



BTO Research Report 560

**Waterways Breeding Bird Survey:
progress 1998–2009 and
long-term population trends**

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R&D project W1–071*

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EXECUTIVE SUMMARY

- 1 BTO has operated two long-running surveys designed to monitor population change among breeding birds along linear waterways in the UK. A territory-mapping survey, the Waterways Bird Survey (WBS) ran from 1974 to 2007, covering water birds only. A new scheme, the Waterways Breeding Bird Survey (WBBS), began in 1998 and is ongoing. WBBS covers all bird species and its sites are mainly randomly selected. It uses transect methods similar to those of the BTO/JNCC/RSPB Breeding Bird Survey (BBS), which monitors birds more generally across the countryside. The run of WBBS data has recently become long enough for joint WBS/WBBS indices of change to be calculated.
- 2 WBBS continues to be well supported by volunteers, and to provide valuable monitoring data. Ongoing long-term index trends, incorporating results from the now-defunct WBS, are available for 24 species and cover periods beginning as early as 1974, while index trends since 1998 can be calculated from WBBS data alone for around 84 species.
- 3 Long-term joint WBS/WBBS indices, updated to include 2009 data are presented here for 24 species of water bird. Sample sizes for England alone are large enough permit trends to be run for all species for which data are available at the UK level. Trends for only five of the species are available for Scotland alone. The population index for Snipe cannot be continued, because the monitoring sample has become too small. Summarised trends and alerts for waterways birds for the period 1975–2008, for the UK and for England, are also presented. These figures update those already published for the years to 2007 on the BTO's BirdTrends web pages (www.bto.org/birdtrends).
- 4 Species trends derived from national WBS and WBBS data provide clear evidence of rapid population change, for example for the demise of a number of species formerly associated with lowland wet meadows, including Snipe, Redshank and Yellow Wagtail, and the rise in introduced geese. Overall, the numbers of increasing and decreasing species are even.
- 5 Overlap between CBC/BBS and WBS/WBBS in species coverage allows comparisons to be drawn between trends in different habitats. The list of species for which WBS/WBBS currently provides the best available long-term monitoring data includes iconic and popular species, such as Kingfisher and Dipper, severely declining species (Redshank) and rapidly increasing introduced birds of potential economic importance (Greylag and Canada Geese).
- 6 Wild bird indicators for freshwater wetlands and waterways, incorporating data from WBS/WBBS have been developed, with funding from the Environment Agency and a breeding wetland bird index was been adopted as an integral component of the UK Sustainable Development Indicators, part of PSA 28, an aggregate indicator comprised of trends in farmland, woodland and wetland birds, and the England Biodiversity Strategy indicators (W1; populations of breeding wetland and waterway birds). The latest versions of these indicators were reported last autumn (2009) updated to include data from 2008. The future of wild bird indicators is uncertain given changes in government priorities and the dropping of many previous PSAs.
- 7 Routine analysis of WBBS data covers only the assessment of population change for each species, for which the first step is to combine counts for each species across all the distance bands and 500-metre sections within a survey stretch. There is great potential, however, for making use of the section data, for example for assessing the relative value to birds of different rivers or catchment sections.
- 8 Few schemes collect mammal-monitoring data from the wider countryside. Although mammal monitoring is not the main purpose of WBBS, and observers are not necessarily well trained in

observing mammal species, therefore, the data that are collected by WBBS are of value. WBBS is able to contribute most to the monitoring of mammals that are characteristic of riverine habitat and in particular of Water Vole, American Mink and Otter.

- 9 It is planned for WBBS to increase the number of surveys conducted each year, by benefiting from the additional observer manpower that will be released after the close of the BTO's current Atlas 2007–11. An online system for data input, to match that already in place for BBS, would be a very valuable development for WBBS, and is seeking dedicated funding.

1 INTRODUCTION

Monitoring the populations of breeding birds along linear waters is important because rivers and canals are components of the countryside that are rich in birds and vulnerable to rapid large-scale change. Since waterways are not covered well by general monitoring programmes, it is important that the populations of breeding birds along linear waters are studied using dedicated surveys. Detailed data collection for breeding birds, alongside habitat recording, can help direct the conservation of wildlife along rivers and canals.

Since 1974, BTO has run two separate annual schemes that have these aims: WBS and WBBS, as discussed below. After an overlap period from 1998 to 2007, WBBS has now taken over from WBS as the main way by which breeding birds of linear waterways are monitored in the UK.

1.1 The Waterways Bird Survey (WBS)

The Waterways Bird Survey (WBS) began in 1974 and closed after the 2007 season. BTO volunteers conducted mapping censuses alongside linear waters, both rivers and canals, with the aim of monitoring bird population change in these important yet vulnerable habitats throughout the UK. The primary role of the WBS has been to record population changes among species poorly represented in the BTO's other monitoring schemes, principally, in its first two decades, the Common Birds Census (CBC). Carter (1989), Marchant *et al.* (1990) and Newson *et al.* (2003) have provided overviews of the WBS and its results.

The territory-mapping method, as was used by both CBC and WBS, produces high-quality maps of the activity recorded for each bird species during the breeding season. These data can also be used to investigate, at a variety of spatial and temporal scales, the ways in which breeding birds use the habitats available to them. Since observers can choose their own survey sites, however, the resulting distribution of sites is non-random and is not necessarily a representative sample of the wider countryside. Because the mapping method is labour-intensive, surveys were relatively few in number. These problems, as they related to CBC, were all addressed by the introduction of a new scheme, the BTO/JNCC/RSPB Breeding Bird Survey (BBS).

BBS began in 1994 and is an ongoing programme that was introduced specifically to take over from CBC as the main way in which population changes of birds are measured in the wider countryside. The CBC ceased in 2000 after 39 years of operation, following a seven-year overlap period between BBS and CBC. Population trends of common and widespread UK birds are now monitored by BBS index series, beginning in 1994, and by joint CBC/BBS trends, most of which date from 1966 (Baillie *et al.* 2010).

The WBS suffers the same disadvantages for bird population monitoring as the CBC did. In addition, WBS covers only a set list of waterside bird families and species, and so provides no information on the more widespread bird species as they occur in the waterside environment. These drawbacks could all be addressed by applying BBS-style transect methods to waterside surveys (Marchant *et al.* 1996).

1.2 Origins and development of the Waterways Breeding Bird Survey (WBBS)

With this background, the BTO has been developing a Waterways Breeding Bird Survey (WBBS) since 1998, in conjunction with the Environment Agency's R&D programme. The overall aims of the project have been to:

- *supplement data from the BBS with counts from rivers and canals, thus maintaining or expanding the level of bird population monitoring currently available through BBS, and satisfying the needs*

of organisations with specific interests in ongoing long-term bird monitoring, such as JNCC and RSPB; and

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

In Phase 1 of the survey in 1998, methods of field survey and plot selection were tested (Marchant & Gregory 1999), and a study was conducted of breeding bird numbers along canals in relation to the timing of the coarse fishing season (Marchant *et al.* 1999).

In Phase 2, 1999–2000, the non-random canal sample was dropped, and WBBS coverage was extended to include WBS observers, who were invited to contribute to the WBBS as well as to WBS on their (self-selected) sites. Also in Phase 2, WBBS bird data from randomly selected sites were compared with River Habitat Survey (RHS) habitat data that was collected from the same sites by Environment Agency contractors (Marchant & Noble 2000, Marchant *et al.* 2002a). A major innovation of WBBS is that it is designed to allow linkage to RHS, with data for both schemes collected for 500-metre sections of waterway. Marchant & Gregory (1999) also discussed initial information on this topic, which has been explored more comprehensively by Vaughan *et al.* (2007).

It was already clear from Phases 1 and 2 of WBBS that the method is valuable as a quick and easy way to assess bird populations in 500-metre river sections. Data gathered in this way can be of value at local or catchment scales, for example for pre- or post-project site appraisals, or for the identification of river or canal sections of special conservation value. Use of the method by the BTO's UK-wide network of volunteers allows large samples to be surveyed on a nationwide basis and enables assessments to be made of changes in breeding bird numbers in the waterside habitat.

Phase 3 of WBBS development, which extended from 2001 to 2004, continued the same protocol aimed to increase the size of the annual sample from randomly selected sites. The start of Phase 3 was delayed by the outbreak of Foot & Mouth Disease (FMD) in February 2001, which required the imposition of severe restrictions on access to most of the UK countryside and greatly reduced the opportunities for WBBS fieldwork (Marchant *et al.* 2002b). Active promotion of WBBS to increase the sample size was postponed until 2002, and fieldwork, originally planned to finish in 2003, was extended, with support from the Environment Agency, to include 2004. Marchant & Noble (2003), Marchant & Coombes (2004) and Marchant *et al.* (2006) provided progress reports on Phase 3.

By the end of Phase 3, it had been demonstrated that WBBS was viable as a long-term survey and could provide results of major value for population monitoring. Various options for constructing population indices had been explored and the results compared between WBS and WBBS.

1.3 More recent WBBS developments

Following Phase 3, WBS continued for three further fieldwork seasons and has since been closed, following completion of data collection for the 2007 breeding season.

WBBS is ongoing as the only specialist monitoring scheme for breeding birds of waterways. Since 2005, funding for WBBS has been obtained in part from the Environment Agency, for a project to develop wild bird indicators for freshwater wetlands and waterways; WBBS is a major contributor of monitoring data to indicators for these habitats. In the most recent seasons, WBBS has been funded substantially by BTO itself. With the shift in funding and the new emphasis on indicator development, there have been no further annual reports since that for 2004 (Marchant *et al.* 2006), until the present report.

After 12 years of successful operation, it is clear that WBBS is viable as a long-term survey and can provide results of major value for population monitoring. These supplement the data from BBS for the countryside as a whole, both as trends for individual species and as multi-species indicators for the waterside environment.

Long-term trends are now available that incorporate the results from both schemes to give a run of annual population monitoring since 1974. These joint WBS/WBBS trends were presented for the first time by Baillie *et al.* (2010), using data for the period to 2008.

1.4 The development of wild bird indicators for freshwater wetlands and waterways

BTO has a long involvement in the development of multi-species indicators derived from combining monitoring trends across suites of species. The aim of such work is to provide a simple measure that will summarise bird trends across a geographical region, a habitat type, or a guild of species that share ecological traits. Carefully designed multi-species trends may indeed indicate the health of elements of the ecosystem beyond the species included within them (Everard 2007).

The Environment Agency has supported the development of waterways indicators, to which WBBS is a major contributor (Everard & Noble 2008, Noble *et al.* 2008a, b).

1.5 The aims of this report

This report documents WBBS progress since the previous reports and incorporates joint index trends from WBS/WBBS, which are now updated to cover the period 1974–2009.

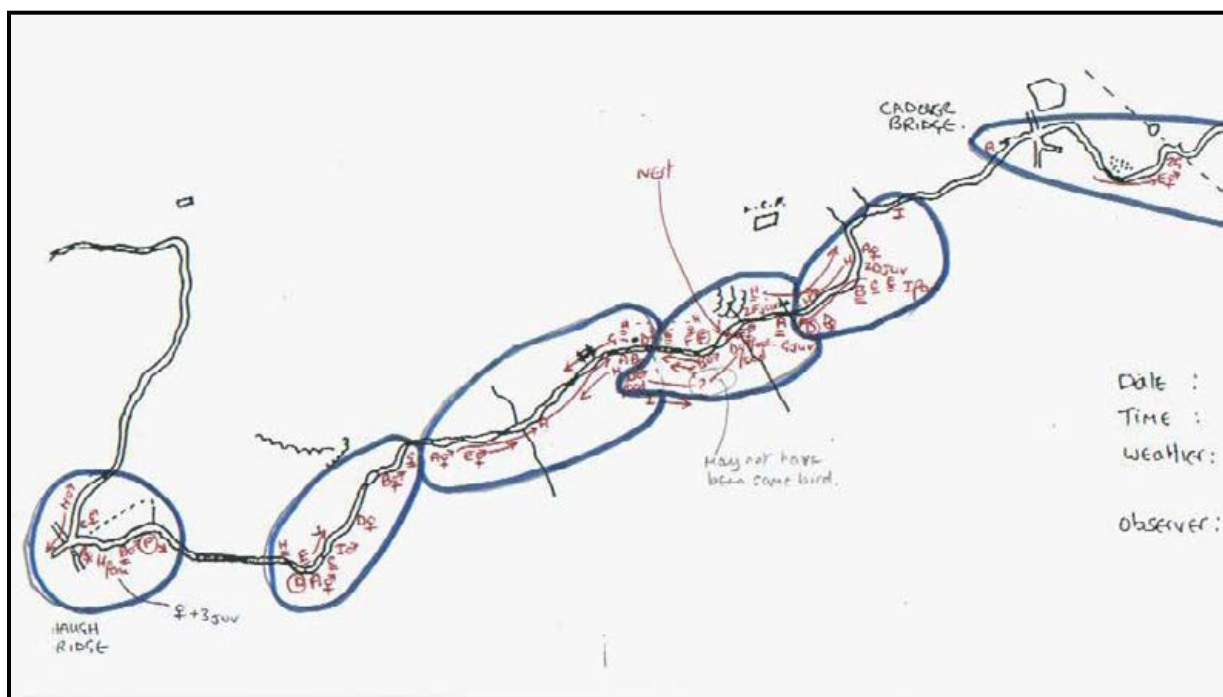
2 METHODS

2.1 Methods of the Waterways Bird Survey

Taylor (1982) and Marchant (1994) have described WBS procedures in full. The bird census method used was territory mapping, which produces an estimate of breeding pairs and a map of breeding territories for each species, stretch and year (see Figure 1). Details of the habitats available to the birds were also mapped. Plots were chosen by the observers themselves, under guidance from BTO staff, and were stretches typically 4–5 kilometres long that were of relatively easy access and of which at least one bank could be walked.

Observers were asked to make nine visits to their site each breeding season. WBS coverage was restricted to waterside specialist birds such as grebes, ducks, geese, swans, waders, and reedbed passerines. Compilation of visit data onto species maps was performed by the observers, many of whom began the process of assessing territory boundaries. To consistency through time and across the sample, final decisions on territory numbers at each site were made by a small number of trained staff at BTO HQ.

Figure 1. Example species map from the Waterways Bird Survey. The species is Grey Wagtail *Motacilla cinerea*.



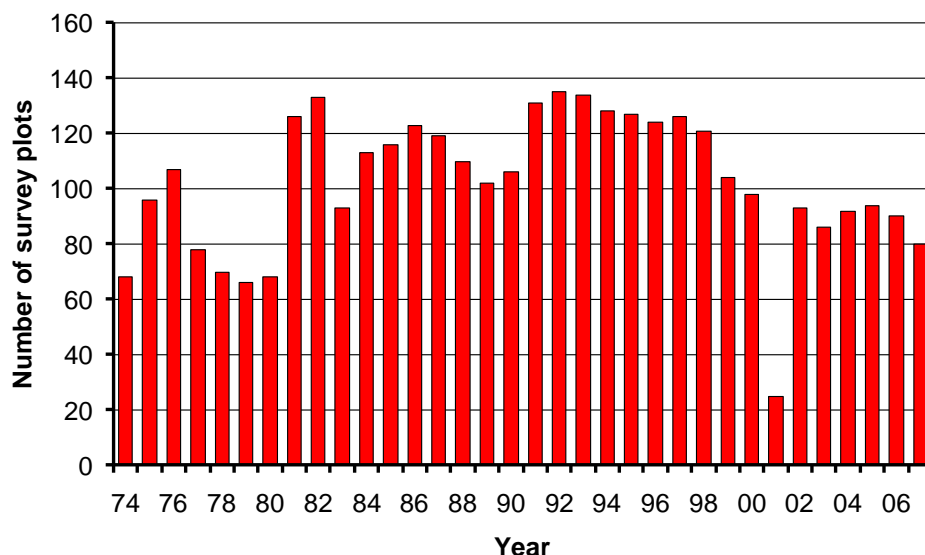
A grand total of 526 different WBS sites were covered in the UK (Table 1), with three more in the Republic of Ireland, and around 3,480 surveys were conducted. Many surveys were very long-running: 106 sites provided data for more than 10 years, 32 for more than 20 years, and eight for more than 30 of the survey's 34 years.

Table 1. Numbers of WBS plots surveyed, 1974–2007, by country and type. UK totals include three fast river stretches on the Isle of Man. ‘Slow’ rivers have a gradient of <5 m/km and generally lie in a broad valley, and ‘fast’ rivers have a gradient of >5 m/km. The overall mean length of plots was 4.6 km, and 2,407 km were surveyed in one or more years.

Waterway type	England	Wales	Scotland	N Ireland	UK total
Fast rivers	73	12	29	4	121
Slow rivers	227	14	21	11	273
Canals	90	1	4		95
Mixed or other types	33	1	1	2	37
Total	423	28	55	17	526

A maximum annual total of 135 WBS returns was received in 1992 (Figure 2). The number of surveys conducted began to fall after the introduction of WBBS in 1998 and reached a low point of just 25 surveys in 2001, when all survey fieldwork was limited by the outbreak of FMD.

Figure 2. Numbers of WBS mapping plots surveyed during 1974–2007.



The units of WBS mapping results are ‘apparently occupied territories’, whereas for WBBS and BBS they are the numbers of birds counted. Long-term monitoring from WBS data is possible for up to 25 species that occur on at least 15 or so plots in each year, where number of territories can be modelled as a function of year and site (e.g. Newson *et al.* 2003).

2.2 Methods of the Waterways Breeding Bird Survey

The WBBS, which began in 1998 and replaced WBS after the 2007 season, is a two-visit transect survey based closely on BBS methodology.

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

2.2.1 Selection of sites for coverage

The following procedure was used to select waterways randomly. First, we made a list of all tetrads (2x2-km national grid squares, bounded by the even-numbered grid lines) in the UK (omitting only those where the southwestern 1-km square held no land), and ranked them in random order. Next, beginning at the top of the list, we examined each tetrad on the Ordnance Survey 1:25,000 map, discarding those without a waterway running through them, until the required number of tetrads with waterways was identified. The tetrad (2x2 km) was selected as the most appropriate grid-square size since, after a trial run, it emerged that too high a proportion of 1-km squares held no waterway. Larger squares (5x5- or 10x10-km) frequently held more than one waterway, and so raised questions about which waterway to select from within the square. Third, we assigned each selected tetrad by BTO region and gave it a regional priority ranking based on the original random numbering.

The number of tetrads selected for possible WBBS coverage was initially 263. The total was increased to 511 in 2002 and to 529 in 2004.

A clear definition was required of the water bodies that formed the population being sampled. There were questions, for example, over whether waterways best described as ditches or drains, as opposed to rivers and canals, should be included in the survey. For rivers, a policy was needed on whether headwaters should be excluded and how this could be achieved, and on whether broad or tidal stretches should be included. For the purpose of the WBBS, therefore, a waterway was defined as any double blue line, with shaded in-fill, on the Ordnance Survey (OS) 1:25,000 Pathfinder/Explorer/Outdoor Leisure map series. Single blue lines, typically minor headwaters and drainage ditches, were ignored, as were all non-linear water features, or linear features less than 500 metres in total length. 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 'NTL' on the OS maps; no upper width limit was applied, and thus river stretches were sometimes tens of metres in width.

No stratification was employed in creating the sample, since it was not required to meet the aims of survey's initial phases. Stratification could be applied to WBBS results and plot selection in the future, however, for example on the basis of waterway type, RHS data, water quality, waterbird density or observer density, with the aim of either reducing the variance of the results or making more efficient use of the available volunteer manpower.

For each selected random waterway, an A4-sized map was prepared showing the boundaries of the random tetrad (positioned roughly centrally) and the selected waterway. The waterway was picked out with a highlighter pen, typically for several kilometres in both directions beyond the tetrad boundary. These maps were sorted by BTO region and sent to the relevant BTO Regional Representative (the RR), whose job it was to match each site with an observer. Sites were referred to by the grid reference of the southwestern 1-km square of the selected tetrad.

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

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

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

Aside from the random stretches, determined on the basis described above, the WBBS sample has also, since 1999, included a substantial number of non-random stretches that were chosen because there are WBS mapping data available for the same sites. The latter are referred to in this report as ‘WBS-linked’ stretches. They differ from the random stretches in their geographical distribution and, having been freely selected by the observers, may perhaps be biased towards places that are richer in breeding birds.

Surveys at sites falling into neither of these categories, listed as ‘other non-random stretches’, are not encouraged but have been included in the data set where available. The canal sites selected for their fishing seasons in 1998 are included in this ‘other’ category.

2.2.2 WBBS fieldwork methods

The BBS method had already proved to be enjoyable, popular with observers, and well suited to its purpose. The original outlook for WBBS was as a direct extension to that scheme and, when WBBS was set up, modifications to BBS procedures were 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, April–June – thus ideally one visits between 1 April and 15 May and a second between 16 May and 30 June (www.bto.org/bbs). The transect route is divided into up to ten sections of fixed length. During each visit, all birds seen or heard are counted, section by section, in each of three distance bands from the transect line (0–25 metres, 25–100 metres, and >100 metres, summing counts from both sides of the transect line); birds seen only in flight are recorded separately.

WBBS instructions and recording forms are based heavily on those designed for BBS. Some details of the design of forms were altered in minor ways between 1998 and 2000 but, once established, the field methods of WBBS have been kept constant. Forms for 1998–99 are each appended to the reports from WBBS for those seasons (Marchant & Gregory 1999, Marchant & Noble 2000). These contain full details of fieldwork methods and recording.

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

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

Other aspects of fieldwork and analysis are identical. WBBS follows BBS in having a reference 1-km square for each survey site, even though the nominal reference may miss the actual survey by 2–3 km.

As on BBS, mammals and signs of mammals were noted on each counting visit. For each species of wild mammal detected, either presence or a pair of counts (one early in the season and one late) was recorded. Observers coded the main features of up to three habitat types per 500-m 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 used widely in BTO surveys.

Within each region, BTO RRs sought volunteer observers to cover as many of their selected sites as possible, beginning at priority 1 and working down the list. RRs distributed survey packs and collected completed forms for return to BTO HQ.

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 in using this method. Importantly, its random sampling design ensures that the results are representative of the waterway habitat.

2.2.3 Coverage achieved by WBBS in 1998–2009

Table 2 shows the numbers of WBBS stretches surveyed, by country within the UK, according to the class of survey, to the end of 2009. WBBS observers surveyed 345 different waterway stretches in England during the 12-year period. Coverage in Northern Ireland, by contrast, was intermittent and at a very low level.

Table 2. Numbers of WBBS stretches surveyed during 1998–2009, by country and selection type.

	England	Wales	Scotland	N Ireland	UK total
Selected but not covered	52	7	95	30	184
Random sites covered	199	45	96	5	345
WBS-linked stretches	106	4	11		121
Other non-random stretches	40	1	1	5	47
Total stretches covered	345	50	108	10	513

The 529 random stretches selected are mapped in Figure 3 with green and red symbols. The pattern of their distribution follows from the area-based method of selection which, since the density of river courses in a catchment is greatest in the upper reaches, is more likely to score a hit with random tetrads that lie close to the watershed. Few stretches were selected in coastal regions and there were concentrations in some areas of higher ground, for example the Grampians, Southern Uplands and Welsh Marches. Eastern East Anglia, where river courses are few and well scattered, was barely represented in the sample since, by chance, just two of the tetrads selected there contained a waterway.

Of the random stretches selected, 184 have not yet been surveyed (shown by red dots in Figure 3). These sites are mainly in Scotland and Northern Ireland, where potential observers are fewest, but some sites in England and Wales are also still awaiting cover. The regional pattern of the sites not yet covered reflects topography, with some upland sites being difficult to access, the distribution of potential observers, and the efficiency of regional organisation for the survey.

The geographical distribution of the 121 WBS-linked stretches is also shown in Figure 3. These sites are mainly in England, with four in Wales and 11 in Scotland (Table 2). Within England there has traditionally been strong participation by the Lancaster & District Bird Watching Society and the Sheffield Bird Study Group, who each began their contributions with pilot studies for WBS in 1973.

Figure 3. Distribution of WBS stretches. Random stretches that have been covered at least once during 1998–2009 are shown as green squares and those not yet surveyed as red dots. WBS-linked stretches surveyed are shown as yellow triangles.

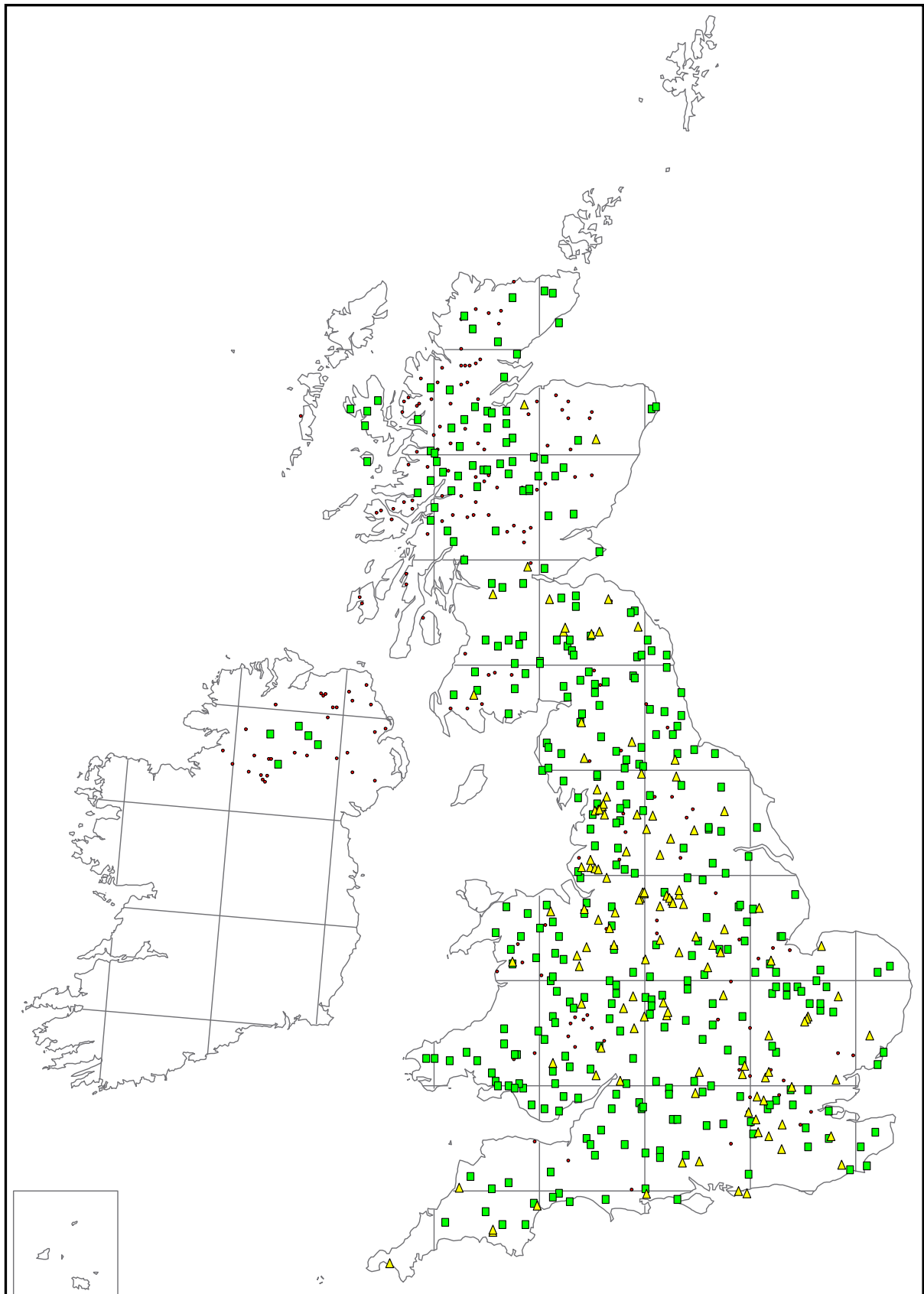


Table 3. Numbers of WBBS surveys during 1998–2009, by year and class of stretch.

Year	Random stretches	WBS-linked	Other non-random	Total stretches	Total 500-m sections	Mean length of stretch (km)
1998	108	20	40	168	1,124	3.35
1999	117	68	1	186	1,261	3.39
2000	110	65	1	176	1,205	3.42
2001	24	27	0	51	380	3.73
2002	162	66	0	228	1,515	3.32
2003	198	64	0	262	1,703	3.25
2004	219	68	0	287	1,863	3.25
2005	231	68	2	301	1,977	3.28
2006	226	65	4	295	1,968	3.34
2007	213	57	0	270	1,770	3.28
2008	201	74	1	276	1,843	3.34
2009	200	82	1	283	1,887	3.33
Total survey-years	2,009	724	50	2,783	18,496	3.32

The annual samples of WBBS stretches surveyed are explored further in Table 3. The survey has been monitoring about 900 km of waterway annually in recent seasons. It has proved difficult to increase the sample of random stretches using the present set of selected sites, since many are difficult to access. The 1998 sample included 60 canal stretches that had been chosen non-randomly on the basis of the fishing seasons in operation there. Some of these were also in the random sample or were also WBS plots. The 40 plots that did not also fall into either the random or the WBS category were dropped from the survey in subsequent seasons. WBS observers were asked to contribute WBBS data also from their stretches, beginning in 1999, and many conducted both surveys on their stretches until 2007. The number of WBS-linked stretches increased markedly in 1999 and again in 2008, when WBS itself ceased operation and observers were asked to transfer to WBBS. Most surveys since 1999 have been repeat surveys at stretches already covered, and can therefore contribute to models of population change.

Only 24 random stretches and 27 WBS-linked ones were surveyed in 2001, when FMD imposed severe restrictions on access to the countryside, representing just 29% of the coverage in the previous year. These sites were concentrated in the English Midlands and the north of Scotland, these being areas where access generally was curtailed to a lesser degree than elsewhere (Marchant *et al.* 2002b). The 2001 WBBS sample is thus rather different in character from the samples in other years.

A full list of stretches covered since the inception of WBBS, with the number of 500-m sections surveyed at each site in each year, is given in Appendix 1.

2.3 Trend analysis from WBS/WBBS and WBBS data

For WBS the number of apparently occupied territories along the stretch of waterway was taken as the count unit. For WBBS, counts are provided by 500-m section but, because the individual WBBS transect sections cannot be treated as independent, it is necessary for statistical reasons to combine these into a single count for each whole survey. We used the sum of the counts across the transect sections for each stretch of waterway in the analysis: counts were first summed across the four distance bands and the higher of the counts across the two visits at the level of each transect section being summed for use in the analysis. The procedure we have used for finding a single count differs from that standardly employed for BBS analyses, where counts are summed across both sections and distance bands and the higher of these overall sums across the two visits enters the calculations.

The WBS and WBBS data sets were combined for the calculation of joint trends whilst the WBBS data set was also analysed on its own. Separate trends were calculated for the UK and for England. Because the nature of WBBS and WBS coverage in 2001 had been so different from the other years, 2001 data were not used at all in these calculations.

Annual population changes were produced using a full site-by-year log-linear GLM with Poisson error terms. Only waterway stretches that were surveyed in two or more of the years of interest were included in the analysis. Waterway stretches with zero counts for a species in all years were not included in the model: this does not affect the model's estimates of annual effects, but leads to more conservative estimation of the standard errors. Counts were corrected to account for overdispersion, with adjustments being made to the standard errors.

To account for the varying length of WBBS survey stretches, the log of the number of transect sections within each waterway stretch was used as an offset variable in the model (Stokes *et al.* 2003). In this case, the offset variable serves to normalise the fitted cell means to a per-section basis, since it is the total count of birds across the whole stretch, not the individual transect section counts, that are used in the model. The offset for WBS sites was set to unity.

Confidence limits were calculated using bootstraps with 199 samples and are presented at the 85% level in charts and analysed at the 95% level. Population indices and bootstraps were smoothed using the TPSPLINE procedure in SAS and population change estimates were based on these smoothed indices. The time series analysed omitted the first and last years of the study to avoid any extreme effects of smoothing at the two ends of the study period. The periods considered were the five, 10 and 25 years up to 2008 and the maximum time period to 2008, which was 1975–2008 for many WBS species and 1999–2008 for WBBS analyses. The percentage change was calculated from the smoothed index values, and the change was considered statistically significant where the bootstrapped 95% confidence intervals for the years under comparison did not overlap zero. If the change was negative and over 25% this was flagged up as an 'alert'. Decreases of more than 50% were flagged as 'high alerts'.

Population indices were calculated for the UK as a whole, England, Scotland and Wales for the joint WBS/WBBS data and for the UK and England for the WBBS data alone. Joint indices were available for a maximum of 25 species, which were the ones with sufficient WBS data. Species displayed in the trend graphs presented in this report are those where the GLMs converged and where there were sufficient data to produce bootstrapped confidence intervals.

2.3.1 Weighting system employed in the model

Originally the random selection of WBBS sites was intended to provide a representative sample of the waterways in the UK. Had all the selected stretches been surveyed, the results would indeed have provided this representativeness, but in fact only 65% of the random stretches were surveyed, and some of these only in a single year.

To counteract any bias in uptake by observers and hence coverage of the UK, counts were weighted to account for differences in sampling effort among Government Office Regions (GORs). Weighting was based on the proportion of those randomly selected sites that were actually surveyed by observers in each of the regions. GORs were chosen as the regional level to ensure there was a sufficient sample size in each of the regions to work out a weighting factor: BTO regions, for example, produced sample sizes that were too small. It was hoped that, after correcting the bias in observer coverage using the weights, the population trends would more accurately reflect the true picture in the UK.

For WBS sites the weighting is based on the method used for weighting the WBS-linked sites. The proportion of WBS sites of the total number of WBBS sites was the basis by which the weightings were

calculated and the weightings for these and the WBS-linked sites were then scaled up to the random WBBS level using the mean random WBBS weighting.

Full details of the weighting system are given in the previous WBBS report (Marchant *et al.* 2006).

2.4 Calculation of multi-species indicators

Of particular interest for freshwater wetlands and waterways is the production of indicators relating to a range of habitat types subjected to particular environmental or anthropogenic pressures. A major part of development of the indicators was to establish habitat groupings and associate these with groups of species for which they were particularly important (Everard & Noble 2008).

A further report (Noble *et al.* 2008a) has described the methods in detail and compiled provisional indicators for four target habitats: fast-flowing waters; slow-moving and standing waters combined; reedbeds; and wet meadows (comprising wet grassland and marshes). In essence, the method is to compile an index from the geometric mean of the population index values for the group of species to be included. Weighting and smoothing can also be applied during the calculation, and a confidence interval can be obtained by bootstrapping.

The UK data can also be subdivided, although the relatively small sample sizes give limited scope for this. Provisional indicators have been reported using data for England alone, as well as for the UK.

3 RESULTS

3.1 WBS/WBBS data collection for birds

There are 25 bird species that were covered historically by WBS, and currently by WBBS, and have enough data to run a long-term joint population index for the UK. These are listed in Table 4, together with mean counts per year of birds (territories or individual birds) and the mean numbers of sites occupied by the species. The number of years is the maximum length of the index sequence for each species. The species were surveyed in other years but samples were too small to permit inclusion in the index calculation.

Table 4. Species for which joint WBS/WBBS indices could be calculated for the UK, with their sample sizes in UK, England, Scotland and Wales.

Species	Number of years	Mean annual counts of birds and numbers of sites							
		UK		England		Scotland		Wales	
		Birds	Sites	Birds	Sites	Birds	Sites	Birds	Sites
Mute Swan	35	343.6	72.6	335.1	64.9	11.5	4.8	8.3	3.2
Greylag Goose	17	378.7	33.8	326.9	29.9	52.5	3.6	8.1	0.9
Canada Goose	29	561.6	58.3	528.0	54.7	18.8	2.3	9.1	2.6
Mallard	35	3206.4	151.3	2865.0	122.8	213.1	17.8	167.1	11.4
Tufted Duck	35	209.7	33.8	198.4	29.8	6.5	2.4	6.9	1.5
Goosander	29	130.7	38.5	103.6	29.1	18.3	6.8	11.8	2.8
Little Grebe	35	63.4	19.9	57.4	18.1	5.2	1.5	0.7	0.3
Moorhen	35	1077.6	115.7	950.9	102.3	82.9	7.8	49.9	6.4
Coot	35	509.7	56.8	473.5	51.8	26.9	3.1	17.7	2.7
Oystercatcher	35	437.2	42.6	316.9	30.5	124.5	11.2	5.3	1.5
Lapwing	30	427.6	63.4	342.0	52.1	75.0	8.8	17.7	3.1
Snipe	35	30.8	12.0	15.6	7.4	15.2	4.3	0.7	0.4
Curlew	35	175.5	40.9	130.3	31.7	45.1	8.2	4.9	1.5
Common Sandpiper	30	261.5	43.8	161.9	29.8	91.9	12.4	18.7	2.4
Redshank	35	119.7	22.7	109.7	19.3	9.7	2.6	1.7	0.9
Kingfisher	35	86.0	51.5	73.0	43.4	6.3	3.6	7.6	4.5
Sand Martin	32	1967.1	41.3	1825.9	32.9	76.3	5.7	69.4	3.0
Whitethroat	35	388.3	73.0	349.7	63.1	18.2	5.8	28.5	4.7
Sedge Warbler	35	556.9	65.2	458.6	54.8	59.4	7.3	39.3	3.6
Reed Warbler	29	429.5	39.4	410.9	35.7	14.2	2.5	16.4	2.2
Dipper	35	194.7	59.3	132.8	39.8	43.0	13.1	23.2	7.2
Yellow Wagtail	35	74.4	23.5	65.7	20.1	5.9	2.0	4.2	1.5
Grey Wagtail	35	295.6	91.1	222.6	67.9	45.0	14.5	29.8	8.5
Pied Wagtail	35	402.4	105.1	304.8	82.1	76.5	16.2	23.6	6.9
Reed Bunting	35	425.1	78.9	368.3	66.9	43.7	8.3	17.9	4.1

Small samples, either of birds or of sites, do not allow the calculation of a sufficiently reliable index trend. Sample sizes for England alone are large enough permit trends to be run for all 25 species for which data are available at the UK level. Trends for only five of the species are available for Scotland alone, however, and no trends can be calculated for any species from waterways data just from Wales or Northern Ireland.

The calculated trends are presented graphically in Appendix 3, in Figures A3.1–A3.3, for the UK, England and Scotland respectively. Unsmoothed values of annual indices are shown as dots, together with a smoothed trend and 85% bootstrapped confidence intervals.

3.2 Trends and alerts for waterways birds

Trends and alerts for waterways birds for the period 1975–2008, for the UK and for England, are presented in Table 5. These figures update those already published for the years to 2007 on the BTO’s BirdTrends web pages (www.bto.org/birdtrends; Baillie *et al.* 2010).

The trends that are reported are for the four standard reporting periods (five, ten and 25 years, and the maximum that can be calculated) that BTO has agreed with JNCC. Reporting periods omit the first and last years of the full index run (usually 1974 and 2009 for the present data set); index values are estimated for these years but are relatively uncertain and it would be unwise to base calculations of long-term change on them. Statistically significant decreases of more than 25% over any of these periods raise ‘BTO alerts’, with changes greater than a 50% decline raising high alerts.

Table 5. Trends and alerts for waterways birds, 1975–2008. Population changes significant at the 5% level are indicated with a plus or minus sign, according to the direction of change. Significant decreases of 25% or more raise alerts.

Species	Period	Number of years	UK			England		
			Population change	Significant change	Alert	Population change	Significant change	Alert
Mute Swan	1975–2008	33	+98%	+		+125%	+	
	1983–2008	25	+83%	+		+87%	+	
	1998–2008	10	+7%			+4%		
	2003–2008	5	+3%			+3%		
Greylag Goose	1993–2008	15	+410%	+		+766%	+	
	1998–2008	10	+78%	+		+182%	+	
	2003–2008	5	+45%	+		+67%	+	
Canada Goose	1981–2008	27	+179%	+		+346%	+	
	1983–2008	25	+185%	+		+297%	+	
	1998–2008	10	+101%	+		+74%	+	
	2003–2008	5	+45%			+33%		
Mallard	1975–2008	33	+207%	+		+150%	+	
	1983–2008	25	+110%	+		+75%	+	
	1998–2008	10	+4%			+2%		
	2003–2008	5	–1%			–4%		
Tufted Duck	1975–2008	33	+111%			+143%		
	1983–2008	25	+57%			+66%		
	1998–2008	10	+8%			+8%		
	2003–2008	5	+6%			+5%		
Goosander	1981–2008	27	+82%	+		+62%		
	1983–2008	25	+47%			+26%		
	1998–2008	10	–4%			–14%		
	2003–2008	5	+7%			–6%		
Little Grebe	1975–2008	33	–39%			–14%		
	1983–2008	25	–28%			–15%		

Species	Period	Number of years	UK			England		
			Population change	Significant change	Alert	Population change	Significant change	Alert
	1998–2008	10	–1%			–2%		
	2003–2008	5	+10%			+12%		
Moorhen	1975–2008	33	–15%			–3%		
	1983–2008	25	+12%			+26%		
	1998–2008	10	–2%			–3%		
	2003–2008	5	–3%			–3%		
Coot	1975–2008	33	+92%	+		+99%	+	
	1983–2008	25	+45%			+46%		
	1998–2008	10	0%			+5%		
	2003–2008	5	+8%			+10%		
Oystercatcher	1975–2008	33	+74%	+		+124%	+	
	1983–2008	25	+1%			+32%	+	
	1998–2008	10	–20%	–		+4%		
	2003–2008	5	–16%	–		–8%		
Lapwing	1980–2008	28	–32%			+58%		
	1983–2008	25	–50%	–	>50	–5%		
	1998–2008	10	–34%	–	>25	–13%		
	2003–2008	5	–27%	–	>25	–10%	–	
Curlew	1980–2008	28	–10%			–8%		
	1983–2008	25	–19%			–20%		
	1998–2008	10	–39%	–	>25	–20%	–	
	2003–2008	5	–21%	–		–9%		
Common Sandpiper	1975–2008	33	–38%	–	>25	–36%	–	>25
	1983–2008	25	–39%	–	>25	–36%	–	>25
	1998–2008	10	–20%	–		–21%	–	
	2003–2008	5	–12%	–		+2%		
Redshank	1975–2008	33	–65%	–	>50	–50%	–	>25
	1983–2008	25	–63%	–	>50	–47%	–	>25
	1998–2008	10	–49%	–	>25	–31%	–	>25
	2003–2008	5	–42%	–	>25	–25%	–	>25
Kingfisher	1975–2008	33	–5%			–7%		
	1983–2008	25	+78%	+		+81%	+	
	1998–2008	10	–1%			–8%		
	2003–2008	5	–6%			–8%		
Sand Martin	1978–2008	30	0%			–2%		
	1983–2008	25	–8%			–13%		
	1998–2008	10	–26%			–30%	–	>25
	2003–2008	5	–1%			–7%		
Whitethroat	1975–2008	33	+119%			+174%		
	1983–2008	25	+280%	+		+306%	+	
	1998–2008	10	+15%	+		+17%	+	
	2003–2008	5	–5%			–2%		
Sedge Warbler	1975–2008	33	–40%	–	>25	–35%		
	1983–2008	25	–25%	–	>25	–32%	–	>25
	1998–2008	10	–27%	–	>25	–27%	–	>25
	2003–2008	5	–17%	–		–14%	–	

Species	Period	Number of years	UK			England		
			Population change	Significant change	Alert	Population change	Significant change	Alert
Reed Warbler	1981–2008	27	+80%	+		+36%		
	1983–2008	25	+83%	+		+45%		
	1998–2008	10	–1%			–8%		
	2003–2008	5	–2%			–3%		
Dipper	1975–2008	33	–31%	–	>25	–18%		
	1983–2008	25	–15%			+2%		
	1998–2008	10	–19%	–		–9%		
	2003–2008	5	–13%	–		–3%		
Yellow Wagtail	1975–2008	33	–96%	–	>50	–95%	–	>50
	1983–2008	25	–95%	–	>50	–95%	–	>50
	1998–2008	10	–74%	–	>50	–71%	–	>50
	2003–2008	5	–47%	–	>25	–46%	–	>25
Grey Wagtail	1975–2008	33	–26%	–	>25	–23%		
	1983–2008	25	+53%	+		+61%	+	
	1998–2008	10	+23%	+		+27%	+	
	2003–2008	5	–3%			–9%	–	
Pied Wagtail	1975–2008	33	–64%	–	>50	–56%	–	>50
	1983–2008	25	–43%	–	>25	–32%	–	>25
	1998–2008	10	–26%	–	>25	–11%	–	
	2003–2008	5	–22%	–		–13%	–	
Reed Bunting	1975–2008	33	–60%	–	>50	–49%	–	>25
	1983–2008	25	–16%			–7%		
	1998–2008	10	+8%			+6%		
	2003–2008	5	+1%			–2%		

3.3 WBBS data collection for mammals

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

In all during 1998–2009, 40 mammal species have been recorded by WBBS observers (Appendix 2). Those species found most frequently were diurnal ones, such as rabbit and grey squirrel, or ones that left obvious signs of presence, such as mole. By far the most numerous mammals seen were rabbit and red deer. Of specialist waterway mammals, water voles were found on 6% of stretches in 2009, American mink on 8%, and otter on 13%.

The sequences of overall summed counts and of occupancy do not suggest any clear trends in mammal population size. There may be a real decline, however, in the proportion of observers who contribute mammal data: in the early years about 90% of observers returned their mammal form but in recent years only around 80% have done so.

Newson *et al.* (2005) have already investigated the potential of the WBBS data for long-term monitoring of mammal populations, and concluded that sample sizes would need to rise considerably in order to provide an appropriate level of power to detect change.

In the most recent BTO report on mammal population trends, WBBS presence/absence data are used, in combination with similar data from BBS, to derive trends for three species – Water Vole, American Mink and Otter (Wright *et al.* 2010). Studies are continuing into the scope for combining mammal data from WBBS and BBS, for waterside species, to maximise the monitoring samples.

4 DISCUSSION

4.1 Species-level data

WBBS continues to be well supported by volunteers, and to provide valuable monitoring data. Ongoing long-term index trends, incorporating valuable results from the long-running but now-defunct WBS, are available for 24 species (Snipe can no longer be indexed reliably due its disappearance from most lowland sites), while index trends since 1998 can be calculated from WBBS data alone for around 84 species. Long-term trends from WBS/WBBS are presented at species level in the BTO's BirdTrends web pages (www.bto.org/birdtrends; Baillie *et al.* 2010), which are updated annually to include each new season's data.

Sample sizes are sufficient to allow many species to be monitored using regional subsets of the full data. Long-term trends for England only can be produced for all 24 species for which such trends can be calculated at UK level. Five species also can be monitored long-term in Scotland but no reliable trends for any species in Wales or Northern Ireland could be produced. Country and regional trends could be calculated for a much wider range of species using WBBS data only, for the period beginning in 1998.

There is considerable overlap between the species monitored long term by CBC/BBS and by WBS/WBBS. Valuable comparisons and contrasts can therefore be drawn between these independent data sets. Differences between habitat-specific trends, such as those between waterways and drier habitats monitored by CBC/BBS, have not yet been fully explored but may well provide insight into the causes of population change. For 14 species, however, WBS/WBBS indices are considered the most reliable or are the only long-term monitoring trend (Baillie *et al.* 2010): Greylag Goose, Canada Goose, Tufted Duck, Goosander, Little Grebe, Moorhen, Coot, Oystercatcher, Common Sandpiper, Redshank, Kingfisher, Sand Martin, Dipper and Grey Wagtail.

The list of species for which WBS/WBBS currently provides the best long-term monitoring data includes iconic and popular species, such as Kingfisher and Dipper, severely declining species (Redshank) and rapidly increasing introduced birds of potential economic importance (Greylag and Canada Geese).

The summarised results of joint WBS/WBBS indices for the UK are presented in Table 5, in the form of estimates of linear change over the standard reporting periods, with alerts raised for species with significant declines of more than 25%.

Three species (Lapwing, Redshank and Yellow Wagtail) raise high alerts at the UK scale because their population size has at least halved over the recent 25-year period. A fourth species (Snipe) would also fall into this category except that it has become extinct over wide areas of lowland Britain and indices can no longer be reliably calculated. The decline for Yellow Wagtail is so severe that the 50% criterion is easily met, even over the 10-year period, while a decrease of 47% is estimated for the recent five-year period. Two further species (Pied Wagtail and Reed Bunting) raise high alerts for the longest (33-year) period only and have shown little change in population in recent years.

Alerts are also raised at the lower level, in the UK, England or both, for Curlew, Common Sandpiper, Sand Martin, Sedge Warbler, Dipper and Grey Wagtail. Thus, 11 of the 24 species for which long-term trends are available for breeding populations on waterways raise alerts for population decline.

In contrast to these decreases, there are significant increases of 100% or more for six species: these are Mute Swan, Greylag Goose, Canada Goose, Mallard, Oystercatcher and Whitethroat). The two goose species and Mallard have all benefited from widespread introductions of birds for shooting or for ornamental purposes. Many Mallards on urban waterways are resident birds with plumage indicating a partly domestic origin and are largely dependent for food on the public. Greylag Goose has shown the fastest rate of increase for any species monitored by broad-scale surveys, having increased by 430% in the

UK and 766% in England during the period 1993–2007, due to a combination of spread from naturalised stock and from the original wild populations.

The presence of non-native Canada Geese in large numbers in urban sites raises widespread concerns about public health and safety: the species poses significant air-strike risks; its droppings create fouling and health hazards in public spaces; the birds damage riverbanks by creating pathways that speed erosion; and economic damage to farmland crops has been reported.

In addition, a further five species show significant increases of at least 33%, which is the level proportionally opposite to a decrease of 25%: these are Goosander, Coot, Kingfisher, Reed Warbler and Grey Wagtail. Thus there are also 11 species in the increase category, with one species, Grey Wagtail, showing statistically significant upturns and downturns across different periods.

4.2 Site-level data

The WBBS collects bird and basic habitat data at the level of the 500-metre section, this being the length of stretch covered also by the River Habitat Survey. By 2009, WBBS had amassed almost 18,500 section–year surveys, each being a count of birds, by species, in a particular 500-metre section in a particular year. Birds are recorded in three distance bands or as in flight, enabling, for example, birds on the waterway or within 25 metres of it to be separated from those more distant or just flying over.

Routine analysis of WBBS data covers only the assessment of population change for each species, for which the first step is to combine counts for each species across all the distance bands and 500-metre sections within a survey stretch. There is great potential, however, for making use of the section data, for example for assessing the relative value to birds of different rivers or catchment sections.

4.3 Contribution of WBBS to mammal monitoring

Few schemes collect mammal-monitoring data from the wider countryside, and even fewer collect it annually from freshwater wetlands and waterways. Although mammal monitoring is not the main purpose of WBBS, and observers are not necessarily well trained in observing mammal species, the data that are collected by WBBS are therefore potentially of considerable value.

WBBS is able to contribute most to the monitoring of mammals that are characteristic of riverine habitat and in particular of Water Vole, American Mink and Otter, although they are not the most frequently detected species. Water Vole trends are of considerable interest because of the marked retraction of range that this species has suffered over recent decades. Mink is an invasive, non-native species for which control measures are often taken to protect fish stocks, and an important predator of wild birds, and better information on its status is required for management. Otter is a charismatic and popular species which has suffered marked declines in the past, and for which population monitoring to track its rate of recovery is also of special value.

The highest samples for mammals from WBBS data are for widespread species common in a broad range of habitats, such as Rabbit, Brown Hare, Red Deer and Roe Deer. These species are better monitored by the much larger BBS but, as for birds, an independent set of data from WBBS for habitat along linear waterways may give insight into where and how different components of their populations are changing.

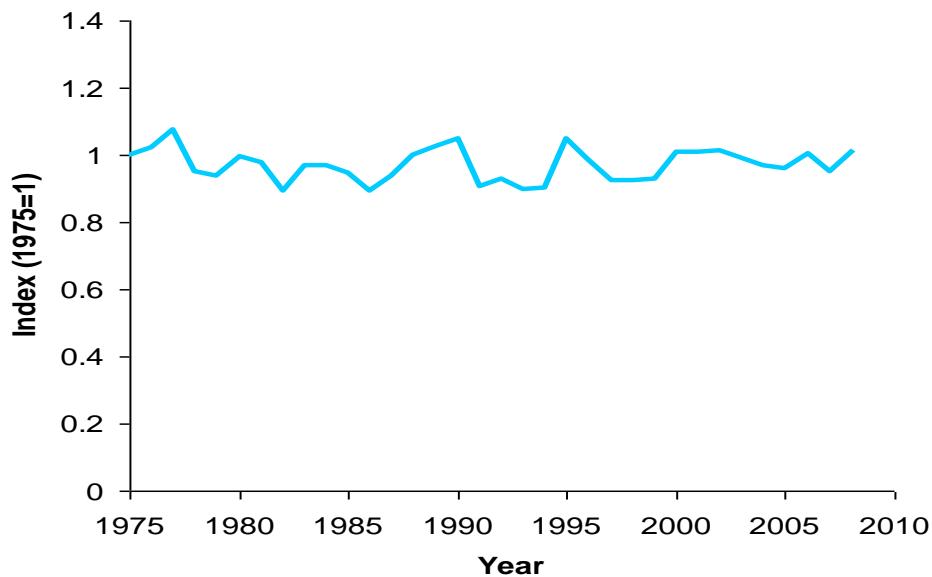
4.4 Developing wild bird indicators for freshwater wetlands and waterways

Progress on creating wild bird indicators for freshwater wetlands and waterways was fully reported in earlier reports to the Environment Agency (Noble *et al*, 2008a, 2008b) and in Everard & Noble (2009)

which included provisional indicators for the period 1974–2006 for both the UK and England. These composite indicators are comprised of the species trends of 26 wetland species found to be strongly associated with freshwater wetland and waterways in the UK and for which sufficient data were available (Everard & Noble 2008). In order to produce indicators covering this whole period, species trends were produced mainly by modelling WBS and WBBS in combination, and for species such as Moorhen found in a greater array of wetland habitats also in combination with Common Bird Census (CBC) and Breeding Bird Survey (BBS). The most reliable trends for three species were obtained from other sources: Grey Heron and Little Egret were estimated using the Heronries Survey and trends for Cetti’s Warbler from the Constant Effort Sites ringing scheme.

Since then, the UK version of the wild bird indicator for freshwater wetlands and waterways, has become part of the set of wild bird indicators for the UK’s Sustainable Development Strategy, reported by Defra alongside trends for farmland, woodland, seabirds and all species (see Defra website and Figure 4).

Figure 4 The UK wetland breeding bird index, 1970 -2008, published in October 2009 as part of the UK Sustainable Development Strategy wild bird indicators.



A smoothed England version of the wild bird indicator for freshwater wetlands and waterways (see Figure 5) was adopted in 2008 as part of the new Public Service Agreement (PSA 28) in the form of an aggregate index composed of trends in birds of wetlands, farmland and woodland, and with separate component intermediate outcome indicators for each of those three groups of birds. The England indicator of freshwater wetlands and waterways was also adopted as a component of the England Biodiversity Strategy indicator suite alongside indicators for coastal and marine birds, farmland birds, woodland birds, and urban species. The wetland bird index for England (shown in Fig.5) has declined for the last three years, but still lies about 13% higher than its starting value in 1975. This is approximately the same value as in 1990 and only 2% higher than that in 2000, so overall the index has been relatively stable over the past 18 years. This indicator is reported with separate indices for species associated with four major freshwater wetland habitats (slow-flowing and standing waters, fast-flowing waters, reed beds, and wet meadows).

Figure 5 The wetland bird intermediate outcome indicator for England (1975-2008), with bootstrapped 95% confidence intervals, a component of PSA 28.

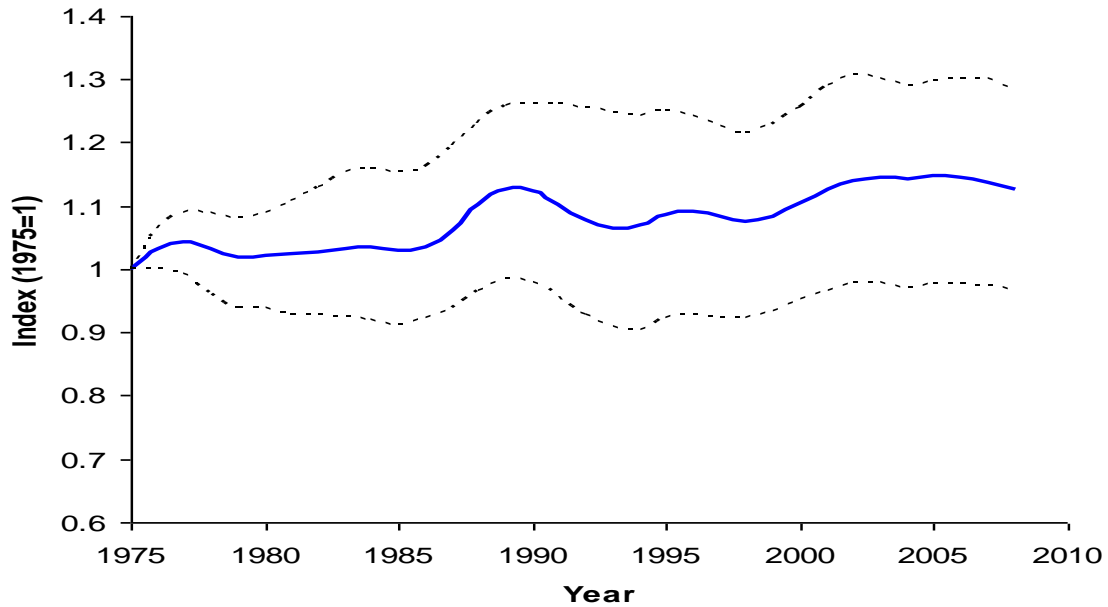
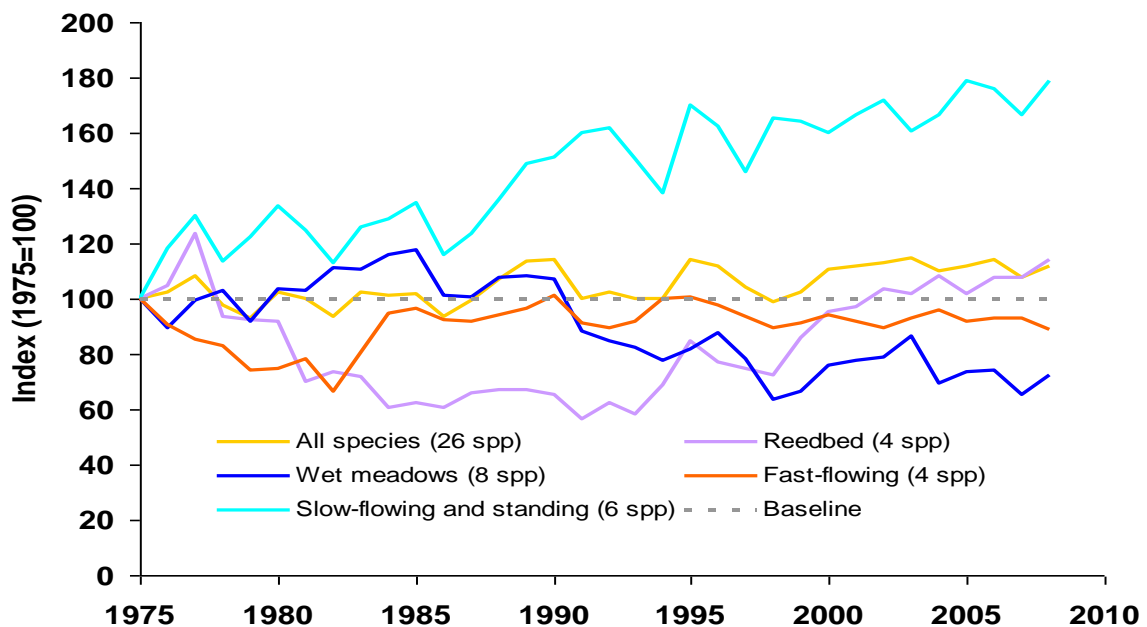


Figure 6 Populations of water and wetland birds (W1) of the England Biodiversity Strategy wild bird indicators, showing separate trend lines for birds associated with each wetland habitats, as published in winter 2009/2010.



The UK and England wild bird indicators for freshwater wetlands and waterways have been updated twice since first developed and the latest versions including data to 2008 were published in autumn 2009. Although the PSA was abolished in June 2010, and the future of the SDS and EBS indicators is uncertain, updates of the wild bird indicator are provisionally expected to remain in the reporting schedule for autumn

2010. None of these indicators have yet been adopted formally by any other body with statutory nature conservation responsibility, such as the Environment Agency.

4.5 The future for WBBS

WBBS is envisaged as a permanent monitoring scheme for tracking changes in riparian species and populations using riparian habitats. With its predecessor the WBS, it has already provided monitoring data for breeding birds along rivers and canals for 37 consecutive years (including data collected in 2010 but not yet available for analysis). The change of method since 1998 to a transect survey based on random selection of survey sites has broadened the scope of monitoring and made it more representative of the countryside as a whole. The broader species coverage of WBBS, since 1998, should make it possible to estimate trends for some of the more common bird species at the country level or regional level.

WBBS has received valuable funding support through various development phases, mainly from the Environment Agency (including support in 2010) and also from BTO, but it receives no other funding and would benefit greatly from a more secure funding base.

It is planned for WBBS to increase the number of surveys conducted each year, by benefiting from the additional observer manpower that will be released after the close of the BTO's current Atlas 2007–11. An online system for data input, to match that already in place for BBS, would be a very valuable development for WBBS, and dedicated funding is being sought for that.

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APPENDIX 1.

Waterway stretches covered by WBBS during 1998–2009. Stretches are ordered by class of survey (random, WBS-linked, or other) and by nominal 1-km grid square. For each stretch, the limiting grid references in the most recent survey are given, together with the number of 500-metre sections covered in each survey year.

Nominal 1-km reference	Waterway name	Start and end grid references		Number of 500-metre sections surveyed											
				98	99	00	01	02	03	04	05	06	07	08	09
1. Random sites				98	99	00	01	02	03	04	05	06	07	08	09
.H3078	Fairy Water	.H304800	.H325780	–	–	–	–	6	–	–	–	–	–	–	–
.H4050	Many Burns River	.H381495	.H504513	–	6	–	–	–	–	–	–	–	–	–	–
.H5688	Glenlark River	.H574871	.H592889	–	6	6	–	6	–	–	–	–	–	–	–
.H6680	Ballinderry River	.H664797	.H680807	–	3	–	–	–	–	–	–	–	–	–	–
.H7672	Rock River	.H7..7..	.H7..7..	–	–	–	–	–	5	–	–	–	–	–	–
NC2634	Maldie Burn	NC252352	NC239340	4	4	4	–	4	–	–	–	–	–	–	–
NC3422	River Cassley	NC344225	NC368203	6	6	–	–	6	–	–	–	–	–	–	–
NC5810	Allt Chaiseagail	NC572106	NC582105	–	–	–	–	2	–	–	–	–	–	–	–
NC7252	River Naver	NC722544	NC723518	–	–	–	–	–	–	6	6	6	6	6	6
ND0258	Forss Water	ND033613	ND036595	–	–	–	–	3	–	3	3	3	3	3	3
ND1056	River Thurso	ND106560	ND128580	–	–	–	–	7	4	7	–	7	7	7	7
ND1628	Dunbeath Water	ND163296	ND143308	–	–	–	5	5	5	5	5	5	5	5	5
NG1846	Hamara River	NG187480	NG199463	–	4	4	–	–	–	4	4	4	4	4	4
NG3230	River Talisker/Sleadale Burn	NG324302	NG316304	–	–	–	–	–	2	2	2	2	2	2	2
NG3444	Allt Ruairidh/River Ose	NG345428	NG344456	–	–	–	–	–	5	5	5	5	5	5	5
NG4454	River Romesdal	NG415536	NG435543	–	–	10	–	–	5	–	4	–	4	10	4
NG8236	Reraig Burn	NG836362	NG846367	–	–	–	–	–	–	–	2	–	–	–	–
NG9406	Allt Coire Sgoireadail	NG952068	NG974088	–	8	8	8	8	8	8	8	8	8	8	–
NG9466	River Grudie	NG965684	NG959663	–	–	–	–	–	–	6	–	–	–	–	–
NG9804	Allt Coire nan Eiricheallach	NG998032	NG994064	5	5	5	5	5	5	5	5	5	6	7	7
NH1264	Abhainn Srath Chrombuill	NH142642	NH102642	–	–	–	8	–	–	–	–	–	–	–	–
NH1428	Allt a' Choire Dhomhain	NH144269	NH156302	6	–	–	–	–	–	–	–	–	–	–	–
NH2210	River Moriston	NH209099	NH247117	–	–	–	–	–	–	–	–	–	10	–	–

Nominal 1-km reference	Waterway name	Start and end grid references		Number of 500-metre sections surveyed											
				98	99	00	01	02	03	04	05	06	07	08	09
NH2636	River Farrar	NH267376	NH239387	-	-	-	-	10	10	10	10	10	10	10	10
NH3648	Allt Cam Ban	NH363497	NH357501	2	1	1	-	1	2	2	-	2	2	2	2
NH4828	River Coiltie	NH524295	NH497282	-	-	-	-	-	-	6	6	6	6	6	-
NH4844	River Beaully	NH497442	NH468423	-	-	-	-	9	-	-	-	-	-	-	-
NH5242	River Beaully	NH517445	NH497442	-	-	-	-	9	9	9	9	9	9	9	9
NH6476	Strathroy River	NH660776	NH644783	-	-	-	-	-	4	4	-	-	-	-	-
NH6614	River Findhorn	NH665140	NH705170	10	10	10	-	10	10	10	10	10	10	10	10
NH6632	River Nairn	NH684340	NH674320	10	10	10	-	10	10	10	10	10	10	10	10
NH6644	River Ness (non-tidal part)	NH664444	NH642413	5	8	8	-	10	10	10	10	10	10	10	10
NH7218	River Findhorn	NH736200	NH705170	-	-	-	-	10	10	10	10	10	10	10	10
NH7698	R Fleet/Abhainn an t-Sratha Charnaig	NH747985	NH730986	-	-	-	-	-	-	-	-	-	-	4	4
NH9200	Am Beanaidh	NH923039	NN917999	-	10	10	-	10	10	10	-	-	-	-	-
NJ3416	Water of Buchat	NJ323189	NJ393157	-	10	-	-	-	-	10	10	-	-	-	-
NK0446	South Ugie Water	NK037478	NK056485	-	9	-	-	-	-	-	10	-	-	-	-
NK0848	River Ugie	NK078498	NK088490	-	-	-	-	-	-	4	4	-	-	-	-
NM3496	Abhainn Rangail	NM342954	NM374964	-	-	-	-	-	7	-	-	-	-	-	-
NM8266	River Hurich	NM849698	NM837682	-	-	-	-	-	-	-	-	-	-	-	4
NM9440	Dearg Abhainn	NM955420	NM967404	-	-	-	-	-	3	3	3	3	3	-	3
NM9478	Dubh Lighe	NM966787	NM932799	-	6	9	-	9	-	-	-	-	-	-	-
NM9852	Salachan Burn	NN968533	NN994517	-	-	-	-	-	-	-	-	-	6	-	-
NN0096	River Kingie	NN042978	NN000964	10	10	10	10	10	10	10	10	10	10	10	10
NN0686	Allt a' Cham Dhoire	NN040863	NN064873	6	-	-	-	-	-	-	-	-	-	-	-
NN1030	Allt Coire Chreachainn/Allt Mhoille	NN109317	NN105304	-	-	-	-	-	10	10	10	10	10	-	10
NN1468	River Nevis	NN145685	NN175686	-	-	-	-	-	-	-	-	6	6	6	6
NN1620	Allt an Stacain	NN153213	NN162218	-	4	-	-	-	-	-	-	-	-	-	-
NN2082	River Spean	NN183837	NN208814	9	9	-	-	-	-	-	-	-	-	-	-
NN2602	Croe Water	NN275020	NN242044	-	-	-	-	-	10	10	10	10	-	-	-
NN3492	River Roy	NN338918	NN384929	-	-	-	-	-	-	-	-	10	10	10	10

Nominal 1-km reference	Waterway name	Start and end grid references		Number of 500-metre sections surveyed											
				98	99	00	01	02	03	04	05	06	07	08	09
NN3872	Allt Feith Thuill	NN400731	NN372711	3	7	7	-	7	-	-	-	-	-	-	-
NN4488	Allt Coire Ardair	NN468886	NN440883	6	6	6	-	6	6	-	10	10	-	-	7
NN4888	Allt a' Chrannaig	NN484873	NN491889	3	3	3	-	3	3	-	5	5	-	-	5
NN5630	River Dochart	NN567321	NN537302	-	-	-	-	8	8	-	-	-	-	-	-
NN6094	River Spey	NN640941	NN596938	10	10	10	-	-	-	-	-	10	-	-	-
NN6884	Unnamed, feeds into aqueduct	NN687855	NN681870	3	-	-	-	-	-	-	-	-	-	-	-
NN7296	Milton Burn	NN744988	NN719956	10	10	10	-	10	10	10	10	10	10	10	-
NN8268	Bruar Water	NN820680	NN821696	-	-	-	-	-	-	3	3	3	-	-	-
NN8868	River Tilt	NN882684	NN896716	-	-	-	-	-	-	3	3	3	-	-	-
NN8870	River Tilt	NN882700	NN896716	-	-	-	-	-	-	4	4	4	-	-	-
NN9682	Bynack Burn	NN972838	NN960823	-	-	-	5	10	7	6	6	-	10	6	-
NO0298	Coire Etchachan Burn	NO034981	NO022999	-	-	-	6	6	3	7	7	7	7	6	-
NO0644	Buckny Burn/Lunan Burn	NO096455	NO060480	-	10	10	10	10	10	10	10	10	-	-	-
NO1282	Baddoch Burn	NO137834	NO129820	5	5	5	5	5	5	5	5	5	5	5	5
NO2090	River Dee	NO213920	NO201908	4	4	4	-	4	-	4	-	-	-	-	-
NO3046	Dean Water	NO339479	NO287457	-	7	7	-	7	7	7	7	10	9	9	9
NO5410	Kenly Water	NO538113	NO553122	4	4	-	-	-	-	-	-	-	-	-	-
NS4626	River Ayr	NS465261	NS464246	-	-	-	-	-	6	6	6	6	6	6	6
NS5280	Blane Water	NS518838	NS544804	-	-	-	-	-	10	-	-	-	-	-	-
NS5820	Lugar Water	NS580203	NS600218	-	-	-	-	-	-	-	5	5	10	-	5
NS6276	Glazert Water	NS608790	NS633771	-	-	-	-	-	10	6	6	-	-	7	7
NS6826	River Ayr	NS682263	NS715281	-	-	10	-	-	-	-	-	-	-	-	-
NS7404	Scar Water	NS768023	NS726039	-	-	-	-	10	10	10	10	10	10	10	8
NS7822	Duneaton Water	NS781226	NS814213	10	10	10	-	10	10	10	10	10	10	10	10
NS8230	Douglas Water	NS840319	NS828300	5	5	5	-	5	-	5	5	5	5	5	5
NS8280	Bonny Water	NS823803	NS793789	8	8	8	-	8	-	-	-	-	-	-	-
NS9804	Crook Burn	NS973063	NS984039	6	6	6	-	-	-	-	-	6	6	6	6
NS9806	Black Burn	NS989056	NS986078	-	-	-	-	-	-	-	-	5	5	5	-

Nominal 1-km reference	Waterway name	Start and end grid references		Number of 500-metre sections surveyed											
				98	99	00	01	02	03	04	05	06	07	08	09
NT0294	Black Devon	NT031942	NT034944	-	-	-	-	1	2	1	2	2	-	2	2
NT1426	Stanhope Burn	NT120304	NT155283	-	-	-	-	3	-	8	9	10	10	10	10
NT1866	Water of Leith	NT199686	NT173672	-	-	-	-	3	3	3	3	3	3	3	3
NT2420	Crosscleuch Burn	NT240202	NT245200	-	-	-	-	2	2	-	-	-	-	-	-
NT2626	Douglas Burn	NT279272	NT269281	-	-	-	-	3	3	3	-	-	-	-	-
NT2816	Ettrick Water	NT299164	NT290160	-	-	-	-	2	2	-	-	-	-	-	-
NT3012	Rankle Burn	NT323130	NT320150	-	-	-	-	-	-	5	5	5	5	5	5
NT3258	River South Esk/Redside Burn	NT324600	NT320591	-	-	-	-	6	6	6	6	-	-	-	-
NT3268	River Esk/North Esk	NT334682	NT345698	-	-	-	-	-	-	-	-	-	4	4	4
NT4630	Ettrick Water	NT474300	NT480314	-	-	-	-	3	-	3	-	-	-	-	-
NT8452	Blackadder Water	NT857543	NT825529	10	10	-	-	-	-	-	-	-	-	-	-
NT8854	Whiteadder Water	NT880550	NT900544	-	-	-	-	-	-	-	-	-	-	-	5
NT9010	River Alwin	NT925073	NT911107	7	-	-	-	7	6	7	7	6	7	6	6
NT9412	Shank Burn	NT973153	NT952137	6	6	6	-	6	6	6	6	6	6	6	6
NU0026	Wooler Water	NT995278	NT997247	-	-	-	-	-	10	7	7	7	7	7	7
NU0416	River Breamish	NU044168	NU017164	-	-	-	-	-	5	5	5	5	5	5	5
NU1800	River Coquet	NU185003	NU197009	-	-	-	-	-	3	3	3	3	5	5	5
NU1812	River Aln	NU186138	NU215125	9	9	9	-	9	9	9	9	9	9	9	9
NX1674	Cross Water of Luce	NX180772	NX192742	10	-	-	-	-	-	-	-	-	-	-	-
NX3696	River Stinchar	NX397956	NX371963	-	-	-	-	-	7	7	7	7	7	7	7
NX3878	Water of Trool	NX400792	NX376780	-	-	-	-	-	-	-	-	6	-	-	-
NX6856	Tarff Water	NX685579	NX682563	-	-	-	-	3	-	-	-	-	-	-	-
NX7480	Urr Water	NX756802	NX754803	-	-	-	-	-	2	1	1	1	1	1	-
NX8494	Scar Water	NX875925	NX835945	-	-	-	-	-	10	10	-	10	8	8	-
NY0002	River Ehen	NY019034	NY009065	-	-	-	-	-	10	-	-	-	8	-	-
NY0428	Lostrigg Beck/River Marron	NY054292	NY061285	-	-	-	-	-	3	-	-	-	4	-	-
NY0604	River Bleng	NY077032	NY103031	4	4	-	-	-	-	5	5	5	5	5	5
NY0624	River Marron	NY074234	NY058272	-	-	-	-	-	-	-	10	10	10	9	9

Nominal 1-km reference	Waterway name	Start and end grid references		Number of 500-metre sections surveyed											
				98	99	00	01	02	03	04	05	06	07	08	09
NY1818	Mill Beck	NY167173	NY189184	-	-	-	-	-	6	-	6	6	6	6	6
NY2082	Water of Milk	NY202826	NY230834	-	-	-	-	4	7	7	-	7	7	7	7
NY2472	Kirtle Water	NY242740	NY240724	-	-	-	-	-	1	1	-	-	-	-	-
NY3648	River Caldew	NY371488	NY366450	-	-	-	-	-	10	10	10	10	-	10	10
NY3688	Ewes Water	NY368880	NY370900	-	-	-	-	4	4	4	-	4	4	-	-
NY3856	River Eden	NY400565	NY376580	-	-	-	-	-	-	10	10	10	10	10	10
NY4496	Hermitage Water (major source)	NY450964	NY460969	-	-	-	-	-	2	-	-	-	-	-	-
NY5076	Black Lyne	NY496734	NY500757	6	-	-	-	-	6	6	-	-	-	-	-
NY5084	Kershope Burn	NY482827	NY520849	10	10	10	-	-	-	-	10	10	10	10	-
NY5464	King Water	NY554668	NY524634	3	-	-	-	-	5	10	5	-	-	-	-
NY5634	Briggle Beck/River Eden	NY565335	NY572321	-	-	-	-	-	-	-	-	-	-	-	3
NY6086	Lewis Burn	NY631887	NY623874	-	4	4	-	4	4	4	4	4	4	4	4
NY7020	Hilton Beck	NY710200	NY719207	-	-	3	-	3	3	3	3	3	-	-	-
NY7804	River Eden	NY781018	NY775044	-	-	-	-	-	-	-	-	-	8	8	8
NY8012	River Belah	NY800124	NY819123	-	-	6	-	6	6	6	6	6	-	-	-
NY8692	River Rede	NY880933	NY864943	-	-	-	-	-	-	-	-	-	-	-	6
NY8890	River Rede	NY888927	NY900901	-	-	-	-	-	-	-	-	7	5	5	5
NY9208	Sleightholme Beck	NY929089	NY920089	-	-	-	-	-	-	-	-	-	-	10	10
NY9424	River Tees/Hudeshope Beck	NY976243	NY934257	-	-	-	-	-	10	10	10	10	10	10	10
NY9606	Arkle Beck	NY970063	NY954074	-	-	-	-	-	5	5	5	6	5	5	5
NZ0260	River Tyne	NZ030620	NZ040616	-	-	-	-	2	2	2	2	2	2	2	2
NZ0836	River Wear	NZ055369	NZ082368	-	-	-	-	10	6	6	6	6	6	-	-
NZ1658	River Derwent	NZ180599	NZ152572	-	-	-	-	10	10	-	-	-	-	-	-
NZ2436	River Wear	NZ243361	NZ259374	2	4	4	-	4	4	4	4	4	4	4	4
NZ2818	River Skerne	NZ302193	NZ291207	6	6	6	-	-	-	-	-	-	-	-	-
NZ2844	River Wear	NZ284438	NZ302456	-	7	7	-	7	7	7	7	7	7	7	7
NZ3254	River Wear	NZ312540	NZ330554	-	-	-	-	-	-	-	5	5	5	5	5
NZ3276	Holywell Dene	NZ336768	NZ336761	-	-	-	-	2	2	2	2	2	2	-	-

Nominal 1-km reference	Waterway name	Start and end grid references		Number of 500-metre sections surveyed												
				98	99	00	01	02	03	04	05	06	07	08	09	
NZ4422	Billingham Beck	NZ446234	NZ457215	-	-	-	-	-	6	6	6	6	6	6	6	6
NZ6418	Skelton Beck	NZ659201	NZ668215	5	5	5	-	5	5	5	5	5	5	5	5	5
SD2092	River Duddon	SD223962	SD200918	-	-	-	-	-	-	10	10	10	-	-	-	-
SD3406	Leeds & Liverpool Canal	SD364068	SD369093	-	-	6	6	6	6	6	6	6	-	-	-	6
SD3476	River Eea	SD362766	SD356764	-	-	-	-	-	1	1	1	1	1	1	1	1
SD3600	River Alt	SD370007	SD359021	-	-	-	-	-	-	-	4	4	4	4	4	4
SD4646	Lancaster Canal	SD481472	SD484453	10	-	-	-	-	6	6	6	6	6	6	6	6
SD4860	Lancaster Canal	SD474609	SD487635	-	-	-	-	-	7	7	7	7	7	7	7	7
SD5030	Lancaster Canal	SD527302	SD5..3..	-	-	-	-	2	-	-	-	-	-	-	-	10
SD5270	Lancaster Canal	SD521734	SD511707	-	-	-	-	-	10	10	10	10	10	10	10	10
SD5296	River Sprint	SD513960	SD521977	-	-	-	-	1	-	-	-	3	3	3	3	3
SD5298	River Sprint	SD521998	SD520983	-	-	-	-	1	-	-	-	3	3	3	3	3
SD7012	Eagley Brook	SD727123	SD712134	4	4	4	-	4	4	4	4	4	-	-	-	4
SD7052	Croasdale Brook	SD704523	SD686555	-	-	-	-	-	-	-	10	10	10	10	10	10
SD7228	Leeds & Liverpool Canal	SD732297	SD740285	-	-	-	-	-	-	-	5	5	5	5	5	5
SD7454	Bottoms Beck	SD741560	SD751595	-	-	-	-	-	-	-	-	7	7	8	8	8
SD7466	River Wenning	SD745670	SD714670	8	8	8	-	8	8	8	8	8	8	8	8	8
SD7488	Clough River	SD764902	SD718906	-	-	10	-	-	10	-	-	-	-	-	-	-
SD7808	Manchester, Bolton & Bury Canal	SD793099	SD779073	-	-	-	-	6	6	6	6	-	-	-	-	-
SD8070	River Ribble	SD812696	SD807727	-	-	-	-	-	-	8	8	8	8	8	8	8
SD8804	Rochdale Canal	SD885079	SD893038	10	10	10	10	-	-	10	10	10	10	10	10	10
SD9664	River Wharfe	SE004633	SD981659	-	8	8	-	8	8	8	8	8	8	8	8	8
SE0278	River Cover	SE045808	SE023791	6	6	6	-	6	6	6	6	-	-	-	-	-
SE3288	River Swale	SE320895	SE337880	8	8	8	-	8	-	8	8	8	8	-	-	-
SE3428	Aire & Calder Navigation/River Aire	SE383279	SE345301	-	-	-	-	10	10	10	10	10	10	10	10	10
SE3800	Dove & Dearne Navigation	SE411022	SE395012	4	4	4	-	-	-	-	-	-	-	-	-	-
SE5846	River Ouse	SE593445	SE600472	-	-	-	-	8	8	8	8	6	-	-	-	-
SE5848	River Ouse	SE602500	SE599467	-	-	-	-	8	8	8	8	8	8	8	8	8

Nominal 1-km reference	Waterway name	Start and end grid references		Number of 500-metre sections surveyed												
				98	99	00	01	02	03	04	05	06	07	08	09	
SE6214	New Junction Canal	SE622126	SE639162	-	-	-	-	-	-	-	-	-	-	-	1	8
SE7044	Pocklington Canal (The Beck)	SE732453	SE711441	-	-	-	-	-	10	-	6	6	6	6	-	-
SE7086	River Dove	SE705877	SE697893	-	-	-	-	-	-	-	-	-	5	4	-	-
SE7404	River Torne + Un-named Drain	SE757067	SE740040	-	-	-	-	7	7	7	7	7	7	7	7	7
SE9620	New River Ancholme	SE972164	SE974208	-	-	9	-	9	9	9	-	-	-	-	-	9
SH5648	Afon Colwyn	SH592480	SH583516	-	-	-	-	10	10	10	10	10	10	10	10	10
SH6672	Afon Aber	SH659725	SH669700	-	-	-	-	6	6	6	6	6	6	6	6	6
SH7032	Afon Eden	SH703321	SH700327	-	-	2	-	-	-	2	-	-	-	-	-	-
SH7218	Afon Wnion	SH729180	SH715181	-	-	-	-	-	-	2	-	-	3	-	-	-
SH8044	Afon Conwy	SH786442	SH815454	-	-	-	-	-	-	-	-	-	7	7	7	7
SH8666	River Elwy (Afon Elwy)	SH880670	SH878680	-	-	-	-	3	2	-	2	2	2	2	2	2
SH9424	Afon Eiddew	SH964244	SH946250	4	4	4	-	4	4	1	4	-	4	4	4	4
SH9852	Afon Alwen	SH976528	SH987519	-	-	-	-	2	-	-	-	-	-	-	-	-
SJ0474	Afon Clwyd	SJ048745	SJ041748	-	-	-	-	-	2	2	2	2	2	2	2	2
SJ0802	Afon Rhiw	SJ093023	SJ085035	-	-	-	-	-	-	3	-	-	-	-	-	-
SJ1006	Afon Banwy neu Einion	SJ105062	SJ115013	3	-	-	-	-	3	3	3	-	-	-	-	-
SJ1058	Afon Clywedog	SJ087583	SJ107605	-	-	-	-	-	7	7	7	7	-	-	-	-
SJ1228	Afon Iwrch	SJ134266	SJ126300	7	7	7	-	7	7	7	7	-	7	7	7	7
SJ1644	River Dee (Afon Dyfrdwy)	SJ196434	SJ183447	-	-	-	-	-	-	-	5	5	-	-	-	-
SJ2022	Afon Tanat	SJ185240	SJ226240	10	10	10	-	10	10	10	10	10	10	10	10	10
SJ4066	Shropshire Union Canal	SJ393687	SJ427665	-	10	10	10	-	-	-	2	-	10	10	10	10
SJ4276	Manchester Ship Canal	SJ476777	SJ451773	5	5	5	-	5	5	5	5	5	5	5	5	-
SJ6402	River Severn	SJ672034	SJ364041	8	8	-	-	-	8	8	8	8	-	8	8	8
SJ6654	River Weaver	SJ650523	SJ662552	10	10	6	-	6	6	6	6	6	6	6	6	6
SJ6672	River Dane	SJ667720	SJ662733	-	-	-	-	-	10	10	10	10	-	-	-	-
SJ6832	Shropshire Union Canal	SJ691325	SJ685345	-	-	-	-	2	4	-	4	-	-	-	-	-
SJ8610	Shropshire Union Canal	SJ849142	SJ875102	10	10	10	-	10	10	10	10	10	10	10	10	10
SK0206	Cannock Extension Canal	SK020069	SK019044	5	-	-	-	-	-	-	-	5	5	-	-	-

Nominal 1-km reference	Waterway name	Start and end grid references		Number of 500-metre sections surveyed											
				98	99	00	01	02	03	04	05	06	07	08	09
SK0836	River Dove	SK102374	SK104346	-	-	10	-	10	-	-	-	-	-	-	-
SK1686	River Noe	SK168846	SK152865	7	7	7	-	7	7	7	7	7	7	7	7
SK3802	Ashby-de-la-Zouch Canal	SK025382	SK038391	-	-	-	-	-	4	-	3	-	4	4	4
SK4226	River Trent	SK422280	SK407270	-	-	-	-	-	-	-	5	5	-	-	-
SK4840	Nottingham Canal (disused)	SK484414	SK476440	-	-	-	-	-	-	5	7	8	8	8	7
SK5298	River Don	SK526400	SK522994	-	-	-	-	2	2	2	2	2	2	2	2
SK5408	Anstey	SK551081	SK547077	-	-	-	-	-	-	1	1	1	1	1	1
SK5662	River Maun	SK601649	SK569638	4	4	4	-	-	8	8	8	8	8	8	8
SK6832	Grantham Canal (disused)	SK676307	SK681331	-	-	-	-	7	7	7	7	7	7	7	7
SK7632	Grantham Canal (disused)	SK757332	SK776353	-	-	-	-	-	6	6	6	6	6	6	6
SK8672	Ox Pasture Drain	SK869705	SK876743	-	-	-	-	-	-	9	9	9	9	-	-
SK8874	Fosdyke Navigation	SK990750	SK880745	6	6	6	6	6	6	6	6	6	6	6	6
SK9240	River Witham	SK920424	SK928397	-	-	-	-	-	-	4	4	7	7	7	7
SK9458	River Brant	SK939583	SK942600	4	4	4	4	4	4	4	10	10	10	10	10
SM9028	Western Cleddau	SM932279	SM924295	-	-	-	-	-	-	-	-	4	4	4	-
SM9828	Afon Anghof	SM971282	SM957263	-	-	-	-	-	4	4	4	-	4	-	-
SN1226	Eastern Cleddau (Cleddau-Ddu)	SN139278	SN127262	-	-	-	-	5	-	-	-	-	-	-	-
SN2834	Afon Cych	SN293350	SN267378	-	-	-	-	-	-	10	8	-	-	-	-
SN3826	Afon Gwili	SN389260	SN386274	-	-	-	-	-	-	-	3	3	2	-	-
SN5214	Gwendraeth Fach	SN544164	SN533161	-	-	-	-	1	-	3	-	-	-	-	-
SN5606	Afon Gwili	SN569065	SN574072	-	-	-	-	-	-	-	2	2	-	-	-
SN5802	River Loughor	SN565020	SN582024	-	-	-	-	-	-	-	4	3	3	-	-
SN6442	Afon Iwrch	SN652433	SN647414	-	-	-	-	4	4	4	4	4	4	4	4
SN6456	Afon Teifi	SN646561	SN660569	-	5	5	-	5	5	5	5	5	5	5	5
SN6802	Lower Clydach River	SN684026	SN687045	5	5	5	-	5	5	5	5	-	-	-	-
SN7400	River Clydach	SN738004	SS737981	9	9	9	-	10	-	7	7	7	7	7	7
SN7432	Afon Tywi	SN762352	SN752326	-	-	-	-	5	6	6	6	6	6	6	6
SN7632	Afon Gwydderig	SN753327	SN759331	-	-	-	-	-	3	3	3	3	3	3	3

Nominal 1-km reference	Waterway name	Start and end grid references		Number of 500-metre sections surveyed											
				98	99	00	01	02	03	04	05	06	07	08	09
SN7804	Dulais River	SN790054	SN790045	-	-	-	-	4	4	4	4	1	1	2	2
SN8200	Melin Court Brook	SN818022	SN838004	-	-	-	-	6	-	-	-	-	-	-	-
SN9654	Chwefri	SN973558	SN983542	-	-	-	-	-	4	4	4	-	-	-	-
SO0246	Duhonw	SO000472	SO045487	-	-	-	-	-	6	6	6	6	6	-	-
SO1016	Afon Crawnon	SO100160	SO133188	-	-	-	-	-	-	10	10	-	-	-	-
SO1068	Afon Ieithon	SO104660	SO104703	-	-	-	-	10	-	10	10	10	-	10	-
SO1204	Afon Rhymni	SO120059	SO138040	-	10	10	10	10	10	10	10	10	10	5	5
SO1262	Mithil Brook	SO115630	SO144628	-	-	-	-	8	-	8	8	8	-	8	-
SO1492	River Severn	SO139929	SO160949	-	-	-	-	-	-	-	6	-	-	-	-
SO2230	Grwyne Fawr	SO253285	SO233307	-	6	-	-	-	6	6	6	6	6	6	6
SO2620	Grwyne Fawr	SO280207	SO279201	-	-	-	-	-	5	5	-	5	5	5	5
SO2682	River Clun	SO282820	SO250826	-	-	-	-	-	-	5	5	5	5	5	5
SO3076	River Redlake	SO317763	SO302767	-	-	-	-	-	5	5	5	3	3	3	-
SO4086	River Onny	SO408867	SO409869	-	-	-	-	-	1	-	-	-	-	-	-
SO4618	Afon Mynwy	SO478168	SO465205	-	10	10	-	8	8	8	8	10	10	10	10
SO5440	River Lugg	SO534425	SO553400	-	-	-	-	-	-	-	-	-	-	-	10
SO6466	River Teme	SO629686	SO656691	7	7	7	-	7	7	7	7	7	7	7	7
SO6680	River Rea	SO662861	SO668787	9	9	9	-	9	9	-	9	9	9	9	9
SO7090	Mor Brook	SO729888	SO707905	-	-	-	-	-	7	-	-	-	-	-	-
SO7098	River Severn	SO721975	SJ700000	8	8	8	-	8	8	8	-	8	8	-	-
SO7454	River Teme	SO746562	SO759545	6	6	6	-	-	-	-	7	7	7	7	7
SO8004	River Frome	SO781057	SO805043	7	6	-	-	7	7	-	8	-	-	6	6
SO8628	River Severn	SO867304	SO844279	6	-	-	-	10	9	9	9	9	9	9	-
SO9886	Dudley Canal	SO970855	SO974851	-	-	-	-	-	-	1	1	1	1	1	1
SP0270	Worcester & Birmingham Canal	SP020739	SP016706	-	-	-	-	8	8	8	8	8	8	8	8
SP0478	Worcester & Birmingham Canal	SP051810	SP047779	-	-	-	-	-	7	7	7	7	7	7	7
SP0484	Worcester & Birmingham Canal	SP044826	SP059867	-	-	-	-	10	-	-	10	10	10	10	10
SP0806	River Coln	SP085094	SP124066	-	-	-	-	-	8	8	8	7	7	7	7

Nominal 1-km reference	Waterway name	Start and end grid references		Number of 500-metre sections surveyed											
				98	99	00	01	02	03	04	05	06	07	08	09
SP1488	River Cole	SP127879	SP165876	-	-	-	-	-	-	-	10	10	10	10	10
SP1658	Stratford-upon-Avon Canal	SP183565	SP167604	-	-	-	-	10	-	-	-	-	-	-	-
SP2000	River Leach	SP225009	SP209031	-	-	-	-	-	5	5	5	5	5	5	5
SP3664	Grand Union Canal	SP339649	SP381639	-	-	-	-	-	-	8	8	8	8	-	-
SP3894	Ashby-de-la-Zouch Canal	SP399979	SP402939	-	-	-	-	-	-	-	10	10	10	10	10
SP4406	River Thames or Isis	SP444087	SP439058	-	-	-	-	10	10	10	10	10	10	10	10
SP5246	River Cherwell	SP505484	SP489475	-	-	-	-	3	3	3	3	-	3	3	-
SP6002	River Thame	SP610030	SP603017	4	4	4	-	4	4	4	4	4	4	4	4
SP6260	Grand Union Canal	SP629602	SP627619	4	4	4	-	-	4	-	-	-	-	4	4
SP6280	Grand Union Canal/Welford Branch	SP644809	SP628826	-	-	-	-	-	-	-	5	5	5	5	5
SP7636	River Great Ouse	SP760373	SP773380	-	-	-	-	-	4	4	4	4	4	4	4
SP9026	River Ouzel/Grand Union Canal	SP920264	SP915270	-	-	-	-	-	-	-	-	4	4	4	4
SP9068	River Ise			-	-	-	-	-	-	-	-	-	-	-	2
SS3216	River Torridge	SS339172	SS325178	-	-	-	-	5	4	4	4	4	4	4	4
SS5204	River Lew	SS535059	SS539043	-	4	4	-	4	4	4	4	4	4	4	4
SS6810	River Taw	SS680116	SS693102	5	5	5	-	5	5	5	-	-	-	-	-
SS9084	Ogmore River (Afon Ogwr)/Afon Garw	SS902838	SS906858	-	-	-	-	-	4	4	4	4	4	-	4
ST0280	Afon Elai	ST039811	ST034824	6	6	6	-	6	5	5	6	6	6	5	5
ST0820	River Tone (also priority 6)	ST078203	ST084221	5	5	5	-	5	5	5	5	5	5	5	5
ST1600	River Otter	ST162013	ST170018	3	3	3	-	3	3	3	3	3	-	-	-
ST1678	River Taff (Afon Taf)	ST171780	ST162783	-	-	-	-	2	2	2	2	2	2	-	-
ST2092	Afon Ebwy	ST229130	ST239130	-	-	-	-	-	2	2	2	2	2	2	2
ST3490	Afon Lwyd	ST304941	ST300959	-	-	-	-	-	3	-	5	5	5	5	5
ST4252	River Axe	ST408537	ST435517	-	-	-	-	-	-	-	7	7	7	7	7
ST4646	River Axe	ST475474	ST451490	-	-	7	-	7	7	7	7	7	7	7	7
ST5036	River Brue	ST494376	ST530360	-	-	-	-	-	-	4	-	-	-	-	-
ST5660	River Chew	ST572617	ST585630	5	5	5	-	-	5	5	5	5	5	5	5
ST6680	River Frome	ST645789	ST663814	-	-	-	-	-	7	10	10	10	10	10	10

Nominal 1-km reference	Waterway name	Start and end grid references		Number of 500-metre sections surveyed											
				98	99	00	01	02	03	04	05	06	07	08	09
ST7094	Little Avon River	ST728925	ST697947	-	-	-	-	9	9	9	9	9	9	9	9
ST7846	River Frome	ST784462	ST787476	5	5	-	-	5	5	5	5	5	5	5	5
ST9286	River Avon	ST923874	ST911869	-	-	-	-	-	-	-	-	3	3	2	3
ST9480	River Avon	ST958781	ST953799	2	2	-	-	-	-	-	-	6	5	5	5
ST9682	River Avon	ST960830	ST978820	6	6	-	-	-	-	-	-	5	4	6	6
ST9804	River Allen	ST996040	ST990060	4	4	4	-	4	2	3	3	3	3	3	3
ST9838	River Wylde	ST974394	ST944406	-	-	5	-	5	5	5	-	-	-	5	7
SU1234	River Avon	SU127354	SU129330	6	6	6	-	6	6	6	6	6	-	-	-
SU1240	River Avon	SU124372	SU157405	-	-	-	-	-	-	10	7	-	-	-	-
SU2094	River Cole	SU234235	SU209974	-	-	-	-	-	1	10	10	10	10	10	10
SU2470	River Kennet	SU270700	SU260708	-	3	-	-	-	-	-	-	-	-	-	6
SU2870	River Kennet	SU279712	SU297708	5	5	5	-	-	-	-	5	5	5	5	5
SU3636	River Test	SU382390	SU357364	-	-	-	-	-	-	9	9	9	9	9	9
SU5296	River Thames/Isis	SU505972	SU538989	10	10	10	10	10	10	10	10	10	10	10	10
SU5664	River Enborne	SU568649	SU557633	4	4	4	-	4	4	4	4	4	4	4	4
SU7266	River Loddon	SU743677	SU734663	4	-	4	-	4	4	4	4	4	4	4	4
SU8892	River Wye	SU892916	SU898911	-	-	-	-	-	4	-	-	-	-	-	-
SU9618	River Rother	SU961197	SU980190	-	6	6	-	6	6	6	6	6	6	6	6
SU9868	Virginia Water (outflow)	SU977686	SU987678	3	-	-	-	-	-	-	-	-	-	-	-
SX0872	River Camel	SX082742	SX065715	-	10	10	-	10	-	-	-	-	10	10	10
SX4682	River Lyd	SX454833	SX478833	5	5	5	-	-	-	-	-	-	-	-	5
SX6270	River Swincombe	SX632718	SX647732	-	-	-	-	5	5	5	5	5	5	5	5
SX8470	River Lemon	SX833711	SX850709	-	-	-	-	4	4	3	3	4	4	3	3
SX9290	Exeter Canal	SX925914	SX940895	-	-	-	-	6	6	6	6	6	6	6	6
SY1096	River Otter	SY088921	SY094948	7	6	6	-	5	5	5	6	6	6	6	6
SY2692	River Axe	SY262955	SY260923	5	5	5	-	5	5	5	5	5	5	5	5
SY6094	River Frome	SY617953	SY605959	-	-	3	-	-	-	3	9	9	9	9	9
SZ2894	Avon Water	SZ298953	SZ292959	-	-	-	-	-	2	2	2	2	2	2	2

Nominal 1-km reference	Waterway name	Start and end grid references		Number of 500-metre sections surveyed											
				98	99	00	01	02	03	04	05	06	07	08	09
TA0448	Watton Beck	TA037491	TA063473	-	-	-	-	-	7	-	-	-	-	-	
TF0070	River Witham/South Delph	TF014709	TF058715	-	-	-	-	-	9	9	9	9	10	10	
TF0210	River Gwash	TF040107	TF028106	-	-	2	-	-	-	-	-	-	-	-	
TF1618	River Glen	TF153185	TF168200	-	-	-	-	5	5	5	5	5	5	5	
TF2210	River Welland	TF230105	TF237136	-	-	-	-	6	6	6	6	6	6	-	
TF2644	North Forty Foot Drain	TF295447	TF280448	-	-	-	-	5	-	5	4	5	-	-	
TF2844	North Forty Foot Bank	TF280448	TF262460	-	-	-	-	4	-	4	4	5	-	-	
TF4084	The Beck	TF383842	TF402853	-	-	-	-	-	-	5	5	5	-	-	
TF6002	Relief Channel	TF602032	TF604044	1	1	-	-	-	-	1	1	2	2	2	
TF6412	River Nar	TF640133	TF663136	5	5	-	-	-	-	5	5	5	5	5	
TG1810	River Tud/River Wensum	TG155115	TG198103	-	-	-	-	-	-	5	5	5	5	5	
TG3016	River Bure	TG304182	TG309164	-	-	-	-	-	-	-	5	6	6	6	
TL1840	River Ivel	TL182402	TL183430	5	-	-	-	5	5	5	5	5	5	5	
TL1890	Yaxley Lode (Drain)	TL226917	TL196914	-	-	-	-	-	4	-	-	-	-	8	
TL2234	River Ivel	TL222368	TL223377	2	2	2	-	-	-	-	-	-	2	2	
TL2296	King's Dike (Drain)	TL250965	TL227963	6	6	6	6	-	-	5	5	5	-	-	
TL3288	Forty Foot or Vermuden's Drain	TL345879	TL315880	6	6	6	-	-	6	6	6	-	-	-	
TL3296	Twenty Foot River (Drain)	TL324967	TL352988	8	7	7	7	7	-	7	7	7	7	7	
TL4296	River Nene	TL421969	TL443985	-	-	-	-	6	6	6	6	6	6	6	
TL4692	Sixteen Foot Drain	TL454924	TL468947	-	-	-	-	5	5	5	5	5	5	5	
TL5480	River Great Ouse	TL544794	TL563807	-	-	-	-	-	5	5	5	5	5	5	
TL6474	River Lark	TL666752	TL642764	-	-	-	-	6	6	6	6	6	6	6	
TL6480	Mildenhall Drain	TL655813	TL650827	3	3	3	3	3	3	3	3	3	-	-	
TL7096	Cut-off Channel	TL715957	TL719966	-	-	-	-	10	10	10	-	2	-	2	
TL7672	River Lark	TL731739	TL762728	7	7	7	7	7	7	7	7	7	7	7	
TM1822	Landermere	TM190239	TM198237	2	2	-	-	-	-	-	2	-	2	-	
TM2434	Shotley Marshes	TM244361	TM251344	4	4	4	4	4	4	4	4	4	4	4	
TQ0056	River Wey	TQ020569	TQ033571	5	5	5	-	-	-	-	-	-	-	-	

Nominal 1-km reference	Waterway name	Start and end grid references		Number of 500-metre sections surveyed											
				98	99	00	01	02	03	04	05	06	07	08	09
TQ1480	River Brent	TQ146820	TQ147810	2	2	2	–	2	2	2	2	2	2	2	2
TQ1684	Grand Union Canal	TQ182836	TQ144843	10	10	10	10	10	10	10	10	10	10	10	10
TQ2288	River Brent	TQ241902	TQ240885	5	–	–	–	–	–	–	–	–	3	3	3
TQ3698	R Lee Navigation/Horsemill Stream	TQ372982	TL372042	–	–	–	–	7	7	7	7	–	–	–	–
TQ3884	River Lea or Lee	TQ383824	TQ383833	–	–	–	–	–	–	–	–	–	–	2	2
TQ5062	River Darent	TQ521617	TQ527627	3	3	3	–	3	3	3	3	3	–	–	–
TQ5244	River Medway (+5, TQ5242)	TQ529437	TQ542437	4	4	4	–	4	–	–	–	–	4	–	–
TQ5298	River Roding	TQ547996	TQ517981	8	8	8	8	8	8	8	8	8	8	–	–
TQ7252	River Medway	TQ740539	TQ704529	9	9	9	–	9	9	9	9	9	9	9	9
TQ7278	Cliffe Fleet	TQ744782	TQ746792	4	4	4	–	4	4	4	4	4	4	4	4
TQ9222	River Rother (non-tidal part)	TQ933227	TQ936244	3	3	3	–	–	–	–	–	–	3	3	3
TR0244	Great Stour	TR038449	TR032430	4	4	–	–	–	–	–	–	–	–	–	–
TR0826	New Sewer	TR091273	TR054265	7	7	7	7	7	7	7	7	7	8	8	8
TR1658	Great Stour	TR155590	TR163598	3	3	3	–	3	3	3	3	–	–	–	–
2. WBS-linked sites (non-random)				98	99	00	01	02	03	04	05	06	07	08	09
NH8350	River Nairn	NH806484	NH832504	–	8	8	–	8	8	8	–	9	9	9	9
NJ5117	River Don	NJ528173	NJ496181	–	9	9	9	9	–	–	–	–	–	–	–
NS5370	Forth & Clyde Canal	NS531704	NS563690	–	–	8	8	8	8	8	8	8	–	–	–
NS8696	River Devon	NS895961	NS863961	–	10	–	–	–	–	–	–	–	–	–	–
NT0765	Linhouse Water	NT075659	NT067636	–	7	7	7	7	7	7	–	–	–	–	5
NT2034	Manor Water	NT203324	NT218365	–	–	–	–	–	10	10	–	–	–	10	10
NT2238	Manor Water	NT218365	NT230395	–	–	–	–	–	10	10	–	–	–	10	10
NT4732	River Tweed	NT458325	NT488322	–	–	–	–	–	–	–	–	6	6	–	–
NT5434	River Tweed	NT578346	NT528348	–	–	10	–	–	–	–	–	–	–	–	–
NT6365	Whiteadder Water	NT623674	NT643646	–	–	–	–	–	–	–	–	–	–	8	10
NT9139	River Till	NT919386	NT912408	–	–	–	–	–	–	10	10	10	10	10	10
NX3574	River Cree	NX349764	NX367726	–	–	–	–	–	–	–	–	9	–	–	–
NY3748	River Caldew	NY371487	NY382516	–	7	7	–	7	7	7	7	7	7	7	7

Nominal 1-km reference	Waterway name	Start and end grid references		Number of 500-metre sections surveyed											
				98	99	00	01	02	03	04	05	06	07	08	09
NY4014	Goldrill Beck	NY401128	NY395167	-	-	-	-	10	10	10	-	-	-	-	10
NY8529	River Tees	NY813290	NY889284	-	10	10	-	10	10	10	10	10	10	10	10
NZ2612	River Tees	NZ273123	NZ259137	-	-	-	-	10	10	10	10	10	-	-	-
SD3710	Leeds & Liverpool Canal	SD3751	SD402119	-	-	-	8	-	-	-	-	-	-	-	-
SD4610	Leeds & Liverpool Canal	SD494104	SD453112	10	10	10	-	-	-	-	-	-	-	-	-
SD4617	Leeds & Liverpool Canal	SD461149	SD458193	10	10	10	-	10	10	10	10	10	10	10	10
SD5009	Leeds & Liverpool Canal	SD524093	SD494104	-	7	7	-	7	7	7	7	7	7	-	7
SD5064	River Lune	SD522648	SD482631	-	10	10	-	10	10	10	10	10	10	10	10
SD5284	Lancaster Canal	SD537831	SD520854	7	7	7	-	7	7	7	7	7	7	7	7
SD5308	Leeds & Liverpool Canal	SD540073	SD525092	-	5	5	5	5	5	5	5	5	5	5	5
SD5365	River Lune	SD545653	SD523649	-	-	-	-	-	8	-	-	-	-	-	8
SD5465	River Lune	SD544652	SD559674	-	5	5	-	5	5	5	5	5	5	5	5
SD5768	Rivers Wenning & Lune	SD585684	SD558673	-	6	-	-	-	6	6	6	-	-	6	6
SD5870	River Lune	SD592722	SD571683	-	-	5	-	5	-	5	10	-	10	10	10
SD5960	River Lune	SD611574	SD592722	-	-	-	-	8	8	8	8	8	8	8	8
SD6100	Leigh Branch Canal	SD602018	SJ630996	8	8	8	8	8	8	8	8	8	8	8	8
SD6177	River Lune	SD611790	SD609750	-	8	-	-	-	-	-	-	-	-	6	6
SD8025	River Limy	SD810237	SD807266	-	-	6	-	-	-	-	-	-	-	-	-
SD9060	River Aire	SD907581	SD901623	-	-	-	-	10	10	10	10	10	10	10	10
SD9499	Gunnarside Beck	SD951982	NY939013	-	-	-	-	-	-	-	-	8	-	-	7
SD9946	River Aire	SD995468	SD986494	-	-	-	-	8	8	-	-	-	-	-	-
SE0559	River Wharfe	SE052574	SE033612	-	-	-	-	-	-	-	-	10	10	10	10
SE1222	River Calder/Calder & Hebble Canal	SE135228	SE128224	-	2	2	-	-	-	-	-	-	-	-	-
SE2237	River Aire	SE215378	SE230363	-	-	-	-	-	-	-	-	-	-	5	5
SE2796	River Swale	SE291965	SE257974	-	10	10	-	10	-	-	-	-	-	-	-
SE4445	River Wharfe	SE440453	SE472447	-	10	10	-	10	10	10	10	10	10	10	10
SE7363	River Derwent	SE733632	SE734657	-	-	-	-	-	-	-	8	8	8	8	8
SH7220	River Mawddach	SH718193	SH735223	-	7	7	-	7	7	7	7	7	7	7	7

Nominal 1-km reference	Waterway name	Start and end grid references		Number of 500-metre sections surveyed											
				98	99	00	01	02	03	04	05	06	07	08	09
SJ0868	River Clwyd	SJ092659	SJ082687	-	9	10	-	10	-	-	-	-	-	-	-
SJ3326	Montgomery Branch Canal	SJ352227	SJ312250	-	-	-	-	-	-	10	10	10	10	10	10
SJ3516	River Severn	SJ344160	SJ371154	-	-	-	-	-	-	-	-	-	-	10	10
SJ4070	Shropshire Union Canal	SJ394706	SJ418719	-	6	6	-	-	-	-	-	-	-	-	-
SJ4234	Llangollen Branch Canal	SJ401343	SJ441342	-	-	-	-	-	-	-	10	-	-	-	-
SJ5360	Shropshire Union Canal	SJ544603	SJ513603	-	-	-	3	3	3	3	3	3	3	6	6
SJ6452	Shropshire Union Canal	SJ629549	SJ638504	10	10	10	10	10	10	10	10	10	10	10	10
SJ6836	Shropshire Union Canal	SJ683348	SJ672389	-	-	9	-	9	9	9	9	9	9	9	9
SJ6967	Trent & Mersey Canal	SJ695671	SJ683689	5	5	5	5	5	5	5	5	5	5	5	5
SJ9279	Macclesfield Canal	SJ933779	SJ929799	8	8	-	-	-	-	-	-	-	-	-	5
SJ9381	Macclesfield Canal	SJ937816	SJ929799	-	-	-	-	-	-	-	-	-	-	-	5
SJ9586	Macclesfield Canal	SJ955863	SJ958881	-	5	5	-	-	-	-	-	-	-	-	5
SJ9785	Peak Forest Canal	SJ964882	SJ971859	-	5	5	-	-	-	-	-	-	-	-	5
SJ9786	River Goyt	SJ975867	SJ967883	-	5	5	-	-	-	-	-	-	-	-	5
SJ9822	Staffordshire & Worcs Canal	SJ995229	SJ971214	6	6	6	-	6	6	6	6	6	6	6	-
SK1241	River Dove	SK124424	SK116404	-	-	-	-	-	-	8	-	-	-	-	-
SK1273	River Wye	SK138732	SK103725	-	-	-	-	10	10	10	-	-	-	9	9
SK1883	River Noe	SK168846	SK204826	-	8	6	-	8	8	10	10	10	10	10	10
SK2181	River Derwent	SK234806	SK205834	-	10	10	-	10	10	10	10	10	10	10	10
SK2378	River Derwent	SK234805	SK242750	-	10	-	-	10	10	9	9	9	9	10	10
SK2476	River Derwent	SK244761	SK248727	-	8	8	-	8	8	8	8	8	8	8	8
SK3029	Trent & Mersey Canal	SK295286	SK325299	-	-	-	-	-	-	-	7	7	7	7	7
SK3084	River Porter	SK302849	SK332857	-	-	-	8	8	8	8	8	8	8	8	8
SK3088	River Rivelin	SK322886	SK289871	-	7	7	7	7	7	7	7	7	-	8	8
SK3475	Barlow Brook	SK336757	SK362753	-	-	-	-	-	-	-	-	-	-	7	7
SK4644	Erewash Canal	SK454471	SK469431	10	9	-	-	-	9	9	9	9	9	9	-
SK5715	River Soar	SK582152	SK565162	-	5	-	-	-	-	7	7	8	8	8	8
SK6236	Grantham Canal	SK639367	SK608368	8	8	8	8	-	-	-	-	-	-	7	7

Nominal 1-km reference	Waterway name	Start and end grid references		Number of 500-metre sections surveyed											
				98	99	00	01	02	03	04	05	06	07	08	09
SK6929	Grantham Canal	SK676307	SK709292	10	10	10	10	10	10	10	10	10	10	10	10
SK7351	River Trent	SK737511	SK762520	–	10	10	10	10	10	10	10	10	10	10	10
SO1024	River Usk	SO123234	SO095253	–	9	9	–	9	9	9	9	9	9	9	9
SO3780	River Clun	SO361805	SO382813	–	6	6	–	6	–	–	–	–	–	6	6
SO5112	River Monnow	SO495146	SO512122	–	10	10	–	10	10	10	10	10	10	10	–
SO5638	River Lugg	SO565372	SO556395	–	–	10	–	10	10	–	10	–	–	10	–
SO7407	Gloucester & Sharpness Canal	SO737050	SO757093	10	–	–	–	–	–	10	10	10	–	–	–
SO7776	Dowles Brook	SO779764	SO743762	–	–	–	–	9	9	9	9	9	9	9	9
SO8687	Staffordshire & Worcestershire Canal	SO864855	SO862887	–	9	9	–	9	9	9	9	9	–	–	–
SO8757	Worcester & Birmingham Canal	SO865576	SO889577	5	5	5	–	5	5	5	–	–	–	–	–
SO9768	Worcester & Birmingham Canal	SO952670	SO994692	–	–	–	–	–	–	–	10	–	–	–	–
SP1581	Grand Union Canal	SP181804	SP144818	8	–	8	8	8	8	8	8	8	8	8	8
SP1869	Stratford-upon-Avon Canal	SP182671	SP187711	8	8	–	–	–	–	–	8	–	–	8	8
SP1972	Grand Union Canal	SP192742	SP189706	–	–	–	–	8	8	8	8	8	8	8	8
SP4915	River Cherwell	SP484159	SP497153	–	3	3	–	–	–	–	–	–	–	3	4
SP7288	Grand Union Canal	SP727879	SP725901	10	10	10	10	–	–	–	–	–	–	10	10
SP9013	Grand Union Canal	SP933136	SP889140	–	10	10	10	–	–	–	–	–	–	–	–
SP9221	Grand Union Canal	SP929202	SP915230	8	8	8	8	8	8	8	8	8	8	8	8
SS2105	Bude Canal & River Neet	SS207063	SS218038	–	–	–	6	6	6	6	6	6	6	3	6
SU3329	River Test	SU330285	SU339310	–	–	–	–	–	–	–	9	–	–	6	6
SU4595	River Ock	SU473959	SU432963	–	10	10	–	10	10	–	10	10	–	10	10
SU4930	River Itchen	SU488301	SU493314	–	–	–	–	3	–	–	–	–	–	–	–
SU8602	Chichester Canal	SU858036	SU842013	8	8	8	8	8	8	8	8	8	8	8	8
SU9400	Alding Bourne/Lidsey Rife	SZ946999	SU960028	–	8	8	8	8	8	8	–	–	–	8	8
SU9677	River Thames/Jubilee River	SU983775	SU973789	–	–	–	–	–	–	8	8	8	8	8	8
SW5533	River Hayle	SW549351	SW565319	–	–	–	–	–	8	8	8	8	8	8	–
SX5363	River Plym	SX533637	SX569651	–	9	9	–	9	9	9	9	9	9	9	9
SX5365	River Meavy	SX527650	SX548669	–	10	10	–	10	10	10	10	10	10	10	10

Nominal 1-km reference	Waterway name	Start and end grid references		Number of 500-metre sections surveyed											
				98	99	00	01	02	03	04	05	06	07	08	09
SX9588	Exeter Canal	SX940894	SX963860	10	10	10	–	10	10	10	10	10	–	–	9
SY9999	River Stour	SZ004998	SY982994	–	6	6	6	6	6	6	6	6	–	6	6
TF0671	River Witham & South Delph	TF060715	TF090710	–	–	–	7	7	7	7	7	7	7	–	–
TF1721	River Glen	TF201245	TF173225	–	10	–	–	7	7	–	–	–	–	–	–
TF6535	Heacham Harbour	TF651338	TF662369	–	–	–	–	–	–	–	–	10	10	10	10
TL1210	River Ver	TL123103	TL128084	–	4	4	–	–	–	–	–	–	–	–	–
TL1515	River Lea	TL140160	TL162145	–	7	7	7	7	7	7	7	7	7	7	7
TL1550	River Ivel	TL155519	TL156501	–	5	5	–	5	–	5	5	5	5	5	5
TL3701	River Lea/Lee Navigation	TL371018	TL375026	–	10	–	–	–	–	–	–	–	–	–	–
TL4963	River Cam	TL502644	TL487621	–	6	6	6	–	–	–	–	6	6	6	6
TL5166	River Cam	TL502644	TL528681	–	–	–	–	–	10	10	10	10	–	8	–
TL5268	River Cam	TL532696	TL521672	–	–	–	–	–	–	–	7	–	–	–	–
TL7908	River Chelmer	TL774087	TL813086	–	–	–	–	–	–	–	10	10	10	10	10
TL8187	River Little Ouse	TL817879	TL786869	–	8	8	–	–	–	–	–	–	–	–	–
TM1150	River Gipping	TM125491	TM113527	–	10	10	–	–	–	–	–	–	–	4	4
TQ0370	River Thames	TQ044695	TQ018721	–	10	10	10	10	–	–	–	–	–	–	–
TQ0492	Grand Union Canal	TQ062940	TQ044902	10	10	10	10	10	10	10	10	10	10	10	10
TQ0558	River Wey Navigation	TQ050578	TQ055586	–	2	2	–	–	–	–	–	–	–	–	–
TQ1088	River Pinn	TQ112891	TQ088878	–	–	–	–	6	6	6	–	–	–	–	–
TQ1554	River Mole	TQ169543	TQ154570	–	–	–	–	8	8	8	–	–	8	–	8
TQ2742	River Mole	TQ276423	TQ259405	–	–	–	–	8	8	8	8	–	–	–	–
TQ2865	River Wandle	TQ282651	TQ261687	–	9	9	–	9	–	–	–	–	–	9	9
TQ7454	River Medway	TQ735536	TQ757555	–	–	–	–	–	–	–	7	7	7	–	7
TQ8427	River Rother	TQ837271	TQ856273	–	–	–	–	–	–	6	6	6	6	6	6
3. Other non-random sites				98	99	00	01	02	03	04	05	06	07	08	09
.J1585	Six Mile Water	.J148859	.J166857	–	–	–	–	–	–	–	–	–	–	6	6
.J2662	River Lagan	.J259624	.J282655	–	–	–	–	–	–	–	–	8	–	–	–
.J2865	River Lagan	.J282655	.J306672	–	–	–	–	–	–	–	–	9	–	–	–

Nominal 1-km reference	Waterway name	Start and end grid references		Number of 500-metre sections surveyed												
				98	99	00	01	02	03	04	05	06	07	08	09	
J3066	River Lagan	J306672	J325691	-	-	-	-	-	-	-	-	-	9	-	-	-
J3370	River Lagan	J325691	J338716	-	-	-	-	-	-	-	-	-	8	-	-	-
NX3277	River Cree	NX322783	NX323772	-	-	-	-	-	-	-	-	3	-	-	-	-
NY1465	Pow Water			-	-	-	-	-	-	-	-	3	-	-	-	-
SD5913	Leeds & Liverpool Canal	SD596168	SD599124	10	-	-	-	-	-	-	-	-	-	-	-	-
SD8434	Leeds & Liverpool Canal	SD843365	SD845327	10	-	-	-	-	-	-	-	-	-	-	-	-
SD9012	Rochdale Canal	SD947182	SD917140	10	-	-	-	-	-	-	-	-	-	-	-	-
SD9702	Huddersfield Narrow Canal	SD984041	SD977025	4	-	-	-	-	-	-	-	-	-	-	-	-
SE0225	Rochdale Canal	SE015259	SE039245	7	-	-	-	-	-	-	-	-	-	-	-	-
SE0612	Huddersfield Narrow Canal	SE039119	SE079139	10	-	-	-	-	-	-	-	-	-	-	-	-
SE1138	Leeds & Liverpool Canal	SE107399	SE125384	5	-	-	-	-	-	-	-	-	-	-	-	-
SE2335	Leeds & Liverpool Canal	SE222368	SE238366	5	-	-	-	-	-	-	-	-	-	-	-	-
SE6029	Selby Canal	SE620320	SE585290	10	-	-	-	-	-	-	-	-	-	-	-	-
SE6416	New Junction Canal	SE634151	SE650184	7	-	-	-	-	-	-	-	-	-	-	-	-
SE6518	Knottingley & Goole Canal	SE648187	SE667193	4	-	-	-	-	-	-	-	-	-	-	-	-
SJ3398	Leeds & Liverpool Canal	SJ350994	SJ341969	10	-	-	-	-	-	-	-	-	-	-	-	-
SJ3699	Leeds & Liverpool Canal	SJ387981	SJ350994	10	-	-	-	-	-	-	-	-	-	-	-	-
SJ5659	Shropshire Union Canal	SJ553599	SJ581588	6	-	-	-	-	-	-	-	-	-	-	-	-
SJ6153	Llangollen Branch Canal	SJ621551	SJ617524	6	-	-	-	-	-	-	-	-	-	-	-	-
SJ6386	Bridgewater Canal	SJ669871	SJ625864	10	-	-	-	-	-	-	-	-	-	-	-	-
SJ6575	Trent & Mersey Canal	SJ644753	SJ666759	6	-	-	-	-	-	-	-	-	-	-	-	-
SJ6764	Middlewich Branch Canal	SJ689658	SJ679632	6	-	-	-	-	-	-	-	-	-	-	-	-
SJ7992	Bridgewater Canal	SJ784912	SJ796937	6	-	-	-	-	-	-	-	-	-	-	-	-
SJ7995	Bridgewater Canal	SJ762986	SJ799945	10	-	-	-	-	-	-	-	-	-	-	-	-
SJ8842	Trent & Mersey Canal	SJ881442	SJ885393	10	-	-	-	-	-	-	-	-	-	-	-	-
SJ9273	Macclesfield Canal	SJ930744	SJ925716	6	-	-	-	-	-	-	-	-	-	-	-	-
SJ9396	Peak Forest Canal	SJ935984	SJ944951	8	-	-	-	-	-	-	-	-	-	-	-	-
SJ9398	Ashton Canal (derelict)	SJ925976	SJ948985	6	-	-	-	-	-	-	-	-	-	-	-	-

Nominal 1-km reference	Waterway name	Start and end grid references		Number of 500-metre sections surveyed											
				98	99	00	01	02	03	04	05	06	07	08	09
SK2525	Trent & Mersey Canal	SK273274	SK238241	10	-	-	-	-	-	-	-	-	-	-	-
SK4799	Sheffield & South Yorkshire Canal	SK468997	SE504001	7	-	-	-	-	-	-	-	-	-	-	-
SK6279	Chesterfield Canal	SK649808	SK611788	10	-	-	-	-	-	-	-	-	-	-	-
SN7305	Swansea Canal	SN752065	SN724041	6	-	-	-	-	-	-	-	-	-	-	-
SO8762	Droitwich Canal	SO868611	SO884627	5	-	-	-	-	-	-	-	-	-	-	-
SO9387	Dudley Canal	SO932892	SO953883	10	-	-	-	-	-	-	-	-	-	-	-
SP1996	Birmingham & Fazeley Canal	SP202984	SP186938	10	-	-	-	-	-	-	-	-	-	-	-
SP4083	Oxford Canal	SP382831	SP421822	10	-	-	-	-	-	-	-	-	-	-	-
SP6791	Grand Union Canal	SP695916	SP664927	8	-	-	-	-	-	-	-	-	-	-	-
SP8737	Grand Union Canal	SP869398	SP877372	6	-	-	-	-	-	-	-	-	-	-	-
ST0213	Grand Western Canal	ST023134	SS999131	10	-	-	-	-	-	-	-	-	-	-	-
ST3134	Bridgwater & Taunton Canal	ST301365	ST322325	10	-	-	-	-	-	-	-	-	-	-	-
ST7666	Kennet & Avon Canal	ST782657	ST755642	10	-	-	-	-	-	-	-	-	-	-	-
SU2063	Kennet & Avon Canal	SU224635	SU179618	10	-	-	-	-	-	-	-	-	-	-	-
SU8953	Basingstoke Canal	SU809536	SU853527	9	-	-	-	-	-	-	-	-	-	-	-
TL8094	River Wissey	TL807945	TL774962	-	10	10	-	-	-	-	-	-	-	-	-
TQ9427	Royal Military Canal	TQ958292	TQ938248	10	-	-	-	-	-	-	-	-	-	-	-

APPENDIX 2.

Mammals recorded on all WBBS stretches reporting mammal data during 1998–09. The number of animals counted is the sum of early and late counts across all occupied stretches. Occupancy rates include sites where presence was known but no animals were counted on WBBS visits.

Mammal species	Number of animals counted, and percentage occupancy of stretches surveyed											
	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Red squirrel <i>Sciurus vulgaris</i>	3 3%	3 4%	2 3%	0 2%	6 4%	0 3%	8 4%	0 5%	0 2%	0 3%	3 4%	0 4%
Grey squirrel <i>Sciurus carolinensis</i>	165 40%	104 43%	118 47%	16 46%	143 45%	198 45%	208 44%	247 47%	96 39%	230 49%	206 41%	136 41%
Eurasian beaver <i>Castor fiber</i>											0 <1%	
Hazel dormouse <i>Muscardinus avellanarius</i>					0 1%		0 <1%					
Bank vole <i>Myodes glareolus</i>		0 1%	1 1%		1 2%			0 <1%			0 <1%	0 <1%
Field vole <i>Microtus agrestis</i>			0 1%		0 1%	0 <1%			0 <1%	0 <1%	0 <1%	0 <1%
Water vole <i>Arvicola terrestris</i>	14 12%	17 16%	12 12%	2 20%	16 12%	3 7%	7 6%	20 9%	6 7%	18 9%	4 6%	10 6%
Wood mouse <i>Apodemus sylvaticus</i>		0 1%	0 1%		0 1%	1 1%	0 2%	0 1%	0 <1%	0 1%		0 <1%
Yellow-necked mouse <i>Apodemus flavicollis</i>								0 <1%				
House mouse <i>Mus domesticus</i>		1 1%			1 1%							
Common rat <i>Rattus norvegicus</i>	8 12%	9 18%	6 18%	0 13%	4 10%	7 9%	3 12%	8 12%	7 11%	2 19%	7 16%	3 14%

Mammal species	Number of animals counted, and percentage occupancy of stretches surveyed											
	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Rabbit <i>Oryctolagus cuniculus</i>	1978 65%	2093 72%	2006 72%	528 65%	2349 69%	2355 68%	2314 66%	2269 65%	2102 68%	2375 68%	2404 70%	2106 67%
Brown hare <i>Lepus europaeus</i>	143 28%	96 33%	95 28%	34 37%	247 29%	162 28%	255 32%	129 28%	196 32%	149 28%	142 29%	98 28%
Mountain/Irish hare <i>Lepus timidus</i>	44 6%	17 4%	19 3%	0 4%	9 4%	12 4%	10 2%	0 2%	2 2%	0 2%	0 3%	0 1%
Hedgehog <i>Erinaceus europaeus</i>	2 15%	2 21%	0 21%	0 17%	0 9%	3 14%	4 13%	0 11%	0 10%	0 10%	0 11%	0 10%
Mole <i>Talpa europaea</i>	11 36%	26 57%	24 58%	2 41%	35 58%	4 49%	2 46%	0 49%	0 51%	20 52%	0 52%	0 48%
Common shrew <i>Sorex araneus</i>	24 26%	12 24%	5 22%	0 22%	2 2%	2 2%	0 <1%	0 1%	0 1%	0 <1%		
Pygmy shrew <i>Sorex minutus</i>								0 <1%				
Water shrew <i>Neomys fodiens</i>						0 1%		0 <1%	0 1%	0 1%		
Daubenton's bat <i>Myotis daubentonii</i>			0 1%						0 <1%		0 <1%	0 <1%
Common/Soprano pipistrelle <i>Pipistrellus pipistrellus/pygmaeus</i>	1 1%							0 <1%	0 <1%		0 1%	
Brown long-eared bat <i>Plecotus auritus</i>	0 1%											
Feral cat <i>Felis catus</i>			36 22%	17 30%	49 18%	45 23%	58 18%	53 21%	38 14%	22 18%	78 20%	40 17%
Wildcat <i>Felis silvestris</i>					0 1%			0 <1%	0 <1%	0 <1%	0 <1%	0 <1%
Fox <i>Vulpes vulpes</i>	22 37%	17 44%	12 50%	2 48%	45 43%	17 40%	32 34%	3 35%	0 34%	0 35%	6 28%	2 33%

Mammal species	Number of animals counted, and percentage occupancy of stretches surveyed											
	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Badger <i>Meles meles</i>	1 17%	1 18%	1 20%	0 15%	1 18%	0 18%	0 20%	0 21%	0 19%	0 21%	0 17%	0 21%
Otter <i>Lutra lutra</i>	8 12%	5 13%	2 13%	0 2%	5 16%	0 14%	9 18%	2 14%	0 18%	2 15%	0 14%	0 13%
Pine marten <i>Martes martes</i>	0 1%	0 1%	1 1%	0 2%	0 1%	0 <1%				0 <1%	0 1%	0 1%
Stoat <i>Mustela erminea</i>	3 14%	8 22%	3 16%	0 13%	4 11%	5 14%	2 9%	0 13%	0 11%	0 8%	0 12%	0 10%
Weasel <i>Mustela nivalis</i>	3 11%	1 12%	2 10%	1 9%	6 8%	0 9%	0 8%	0 10%	0 9%	0 6%	0 9%	0 7%
Polecat <i>Mustela putorius</i>								0 <1%			0 1%	
American mink <i>Mustela vison</i>	3 10%	4 21%	0 22%	0 13%	1 10%	0 15%	1 10%	0 7%	0 9%	0 9%	0 10%	0 8%
Common seal <i>Phoca vitulina</i>									0 <1%			
Reeves' muntjac <i>Muntiacus reevesi</i>	1 3%	1 7%	15 8%	0 4%	3 2%	1 4%	6 4%	0 4%	0 5%	0 4%	0 5%	7 6%
Red deer <i>Cervus elaphus</i>	381 8%	385 11%	565 9%	509 15%	1560 11%	891 9%	1337 9%	945 10%	779 7%	421 9%	215 9%	304 6%
Sika <i>Cervus nippon</i>					0 1%		0 <1%		0 <1%		0 1%	
Fallow deer <i>Dama dama</i>	2 3%	11 1%	1 1%	5 2%	1 2%	9 3%	7 2%	0 3%	0 2%	24 2%	0 1%	0 2%
European roe deer <i>Capreolus capreolus</i>	27 18%	40 25%	59 23%	18 22%	98 30%	72 23%	148 25%	90 22%	65 26%	45 28%	53 26%	43 24%
Chinese water deer <i>Hydropotes inermis</i>								0 1%				

Mammal species	Number of animals counted, and percentage occupancy of stretches surveyed											
	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Feral goat <i>Capra hircus</i>	14 1%	3 1%	2 1%		3 1%	22 1%	12 1%	0 1%	28 1%	5 1%	31 1%	3 1%
% of WBBS mammal surveys on which no mammals were recorded	7%	6%	3%	4%	7%	9%	7%	4%	7%	5%	4%	4%
Number of stretches on which mammal surveys were made and as % of total WBBS surveys	155 92%	174 94%	158 90%	46 90%	196 86%	222 85%	244 86%	251 83%	242 82%	218 81%	225 82%	224 79%

APPENDIX 3. Graphs of WBS/WBBS joint index trends 1974–2009.

Figure A3.1 UK: smoothed WBS/WBBS joint trends with 85% bootstrapped confidence intervals. Dots are the unsmoothed values of annual indices. Datum level (100) is the value of the smoothed trend in the first year of the run.

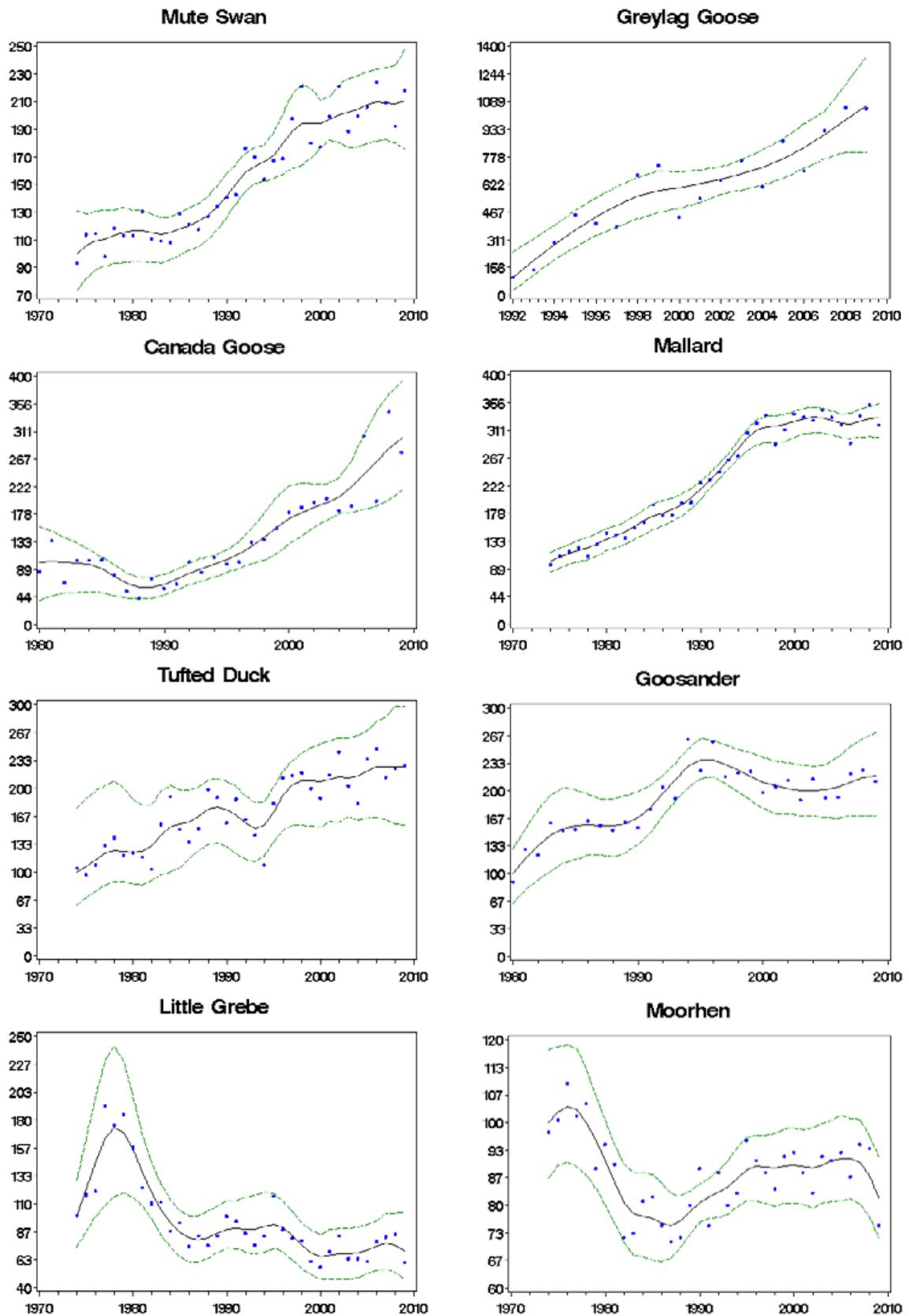


Figure A3.1 UK: smoothed WBS/WBBS joint trends (continued)

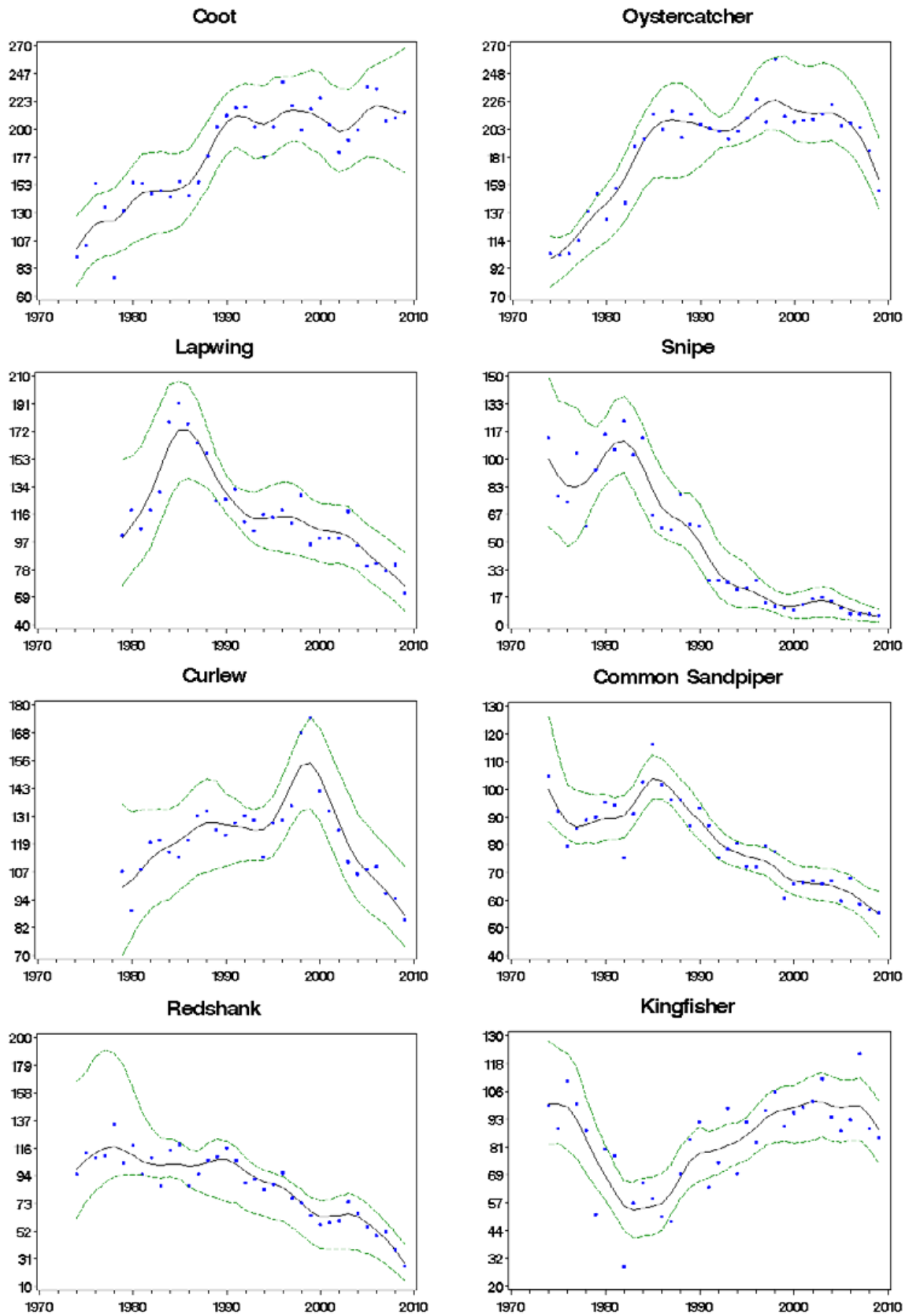


Figure A3.1 UK: smoothed WBS/WBBS joint trends (continued)

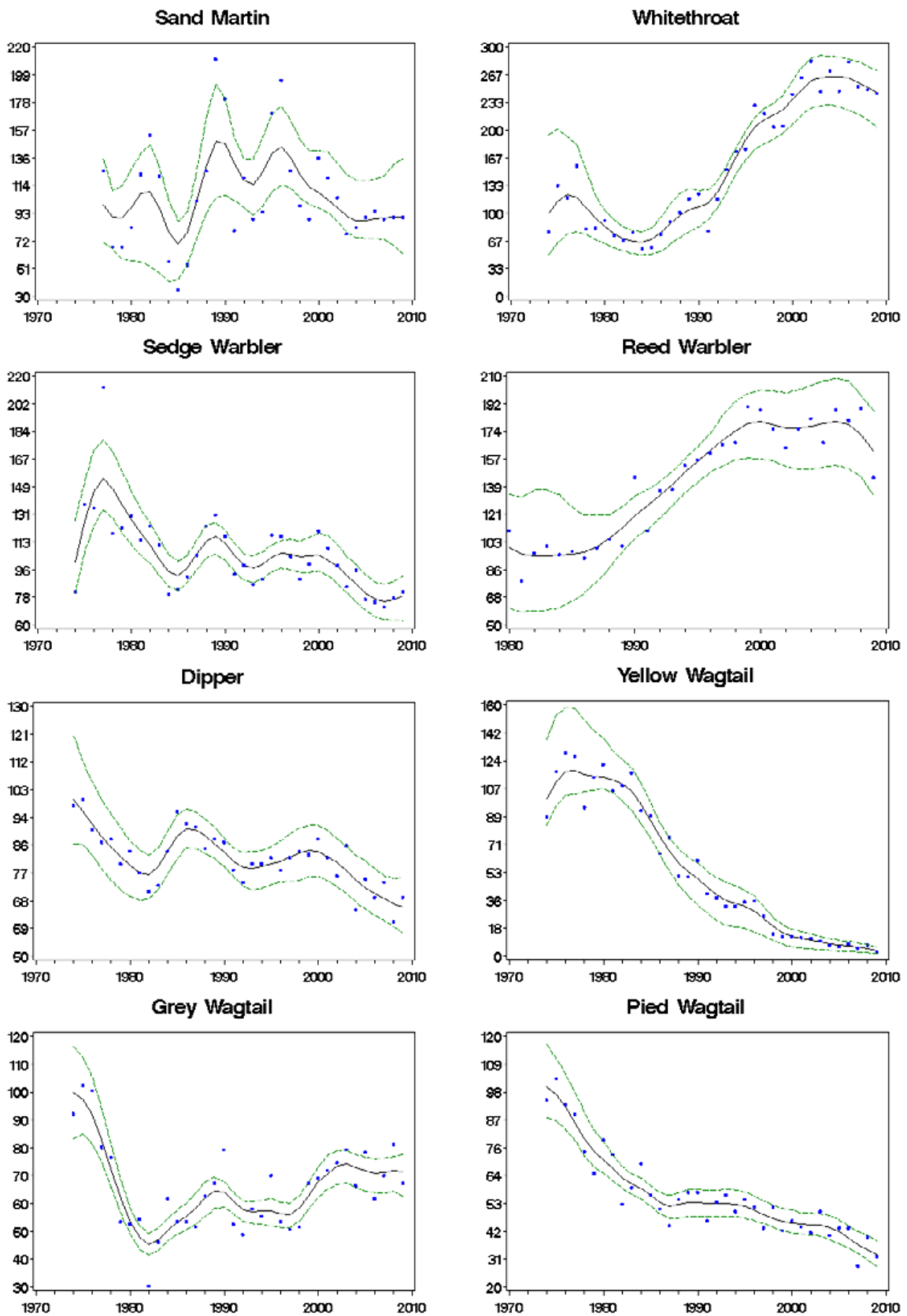


Figure A3.1 UK: smoothed WBS/WBBS joint trends (continued)

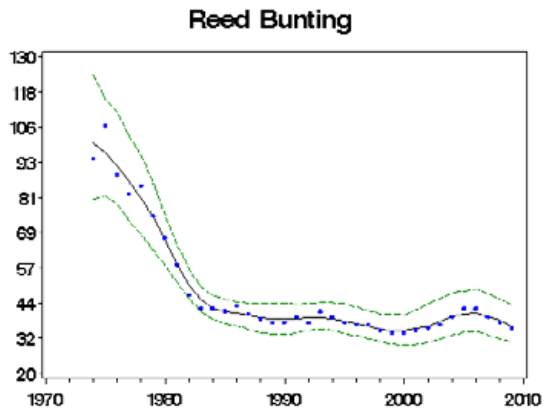


Figure A3.2 England: smoothed WBS/WBBS joint trends with 85% bootstrapped confidence intervals. Dots are the unsmoothed values of annual indices. Datum level (100) is the value of the smoothed trend in the first year of the run.

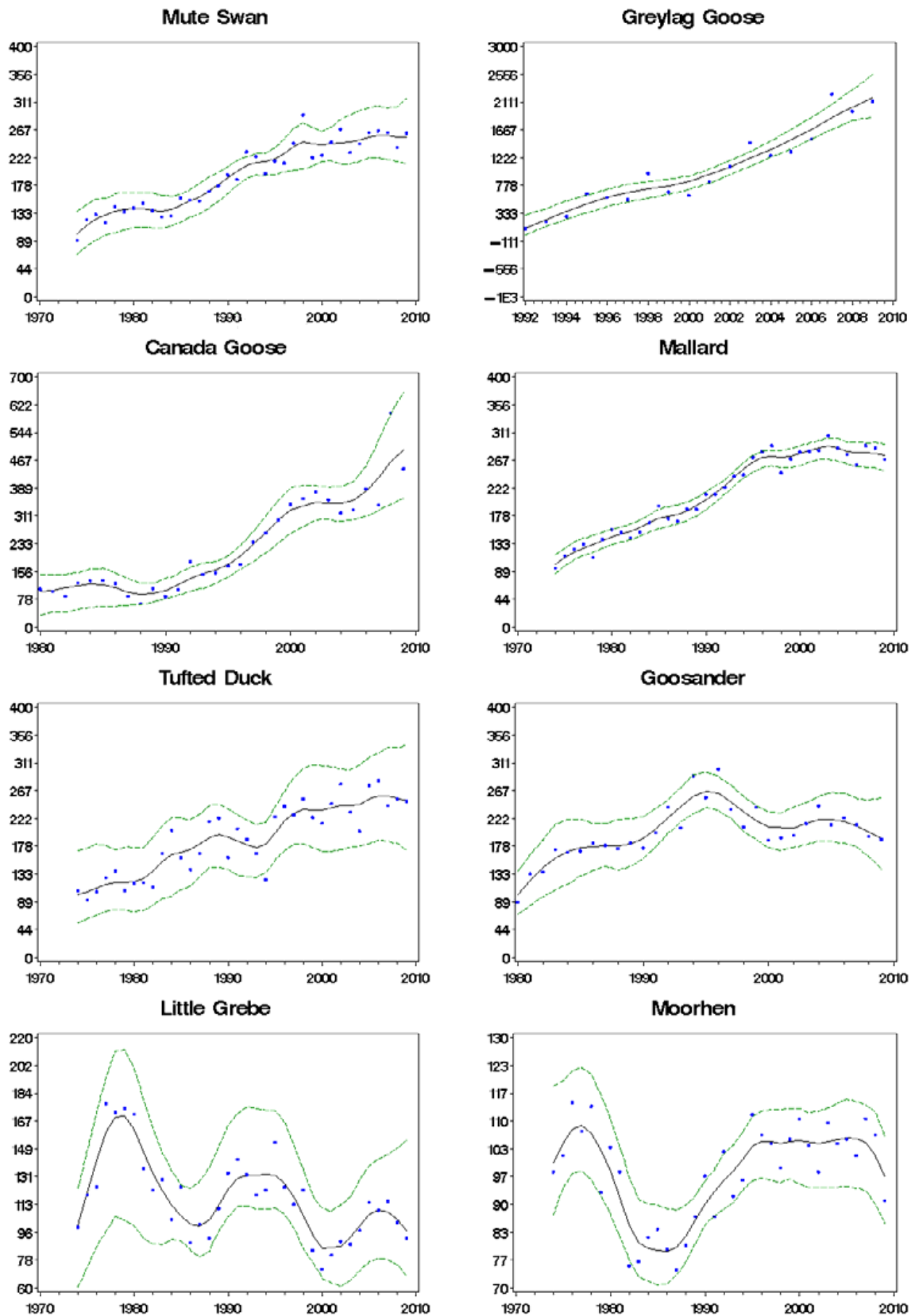


Figure A3.2 England: smoothed WBS/WBBS joint trends (continued)

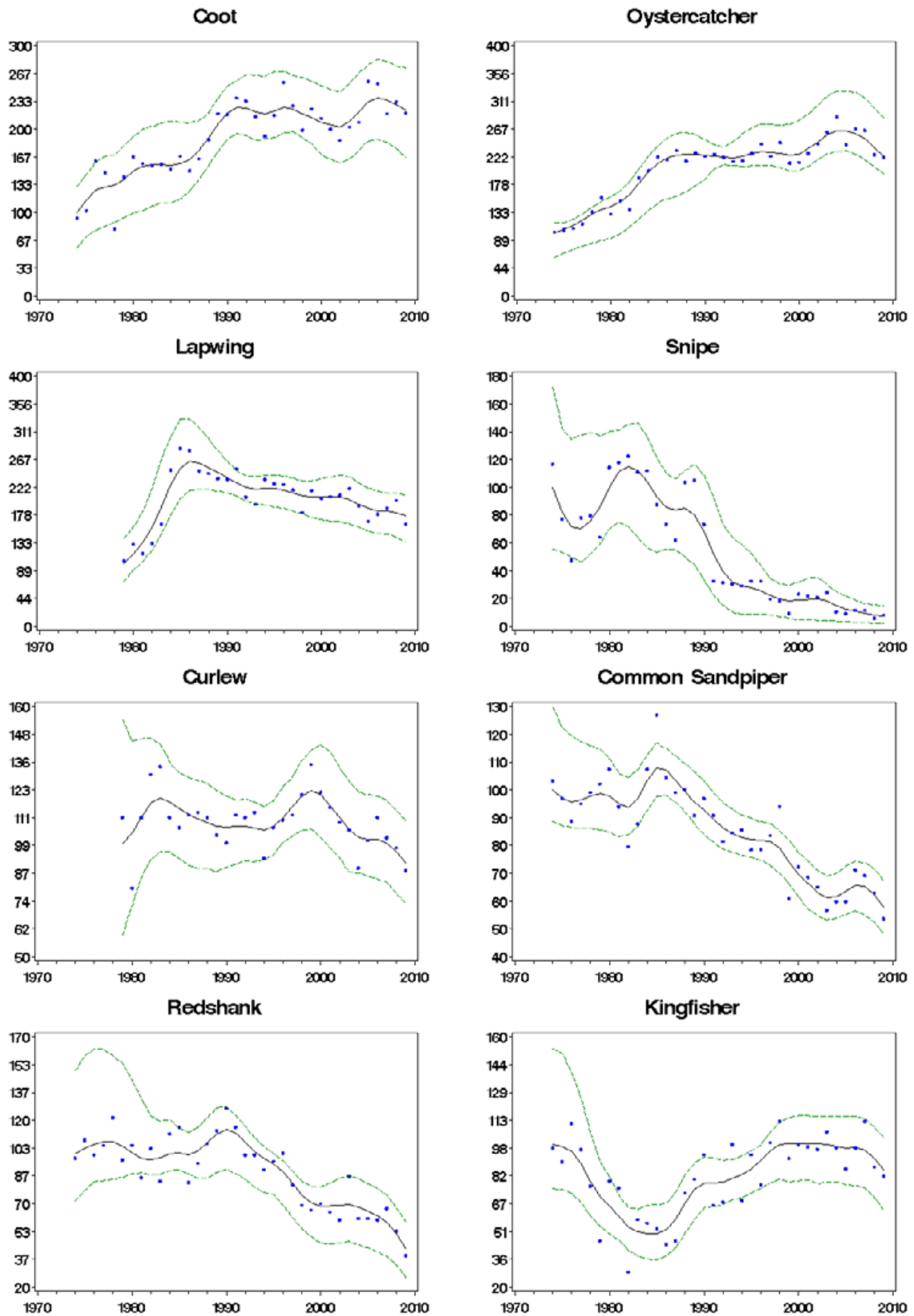


Figure A3.2 England: smoothed WBS/WBBS joint trends (continued)

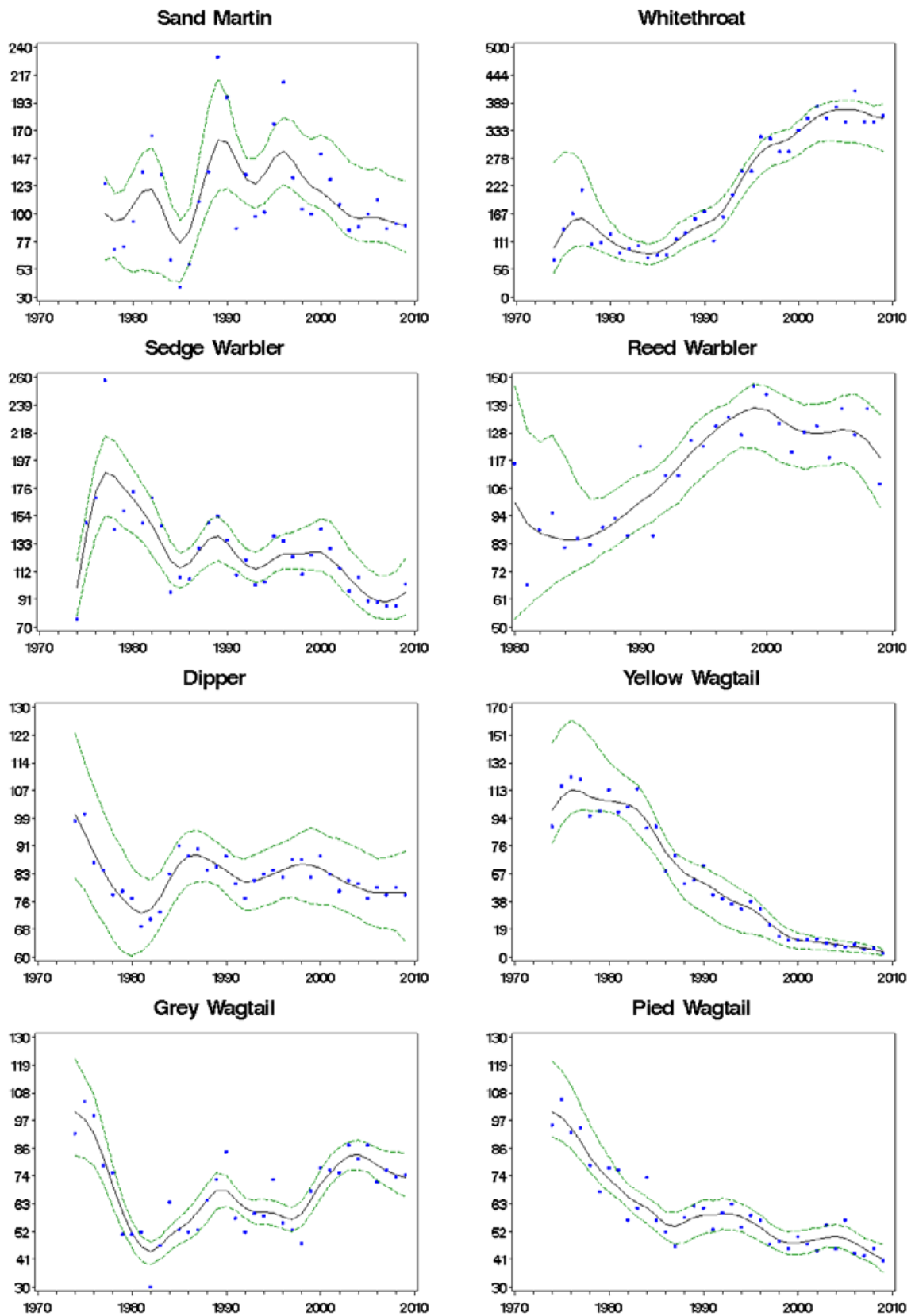


Figure A3.2 England: smoothed WBS/WBBS joint trends (continued)

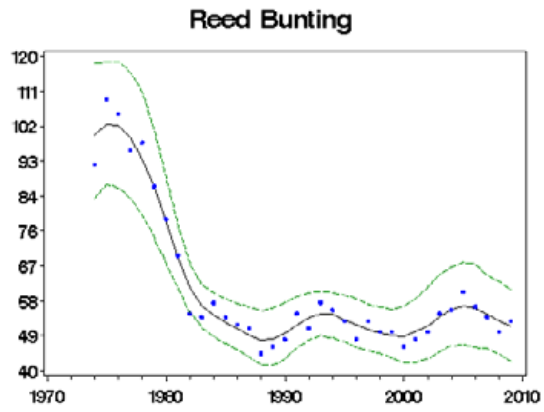


Figure A3.3 Scotland: smoothed WBS/WBBS joint trends with 85% bootstrapped confidence intervals. Dots are the unsmoothed values of annual indices. Datum level (100) is the value of the smoothed trend in the first year of the run.

