DEMOGRAPHIC MONITORING: A STRATEGY TO INCREASE THE CONTRIBUTION OF RINGING AND NEST RECORDING TO CONSERVATION SCIENCE

Summary

1. A key aim of the ringing and nest-recording schemes is to deliver robust time-series of demographic parameters that can be incorporated in integrated population models to help explain the demographic and environmental causes of changes in abundance.
2. The overall aim of this work is both to elucidate the mechanisms of changes in the abundance of individual species and to contribute to understanding of wider biodiversity and environmental change. Such information is widely used by government and the voluntary sector to inform environmental policy and conservation actions. We will, therefore, focus effort on monitoring a suite of key species that are representative of different habitats, ecologies and life histories. The species have been selected with this aim in mind, while also taking account of practical considerations applying to volunteer-based monitoring.
3. We consider monitoring of two key groups; breeding terrestrial species and wintering waterfowl. Seabirds, a further very important group, are the subject of a separate, ongoing review and will be considered in detail at a later date. Demographic monitoring of seabirds should be closely integrated with the Seabird Monitoring Programme.
4. Out of 133 terrestrial species with UK breeding populations of over 1500 pairs we identify 57 that are priorities for monitoring. These species are broadly representative of the habitat preferences, life histories and ecologies of the wider suite of species from which they are drawn. Heathland and upland species are under represented as birds in these habitats are widely dispersed and difficult to sample.
5. For 24 of these terrestrial species coverage is already good and further developments should focus on improving geographical and habitat coverage. For the remaining 33 species, improved data are required to generate good quality annual time series of demographic parameters. Development of RAS projects could potentially contribute to improving the monitoring of 18 of these 33 species.
6. Out of 34 wintering waterfowl with over 1000 wintering individuals (excluding 4 largely resident species) 7 are well monitored via largely professional studies and a further 8 are identified as priorities for improved demographic monitoring. The resulting suite of 15 species would be broadly representative of the origins and habitats of wintering waterfowl although ducks and species breeding in Iceland would be under represented.
7. The priority wintering waterfowl for improved coverage are Wigeon, Oystercatcher, Knot, Sanderling, Purple Sandpiper, Dunlin, Redshank and Turnstone. All of these species could be monitored through development of more systematic cannon-netting programmes, in some cases supplemented by resightings of colour marked birds gathered using standardized protocols.
8. Within the Ringing Scheme the most useful demographic information is likely to come from structured schemes such as Constant Effort Sites (CES) and Retrapping Adults for Survival (RAS) where there is some consistency in recapture effort over

time. Similarly nest recording is more likely to yield high quality information when it is based around systematic coverage of defined study areas. There is a need for a more formally structured scheme covering the ringing of wintering waterfowl.

9. The RAS scheme should be further promoted and developed, wherever possible encouraging participants to undertake local population studies of their chosen study species by recording abundance and productivity as well as survival. To help understanding of the aims of the project it should be renamed to reflect the inclusion of other population data. Formal species-specific recording protocols will be developed. Where possible these will be informed by simulation studies or other analytical work designed to optimize the trade off between sample size, number of studies and ease of contributing to the scheme.

10. Ring recoveries will continue to provide an important means of estimating survival rates for those populations from which sufficient individuals are recovered. In particular, this is often the only way to get good direct estimates of post-fledging and first year survival. This applies mainly to a suite of larger species, sized from Song Thrush upwards, for which it is important that adequate levels of "general ringing" of the target populations should be maintained and that long-term declines in ring reporting rates should be reversed.

11. Implementation of the strategy will depend on effective communication with volunteers and continuing high quality support for the volunteer network. The Annual Ringing Report will be developed so as to better reflect the priorities of the Ringing Scheme. It will be essential to make an understanding of key monitoring priorities and promotion of high priority fieldwork key elements of the training of ringers and nest recorders. Within this context it will be particularly important to explain why structured projects are more important than simply ringing large numbers. Key messages include the fact that CES is not unduly restrictive and that RAS provides a flexible framework for Ringing projects that will both be enjoyable for participants and provide high quality information for conservation science.

12. Ring subsidies and refunds should be adjusted in line with the new strategy. They should be seen as one of several ways of supporting key messages rather than the primary driver of volunteer effort.

Background

The JNCC/BTO partnership operates several schemes aimed at monitoring the numbers and demography of a range of widespread UK birds. A key aim of this monitoring is to understand how and why bird populations change, both to inform effective species conservation and to contribute to the evidence-base supporting the conservation of wider biodiversity and the environment. The evidence from this area of BTO research is already widely used by government and the voluntary conservation sector and a key aim of this strategy is to further improve the value and quality of the information obtained. All population changes are a consequence of underlying demographic rates, which are themselves determined largely by environmental conditions. Thus the Partnership's demographic monitoring schemes have a critical part to play in understanding the causes of change by providing estimates of survival, productivity and dispersal with which to model abundance changes measured by schemes such as BBS and WeBS. Wherever possible we aim to relate variation in these demographic rates to underlying environmental factors.

JNCC and BTO wish to improve the targeting of demographic monitoring effort during the current partnership period (2010-2016) and beyond to increase our understanding of the impacts of environmental and land-use change on biodiversity. Such targeting aims to increase the number and representativeness of species for which good quality demographic analyses can be produced (and hence for which demographic drivers of population change can be inferred) and to provide measures of cross species patterns that are indicative of broad environmental change. To do this we develop a demographic sampling framework to ensure that the suite of species which we either already monitor or plan to start monitoring in future are representative of a range of habitats, diets, life-histories and status categories. Wherever possible we also plan to collect data in ways which will allow us to make best use of differences in trends between different regions and habitats for drawing inferences about the causes of change.

Aims

We aim to construct integrated population models for a representative range of common species to identify ecological drivers of species and environmental change across the wider countryside. This will require a program of seasonally and geographically structured ringing and nest recording to provide the demographic information to parameterise the integrated models.

Our aim is to be able to construct such models for around 72 species (57 terrestrial, 15 wintering waterfowl, seabirds still under consideration) for which we also have population trend data. This will require two phases of development: improving our data gathering and developing sufficiently general analytical methods that such models can be applied to a wide range of species in a cost-effective manner. Plans for the development of data gathering are outlined here and some of the necessary analytical developments are planned for future years of the JNCC/BTO partnership work programme. The main results from this work will be published in the peer-reviewed literature in line with normal scientific practice. We will present periodic updates of the results of these models with interpretation on the drivers of change online in BirdTrends (formerly the Wider Countryside Report) and the results will also feed into a range of policy-relevant advice provided by JNCC and others.

Here we focus primarily on data gathering. We already collect good quality data for a number of species, and will work to improve the quality of data collected for the remainder. This will particularly include data on adult survival and productivity. We also aim to improve the sampling of populations from different regions and habitats (particularly those showing

contrasting population trends) so as to provide greater insight into the impacts of environmental change. We also aim to collect more basic demographic information on about 30 additional species. These data will not be sufficient for producing fully time-specific demographic models but will provide average estimates of demographic rates that, in combination with other information, can be used to build simple models that will inform our understanding of the likely causes of change.

Strategy Development Process

This strategy represents a further development of the concept of Integrated Population Monitoring which has been under development by the BTO since at least the late 1980s and arguably earlier (Baillie 1990, Ibis 132, 151-166). The ideas were developed as part of the negotiations for the JNCC/BTO Partnership that started in April 2010. Initial proposals were discussed by RIN in April 2010 (RIN:APR10:2 and MIN9) with further discussions in October 2010 (RIN:OCT10:1 and MIN5) and May 2011 (RIN:MAY11:1 and MIN7). A ringer survey was carried out in January 2011 and further consultation was undertaken by email in August 2011. A Stakeholder workshop involving representatives of JNCC, other Statutory Conservation Agencies, Conservation NGOs and the ringers was held on 6 September 2011. The present strategy was agreed at the October 2011 meeting of RIN and launched from the beginning of 2012. As with any monitoring strategy of this kind it is important that we should stick to the broad structure of the strategy for a reasonably long time period. However, it will also be important to learn from our experiences of implementing the strategy and to make minor adjustments accordingly.

Approach

We will consider the following groups, each of which is likely to require a different approach:

1. Terrestrial breeding birds
   Monitoring terrestrial bird species is particularly important because most bird species found in the UK occupy terrestrial habitats and they are thus the group likely to provide the most representative information on broad environmental pressures. We focus on breeding species both because this is the largest group in terms of life histories and because fidelity to breeding locations makes it more practical to study demography than is the case for winter visitors or passage migrants. We have robust abundance trends for nearly all widespread breeding bird species from the Breeding Bird Survey. This is by far the largest group of species within this strategy and includes those that the majority of ringers and nest recorders are likely to be able to monitor. We note that top predators (raptors, owls, herons and egrets) are included within this group.

2. Colonial breeding Seabirds
   Britain and Ireland host internationally important numbers of several species and have legal obligations for their monitoring. Breeding seabirds pose particular challenges relating to the remote locations of colonies and their life-histories, which involve long periods away from land. Monitoring of their demography is already the focus of some targeted effort, both volunteer and professional. A review of the potential for Integrated Population Monitoring of seabirds was undertaken recently (Robinson and Ratcliffe 2010, BTO Research Report 526) and a further review of demographic sampling strategies is in progress and will report later this autumn. We are not proposing any changes to demographic monitoring programmes for seabirds until this work has been completed.

3. Wintering Waterfowl

Britain and Ireland support internationally important numbers of waders and wildfowl during the non-breeding period, the abundance of which is well monitored by the Wetland Bird Survey. Monitoring results for many of these species need to be interpreted in a flyway context and identifying individuals from different populations may prove challenging for some species. For some wildfowl species, particularly geese in Scotland, there is interest in more rigorous management of hunted populations by adopting an approach based on adaptive harvest management. Adequate monitoring of both hunting bags and overall survival rates would form an essential part of any such management programme.

We aim to monitor species that are representative of a broad range habitats or ecological processes (e.g. migrants, top predators) and are thus likely to reflect factors impacting on wider biodiversity and the environment as well as on the particular species being monitored. In order to ensure we have appropriate species coverage, we have categorised species by habitat and ecology. These categories can also be used to infer impacts of particular environmental and policy drivers. Thus, studies of farmland birds, particularly seed-eaters, have been key in identifying the impacts of agricultural intensification and, more recently, have been used to investigate the benefits of agri-environment schemes. A contrasting example is provided by the monitoring of productivity of marine species, which has been important in distinguishing the impacts of climate change and fisheries policy. Of course, future policy and environmental drivers are unknown, hence the requirement for broad species coverage. For example, ringing data have helped track the spread of the recent outbreak of trichomonosis in Greenfinches and Chaffinches and studies of the breeding success of woodland migrant species may help us to understand the importance of phenological change as our climate warms. Since data-gathering is time-consuming, such analyses rely heavily on a pre-existing network of data collection, which we aim to provide.

Species and scheme priorities

Terrestrial breeding birds

In determining which species are priorities for our large-scale demographic monitoring program we initially consider those with a breeding population of more than 1,500 pairs (i.e. species that are not routinely considered by the Rare Breeding Birds Panel). The scarcer species considered by RBBP tend to be more localised and hence their responses to environmental change may be less representative of those happening in the Wider Countryside. Such species may be more suited to professional studies than large-scale volunteer-based monitoring; for many we also lack good data on population change. It should be noted, however, that a few volunteers do undertake systematic monitoring of such species (e.g. we have a small number of Bearded Tit RAS projects), and we will continue to support such monitoring where it is practical and likely to deliver useful information on localised species or habitats.

There are 133 terrestrial breeding species of bird (and a further 18 marine species, to be considered elsewhere) in Britain and we have data on population change for the majority (105) through BBS (and previously CBC for some). These occur in a broad range of habitats and have varying life-history traits and ecologies (Table 1, Figure 1). We aim to provide good demographic information on about 50 species, or one-third of our breeding species and for these species to be representative of a wide range of habitats and ecologies.

We have identified 57 species for which it is reasonable to expect that we could deliver good demographic information to inform population change (Appendix 1). In compiling this list

we have taken account of the need to ensure representation across the range of habitats and ecologies; we have therefore included some species, which though likely to be representative of particular habitats and ecologies are likely to prove challenging in terms of gathering appropriate data. We will need to provide particular encouragement and support to volunteers who monitor these species. Our list includes a broad and diverse range of species, which should provide information that can be used to inform a wide variety of environmental and policy drivers (Table 1). We aim to achieve good coverage across a broad range of habitats and ecologies, though some habitats will remain under represented because they are either localised (heathland) or difficult to access (upland); particular attention will need to be given to helping support volunteer activity in these areas.

In general, we have identified two key areas in which we need to develop our volunteer engagement and data collection, while maintaining the network and volunteer effort we have in place. Firstly, we have identified a need to increase the number of nest records, both generally but more particularly within defined study areas, so as to provide improved information on breeding success and productivity. We also need to encourage the collection of multi-visit nest records, particularly those starting at the egg stage. Secondly, we need to promote the extension of the RAS network to provide better information on abundance, productivity and survival, and where possible to develop a network of local population studies. In achieving both of these aims engaging with the volunteers, providing support (especially for the more challenging species) and feedback of results and clearly explaining the rationale and benefits of our proposed approach will be critical. CES and ring recoveries also provide important sources of information which should be maintained.

We are already improving the demographic information provided by the Nest Record Scheme. A recent substantial investment of money from the Dilys Breese legacy has allowed us to greatly improve the infrastructure of the Nest Record Scheme and the number of nest records has increased steadily. These funds will also support the development next year of a system for observers to enter and manage nest records on-line, linked to JNCC funded developments of our demographic databases. A key aim for the future will be to increase the number and quality of records submitted for the species listed in Appendix 2. Many of these are open-nesting species, which require particular skills to find and record. Our recently published *A field guide to monitoring nests*, the first modern guide to nest-finding should help enormously in this respect by providing up-to-date information on how to monitor nests safely. We intend to support this through development of the Nest Record Scheme web pages to provide further advice, information and feedback. We have also recently (2008) commenced a series of nest-finding training courses which have helped people target open-nesting species, many of which appear in Appendix 2. Recent courses have been supported through the Dilys Breese legacy and we will need to seek alternative funding if they are to continue.

The RAS scheme is amongst the most demanding of all the BTO volunteer recording schemes, requiring as it does a substantial investment of time and effort by the volunteer (typically in the region of 20 days per year). Currently, the primary focus of RAS is on collecting recapture or resighting data to estimate survival rates but, given the intensive nature of the fieldwork, many projects record more than this, for example, the number of breeding pairs (often necessary to know to ensure all birds have been re-encountered) and the success of nesting attempts (particularly when territories have been identified, adults can be easier to encounter near the nest). We strongly encourage such activities, since having multiple sources of demographic information from the same site can be powerful in identifying reasons for population change. To encourage further development of the

recording of other data we propose changing the name of this scheme to something more representative such as ASP (Assessing Survival and Productivity). We need to have a greater focus on individual species, since the best methods for operating a RAS will vary (sometimes substantially) between species. We plan to use the RAS part of website to develop and disseminate such protocols, both in terms of engaging ringers and nest recorders in their development and for providing feedback. Ideally we would like to undertake simulation studies to explore the potential for modifying RAS sampling protocols, with a view to identifying any circumstances where the recommended number of adults recaptured per year could be reduced. This might allow more ringers to participate in the scheme under some circumstances, although such an approach is only likely to be effective where re-encounter rates are high. Clearly developing RAS in these ways will require a substantial investment of staff time.

There are a suite of species for which CES provides high quality data on relative abundance, productivity and survival (Appendix 2) and it is important that this coverage should be maintained. However, there are only quite a small number of additional species that might be added by increasing CES coverage, although there is scope for improving its capability to provide comparative data from different regions and habitats (below). Ring recoveries have traditionally provided a further source of information on survival rates, particularly for larger species with higher ring reporting rates. Even amongst farmland seedeaters it was ring recoveries that allowed us to document reductions in survival linked to agricultural change. Because many birds ringed as juveniles do not return to their natal sites to breed, ring recoveries generally provide more robust estimates of post-fledging and first year survival than do mark-recapture data. However, the main difficulty with ring recoveries is that for most species reporting rates are low, and furthermore there has been a long-term decline in these reporting rates. Steps such as the use of a web address on rings are helping to improve the situation but currently reporting rates remain low. We recommend that at present we should continue to regard recoveries from species of Song Thrush size and above as a potentially useful source of information on survival, but note that this must be linked to ongoing efforts to increase reporting rates. In this context it is essential that ringers should be fully aware of the importance of reporting all dead recoveries. For three medium sized passerines, Song Thrush, Blackbird and Starling, we have particularly good time series of survival data from recoveries, all of which have given rise to some key ecological publications. Experience shows the importance of maintaining such time series if at all possible.

In addition to collecting data on a representative range of species, it is important to collect data within a species from a representative range of geographical regions and habitats. Typically the environmental drivers of population change will vary between regions, or between habitats. Being able to compare demographic processes between different areas within the same species can be a powerful method for understanding the causes of population change. For example, populations of Willow Warblers, in common with many other migrant species, are faring better in Scotland than in England. Recent analyses of demographic data from these regions have highlighted differences in breeding success and survival between the two countries which point to ecological drivers of the differential population change. Thus, we have divided the species list in Appendix 2 into those species for which we need to concentrate on gathering data at a national scale, and those for which we gather sufficient data currently, and that it would be appropriate to promote more regionally-focussed data gathering. For these species we will look at current regional and habitat coverage when advising on priorities for setting up new studies in particular areas. Priorities within particular regions may change quite rapidly so it is not appropriate to

document the fine detail of this here. One priority should be to consider how the CES scheme can be extended to cover urban habitats and gardens and to incorporate more woodland sites. Under some circumstances there might also be merit in developing farmland CES sites, although the feasibility of such a development is currently unclear and it would almost certainly need more novel development than an extension of the scheme to urban habitats, gardens and woodland.

Breeding Seabirds

This group is not discussed here because they are the subject of a separate, ongoing review (see above). Current priorities and subsidies for seabird ringing will be retained until that review is implemented.

Wintering Waterfowl

During the non-breeding period Britain and Ireland host internationally important numbers of waders and wildfowl, both on passage in spring and autumn and those that stay for the winter months. As with seabirds, this group poses particular challenges in monitoring demographic processes; perhaps primary amongst these is the tendency for individuals from some populations to be highly mobile during the non-breeding season. In addition, some species found here in winter are a mix of birds from different breeding populations (meaning that they are likely to be subject to differing environmental pressures) and the balance of birds from different populations may vary geographically. Individuals from some populations of some species can be identified on the basis of biometric and other characteristics and these may prove easier to monitor, as will those that tend to exhibit a higher degree of site philopatry within and between winters. In all cases it will be important to consider monitoring in a flyway context. This is particularly important currently, since the declines in numbers observed in many species wintering in the UK may reflect changes in migratory tendency (individuals wintering closer to their breeding grounds) or changes in survival.

For some species, particularly those that breed in the high Arctic, monitoring birds on the wintering grounds may provide much useful information given logistic constraints on conducting fieldwork in their breeding areas (birds are widely dispersed, difficult to locate and are in remote areas that are hard to access). An example of this is in monitoring productivity of waders and some wildfowl by quantifying the proportion of juveniles present in wintering flocks. This is a synthetic measure of productivity incorporating both nesting success and juvenile survival to reflect recruitment of young birds into the wintering population, but one which will be useful in undertaking analysis of population change, and potentially management.

There are six wintering wildfowl and one wader where a significant amount of demographic monitoring is being, or has been, undertaken through professional studies (Appendix 3). The main need here is to develop mechanisms for bringing these data together to address issues that extend beyond individual study populations or species. There may also be scope for more volunteer involvement to develop and extend the coverage of some of these studies.

We identify a further eight species, comprising one duck and seven waders, for which implementation of more formal demographic monitoring should be a priority (Appendix 3). Wintering waterfowl are already monitored in a more or less structured way by several specialist ringing groups (such as those operating on the Humber, Moray Firth, North Wales, Solent and Wash) and some individuals. Thus a network of data gathering already exists and we should aim to support and expand this. A formally structured scheme needs to be

established and standardized data gathering protocols developed, based around current work and drawing on existing expertise. Although most of the detailed ringing and recapture data from these studies are already collected and stored centrally, there is a need to develop mechanisms for collating appropriate data on factors such as recording effort, coverage and habitat. For wintering waterfowl it will be useful to collect data on condition to help understand changes in survival in unusually cold weather. We then need to develop mechanisms for combining all relevant data and to develop methods of quantifying changes in productivity and survival, linked to changes in abundance measured through WeBS.

A complete list of the 15 waterfowl species that we identified as priorities for demographic monitoring is given in Appendix 3. These species are broadly representative of the winter habitats and geographical origins of the group as a whole except that species breeding in Iceland and marine species are under represented (Table 2, Figure 2). There is a need to establish a more formal scheme for collating, analysing and reporting on these demographic monitoring data, analogous to the current operation of CES and RAS.

Implementation

Volunteer engagement

In implementing this strategy the support and engagement of our ringers and nest-recorders is vital, since they will be required to modify their substantial investment of time, effort and money if our demographic schemes are achieve their goals. To inform the development of this strategy we solicited comment on a briefing paper outlining the rationale and framework of the proposed strategy. Most of those who responded were broadly supportive of our aims and understand the value of structured ringing, which forms the core of our strategy. We note that many ringers already undertake some form of structured ringing that could potentially yield valuable information if it can be incorporated within our national framework. In many cases the modifications needed to incorporate activities within CES or RAS are relatively small.

A key part in the implementation of our strategy will involve providing updated information on demographic projects to ringers and following this up with individual ringers and groups to show how they can contribute. We will also need to strengthen the focus of training of ringers and nest recorders on the merits and methods of demographic monitoring. There needs to be a significant cultural shift away from ringing large numbers and towards carefully following the histories of known individuals within well thought out yet easy to implement study designs. It seems likely that amongst those who are not already engaged in such projects those that are new to ringing are more likely to take up such an approach. The training system needs to be modified so that we ensure that all new recruits to the Ringing Scheme understand our core objectives and that there are exciting and rewarding opportunities for them to contribute. We will reflect this in the annual Ringing Report with a greater focus on structured projects, especially now that recovery details are available online on the BTO website.

Implementing the strategy will require substantial interaction with staff or volunteers who have been specifically trained to promote demographic monitoring schemes and to explain what is involved. This complements broader volunteer training initiatives within the BTO and we will draw on expertise elsewhere in the organisation where appropriate. We need to provide improved information on opportunities and priorities for contributing in particular parts of the country. The development of more formal species protocols for RAS projects,

which will be made available on-line, should help new and existing ringers to understand what is involved. We will also revise the CES guidelines making it more clear how easy it can be to adapt regular ringing at a site to the CES protocol and promoting the establishment of CES sites in additional habitats (above). New applicants for permits will be provided with more information about demographic projects and encouraged to take part in them.

Within the Ringing Scheme there should always be encouragement for those who wish to undertake their own studies outside the range of projects that are organized centrally. However, those who follow this route will need to take responsibility for ensuring that they are able to obtain any necessary advice and assistance in relation to study design, analysis and publication. While BTO staff will usually be keen to help when they can, limited staff resources will mean that they may sometimes be unable to do so.

Semi-structured ringing

There remains an outstanding question as to whether some useful information on demographic processes might be obtained from the semi-structured data that are already collected by many ringers, perhaps linked to some measures of effort. This may well be the case in some instances but unfortunately working out what is or is not possible would require significant research effort. From experience with CES we know that standardizing effort is hugely beneficial in terms of producing robust analyses. We also know that even with CES data there are often some tricky modelling problems, for example those around modelling the proportion of transients. Thus while measuring effort might sometimes allow us to model recapture probability as a constant linear function of effort, it seems unlikely that this will usually be the case. In many instances such an effort measure may only explain a small part of the variance in capture probability. We will seek opportunities to investigate this issue further as resources allow, but it is unlikely that such "smart analyses" would provide an adequate substitute for properly structured monitoring schemes. For the present it would seem sensible to maintain a relatively neutral view of the potential value of such activities, noting that properly structured projects will always be preferable where possible, but that effort recording may provide useful supplementary data in some circumstances. We should look for ways to fund research into analyses of measured effort data to establish their potential value and, if appropriate, guide future ringing. If adequate effort data could be generated from the data we already hold there could also be potential for retrospective analyses where historical ringing data are incorporated in the ringing database.

Ring Pricing

The Ringing Scheme is only able to operate at its present level because ringers cover a large part of the costs, particularly through buying rings. Traditionally ring subsidies (i.e. reductions at source in the full economic price that might otherwise be charged to ringers) and refunds (payments made at the end of the year to cover part of a ringer's expenditure on priority species) have been viewed as a key mechanism for setting priorities. However, while there is little doubt that the ringing of some large species, such as seabirds and waterfowl, has been limited by the cost of rings, for small birds other factors may be more influential and direct correlations between subsidies/refunds and numbers ringed often appear weak. In developing and promoting this strategy it is important that ring subsidies and refunds should be consistent with our aims, but good volunteer support and training may well have a greater influence on activity patterns.

Currently support in some form is provided for the following activities and species groups. It should also be noted that there is a modest general subsidy for all ringing, which reduces the cost to the ringers of all rings.

Activities: CES, RAS, Submission of computerized data.
Species groups: Declining species on BoCC list, Waders, Seabirds, Top Predators (raptors, owls and herons).

We propose that the subsidies and refunds should in future support the following activities and species groups:

Activities: CES, RAS, any future monitoring scheme for wintering waterfowl.
RAS support might be in the form of grants rather than per ring payments.
Support for the ringing of pulli when a multi-visit nest record card of adequate quality is also submitted.
Computerization refunds would be discontinued as nearly all data are now submitted in computerized form and submitting computerized data will be a prerequisite for getting any refund.

Species groups: Subsidies for waders should continue for the immediate future, but might eventually be transferred to support a more structured demographic monitoring scheme for wintering waterfowl.
Seabird ring subsidies are subject to ongoing review and are taken as unchanged here.
Support for top predators should continue, but in future will be conditional on the submission of Nest Record Cards for nests where chicks were ringed (to be introduced once the necessary IT systems are in place).
There should be some support for ringing of species such as Song Thrush, Blackbird and Starling where it is desirable to maintain a time series of ring recovery data.
Support for BoCC species will be discontinued.
The modest general subsidy for all ringing should continue.

Detailed proposals concerning ring prices, subsidies and refunds are covered in a separate paper that will be presented to the April 2012 meeting of RIN.

Other data sets
In setting out this strategy we focus largely on improvements that can be made through the BTO volunteer network to collect demographic data (and where appropriate associated abundance and environmental data) across a large spatial scale. We note that some species, particularly certain seabirds, wildfowl and raptors, are already the subject of (mainly professional) studies which either currently do, or have the potential to, yield good data on demographic parameters. To support the strategy outlined here, it would be beneficial to investigate mechanisms by which data from such intensive studies could contribute to a wider demographic monitoring programme. Approaches to this could involve some combination of the following:

(a) BTO holding archive copies of such data sets and establishing agreements with the owners about how they might be utilised within the broader environmental monitoring programme.
(b) BTO maintaining a metadata catalogue about such datasets, with raw data being requested only in relation to specific questions.
(c) Summary data provided by the institution or individual being shown on BirdTrends or other relevant website, badged with the logo etc of those providing them.

Seabirds and wintering waterfowl are likely to be a particular priority for such data sharing given current patterns of data gathering.

Initial timetable for implementation

November/December 2011	Publicise to ringers, nest recorders and other volunteers via *Ringing News* and conferences
December 2011	Main BTO conference on theme of demographic monitoring
March 2012	Publicise to nest recorders via Nest Records News
April 2012	RIN to agree revised subsidies and refunds taking account of the strategy. RIN to hold initial discussion of proposals and funding requirements for developmental work that is not included in the JNCC/BTO Partnership work programme.
October 2012	RIN to agree medium-term implementation plan and performance indicators for measuring success of strategy. This will include prioritized proposals and funding requirements for developmental work that is not included in the JNCC/BTO Partnership work programme.
December 2012	First issue of new format Ringing Report giving greater emphasis to results from demographic monitoring and their policy relevance
April 2013	RIN to review performance of strategy over first year (2012) and propose adjustments if necessary.

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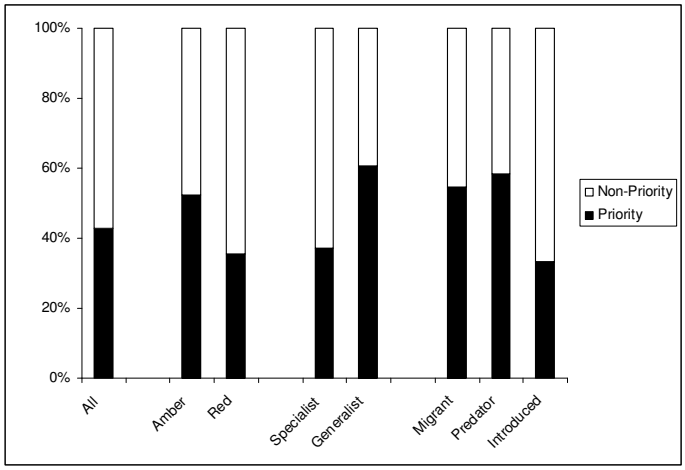
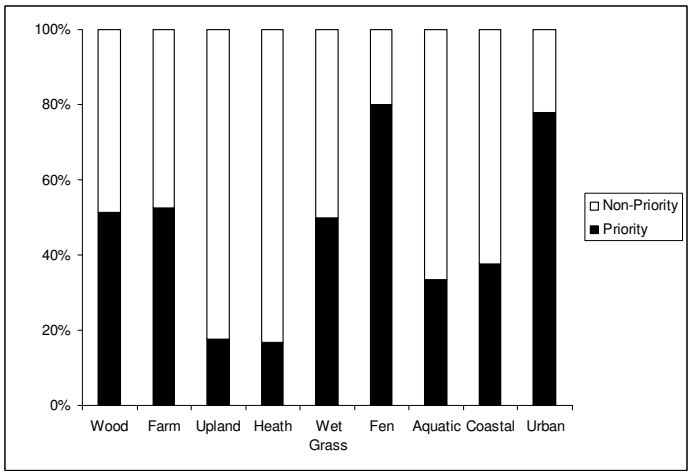
Figure 1. Proportion of priority and non-priority terrestrial species by conservation and ecological groupings

(a) All species and by BoCC listing and life history



(b) By habitat



(c) By diet

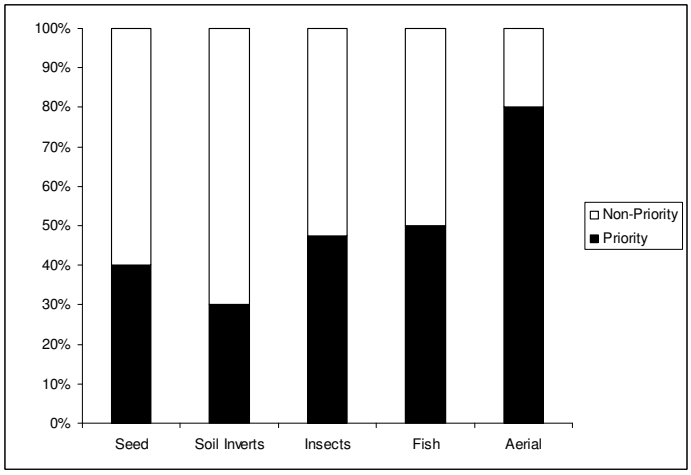
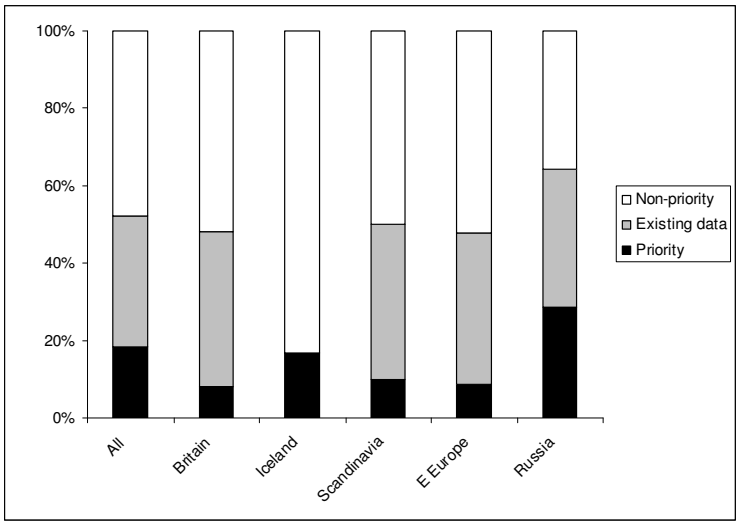


Figure 2. Proportion of priority and non-priority wintering waterfowl by conservation and ecological groupings

(a) By breeding origin (a species may have more than one breeding origin)



(b) By habitat

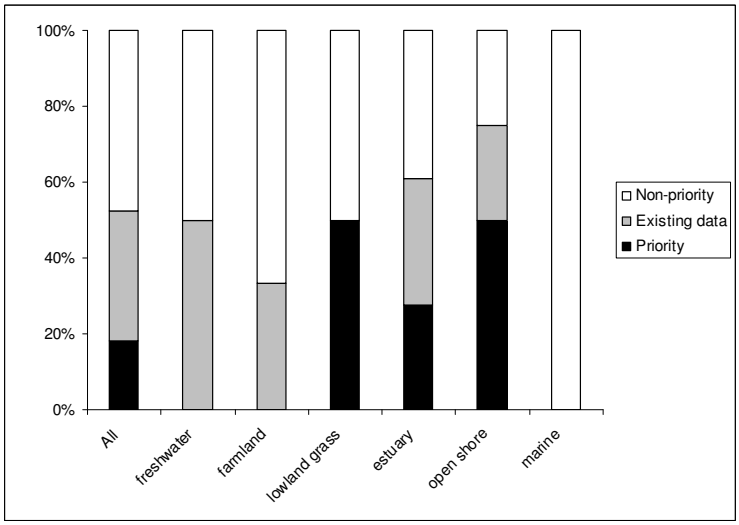


Table 1. Summary of representativeness of demographic monitoring of British breeding birds by ecological grouping.

We have included all widespread terrestrial species with a breeding population of greater than 1,500 pairs (i.e. excluding those which are considered by RBBP), a total of 133 species. For 'Good' species we already collect data which may be used to undertake population analyses, for 'Priority' species we are close to this goal. For 'Difficult' species we are unlikely to collect sufficient data for full population analysis, but may be able to collect limited demographic data to inform an analysis of population change. 'Unsuitable' species are not amenable to large-scale monitoring, often due to the practicalities of sampling a sufficient number of individuals.

		Good	Priority	Difficult	Unsuitable	Total	% Target
All Species		24	33	41	35	133	43
BOCC	Amber	9	14	9	12	44	52
	Red	3	7	11	7	28	36
Habitat	Specialist	12	25	33	30	100	37
	Generalist	12	8	8	5	33	61
	Wood	12	8	9	10	39	51
	Farm	7	3	9	0	19	53
	Upland	0	3	6	8	17	18
	Heath	0	1	2	3	6	17
	Wet Grass	0	2	1	1	4	50
	Fen	3	1	1	0	5	80
	Aquatic	1	4	5	5	15	33
	Coastal	0	3	4	1	8	38
	Urban	1	6	0	2	9	78
Life History	Migrant	10	8	11	4	33	55
	Predator	1	6	3	2	12	58
	Introduced	0	2	0	4	6	33
Diet	Seed	4	4	10	2	20	40
	Soil Inverts	3	0	3	4	10	30
	Insects	14	4	17	3	38	47
	Fish	0	2	0	2	4	50
	Aerial	2	2	0	1	5	80

Table 2. Summary of representativeness of demographic monitoring of wintering birds in Britain and Ireland by breeding origin and habitat.

We included all wildfowl and wader species with a peak monthly count greater than 1,000 birds, but have excluded four species (Mute Swan, Greylag, Canada Goose and Ringed Plover) which are largely comprised of British and Irish breeding birds. For 'Good' species we already collect data which may be used to undertake population analyses, for 'Priority' species we are close to this goal. For 'Difficult' species we are unlikely to collect sufficient data for full population analysis, but may be able to collect limited demographic data to inform an analysis of population change. 'Unsuitable' species are not amenable to large-scale monitoring, often due to the practicalities of sampling a sufficient number of individuals. For some species demographic data are already collected, largely as part of professional studies.

	Good	Priority	Difficult	Unsuitable	Existing	Total
All species	4	4	15	6	7	36
Breeding Origin						
Britain/Ireland	2		10	3		15
Iceland	1			5	3	9
Scandinavia	1	1	8	2		12
E Europe/Russia		2	9	3		14
Arctic	2	2	5		5	14
Habitat						
freshwater			7		2	9
farmland			1	1		2
lowland grass		1		1	4	6
estuary	3	2	6	1	1	13
open shore	1	1	1			3
marine				3		3

Appendix 1 Priority terrestrial species for monitoring, separated into those for which we already have good data and improving spatial coverage would increase our ability to interpret demographic trends (by examining regional or habitat variation in demography) and those for which more data would improve the quality of demographic interpretation of population trends. Species marked with an asterisk are likely to be practically more challenging.

	Habitat	Life-history	Diet	Priority
Improve Spatial Coverage				
Barn Owl	Farm	Predator	Other	RAS
Blackbird	Wood	Resident	Soil Inverts	
Blackcap	Wood	Migrant	Insect	Nest Records
Blue Tit	Wood	Resident	Insect	
Bullfinch	Farm	Resident	Seeds	Nest Records
Chaffinch	Farm	Resident	Seeds	Nest Records
Chiffchaff	Wood	Migrant	Insects	Nest Records
Dunnock	Wood	Resident	Insects	Nest Records
Garden Warbler	Wood	Migrant	Insects	Nest Records
Great Tit	Wood	Resident	Insects	
House Sparrow	Urban	Resident	Seeds	RAS
Long-tailed Tit	Wood	Resident	Insects	CES
Pied Flycatcher	Wood	Migrant	Insects	RAS
Reed Bunting	Fen	Resident	Seeds	Nest Records
Reed Warbler	Fen	Migrant	Insects	
Robin	Wood	Resident	Insects	
Sand Martin	Aquatic	Migrant	Aerial Insect	RAS
Sedge Warbler	Fen	Migrant	Insects	CES
Song Thrush	Farm	Resident	Soil Inverts	
Starling	Farm	Resident	Soil Inverts	RAS
Swallow	Farm	Migrant	Aerial Insect	RAS
Whitethroat	Farm	Migrant	Insects	Nest Records
Willow Warbler	Wood	Migrant	Insects	Nest Records
Wren	Wood	Resident	Insects	Nest Records
Improve Data Collection				
Canada Goose	Other	Introduced	Other	Target Ringing
Cetti's Warbler*	Fen	Resident	Insects	CES
Collared Dove	Urban	Resident	Seeds	Target Ringing
Common Sandpiper	Upland	Migrant	Other	RAS
Dipper	Aquatic	Resident	Other	RAS
Greenfinch	Farm	Resident	Seeds	CES
Grey Heron	Aquatic	Predator	Fish	Target Ringing
Grey Wagtail*	Aquatic	Resident	Insects	Nest Records
Greylag	Other	(Introduced)	Other	Target Ringing
Herring Gull	Coastal	Resident	Other	Target Ringing
House Martin	Urban	Migrant	Aerial Insects	RAS
Jackdaw		Resident	Other	RAS
Kestrel	Farm	Predator	Other	RAS
Lapwing*	Wet Grass	Resident	Soil Inverts	Target Ringing

Lesser Blackback	Coastal	Resident	Other	Target Ringing
Little Owl	Farm	Predator	Other	RAS
Marsh Tit	Wood	Resident	Insects	RAS
Meadow Pipit*	Upland	Resident	Insects	Nest Records
Mute Swan	Aquatic	Resident	Other	Nest Records
Nightingale	Wood	Migrant	Insects	Nest Recs/CES
Redshank*	Wet Grass	Resident	Soil Inverts	Nest Records
Redstart*	Wood	Migrant	Insects	RAS
Ringed Plover*	Coastal	Resident	Other	RAS/Census
Sparrowhawk*	Wood	Predator	Other	RAS
Spotted Flycatcher	Wood	Migrant	Insects	Nest Recs/RAS
Stock Dove	Farm	Resident	Seeds	Nest Records
Stonechat*	Heath	Resident	Insects	RAS
Swift	Urban	Migrant	Aerial Insects	RAS
Tawny Owl	Wood	Predator	Other	RAS
Tree Sparrow	Farm	Resident	Seeds	RAS
Wheatear*	Upland	Migrant	Insects	RAS
Willow Tit	Wood	Resident	Insects	RAS
Wood Warbler*	Wood	Migrant	Insects	RAS

Appendix 2 Current data availability for priority species.

	NRS[1]	CES[2]	RAS[3]	Ringing[4]
Improve Spatial Coverage				
Barn Owl	84	-	0	603
Blackbird	245	141	2	175
Blackcap	36	97	-	24
Blue Tit	834	98	-	128
Bullfinch	11	84	(1)	16
Chaffinch	54	59	5	99
Chiffchaff	45	48	-	20
Dunnock	65	112	(1)	50
Garden Warbler	11	48	-	2
Great Tit	712	67	(4)	122
House Sparrow	99	-	5	57
Long-tailed Tit	41	60	-	13
Pied Flycatcher	357	-	12	10
Reed Bunting	14	43	-	6
Reed Warbler	110	84	5	16
Robin	102	67	(1)	60
Sand Martin	70	-	17	4
Sedge Warbler	<10	96	(4)	7
Song Thrush	115	36	(1)	18
Starling	48	-	(1)	70
Swallow	749	-	7	58
Whitethroat	19	49	5	9
Willow Warbler	17	133	(3)	12
Wren	59	108	-	23
Improve Data Collection				
Canada Goose	None input	-	0	87
Cetti's Warbler*	<10	0	-	1
Collared Dove	37	-	0	7
Common Sandpiper	Not estimated	-	2	<1
Dipper	68	-	2	4
Greenfinch	41	(22)	(1)	224
Grey Heron	<10	-	-	11
Grey Wagtail*	27	-	0	1
Greylag	None input	-	0	56
Herring Gull	N/a	-	0	69
House Martin	<10	-	4	6
Jackdaw	65	-	0	21
Kestrel	51	-	0	89
Lapwing*	Not estimable	-	0	11
Lesser Blackback	N/a	-	0	77
Little Owl	28	-	0	10
Marsh Tit	16	-	(1)	2
Meadow Pipit*	10	-	0	4
Mute Swan	24	-	0	277
Nightingale	<10	4	0	<1
Redshank*	Not estimable	-	0	7

Redstart*	32	-	0	1
Ringed Plover*	Not estimable	-	1	1
Sparrowhawk*	15	-	0	36
Spotted Flycatcher	39	-	0	1
Stock Dove	141	-	0	8
Stonechat*	41	-	(1)	1
Swift	<10	-	(1)	6
Tawny Owl	83	-	0	49
Tree Sparrow	639	-	0	37
Wheatear*	<10	-	2	1
Willow Tit	<10	-	0	1
Wood Warbler*	<10	-	(1)	<1

[1] NRS – the number of nest records contributing towards the estimate of fledglings per attempt (fpba) each year. For wader and wildfowl species fpba is not estimable because the chicks are nidifugous.

[2] CES - the total number of sites contributing to survival rates. Note estimating survival rates requires a good number of adult birds caught on each site, so the number of sites contributing is generally (much) smaller than for productivity or abundance.

[3] RAS – number of sites that have contributed sufficient data to estimate survival rates. Studies in parentheses do not currently yield robust estimates of survival.

[4] Ringing – the average number of dead recoveries per year for birds ringed in the summer months (April to September)

Appendix 3 Priority species for monitoring wintering waterfowl, separated into those for which we already have reasonable data and improving spatial coverage would increase our ability to interpret demographic trends (by examining regional or habitat variation in) and those for which more data would improve the quality of demographic interpretation of population trends. For some species demographic data have already been collected at a large scale as part of particular studies.

Species	habitat	origin
Improve Spatial Coverage		
Oystercatcher	estuary	Britain/Scandinavia
Purple Sandpiper	open shore	Arctic
Redshank	estuary	Britain/Iceland
Sanderling	estuary	Arctic
Improve data collection		
Wigeon	lowland grass	E Europe
Knot	estuary	Arctic
Dunlin	estuary	Scandinavia/E Europe
Turnstone	open shore	Arctic
Existing Data		
Bewick's Swan	freshwater	Arctic
Whooper Swan	freshwater	Iceland
Pink-footed Goose	lowland grass	Iceland/Arctic
White-fronted Goose	lowland grass	Arctic
Barnacle Goose	lowland grass	Arctic
Brent Goose	estuary	Arctic
Black-tailed Godwit	lowland grass	Iceland