JNCC 10 P10
September 2010

Joint Nature Conservation Committee

OBTAINING THE BENEFITS FROM BIOLOGICAL RECORDING

This paper was provided to the Joint Committee for decision/discussion or information. Please refer to the minutes of the meeting for Committee's position on the paper.

To view other Joint Committee papers and minutes visit http://www.jncc.gov.uk/page-2671

To find out more about JNCC visit http://www.jncc.gov.uk/page-1729

JOINT NATURE CONSERVATION COMMITTEE

OBTAINING THE BENEFITS FROM BIOLOGICAL RECORDING

Paper by Steve Wilkinson

1. Background

1.1 JNCC delivers the 'gateway' function of the National Biodiversity Network (NBN). This covers both the assistance necessary to help voluntary and public bodies prepare data for publication, and the development of applications to meet user needs. The total cost of this is about £200k per annum with £62k from the country conservation bodies directly, £70K from the country bodies and JNCC via the NBN Trust, £25K from Defra, and the remainder (£43k) from JNCC. These costs exclude the NBN Trust secretariat.

1.2 This level of spend has delivered growth in content from 20 million to 52 million records over three years. 5% of the records (2.9 million) relate to UK Biodiversity Action Plan (BAP) priority species of which 1.2 million records are recent (post-2000) and at high spatial resolution (see Annex 1 for further detail). JNCC estimates that the current level of investment would continue to maintain growth and coverage of the majority of the voluntary recording schemes, while gradually improving the efficiency of their operation and quality of the data they produce. It could also stretch to publishing statutory agency data and a growing percentage of data held in local records centres, provided agencies still support these and mandate publishing of their data on NBN.

1.3 The NBN is consequently a cost-effective data access system compared to any equivalent publically resourced portal delivering environmental data but there is room for further efficiencies as outlined below.

1.4 The country conservation bodies in Great Britain have each built ways of using NBN data into corporate information systems, but their overall use of data delivered through the NBN gateway is low, less than 5% of the total.

1.5 Without wishing to prejudice each organisation's own conclusions, JNCC has undertaken a quick review of the use of NBN data by the country conservation bodies in collaboration with colleagues in those bodies, and the initial conclusion is that there are several reasons why use of NBN data is low:

i. internal constraints on development of applications to use NBN data. This includes both a lack of internal development capacity as well as restrictions imposed through out-sourcing;

ii. application of NBN is not sufficiently tailored to requirements;

iii. insufficient internal promotion of the use of NBN. Even where applications are available there does not appear to have been sufficient promotion and potential users are often wedded to alternative, less evidence-driven, mechanisms;

iv. some of the pilots have highlighted that the data are insufficient to influence the operational decisions being made;

v. performance of some of the applications is too slow to be adopted by potential users.

1.6 The investment in the Biological Records Centre (BRC) at the Centre of Ecology and Hydrology (CEH) has delivered a lot of content for NBN, especially for the less intensively recorded species groups. However, the other aim of investment in BRC was to produce primary analyses of the data that would a) contribute to reporting needs (e.g. for country biodiversity strategies and the Habitats Directive) and b) produce evidence of the factors affecting biodiversity.

1.7 JNCC's investment in BRC has led to some preparatory work to improve the value and potential for applying the data (e.g. publishing species attribute information, developing analytical tools, and investigating modelling methods) but the outputs most visible to users have remained atlases or simple on-line equivalents to atlases.

2. Potential

2.1 There is an opportunity to further streamline the data access function. On-line recording could have a big impact in reducing the collation and validation time for volunteers, the scale of the NBN function, and helping remove the duplication caused by schemes relying on traditional working practices and BRC support. There are further opportunities for efficiencies by looking at the way in which the NBN Trust is operated and run as an umbrella for this access activity.

2.2 In addition, having an efficient collation and reporting mechanism is particularly important for the evidence strategy to underpin the detection and spread of non-native species. This is also being taken forward through the NBN and BRC investment.

2.3 There is strong potential to get both reporting and primary evidence that can be rapidly repurposed for application to policy. This is primarily through a) the development of habitat and functional attributes, allowing species to be grouped effectively in analyses, and b) through the development of statistical methods that can be applied to the large volumes of data now available in a consistent format.

2.4 The main advances in methods, including pros and cons, are covered in Annex 2.

2.5 The potential of new analytical methods is illustrated by the following examples:

i. *Phytophthora* is a fungal disease of plants. Modelling of the distribution of host plants, to provide accurate fine-resolution

distributions from coarser data, has directed monitoring of the disease, and supported research into the potential scale of impact on conservation objectives. The analysis was done in less than a week;

ii. BICCO-Net is a Defra-funded research project that has shown, for the first time, how abundance is related to climate change for a range of species (birds, bats, butterflies, plants, moths, aphids). The results will start to become available from autumn 2010. Combining these results with trends from biological recording data and attributes derived from the BICCO-Net analysis for several thousand species could strengthen the assessment of functional links, e.g. pollinator, detritivore, and hence be much closer to providing evidence on the impact of climate change on ecosystem services;

iii. evidence to help determine the scale of air pollution impact on nature conservation objectives has been assisted by plant and bryophyte characteristics produced by BRC combined with modelling. Biological recording/atlas data sets have shown positive links between pollution and species loss that can be related to changes in the condition of a range of habitats. This work is due to report in October 2010;

iv. JNCC has developed methods that allow changes in distribution for several thousand species to be quantified and related to land cover. By assessing the faithfulness of each species to land cover types, it then becomes possible to make an assessment of species trends by land cover types and compare land cover types.

2.6 The potential for application of biological recording data and NBN in the UK extends well beyond these few examples, and more work is now needed to explore how the advances could be applied to other areas of business, particularly the more operational ones. Extending application of the use of biological recording data along the lines proposed below is very much in line with the direction advocated by the new NBN strategy and could help to guide NBN in implementation of its strategy:

i. **strategic planning**. At present biodiversity planning within a country is developed at a regional or sub-regional scale (e.g. Natural Character Areas in the case of Natural England). Some use is made of data in developing these plans but it is likely that significantly more benefit could be extracted, such as looking at general trends within individual areas, as well as combining trends across land cover types as a whole and developing models (e.g. of expected species distribution given dispersal potential, habitat connectivity or anticipated shifts in distribution in relation to climate change);

ii. **local planning.** While the data are already being applied to general planning assessments their use in awarding agri-environment subsidies has been less successful, particularly as a result of the patchy nature of the observational data and the relatively small areas being assessed. More work is needed here to assess whether it is possible to use modelling techniques to compensate for the patchy data or to provide confidence maps to assist in the interpretation of the data, and also to assess the extent of the difference the application of the data could potentially have made to the final awards. There is also potential to use similar mapping, combined with some of the

techniques developed within the strategic planning, to help local authorities design appropriate biodiversity offsetting.

iii. **assessing impact of action**. Another potential application will be assisting with assessing the outcome of action being undertaken. This is typically monitored through more specific mechanisms (e.g. Common Standards Monitoring or the monitoring programmes initiated to assess the impact of agri-environment schemes). However, it is possible that the more general data available through the NBN (alongside that from more organised surveillance schemes) could complement these by providing a context and hence allow them to be more focused by risk, thereby reducing costs. Some work has already been initiated here to look at trends in moths at locations within and outside SSSIs. It would also be interesting to explore whether the application of the data to areas such as Habitats Directive reporting can be improved.

2.7 Overall the recommended proposal is for JNCC to initiate a programme of work to link closely with the UK country conservation bodies and look at a range of areas of business and explore how the available data and techniques can be adapted to improve either the efficiency of the operations or the quality of the outcome. The strategy will make increased use of the analytical capacity within CEH through the current BRC contract.

3. Options

3.1 There are a range of options for the focus of the forward JNCC/NBN investment:

i. ***More focus on priority species***
Many of the current country conservation body priorities in terms of operational decisions and reporting obligations revolve around priority species. Focusing data access on these priority species would reduce some overheads but would actually create others, such as ensuring that the correct records are extracted from much broader collations. However, more critically, it severely limits the potential use of the data. Priority species are by their nature generally rare and potentially susceptible to specific changes in environmental conditions. As a result they are unlikely to be applicable to more general problems such as the development of a good general suite of indicators of change in the wider environment or allowing detection of the potential drivers of that change.

ii. ***Continue to focus on building content for a broad range of species***
This approach means that the investment through NBN/BRC focuses on the efficient mobilisation and publication of a broad range of species records. Given the techniques that have now been developed this could provide a more general ability to detect change in the environment, identify possible drivers of that change, and potentially help direct any new surveillance that would more specifically test or monitor the impact. It should be stressed that this option focuses purely on the provision of the raw species data – the job of developing methods, verifying them with experts, as well as assessing the

potential application to policy would fall to the country conservation bodies.

iii. ***Focus on a broad range of species and the production of primary evidence from the raw data***
This option is an extension to option ii. that also provides for the generation of primary evidence from the raw biological recording data. This would include the development of potential techniques, verifying the outputs with experts, erection of additional hypotheses and developing ideas on how the methods could be applied to more general problems (e.g. ecosystem services, biodiversity offsetting, etc). The application to policy would remain a country lead although JNCC could provide an advisory role on how the available techniques could be applied to specific areas as well as generally keeping partners aware of the emerging methods (e.g. through workshops). In addition, the JNCC function could help to spot opportunities and applications of the data/techniques at the UK and potentially EU level.

3.2 There are significant advantages in adopting option iii., specifically:

i. the analytical power will be greatest at a UK scale and this will provide added value regardless of the scale at which the results are finally applied;

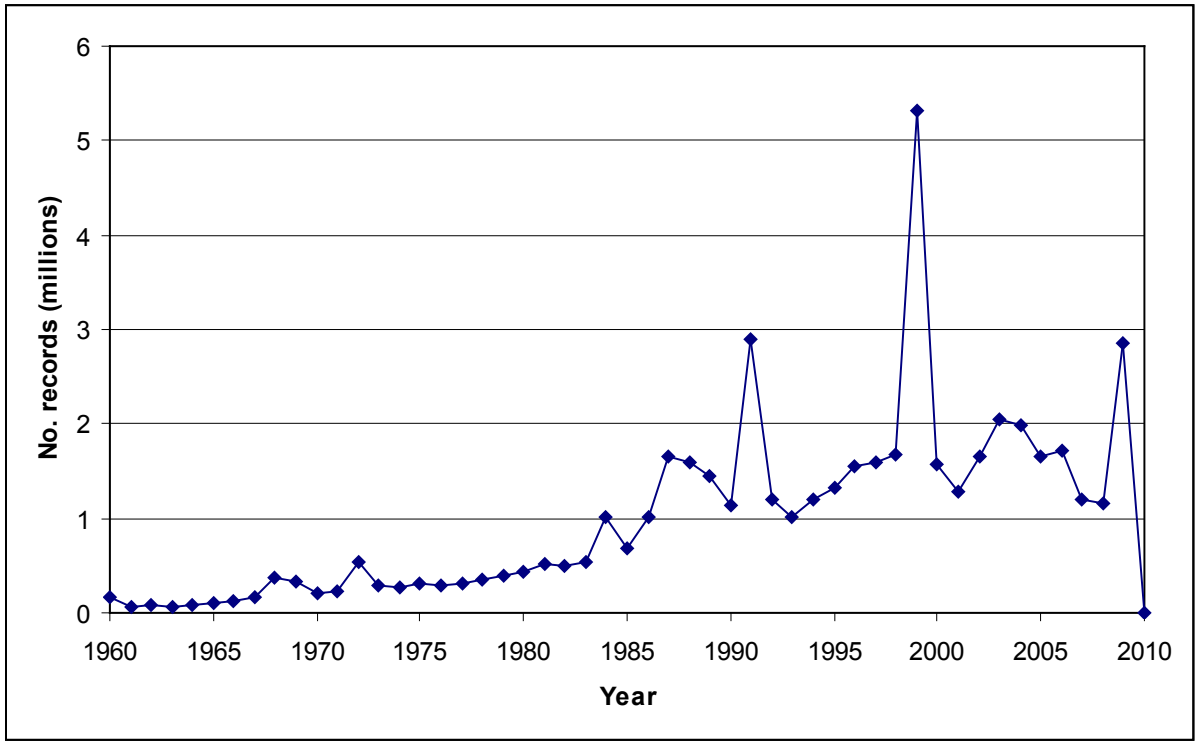
ii. it is efficient – the development of the methods and techniques is relatively time consuming and therefore best undertaken once;

iii. it gives the best chance of realising the true value of the data.

Annex 1. Summary of the data currently available through the NBN Gateway

1. **Summary of the data available through the NBN Gateway showing the number of records made each year**

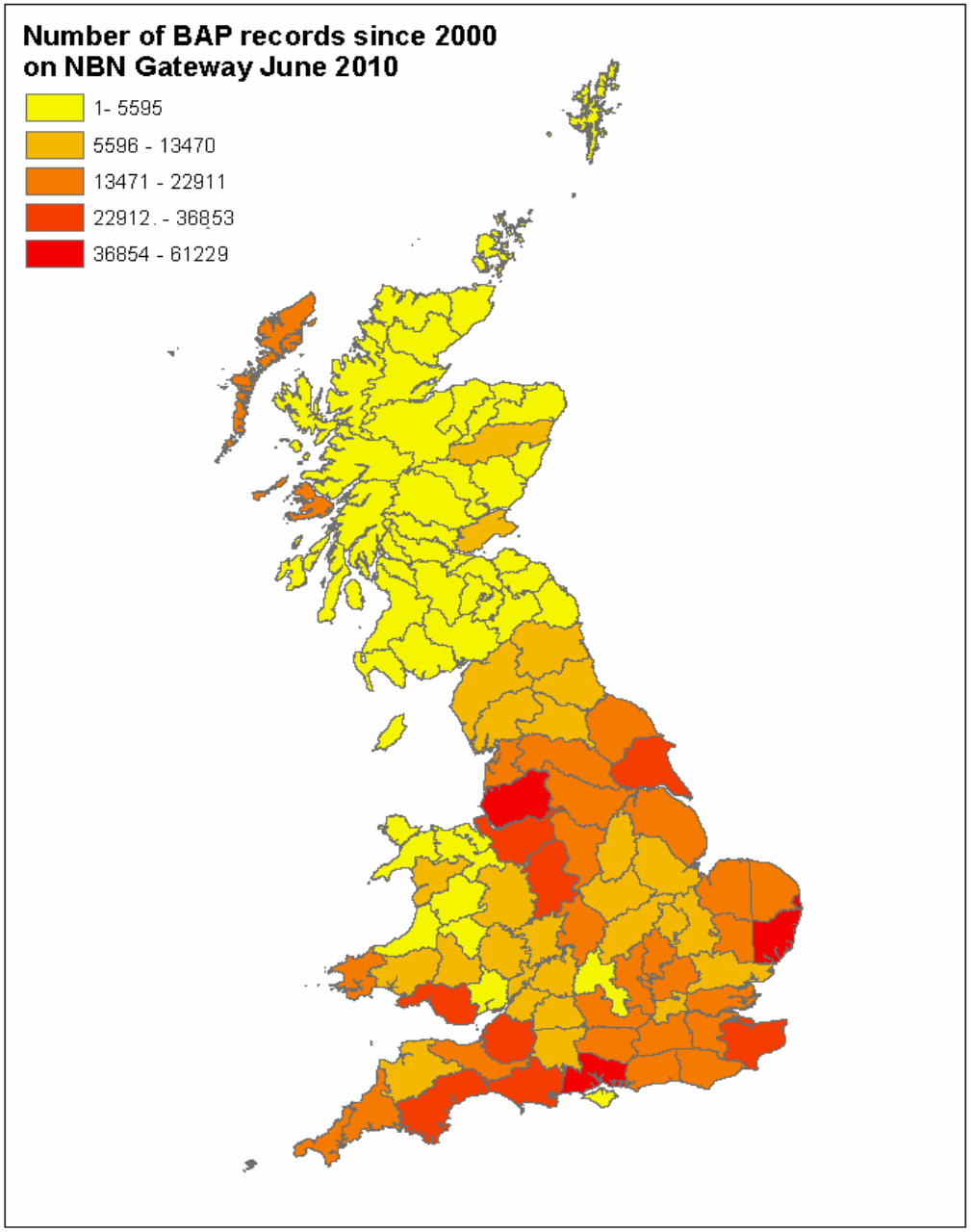
Note that at least 1 million records are available for each year back to 1986.



2. **Summary of the coverage of BAP species through the NBN Gateway**

Number of BAP taxa:	1150
Number of BAP taxa with records on NBN Gateway: (Centipede *Nothogeophilus turki* has no records)	1149
Number of BAP records:	2,941,568
Number of BAP records from 2000 onwards:	1,263,816
Number of BAP records from 2000 onwards (>=1km)	1,233,890

3. **Spatial distribution of BAP-listed species records made since 2000 which are available through the NBN Gateway**



Annex 2. Emerging applications of the NBN data

This annex provides more details on the various methodologies that have been developed to apply to the data now available through the NBN.

1. Mapping recorded species distributions

1.1 This is the simplest use of data from NBN but still potentially useful for certain pieces of casework and also for providing broader geographical context for a species or the ecosystem/habitat it is associated with. In essence, the detailed locations where one or a number of species have been recorded are displayed on a map along with additional contextual information such as the boundaries of protected sites.

1.2 The technique has been used by CCW, SNH and NE within their internal systems to display NBN data to staff. It has also been used by SNH and CCW to display the data for external consumption through their own websites.

Pros

i. easy to produce and provides whatever detailed information is available on a species of interest with a specific geography;

Cons

i. obviously prone to gaps in sampling effort or other.

2. Geographical weighting by species records

2.1 This methodology essentially uses a count of species of interest within a particular geographical area as some form of weighting for that area. It is often used used in combination with other relevant sources such as presence of particular habitats, overlap with protected sites, etc.

2.2 This technique has already been applied in a couple of areas. Natural England have used it regionally and locally to inform agri-environment targeting. JNCC have also applied the methodology to produce a tool to assist with the identification of priority stretches of river.

Pros

i. very simple technique to rapidly apply to give an overview of the relative importance of a geographical area;

Cons

i. very influenced by sampling effort – in its raw form the technique does not take into account the extent to which an area has been sampled;

ii. biased by the species selection made – in particular they often rely on BAP listed species which may not be the best measure of condition of an area.

3. Trends in range size and occupancy of a species

3.1 Assessing the range of a species (and changes in range) can either consider the range occupancy by counting the squares that the species has been recorded in or consider the range size by drawing a polygon around all the points where the species has been recorded. There are a number of methods for producing the polygons for assessing range size, and these vary in their sensitivity to outliers.

3.2 Both of these techniques (size and occupancy) have been used in Habitats Directive reporting, although the occupancy measures can only produce a rough proxy for population size. The techniques have also been applied during the review of UK BAP priority species, assisting in identifying those species that are undergoing rapid declines. A variant of these measures, specifically assessing shifts in range margins (independently of range size and occupancy), has also been used in assessing impacts of climate change, and is being considered within the Streamlining European 2010 Biodiversity Indicator set.

Pros

i. square counts are simple and easily understood;

ii. alpha shapes provide an intuitive measure of range;

iii. can be produced for all species regardless of frequency;

Cons

i. very prone to variation and geographical bias in recording effort and hence requiring expert involvement in interpretation to ensure that results accurately portray the situation;

ii. alpha shapes are strongly influenced by the value chosen for alpha – exploratory analysis is needed to select meaningful values.

4. Trends in frequency of recording

4.1 The best method of determining change in the abundance of species is through systematic sampling using identical methodology at the same places over an extended period of years. There are a number of such schemes already in place but the taxonomic coverage is limited (primarily birds, mammals and Lepidoptera). The NBN provides access to a taxonomically wider data source but the data have been collected in an *ad hoc* manner with considerable geographical and temporal variation which obscures any signal in trends of the species. JNCC has attempted to extract the trends in the frequency with which a species is recorded by compensating for the sampling effort.

4.2 At present there are no operational applications of this technique. JNCC are looking at verifying the outputs it produces for the emerging national moth recording scheme dataset and comparing with the results from the Rothamsted light traps.

Pros

i. potentially allows the production of trends across a huge range of species;

Cons

i. the *ad hoc* nature of the data means that only large changes are likely to be detected;

ii. requires a relatively large volume of data over a reasonable period of time (e.g. 20 years);

iii. cannot be used for rarer species, and hence not suitable for much BAP reporting;

iv. care needed to avoid pitfalls in interpretation (e.g. as a result of taxonomic changes) and so requiring expert involvement.

5. Species categorisation

5.1 The ability to categorise species by habitat association, life style traits, and sensitivity to environmental factors (e.g. Ellenberg indicator values) is extremely useful when interpreting other analyses. For example, one can take the results from the "trends in range" or "trends in abundance" type analyses above and aggregate them according to some categorisation of the species to ask questions such as: what proportion of species associated with the various broad habitats are increasing/declining? This may give some insight into the factors driving such changes. Similarly, categorisation can provide further insights from other analyses, such as spatial analyses of species data against pressure data. Many such categorisations have been attempted (deadwood indicators, BAP species/habitat associations, PLANTATT, Natural England's ISIS, etc). Most of these are based on expert judgement, although the larger collations of multiple attributes (Plantatt, Bryoatt) provide summaries of field-based observations, species biology and distribution modelling as well as expert judgement.

5.2 Recently the technique was used to identify potential habitats on farms (on the basis of the species recorded there) and suggested options for those species.

Pros

i. simple and intuitive interpretation, i.e. how much more likely a species is to occur within a category than would be expected by chance;

ii. possibility of validating or challenging categorisations based on expert judgement;

Cons

i. None.

6. Spatial and temporal correlations with pressure data

6.1 It is increasingly necessary to relate species distributional data to the environmental pressures that may be driving distributional change. Analysis tends to be complex, requiring Generalised Additive Models, but can be highly informative.

6.2 Usage of this kind of analysis is still limited though growing, with limitations mostly arising from the complex nature of the analysis required. Recent work considering the spatial and temporal impacts of air pollution has utilised a Generalised Additive Model to consider the significance of a range of impacts on species. This can be further used to project likely future impacts.

Pros

i. can be used to understand current and likely future impacts;

Cons

i. analytically complex – cannot be used as a routine tool, instead requires occasional dedicated research to be resourced.

7. Species distribution modelling

7.1 The distributions of many species are poorly known as a result of limited or unbalanced recording but knowing the true distribution is critical to managing them effectively or in understanding likely responses to land use change and trends in environmental pressures. JNCC has attempted to use Species Distribution Modelling which uses the known occurrences of a species combined with a set of environmental layers (e.g. topography, land cover, climate, soil) to predict where a species is likely to occur. The technique works particularly well for species which are strongly associated with environmental factors which are well mapped.

7.2 Distribution modelling is being used to understand the likely impacts of the spread of novel *Phytophthora* species, and in targeting surveillance of the host species.

Pros

i. can rapidly produce 'potential distribution' of species from known occurrences;

ii. often works well where known occurrences are scattered over the range and the species has strong habitat associations;

iii. prediction accuracy for ‘good’ models is typically around 70-75%;

Cons

i. extrapolation of models beyond the fitted range of the environmental layers (temporal or geographical) is often very poor. Therefore use to predict spread of invasive species or responses to climate change is dubious;

ii. may or may not work well for the species where it would be most useful (e.g. BAP priority species).