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THE PILOT DISPERSED WATERBIRDS SURVEY

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1. EXECUTIVE SUMMARY

- During the winter of 2002/2003, WeBS plans to conduct a Dispersed Waterbird Survey (DWS) targeting those parts of the populations of several waterbird species not monitored by other WeBS surveys, henceforth referred to as dispersed populations.

- During December 2000 and January 2001 a pilot survey (pDWS) was conducted to test the chosen quadrat sampling methodology and, if possible, to assess for which species reliable and useful results might be expected.

- Counts of all waterbird species were made within 1 km x 1 km quadrats (intensive square) that constituted the southeast quarters of 2 km x 2 km quadrats (extensive squares). A subset of species (swans, geese and grassland plovers) were counted in the remaining three 1 km x 1 km grid-squares of the extensive squares. Known WeBS core sites were excluded and counts for terrestrial habitats, rivers and other wetlands were recorded separately. Waterbodies overlapping south and west quadrat boundaries were counted in their entirety, those overlapping north and east quadrat boundaries were excluded.

- The quadrats chosen for the pDWS were a randomly selected subset of those previously used for the Naturalised Goose Survey (NGS). Maps had already been prepared for these quadrats and we were able to allow for quadrats where access to volunteers had been previously denied and for recent changes in habitat not apparent without having made a visit. This was important because we did not wish to lose quadrats from an already small sample.

- The winter of 2000/2001 was exceptionally wet and the associated widespread flooding may have had consequences for the distributions of some of the species and caused problems of access to some areas. This is a potential problem with any single-year survey.

- From the results of the pDWS, we would expect that the DWS would generate reliable dispersed population estimates for Grey Heron, Teal, Mallard and Coot. We would also expect to generate useful baseline indices for Moorhen, Lapwing and Snipe against which relative changes in numbers in the future might be measured, though the DWS would not be able to assess the proportion of the dispersed populations that these indices represent.

- The remaining species were either recorded too infrequently to be able to assess the suitability of the survey in estimating their dispersed populations (Little Grebe, Greylag Goose, Canada Goose, Wigeon, Shoveler, Water Rail, Golden Plover, Jack Snipe and Green Sandpiper) and/or their current GB population estimates were too imprecise to allow a proper assessment of the survey's results (Water Rail, Jack Snipe and Snipe). The low recording rates may be due to stealthy behaviour (Little Grebe Water Rail, Moorhen, Jack Snipe), cryptic colouration (Snipe, Jack Snipe) or indeed reflect the small numbers probably present (Little Grebe, Water Rail, Green Sandpiper).

- Assuming contact rates for the DWS will be similar to those for the pDWS we may also expect to get sufficient data for Little Grebe and Golden Plover to be added to the list of species for which data would generate baseline indices against which to monitor future changes. We would also expect to be able to do likewise for swans and geese but recognise that existing surveys for these groups are likely to provide more suitable data.

- There was no clear advantage to be gained by using data from outside the intensively counted 1 km x 1 km square. We therefore recommend that the DWS only collect data from a sample of 1km x 1 km quadrats. This should make the survey more attractive to volunteers and improve the thoroughness with which quadrats are searched.

- As a result of comments received from volunteers, we recommend some changes to the methodology to enhance volunteer interest. Each waterbody would be counted separately to allow existing WeBS Core sites and all other waterbodies overlapping quadrat boundaries to be counted. (Visits to WeBS Core sites would be archived as additional visits unless they coincided with a standard visit). All waterbirds, including Gulls, would be counted. This would reduce the complexity needed for the counter instructions, increase the probability that volunteers find waterbirds to count and provide useful extra information, especially for the design of future surveys.

- Based on the results of this pilot survey and experience gained during the analysis of data collected during the NGS we conclude that 2000 quadrats should be targeted. A random sample, stratified by urbanisation, water cover and upland/lowland character, is recommended to make efficient use of volunteer effort. Any shortfall to this target will be at the expense of the precision of the resulting estimates, particular if such a shortfall were to be biased against particular habitats.

- It will be necessary to promote the survey to counters well in advance of January 2003 through direct contact and the WeBS newsletter.

2. INTRODUCTION

2.1 Background

The Wetland Bird Survey (WeBS) provides the principle source of data from which population estimates of the UK's non-breeding waterbirds are derived, the international importance of UK wetland sites are assessed, long-term trends are monitored and waterbird distributions are understood. WeBS Core Count data are obtained from most wetland habitats including all but a few UK estuaries, some non-estuarine coastal areas and an un-quantified proportion of inland still waters, river stretches and marshes. WeBS Low Tide Counts have a different role in that they are specifically concerned with estuaries and collect data that describe the distribution of waterbirds feeding on estuarine flats. Periodic WeBS "special" surveys include the Non-Estuarine Waterbird Survey (NEWS) and the forthcoming Riverine Survey and Dispersed Waterbirds Survey (DWS). These special surveys aim to supplement WeBS Core Counts by providing data collected on habitats for which WeBS core has incomplete coverage. NEWS aims to produce periodic estimates of the populations of waterbirds on the entire non-estuarine coast and the Riverine Survey will aim to do the same for riverine habitats. The DWS will aim to provide estimates of waterbirds dispersed across the wider countryside including those on flowing waters of insufficient width to be included in the Riverine Survey and sites included within the WeBS core survey. In addition WeBS makes use non-WeBS surveys such as those for Swans and Goose Roost Counts to obtain the most comprehensive understanding of wintering waterbird numbers as possible.

These periodic surveys are necessary because, although WeBS recognises that the habitats they concentrate on are sampled to some extent by the WeBS Core Counts, the sample has not been randomly selected and resulting biases need to be further investigated. Biases are, however, likely to be large given that the selection of count sites has traditionally been made by counters who have offered to cover specific locations which are likely to have been chosen because they are “good for waterbirds”. Furthermore, the proportional coverage of these habitats within the UK obtained by WeBS Core Counts has not been quantified because WeBS does not have data on the extent of wetland habitats within the UK. The Riverine Survey and DWS will rely on a more pro-active approach to survey design than the WeBS Core Counts in that volunteers will be directed to count units that have been chosen to be representative of their habitat across the UK. This will enable statistical confidence to be attached to the resulting population estimates extrapolated from the sample.

Unlike NEWS, which was able to sample a large proportion (30%) of the UK coast, the DWS must inevitably sample a much smaller proportion of the area it targets (approximately 250,000 1 km x 1 km grid-squares). To ensure that the survey methodology will provide a defensible basis for estimating dispersed waterbird populations, a pilot survey was carried out between December 2000 and January 2001. Here we report on the results of that pilot survey (pDWS). Firstly, we consider how the survey was received and perceived by WeBS counters. Secondly, we consider whether or not the data collected during the pilot survey suggest that a full survey is likely to meet its objective of assessing the numbers of waterbirds on habitats and areas not covered by WeBS Core Counts or other special surveys, particularly for species for which a large proportion of their population are believed to be supported by these habitats and areas.

2.2 Aims

The DWS will aim to estimate the dispersed populations of waterbirds on all areas not counted by other WeBS surveys, principally WeBS Core Counts, NEWS and the WeBS Riverine Survey. The aim of the pDWS was three-fold, firstly to assess the practicalities of the methodology, secondly to gauge counter response and thirdly, and within the limits of the scaled-down survey, make informed judgements regarding the suitability of the survey for each waterbird species were the full DWS to be endorsed by WeBS.

3. METHODS

3.1 Questionnaire to Observers

Observers were asked to complete and return a questionnaire, which would allow us to assess how the DWS would be perceived and received by WeBS volunteers. Additionally, it provided guidance as to how the survey methodology might be modified so as to improve the consistency with which volunteers interpreted the instructions.

3.2 Survey Methods

Observers made a single site visit, of at least two hours, during which they recorded waterbirds seen during an extensive survey of three 1 km grid-squares (Northwest, Northeast and Southwest) of a randomly chosen tetrad (2 km x 2 km), henceforth referred to as the extensive quadrat, and an intensive survey of the remaining (Southeast) 1 km grid-square, henceforth referred to as the intensive quadrat. All species of waterbirds were recorded on the intensive quadrat, while species predefined as relatively difficult to count were not recorded on the extensive quadrat. For the intensive quadrat separate counts were recorded for still waters, riverine habitats and all other habitats combined. An example of the count form and instructions provided to counters is given in Appendix 1. Birds on areas counted by WeBS Core Counts were excluded and a strategy for covering waterbodies overlapping quadrat boundaries was implemented: the whole of waterbodies overlapping west and north quadrat boundaries were excluded and the whole of water bodies overlapping east and south quadrat boundaries included. Areas to be excluded were indicated on the maps supplied to observers who in addition indicated on the recording forms other areas which were not covered and why.

3.3 Sample Stratification

Tetrad selection was based upon a random sub-set of those used during the Naturalised Goose Survey (NGS). An advantage of re-using NGS quadrats was that maps were already prepared for these areas and we were able to allow for changes in habitats reported by the NGS counters and for sites where access had previously been denied and thus not to lose tetrads unnecessarily from our sample. For the purpose of analysis, the NGS had employed a habitat-based stratification, which, in the absence of data to suggest otherwise, would probably be suitable for the DWS. The NGS stratification was based on the degree of urbanisation, the degree of water cover and overall upland/lowland character (Appendix 2). Because we re-used quadrats sampled for the NGS, Northern Ireland was not sampled for the pDWS.

4. ANALYSIS

Although we report on the analysis of those data collected during the pDWS it is important to recognise, when interpreting the results, that the aspects of the DWS that the pilot survey could fully address were to field-trial the methodology and gauge counter response. It was unlikely that the pDWS would have obtained sufficient data to make informed judgements regarding the reliability of estimates that would be derived from the survey for all waterbird species, even if we had obtained full coverage of all the targeted quadrats. Dispersed population estimates made from the pDWS data would not be expected to represent the true value for most species because the sample size was much smaller than that likely to be required to produce accurate and reasonably precise values, and insufficient to support any habitat stratification that might be used to improve the precision and accuracy of those estimates. If this was not the case then a full DWS would be superfluous. Recognising this fact does allow some useful insight into the suitability of the survey, at least for some of the species, especially when supported by information gleaned from other WeBS and non-WeBS surveys.

The DWS will aim to estimate the dispersed populations of waterbirds on all areas not counted by other WeBS surveys, principally WeBS Core Counts, NEWS and the WeBS Riverine Survey. If the sample size of the DWS were sufficiently large to be representative of all habitats a quadrat-based survey would be able to generate country-wide population estimates with statistical confidence limits. However, it is unlikely that such a survey would be extensive enough to achieve this. Thus, inevitably, future population estimates will need to be based on estimates of dispersed populations in combination with data collected from specific sites by WeBS Core Counts and data gathered by other special surveys. The exclusion of birds on WeBS Core Count sites and separate recording of birds counted on land and on still and flowing waters ensures that the DWS data can be used flexibly. National population could be obtainable by:

1) Summing all WeBS Core Counts and adding them to extrapolations from the Riverine Survey and all habitats from DWS excluding those covered by the other surveys. Surveys are treated as independent and so statements of statistical confidence would not be possible.
2) Summing all WeBS Core Counts and adding them to extrapolations from all habitats (including riverine) from DWS. Surveys are treated as independent and so statements of statistical confidence would not be possible.
3) Combining DWS and WeBS Core Counts on a tetrad by tetrad basis for all tetrads in DWS and extrapolating from these combined data. Surveys are combined and so statements of statistical confidence would be possible.

For coastal species, population estimates obtained from NEWS would also be included. Option 1 is most likely to be adopted, although option 2 would be equally valid if DWS was to include a representative sample of quadrats containing riverine habitat. Option 3 would also be valid if DWS quadrats were to include a representative sample of all wetland habitats. While it is unlikely that sufficient coverage would ever be obtained for Option 3 to be feasible, and there would be problems associated with assigning the counts from larger sites that overlap many quadrats, it would reduce problems associated with lack of information regarding the completeness of coverage of habitats by site orientated counts and allow statements of statistical confidence to be attached to population estimates. Our analysis of the pDWS concentrates on Option 2 because Option 1 cannot be considered without Riverine Survey data especially as the random sample chosen contained too few stretches of riverine habitat to usefully separate out riverine data. A sufficiently large sample for Option 3 to be valid is unlikely to be obtained in practice.

Extrapolations of population estimates from the DWS would be obtained, and qualified with confidence limits, by bootstrapping the sample data. However, because of the relatively small sample size obtained for the pDWS, this approach would not be meaningful. Consequently, direct extrapolations were obtained by multiplying the mean count for each species per quadrat in a habitat stratum by the total number of quadrats in the stratum in Great Britain and then summing across

strata. Separate extrapolations were obtained using five alternative data consolidations based on counts from:

1) The three 1 km x 1 km grid squares of the extensive survey quadrat.
2) The intensive survey quadrat excluding habitats that will be covered by the WeBS Riverine Survey (rivers wider than 5 metres).
3) The sum of the two previous consolidations.
4) All habitats within the intensive survey quadrat.
5) The whole of the tetrad.

In all cases areas covered by WeBS Core count sites were excluded.

Summary statistics were obtained for each species and stratum to provide insight into the variation expected from the different consolidation methods.

Extrapolated population estimates for habitats covered by pDWS were added to inland population totals based on WeBS Core Counts for January 2001 (WeBS unpublished). The resulting population estimates were compared to new population estimates for Great Britain produced by WeBS (Kershaw & Cranswick in prep; Rehfisch *et al*. in prep). This approach assumes that there is no bias in the sample with respect to coincidence with WeBS Core Count sites.

In the results and discussion which follow, the term “wetland habitat” refers to still waters such as larger pools and reservoirs of the type typically targeted by WeBS Core, and riverine habitats that will be targeted by the WeBS Riverine Survey. Those Terrestrial habitats and wet habitats not covered by WeBS Core Counts are referred to as "dispersed habitats". The term "dispersed population" is used to refer to waterbirds found on these dispersed habitats.

5. RESULTS

5.1 Observer Response and Questionnaire

A total of 238 quadrats, allocated to 72 WeBS Local Organisers, were selected for the survey. Local Organisers were initially contacted and asked to respond if they were unable to help with the survey. Recording sheets were sent out to all Local Organisers who did not respond. Overall 64% of local organisers contacted were able to obtain coverage for one or more of their allocated tetrads, which resulted in 127 (54%) being visited. A full breakdown of the coverage obtained and the reasons for shortfall is given in Table 1.

Completed questionnaires were returned by 99 counters. The responses to specific questions are given in Table 2a and a synthesis of general comments given in Table 2b.

5.2 Comparisons of Waterbird Numbers Between Strata

Mean counts and the number of records of each species for each of the habitat strata are given in Appendices 3 (species recorded intensive survey quadrat only) and 4 (species recorded throughout tetrad).

5.3 Average Counts and Habitat

Of the species only counted within the intensive quadrats, average counts for Mallard, Moorhen and Coot were considerably higher when wetland habitats were included, with a four-fold increase to the estimate for Moorhen. Average counts for Teal and Snipe were roughly similar whether or not wetland habitats were included. There were too few records for Little Grebe, Wigeon, Shoveler, Water Rail, Jack Snipe and Green Sandpiper for meaningful comparisons to be made.

Of the species that were counted throughout the tetrad, average counts made from data collected within the intensive quadrats only were, with the exception of Canada Goose, similar to those from the extensive survey, regardless of whether wetland habitats were included or not. There were insufficient records of Golden Plovers for comparisons to be meaningful. Average counts obtained using data from both the intensive and extensive quadrats and various habitat combinations tended not to be in close agreement. This was probably largely explained by the small sample size of the pDWS and for many species the low number of contacts which meant that a difference of one or two contacts between different habitat combinations could have a marked effect on the values produced. We therefore chose to analyse further only those data obtained from the intensive 1-km quadrats even for species where data from the extensive quadrats were available because the former were assumed to be more accurate as the counters targeted more effort into those parts of the tetrads. Also, those species recorded throughout the tetrad were species such as swans, geese and grassland plovers rather than the key species being specifically targeted by the DWS. While it would have been possible to produce analyses of many different combinations of intensive and extensive quadrats with various habitat (riverine, still water and terrestrial) combinations chosen from the intensive square the pDWS sample size would render comparisons between the alternatives meaningless. The main purpose for including these habitat divisions in the pDWS was to conform with recording expected to be used for the full DWS so as to simulate data collection for that survey.

5.4 Comparison of Overall WeBS Estimates to Published Estimates

The comparisons made between the population estimates obtained by adding DWS extrapolations to WeBS Core Counts and the published GB population estimates (Table 3) give, with the caveats discussed earlier, an indication as to the species for which the DWS could be expected to contribute towards generating reliable wintering waterbird population estimates or add substantially to the proportion of those populations monitored by WeBS. As the pDWS has preceded the WeBS Riverine Survey, the results presented make use of the data from all habitats within the intensive quadrats.

6. DISCUSSION

6.1 Observer Response and Questionnaire

It is important to recognise that the exceptionally wet weather conditions during the winter of 2000/2001 may have affected both the way in which the pDWS was received by counters and the data themselves as widespread flooding may have affected both accessibility and waterbird distribution.

It is perhaps inevitable that observers will find a survey based on a random sample of quadrats less attractive than an observer-led system such as employed by WeBS Core Counts where volunteers choose their own locations and so guarantee themselves reasonable numbers of birds to count. The level of dissatisfaction (53% found the survey uninteresting) intimated by responses to the questionnaire and the 47% drop-out rate from the original selection of survey quadrats suggest that in order to achieve a reasonable sample for the DWS a concerted observer recruitment drive would be required. The pDWS provided insufficient information on which to judge the sampling level required for the DWS, but from experience gained with the NGS coupled with a consideration of the recording rate of key species during the pDWS, it is likely that DWS would need to cover at least 2000 quadrats. Less than this number would probably not generate enough data for meaningful dispersed population estimates to be derived for many species. With about 200 WeBS Local Organisers to call upon we would need to ensure that on average each obtained coverage for about 10 quadrats (although the stratification used would mean that those in upland, northern areas would be assigned fewer while those in lowland, southern areas would be assigned more). Given that we only received help from 64% of the Local Organisers contacted regarding the pDWS WeBS staff may have to recruit volunteers directly to achieve the required coverage.

As a result of comments received from volunteers we would also recommend some changes to the methodology to enhance volunteer interest and understanding. We should aim to reduce the complexity needed for the counter instructions and increase the probability that volunteers find waterbirds to count. Collecting counts for all waterbirds, including gulls, would increase the probability that volunteers had birds to count, as would making it optional to count existing WeBS Core sites and all waterbodies overlapping quadrat boundaries. This would probably be popular because of its added interest. Given that some of the returned questionnaires suggested a reluctance by counters to visit non-wetland habitats, which rather misses the point of the survey, we would need to ensure that this did not encourage counters to ignore those habitats. Separate counts would need to be recorded for each waterbody and the remaining areas divided into riverine and non-riverine habitat. Data collected from existing WeBS Core sites and riverine habitats could be incorporated as appropriate into the Integrated Waterbird Database as additional visits. The inclusion / exclusion of waterbodies that overlap quadrat boundaries would be dealt with at the analysis stage rather than the data collection stage (simplifying counter instructions) and data for excluded waterbodies could be fed into WeBS Core so that none need be discarded.

Comparisons between the various methods of extrapolating the dispersed populations suggest that those based on data that included the 3-km extensive survey offered no clear improvement over those using only data from the 1-km intensive quadrat (see below). This, coupled with the fact that over half the species covered by the extensive part of the survey were those that are monitored adequately by other surveys and the views of the counters suggests that the DWS should be based on 1-km x 1-km intensive quadrats alone. This should encourage observers to participate and allow counters to increase the effort put into searching the 1-km x 1-km quadrat and so reduce the probability of waterbirds being overlooked. All waterbird species should be surveyed to maximise interest for the volunteers. Also it would provide a means of assessing the suitability of winter-period quadrat-based surveys to a wider range of species than those being specifically targeted, particularly gulls, which may prove useful in the design of future surveys.

On a more general point, if the DWS and other future surveys based on random selections of sample sites are to be successful then every opportunity to educate volunteers as to the benefits of such an

approach should be seized upon. In particular we need to educate volunteers concerning the value in sampling habitats, which, although supporting waterbirds at low densities (for example the pDWS "No urban, no water" stratum) can hold a large proportion of the total population because of their extent. To this end it would be useful to include appropriate material in forthcoming issues of the WeBS counters news-letter and future counters conferences.

6.2 Survey Stratification

Because of the small sample size obtained for the pDWS it would be unwise to draw conclusions regarding the suitability of the stratification used for any one species, although a few general observations can be made. Only counts of Grey Heron showed little variation between the habitat strata. However, it should be noted that the incidence of many species (Little Grebe, Teal, Shoveler, Water Rail, Jack Snipe, Snipe, Green Sandpiper), was too low to draw any such comparisons. This was partly due to the small sample size for each strata but for some species would have also been due to the small numbers believed to be present during the winter (Little Grebe, Water Rail, Green Sandpiper) or their stealthy behaviour (Water Rail, Jack Snipe, Snipe). The stratification based on urbanisation and water cover worked well for the NGS and therefore, in the absence of evidence to the contrary we recommend that a similar stratification be used for the DWS. Status as upland or lowland should also be included in a full survey in order that effort directed at remote and unrewarding upland areas can be kept to a minimum. Inevitably any stratification used for a multi-species survey will be a compromise between what is best for each and it may be appropriate to combine strata for some species.

6.3 Dispersed Population Estimates

Before discussing in any detail the estimates produced by this pilot it is worth reiterating two facts.

Firstly the winter of 2000/2000 was exceptionally wet and flooding might have both affected the distribution and behaviour of waterbirds as well as the counters ability to observe them.

Secondly the sample size obtained for the pDWS was small. This meant that techniques to improve the analysis, particularly the use of the habitat stratification, as is envisaged for reporting on the DWS, could not be used here. Furthermore, the small sample size means that, even for species with the highest encounter rates from pDWS, the agreement or otherwise of extrapolated populations with current estimates, that are the basis for the following the discussion, might easily be due to chance.

6.4 Comparison of Overall WeBS Estimates to GB Population Estimates

Overall WeBS estimates were derived by summing WeBS Core Counts with pDWS counts from all habitats. These estimates are the most complete that can be obtained from available data. Ultimately, when it has been collected, data from the WeBS Riverine Survey will replace data from riverine habitats in the DWS. For many of the species recorded during the pDWS (excluding swans and geese), the current GB winter population estimates can only be taken as a rough guide to the actual winter populations because these are the very species for which there is a paucity of information regarding winter numbers and hence the need for the DWS. This is particularly true for Grey Heron and Moorhen, for which winter population estimates are based on extrapolations from breeding populations, and for Snipe and Jack Snipe, which have no firm basis. Consequently, overall estimates, apparent shortfalls and over-estimates must therefore be viewed with caution. There is also a very real possibility that with a pilot of this size, even if these concerns were not at issue, some unexpected and misleading results might arise by chance.

Adding dispersed population estimates from the pDWS to the January 2001 totals from WeBS Core produce overall estimates for Grey Heron, Teal, Mallard and Coot which are reasonably close to the current GB population estimates (132.9%, 87.4%, 135.0% and 109.2% respectively) albeit that these

estimates themselves may be inadequate. We may therefore expect that, this concern aside, the DWS would produce reliable new estimates for these species.

Encounter rates for Mute Swan, Moorhen, Lapwing and Snipe were also reasonably high. When population estimates for Moorhen and Lapwing derived by combining pDWS and WeBS Core data were compared to the current GB population estimates there were considerable shortfalls. Thus, unless the current GB population estimates for these species are several times too large, even with data from the DWS, WeBS would seriously underestimate these populations. However, with DWS there would be a considerable increase in the proportion of the GB population of these species that would be sampled by WeBS. Currently WeBS only monitors a small proportion of the GB population of Moorhen (1.5%) and Lapwing (20.5%) and so the addition of DWS data would enable WeBS to generate useful baseline indices for these species against which relative changes in numbers in the future might be measured. The estimate for Mute Swan was considerably higher than the current GB population estimates to an extent that, unexpectedly, might bring into question the suitability of the survey design for this species. However, given the success of the NGS which surveyed species of similar detectability and distribution we might expect the DWS to produce more reasonable estimates. It is possible that the poor estimate obtained from the pDWS is a function of the small sample size. The extrapolated estimate for Snipe is not unreasonable and within the broad range of the current population estimate, however, the latter is extremely imprecise. The DWS would, however, considerable increase in the proportion of the GB population of this species that would be recorded by WeBS.

For the remaining species either the contact rate during the pDWS was insufficient to be able to assess of the suitability of the survey in estimating their dispersed populations (Little Grebe, Greylag Goose, Canada Goose, Wigeon, Shoveler, Water Rail, Golden Plover, Jack Snipe and Green Sandpiper) and/or their current GB population estimate is too imprecise to make comparisons (Water Rail and Jack Snipe). Assuming contact rates for the DWS will be similar to those for the pDWS we might expect to get sufficient contact rates for Little Grebe, Greylag Goose, Canada Goose, Golden Plover and Snipe upon which to generate baseline indices for monitoring population change. Species-specific surveys might be the only worthwhile approach for some species for which the contact rate for the pDWS was particularly low (Wigeon, Shoveler, Water Rail, Jack Snipe and Green Sandpiper) and may be preferable for others (Snipe).

With respect to swans and geese, any disagreement between results generated here and the current GB population estimates or low encounter rates should not give cause for concern as these species are well monitored by other surveys. Consequently population estimates for Mute Swans and geese would probably best be based on existing methods including Goose roost counts and periodic repeats of the Mute Swan Survey and NGS. The latter two surveys, although quadrat based, target breeding populations. The NGS has demonstrated that a random quadrat-based survey can produce reasonable estimates of the breeding populations of geese, but the sample size was much larger than that from the pDWS. It may be that a quadrat-based survey is less appropriate for geese outside of the breeding season when they are assembled into flocks but the pDWS sample is too small to determine whether this is the case. It would be useful to re-assess this using data from the DWS.

In summary (Table 4) we might expect that the DWS would provide reasonable estimates of the dispersed populations of Grey Heron, Teal, Mallard and Coot. That for Snipe may also be reasonable and probably preferable to the imprecise and speculative current estimate although it would probably be best treated as a baseline index against which to measure future change as would be the case for estimates for Moorhen and Lapwing. Encounter rates during pDWS for the remaining species were too low for further analysis, however, in the case of Little Grebe, Mute Swan, Greylag Goose, Canada Goose and Golden Plover they may be sufficient for the full DWS to produce baseline indices against which to monitor relative change. For most species the DWS would provide useful data for the design of future surveys. For many of the target species it would be expected to considerably increase the proportion of the UK population monitored by WeBS.

7. THE FUTURE OF THE DISPERSED WATERBIRDS SURVEY

Given that pDWS suggested that reliable dispersed population estimates may only be obtained for four species (Grey Heron, Teal, Mallard & Coot) should the full DWS be undertaken by WeBS? If the only motivation for conducting such a survey were to enable WeBS to provide a complete "head count" of all waterbirds in the UK then the DWS is unlikely to fulfil this aim other than for those four species. However, currently, WeBS does not possess baseline indices for any dispersed waterbird populations against which future change might be measured. Other WeBS products, including the population indices reported in the annual report and alerts of significant population change, do not assume WeBS counts provide a full census of each species (although for some species, particularly estuarine waders and some swans and geese, the data used may approximate to a census), but that the population trends in the country as a whole are represented by data from the sites that were sampled. This is also true of many of the long running surveys run by the British Trust for Ornithology such as the Breeding Bird Survey, Common Bird Census and Constant Effort Site ringing. These surveys aim to monitor relative not absolute bird numbers and make no attempt to extrapolate survey results to population estimates recognising the fact that not all individuals are recorded. The DWS has the potential to provide similar indices for some the species not well monitored by existing WeBS surveys. In addition to the four species for which we would expect to obtain reliable dispersed population estimates, the DWS would be likely to provide useful baseline indices for a further five species (Little Grebe, Moorhen, Golden Plover, Lapwing & Snipe) against which future changes would be measured. The extrapolated estimates for two of these (Little Grebe and Golden Plover) were close to those expected from current estimates but, with so few observations, this could easily have been due to chance. Additionally we would expect estimates for the dispersed populations of swans and geese to yield reasonable results given their high visibility compared to the other species considered here. The poor performance of the pDWS with respect to swans and geese is almost certainly due to the sample size being insufficient to allow for the clumped distribution of these species in winter

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Local Organiser response	Number of LOs	Number of tetrads	Notes
Responded to initial contact but unwilling to assist with survey	8	31	No recording sheets supplied
Did not respond to initial contact but returned recording sheets because unwilling or unable to obtain coverage	5	15	
*Did not respond to initial contact and did not return recording sheets	13	46	Recording sheets supplied but no subsequent communication received
Coverage obtained for one or more tetrads	46	covered 127 not covered 19	
Overall	72	238	

Table 1 Breakdown of coverage obtained for pDWS. * Local organisers in this group have failed to respond to any communications.

Table 2 Volunteer responses to questionnaire (based on 99 returns).

a) Responses to specific questions

Were the survey methods easy to follow?,	Very easy	70%
	Reasonably easy	28%
	Not very easy	2%
	Difficult	None
Was the survey interesting?	Interesting	47%
	Not very interesting	47%
	Would not consider doing it again	6%
Was a tetrad a reasonable area to cover?	Easy	72%
	Difficult	24%
	Far too much	4%
How easy was it to cover the intensive one km square?	Easy	32%
	Reasonable	50%
	Difficult	14%
	Very difficult	4%
Was the form easy to complete?	Easy	86%
	Reasonably easy	14%
	Too complicated	None

b) Synthesis of general comments

Area to be covered	Twenty-two people commented on the **difficulty of covering the area**. This was mostly due to the **nature of the terrain**, but also due to **uncooperative landowners** and the **extraordinarily wet conditions** during the 2000/2001 winter. However, others stressed how easy it had been to cover the area Nine people commented that the survey would have been more interesting if they had been "allowed" to **record all waterbirds** in the whole tetrad, rather than just the 1-km square, and suggestions were also made that **the whole area should be intensively covered**.
Instructions	Some comments were made about the survey form and instructions, but all were fairly trivial, regarding start/finish times, dates and definitions. Three people commented that parts of the **instructions were a little confusing** (e.g. regarding rivers and water bodies at the periphery of the tetrad; habitat classifications) and required clarification. Three comments were also made that the **maps were out of date** (this is a problem with Ordnance Survey as the most recently published 1:25,000 publications were those used).
Tetrad selection	The most serious comments revolved around the random tetrad selection. Many **counters disliked the random nature of tetrad locations** because some consisted mostly of built-up areas/industry or barren rocky moorland. Others had large areas excluded as they are already surveyed for WeBS Core Counts and these people stated that these tetrads should not be selected. One surveyor made the comment that the survey was "too random"!
Volunteer interest	The general impression we have received from Local Organisers was that it was difficult to find volunteers for this survey and that over half of the volunteers taking part **did not find the survey very interesting or rewarding**. Thirty volunteers commented that this was **due to lack of birds**. However, six people also said how interesting the survey was, because it allowed them to look at new areas with a purpose.

Species	Current GB population estimate	Total number counted by WeBS core	Percentage of current GB population counted by WeBS core	Dispersed population estimate from pDWS	Percentage of current GB population estimated by pDWS	Percentage of current population that could be counted by WeBS (Core + pDWS)	Number of records from pDWS
Little Grebe	7,770	2,922	37.6	(6,245)			5
Grey Heron	30,000* (*38,700*)	2,241	7.5 (*5.8*)	49,173	163.9 (*127.1*)	171.4 (*132.9*)	21
Mute Swan	37,500	16,355	43.6	66,421	177.1	220.7	13
Greylag Goose	121,020	42,308	35.0	(33,385)			6
Canada Goose	96,100	40,534	42.2	(265,021)			5
Wigeon	406,000	347,191	85.5	(359)			1
Teal	192,000	138,162	72.0	25,684	13.4	87.4	10
Mallard	325,000	128,916	39.7	309,567	95.3	135.0	31
Shoveler	14,800	8,171	55.2	(144)			1
Water Rail	(Unknown)	338		(568)			2
Moorhen	750,000	11,050	1.5	191,380	25.5	27.0	38
Coot	173,000	93,312	53.9	95,743	55.3	109.2	17
Golden Plover	300,000	152,831	50.9	(228,041)			5
Lapwing	2,050,000	419,258	20.5	725,551	35.4	55.9	15
Jack Snipe	(10,000-100,000)	84		(14,164)			1
Snipe	(>> 100,000)	6,536		114,975			11
Green Sandpiper	926	95	10.3	(72)			1

Table 3 GB population estimates, total numbers counted by WeBS Core Counts and population estimates generated by extrapolating from data obtained by pDWS. Population estimates for Water Rail, Jack Snipe and Snipe are too imprecise for comparison to be made with WeBS Core Count totals and pDWS estimates and the number of observations made for Little Grebe, Greylag Goose, Canada Goose, Wigeon, Shoveler, Golden Plover during pDWS were too few (<10) for meaningful extrapolations to be made (these values are given for reasons of completeness but enclosed in parentheses). Other than that for Grey Heron, which is based on Lack (1986), GB population estimates used here are the new estimates produced by WeBS (Kershaw & Cranswick submitted; Rehfisch *et al*. in prep). All estimates are for winter populations. * The population estimate for Grey Heron used here may be low: estimates of the breeding population in England and Wales, using new methodology suggests that there may be 9,000 pairs rather than the 7,000 pairs (John Marchant pers. comm.) which together with 3,000 pairs in Scotland make up the 10,000 pairs given in Stone *et al*(1997). If we assume the same upward correction is valid for Scotland and assume that the same correction for the winter population as that used in Lack (1986) is valid, then the winter population of Grey Heron could be as high as 38,700. Alternative calculations based on this figure are given in parentheses.

Species	Estimate of dispersed population	Index of dispersed population	Baseline data for design of future surveys
Little Grebe	Unlikely	Yes	Yes
Grey Heron	Yes	Yes	Yes
Mute Swan	Unlikely	Probable	Yes
Greylag Goose	Unlikely	Probable	Yes
Canada Goose	Unlikely	Probable	Yes
Wigeon	Unlikely	Probable	Yes
Teal	Yes	Yes	Yes
Mallard	Yes	Yes	Yes
Shoveler	No	Unlikely	Unlikely
Water Rail	No	Unlikely	Unlikely
Moorhen	Unlikely	Yes	Yes
Coot	Yes	Yes	Yes
Golden Plover	Unlikely	Yes	Yes
Lapwing	Unlikely	Yes	Yes
Jack Snipe	No	Unlikely	Unlikely
Snipe	Unlikely	Yes	Yes
Green Sandpiper	No	Unlikely	Unlikely
(Gulls)	(Possible)	(Possible)	Yes

Table 4 Summary of what the DWS would be expected to achieve for each species based primarily on results of the pDWS. Both extrapolated estimates and encounter rates were taken into consideration. If data from less than about 2000 quadrats were to be obtained by the DWS some of the "Yes" comments would need to be reconsidered. Gulls were not counted for pDWS.

Appendix 1 Dispersed Waterbirds Pilot Survey Count Form.

WeBS Dispersed Waterbirds Pilot Survey

Name & Address:	Tetrad:	1 km square:
	START:	START:
	FINISH:	FINISH:
Counter Code: Phone Number:	Date:	

	Species	3 km squares	Intensive 1 km square		
			Terrestrial	Still Waters	Rivers
LG	Little Grebe				
H.	Grey Heron				
MS	Mute Swan				
PG	Pink-footed Goose				
GJ	Greylag Goose				
CG	Canada Goose				
WN	Wigeon				
T.	Teal				
MA	Mallard				
SV	Shoveler				
WA	Water Rail				
MH	Moorhen				
CO	Coot				
GP	Golden Plover				
L.	Lapwing				
RU	Ruff				
JS	Jack Snipe				
SN	Snipe				
GE	Green Sandpiper				
	Other Species – please specify				
	Other Species – please specify				
	Other Species – please specify				
	Other Species – please specify				
	Other Species – please specify				
	Other Species – please specify				
	Other Species – please specify				

MAP OF COUNT AREA WITH TETRAD AND 1-KM SQUARE CLEARLY DEFINED

Coverage: Please indicate how well the non-intensive 3 km squares and intensive 1 km square were covered

3 km	OK	LOW
1 km	OK	LOW

Notes: For Counter's use (*e.g.* running totals, comments – this information will not be computerised)

PLEASE RETURN THIS FORM TO YOUR LOCAL WeBS ORGANISER BY THE END OF FEBRUARY 2001

Appendix 1 Continued.

Dispersed Waterbirds: Pilot
November – February 2000/01

IMPORTANT: this form is for recording counts for the Wetland Bird Survey (WeBS) Dispersed Species Survey. Counts should be made between 9.00 am and 2.30pm. Please read the accompanying instructions for counters carefully before making your counts and completing this form. Thank you.

← **Name and Address:** Please enter your name and address (and your WeBS Counter Code if you know it) in the box provided.

② **Tetrad and 1 km Square:** The number of the tetrad and 1 km square should already be entered on the recording form. If they are missing, please contact either your local WeBS Organiser or the BTO.

③ **Date and Time:** Please enter the date of the count and approximate start and finish times using the 24 hour clock (e.g. 0900/1300).

④ **Waterbird Counts:** All the waterbird species normally counted for WeBS may be recorded. However, we are particularly interested in counts for those species not properly monitored by WeBS, with populations away from the regularly monitored sites. These include species such as Little Grebe, Grey Heron, Water Rail, Moorhen, Coot Golden Plover, Lapwing, Ruff, Jack Snipe, Snipe and Green Sandpiper. Please do not record numbers of gulls and terns. There are several blank lines to record additional species not listed on the form.

In the three non-intensively covered 1 km squares, we are only interested in counts for the more obvious species such as herons, swans, geese and plovers, most of which should be visible from a fair distance away. All counts from these three squares should be entered in the appropriate species column on the recording form (*i.e.* 3 km squares).

The remaining 1 km square comprising the tetrad needs to be covered more thoroughly, preferably mostly on foot where access and topography allow. We are keen to get accurate counts for ***all*** waterbirds within this square. **For the 1 km square only**, please record the waterbirds using one of the following three habitat classifications; "Terrestrial" (to include all streams and ditches, permanent water meadows and temporarily flooded fields), "Still Waters" (to include all ponds, lakes, gravel pits and reservoirs), and "Rivers". All count data from this single square should be entered under the "Intensive 1 km square" section on the recording form.

For both the three non-intensively covered squares and the intensively covered 1 km square please:

- Use brackets to enclose gross UNDERestimates, e.g. [100].
- Write "NC" (No Count) in the appropriate box if a species was present which you were unable to count.
- Birds flying overhead should be excluded unless obviously using the counting area.
- For Bean, Brent or White-fronted Geese, please try and identify the race seen. Circle counts of species if you could not identify the race involved, e.g. ⑥

Any sites already currently counted by WeBS should be excluded. These should be already indicated on the map on the recording form.

Where the boundary of the tetrad or intensively covered 1 km square bisects a permanent waterbody, please use the following rules. If the bisected waterbody lies along either the northern or eastern boundary of the tetrad/1 km square, then please record the waterbird present on the entire waterbody, including those parts outside of the square. Conversely, if the bisected waterbody *etc.* lies along either the southern or western boundaries of the tetrad/intensively covered 1 km square, **none** of the waterbody, including that part falling within the square itself should be counted.

⑤ **Coverage:** Recording of coverage is essential if we are to interpret your counts properly. Please circle the most appropriate description of the level of coverage for both the 3 km squares and the intensively covered 1 km square.

SAFETY: Counters should not put themselves in a position, which could place them, or others, in danger. The WeBS partners do not take any responsibility or liability for any actions and subsequent consequences from the activities of counters.

Please return completed forms promptly to your WeBS Local Organiser by February 2001.
THANK YOU FOR YOUR HELP

British Trust for Ornithology · WWT · RSPB · JOINT NATURE CONSERVATION COMMITTEE

Appendix 2 NGS survey stratification.

The habitat stratification used for the pDWS was based on that used for the NGS. The NGS stratification had been based on the degree of urbanisation, the degree of water cover and overall upland/lowland character. Due to restrictions imposed by the sample size, the land character (upland/lowland) layer was not used for the pDWS, although the intention would be to make use of that layer for the DWS.

The required habitat data were obtained from the Centre for Ecology and Hydrology (CEH) remotely sensed Land Cover Map of Great Britain: one-kilometre summary data (a 25-class system), last updated in April 1997. The pixel resolution corresponds to a 25-metre grid cell. Each record contains the percentage cover for each of 25 land cover classes for a one-kilometre Ordnance Survey grid-square.

Urban cover was based on category 21 *i.e.* "*Industrial, urban and any other developments, lacking permanent vegetation: The urban development category covers all developments which are large enough to completely fill individual pixels, to the exclusion of any significant quantities of permanent vegetation. It includes cities, large town centres, major industrial and commercial sites, major areas of concrete and tarmac, plus permanent bare ground associated with these developments, such as car-parks and tips*."

This information was used to derive three levels of urban cover for the tetrad stratification:

high urban ➜ ≥ 5% urban
low urban ➜ < 5% urban
"no" urban ➜ 0 % urban

Due to sample size considerations it was necessary to combine high and low urban classes for the DWS giving two classes: urban and "no" urban.

Water cover was based on category 2 *i.e.* "*Inland fresh waters and estuarine waters above the first bridging point or barrier: inland water includes all Mapbase fresh waters and any estuarine waters which are excluded from category 1 (Sea / Estuary). The maps record only those areas that are water-covered on both winter and summer images. Thus, reservoirs with summer draw-down, or winter-flooded meadows are classified to the summer class (i.e. bare or grassland in these examples)*."

This information was used to derive three levels of water cover for the tetrad stratification:

high water ➜ ≥ 5% water
low water ➜ < 5% water
"no" water ➜ 0 % water

Cross-tabulating the urban and water habitat layers resulted in a 6-class stratification.

Stratum	Number of tetrads in GB	Number of tetrads in sample
No urban, high water	1429	8
No urban, low water	4618	21
No urban, no water	103402	19
Urban, high water	431	25
Urban, low water	1983	32
Urban, no water	13137	22

Appendix 3 Mean counts and number of encounters of species by habitat based on the intensive quadrats. Habitats used are: No urban, high water; No urban, low water; No urban, no water; Urban, high water; Urban, low water; Urban, no water. Those containing no birds of a given species are not listed.

Species	Stratum	Mean count and the number of encounters	
		non-wetland habitat within the intensive survey quadrat	all habitats within the intensive survey quadrat
Little Grebe	No urban, low water	0	0.95 (1)
	Urban, high water	0	0.83 (2)
	Urban, low water	0.5 (1)	0.75 (2)
Wigeon	Urban, high water	0.83 (1)	0.83 (1)
Teal	No urban, high water	0	2.00 (1)
	Urban, high water	1.50 (3)	3.50 (5)
	Urban, low water	4.50 (1)	10.75 (4)
Mallard	No urban, high water	0.50 (1)	3.00 (2)
	No urban, low water	0.57 (2)	7.24 (4)
	No urban, no water	0	1.26 (1)
	Urban, high water	3.50 (3)	28.00 (8)
	Urban, low water	9.88 (3)	14.25 (8)
	Urban, no water	2.00 (2)	7.68 (8)
Shoveler	Urban, high water	0	0.33 (1)
Water Rail	Urban, high water	0.17 (1)	0.17 (1)
	Urban, low water	0.25 (1)	0.25 (1)
Moorhen	No urban, high water	0	1.00 (2)
	No urban, low water	0.57 (2)	1.14 (3)
	No urban, no water	0	0.42 (1)
	Urban, high water	13.00 (6)	30.00 (10)
	Urban, low water	9.20 (9)	16.32 (13)
	Urban, no water	1.27 (3)	7.30 (9)
Coot	No urban, high water	0	0.50 (1)
	No urban, low water	12.57 (2)	13.71 (3)
	Urban, high water	0.50 (1)	16.50 (8)
	Urban, low water	4.38 (3)	6.38 (4)
	Urban, no water	0	0.91 (1)
Jack Snipe	Urban, low water	7.14 (1)	7.14 (1)
Snipe	No urban, high water	11.50 (1)	11.50 (1)
	No urban, low water	1.90 (2)	1.90 (2)
	No urban, no water	0.63 (2)	0.63 (2)
	Urban, high water	0.33 (1)	0.50 (2)
	Urban, low water	1.38 (3)	1.38 (3)
	Urban, no water	1.64 (1)	1.64 (1)
Green Sandpiper	Urban, high water	0	0.17 (1)

Appendix 4 Mean counts and number of encounters of species by habitat based on the intensive and extensive quadrats using various consolidations. Habitats used are: No urban, high water; No urban, low water; No urban, no water; Urban, high water; Urban, low water; Urban, no water. Those containing no birds of a given species are not listed.

Species	Stratum	Mean count (number of encounters)				
		non-wetland habitat within the 1 km^2 intensive survey quadrat	all habitats within the 1 km^2 intensive survey quadrat	3 km^2 extensive squares + non-wetland habitats in 1 km^2 intensive quadrat	all habitats within 3 km^2 extensive quadrat only	3 km^2 extensive squares + all habitats in 1 km^2 intensive survey quadrat
Grey Heron	No urban, low water	0.76 (3)	0.76 (3)	1.02 (5)	0.25 (3)	1.02 (5)
	No urban, no water	0.21 (1)	0.21 (1)	0.78 (6)	0.57 (5)	0.78 (6)
	Urban, high water	0.83 (4)	1.83 (6)	1.50 (8)	0.67 (7)	2.50 (9)
	Urban, low water	1.64 (7)	2.01 (8)	2.18 (11)	0.54 (9)	2.56 (12)
	Urban, no water	1.09 (3)	1.45 (3)	1.76 (10)	0.67 (8)	2.12 (10)
Mute Swan	No urban, high water	0	0	6.87 (1)	6.87 (1)	6.87 (1)
	No urban, no water	0.42 (1)	0.42 (1)	18.11 (2)	17.68 (2)	18.11 (2)
	Urban, high water	14.33 (3)	16.00 (5)	15.78 (7)	1.44 (7)	17.44 (7)
	Urban, low water	1.91 (5)	2.04 (5)	4.00 (9)	2.08 (7)	4.12 (9)
	Urban, no water	0	0.91 (2)	0.61 (3)	0.61 (3)	1.52 (5)
Pink-footed Goose	No urban, high water	0	0	5.67 (1)	5.67 (1)	5.67 (1)
	Urban, low water	0	0	2.33 (1)	2.33 (1)	2.33 (1)
Greylag Goose	No urban, no water	0	0	0.14 (1)	0.14 (1)	0.14 (1)
	Urban, high water	28.00 (3)	28.00 (3)	28.78 (4)	0.78 (2)	28.78 (4)
	Urban, low water	10.75 (3)	10.75 (3)	30.21 (8)	19.46 (6)	30.21 (8)
Canada Goose	No urban, low water	0	0	7.68 (1)	7.68 (1)	7.68 (1)
	No urban, no water	0	0	0	0	0
	Urban, high water	19.50 (2)	24.17 (3)	59.56 (7)	40.06 (7)	64.23 (7)
	Urban, low water	3.13 (1)	3.13 (1)	6.98 (8)	3.85 (7)	6.98 (8)
	Urban, no water	0	18.91 (1)	0.06 (1)	0.06 (1)	18.97 (2)
Golden Plover	No urban, low water	0	0	73.02 (1)	73.02 (1)	73.02 (1)
	No urban, no water	0.63 (1)	0.63 (1)	2.67 (1)	2.04 (1)	2.67 (1)
	Urban, high water	2.00 (1)	2.00 (1)	4.91 (3)	2.91 (3)	4.91 (3)
	Urban, low water	0.13 (1)	0.13 (1)	0.13 (1)	0	0.13 (1)
	Urban, no water	12.30 (2)	12.30 (2)	12.30 (2)	0	12.30 (2)
Lapwing	No urban, high water	3.00 (1)	3.00 (1)	10.50 (2)	7.50 (1)	10.50 (2)
	No urban, low water	87.62 (1)	87.62 (1)	112.06 (2)	24.44 (2)	112.06 (2)
	No urban, no water	0	0	23.37 (2)	23.37 (2)	23.37 (2)
	Urban, high water	69.00 (7)	69.00 (7)	85.18 (9)	16.17 (6)	85.18 (9)
	Urban, low water	83.25 (4)	83.25 (4)	94.92 (6)	11.67 (4)	94.92 (6)
	Urban, no water	9.27 (2)	9.27 (2)	11.64 (4)	2.36 (2)	11.64 (4)