	Afon Tanat	River	SJ185240 - SJ226240	10	52
SJ47I	Manchester Ship Canal	Large canal	SJ476777 - SJ451773	5	54
SJ60L	River Severn	River	SJ636042 - SJ673034	8	49
SJ65S	River Weaver	River	SJ650523 - SJ662552	10	45
SJ81Q	Shropshire Union Canal	Large canal	SJ849142 - SJ875102	10	29
SK00I	Cannock Extension Canal	Large canal	SK021069 - SK019045	5	47
SK18T	River Noe	River	SK152864 - SK168846	7	43
SK56R	River Maun	River	SK569638 - SK601649	4	44
SK87X	Fossdyke Navigation	Large canal	SK880745 - SK909749	6	30
SK95P	River Brant	River	SK943600 - SK940588	4	37
SN60W	Lower Clydach River	River	SN687045 - SN684026	5	38
SN70K	River Clydach	River	SN741010 - SS738972	9	30
SO66N	River Teme	River	SO629686 - SO656691	7	34
SO68Q	River Rea	River	SO662821 - SO668787	9	53
SO75M	River Teme	River	SO746563 - SO758544	6	49
SO79E	River Severn	River	SJ707004 - SO722975	8	53
SO80C	River Frome	River	SO820046 - SO783057	7	27
SO82U	River Severn	River	SO867304 - SO844279	6	40
SP60B	River Thame	River	SP612027 - SP605017	4	31
SP66F	Grand Union Canal	Small canal	SP626619 - SP630602	4	29
SS61V	River Taw	River	SS682115 - SS685099	10	35
ST02V	River Tone	River	ST078203 - ST084221	5	43
ST08F	Afon Elái	River	ST034824 - ST039811	6	47
ST10Q	River Otter	River	ST160012 - ST170018	3	29
ST56Q	River Chew	Stream	ST571617 - ST584630	5	35
ST74Y	River Frome	River	ST785462 - ST787476	5	38
ST90X	River Allen	River	ST990060 - ST996040	4	52
ST98K	River Avon	River	ST953800 - ST960805	2	35
ST98R	River Avon	River	ST960831 - ST977820	6	46
SU13H	River Avon	River	SU127354 - SU129330	6	41
SU27V	River Kennet	River	SU280715 - SU299710	5	27
SU56S	River Enborne	River	SU557633 - SU567648	4	22

SU59I	River Thames/Isis	River	SU539989 - SU505971	10	48
SU76I	River Loddon	River	SU734663 - SU743677	4	37
SU96Z	Virginia Water (outflow)	River	SU977686 - SU987678	3	30
SX48R	River Lyd	River	SX478835 - SX454834	5	43
SY19D	River Otter	River	SY112983 - SY093960	7	56
SY29R	River Axe	River	SY263954 - SY260924	5	40
TF61L	River Nar	River	TF640133 - TF663136	5	48
TL14V	River Ivel	River	TL182402 - TL184429	5	45
TL23H	River Ivel	River	TL222369 - TL223377	2	34
TL29I	King's Dike (Drain)	Small canal	TL250965 - TL222963	6	43
TL38J	Forty Foot/Vermuden's Drain	River	TL315880 - TL345879	6	36
TL39I	Twenty Foot River (Drain)	Large canal	TL348987 - TL316962	8	36
TL68K	Mildenhall Drain	Small canal	TL655813 - TL650827	3	28
TL77R	River Lark	River	TL766729 - TL731739	7	61
TM12W	The Dyke, Landermere	Large canal	TM489239 - TM497238	2	15
TM23M	Shotley Marshes	Small canal	TM245361 - TM252343	4	55
TQ05D	River Wey	River	TQ021568 - TQ033572	5	48
TQ18K	River Brent	River	TQ146820 - TQ146810	2	28
TQ18S	Grand Union Canal	Large canal	TQ182836 - TQ144843	10	34
TQ28J	River Brent	River	TQ240885 - TQ241902	5	29
TQ54H	River Medway	River	TQ529437 - TQ542437	4	34
TQ56B	River Darent	River	TQ521617 - TQ527627	3	37
TQ59J	River Roding	River	TQ547996 - TQ517981	8	43
TQ75G	River Medway	River	TQ704529 - TQ740539	9	49
TQ77J	Cliffe Fleet	Large canal	TQ744782 - TQ746792	4	43
TQ92G	River Rother	River	TQ937243 - TQ933227	3	48
TR02Y	New Sewer	Large/small canal	TR581264 - TR090273	7	38
TR04H	Great Stour	River	TR038449 - TR032430	4	57
TR15U	Great Stour	River	TR155590 - TR163598	3	48

Notes:

1. Tetrad letters are defined by the "DINTY" system: with A in the bottom left of each 10-km square and Z in the top right.

2. Waterway types are as defined in Table 4.

APPENDIX 3. Birds recorded on random WBBS stretches in 1998. 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 total stretches that were occupied.

Species	Birds per 10km (total)	Birds per 10km (in 0-25m distance band)	Percentage of stretches occupied
Little Grebe	1.2 ± 0.5	1.1 ± 0.5	11%
Cormorant	2.3 ± 0.5	0.6 ± 0.2	25%
Grey Heron	4.8 ± 0.7	2.1 ± 0.3	59%
Mute Swan	9.1 ± 2.6	5.2 ± 1.3	37%
Greylag Goose	3.6 ± 1.6	0.8 ± 0.5	12%
Canada Goose	7.9 ± 1.8	3.2 ± 1.0	34%
Shelduck	13.1 ± 8.6	1.5 ± 1.1	9%
Gadwall	1.4 ± 0.7	0.8 ± 0.4	7%
Teal	0.5 ± 0.2	0.4 ± 0.2	8%
Mallard	40.7 ± 5.2	27.9 ± 3.8	85%
Tufted Duck	4.6 ± 1.9	2.5 ± 1.0	16%
Goosander	1.4 ± 0.4	1.0 ± 0.4	16%
Sparrowhawk	1.0 ± 0.2	0.1 ± 0.1	19%
Buzzard	2.4 ± 0.5	0.4 ± 0.1	30%
Kestrel	1.7 ± 0.3	0.2 ± 0.1	32%
Red-legged Partridge	2.3 ± 1.0	0.4 ± 0.2	16%
Grey Partridge	1.0 ± 0.3	0.3 ± 0.2	11%
Pheasant	8.9 ± 1.4	1.3 ± 0.3	55%
Moorhen	9.8 ± 1.4	8.5 ± 1.3	59%
Coot	5.5 ± 1.3	4.7 ± 1.2	27%
Oystercatcher	7.8 ± 2.2	2.7 ± 0.8	23%
Lapwing	17.4 ± 6.3	2.7 ± 1.4	32%
Snipe	0.8 ± 0.3	0.1 ± 0.1	10%
Curlew	3.9 ± 1.0	0.3 ± 0.1	23%
Common Sandpiper	5.1 ± 1.1	4.8 ± 1.0	31%
Black-headed Gull	33.7 ± 22.2	3.6 ± 2.5	32%
Common Gull	4.9 ± 1.9	0.6 ± 0.3	14%
Lesser Black-backed Gull	7.9 ± 3.9	0	20%
Herring Gull	19.3 ± 7.6	0.4 ± 0.2	26%
Common Tern	1.1 ± 0.4	0.1 ± 0.1	11%

Feral Pigeon	15.3 ± 4.2	6.1 ± 3.1	22%
Stock Dove	5.6 ± 1.4	1.5 ± 0.7	29%
Wood Pigeon	65.8 ± 6.6	21.9 ± 3.4	84%
Collared Dove	5.5 ± 1.1	2.7 ± 0.7	41%
Turtle Dove	1.3 ± 0.6	0.8 ± 0.6	9%
Cuckoo	2.4 ± 0.4	0.2 ± 0.1	39%
Little Owl	0.3 ± 0.1	0.1 ± 0.1	6%
Swift	20.2 ± 4.7	0.2 ± 0.2	56%
Kingfisher	1.9 ± 0.4	1.3 ± 0.3	29%
Green Woodpecker	2.0 ± 0.4	0.3 ± 0.1	28%
Great Spotted Woodpecker	2.5 ± 0.5	0.8 ± 0.2	35%
Skylark	11.5 ± 2.0	1.5 ± 0.4	51%
Sand Martin	16.3 ± 6.0	4.4 ± 2.3	26%
Swallow	15.3 ± 2.1	1.9 ± 0.4	69%
House Martin	15.0 ± 2.9	0.3 ± 0.2	45%
Tree Pipit	0.2 ± 0.1	0.1 ± 0.1	6%
Meadow Pipit	19.6 ± 4.1	9.6 ± 2.1	35%
Yellow Wagtail	2.4 ± 1.0	0.8 ± 0.3	12%
Grey Wagtail	3.7 ± 0.6	3.3 ± 0.6	41%
Pied Wagtail	6.4 ± 1.0	4.0 ± 0.7	60%
Dipper	3.2 ± 0.7	2.8 ± 0.7	36%
Wren	38.8 ± 3.8	25.1 ± 3.0	83%
Dunnock	8.4 ± 1.2	5.3 ± 1.0	60%
Robin	18.8 ± 2.1	11.3 ± 1.5	74%
Redstart	1.0 ± 0.3	0.6 ± 0.3	10%
Whinchat	0.7 ± 0.2	0.3 ± 0.1	11%
Wheatear	2.3 ± 0.8	1.4 ± 0.6	15%
Blackbird	33.3 ± 3.2	17.7 ± 2.4	80%
Song Thrush	10.6 ± 1.4	4.9 ± 0.9	69%
Mistle Thrush	5.0 ± 0.9	1.7 ± 0.4	46%
Sedge Warbler	6.4 ± 1.4	5.1 ± 1.2	29%
Reed Warbler	7.4 ± 2.2	6.7 ± 2.1	21%
Lesser Whitethroat	0.9 ± 0.4	0.3 ± 0.2	12%
Whitethroat	7.9 ± 1.4	4.5 ± 0.9	49%
Garden Warbler	2.8 ± 0.5	1.4 ± 0.3	35%
Blackcap	11.1 ± 1.6	6.3 ± 1.2	58%

Chiffchaff	8.4 ± 1.2	4.1 ± 0.7	53%
Willow Warbler	16.0 ± 2.6	7.3 ± 1.4	74%
Goldcrest	2.3 ± 0.5	1.5 ± 0.4	29%
Spotted Flycatcher	1.3 ± 0.3	0.9 ± 0.3	19%
Long-tailed Tit	6.7 ± 1.0	4.8 ± 0.8	49%
Marsh Tit	0.6 ± 0.2	0.4 ± 0.2	10%
Willow Tit	0.5 ± 0.2	0.3 ± 0.2	9%
Coal Tit	2.5 ± 0.7	1.2 ± 0.3	23%
Blue Tit	31.1 ± 3.0	20.8 ± 2.3	80%
Great Tit	18.5 ± 1.8	11.4 ± 1.3	78%
Nuthatch	1.0 ± 0.3	0.4 ± 0.2	17%
Treecreeper	1.6 ± 0.3	1.0 ± 0.2	27%
Jay	2.4 ± 0.5	0.7 ± 0.2	26%
Magpie	11.5 ± 1.4	4.2 ± 0.7	64%
Jackdaw	23.4 ± 4.8	3.1 ± 1.3	51%
Rook	57.3 ± 13.3	1.3 ± 1.1	53%
Carrion Crow	32.8 ± 3.7	5.8 ± 1.1	83%
Hooded Crow	0.6 ± 0.2	0.1	7%
Raven	0.5 ± 0.2	0.1	9%
Starling	65.7 ± 26.8	15.2 ± 6.1	61%
House Sparrow	10.2 ± 2.1	7.2 ± 1.7	43%
Chaffinch	39.2 ± 4.4	19.8 ± 2.2	88%
Greenfinch	9.2 ± 1.6	4.0 ± 0.9	55%
Goldfinch	9.5 ± 1.5	3.4 ± 0.8	52%
Siskin	0.8 ± 0.3	0.4 ± 0.2	10%
Linnet	7.2 ± 2.7	2.1 ± 0.8	25%
Redpoll	0.4 ± 0.2	0.1 ± 0.1	6%
Bullfinch	1.6 ± 0.4	1.0 ± 0.3	23%
Yellowhammer	3.9 ± 0.8	2.0 ± 0.5	33%
Reed Bunting	4.7 ± 0.8	3.0 ± 0.6	41%
Corn Bunting	0.8 ± 0.3	0.2 ± 0.1	7%