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The development of a lowland heathland structured species surveillance partnership and sites network

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Foreword

Natural England commission a range of reports from external contractors to provide evidence and advice to assist us in delivering our duties. The views in this report are those of the authors and do not necessarily represent those of Natural England.

Background

The cultural and conservation value of lowland heathland is well recognised across Europe. The quality of lowland heathland is ultimately largely a function of the different kinds of species found there, and many species typically associated with this habitat are rare or rapidly declining. The Biodiversity 2020 Strategy aims to protect many of these species, and effective national monitoring and surveillance programmes are necessary to understand their population status and trends. Structured surveillance with volunteer recording communities is one potential approach.

Species taxon-group-based monitoring programmes using volunteers have been successful in providing evidence of the trends in biodiversity (for example, Breeding Bird Survey (BBS), UK Butterfly Monitoring Scheme, National Bat Monitoring Programme). They have also provided some multi-taxa sampling at the same locations (for example, mammals collected at BBS sample locations; other insects collected at Wider Countryside Butterfly Survey locations).

However, to enable reporting on the quality of habitats and to broaden the taxonomic scope beyond groups with a large pool of volunteers (for example, beyond birds, butterflies and bats) there is a need to expand and develop volunteer-based surveys.

A *habitat* focus to structured species surveillance offers the possibility of networks, with multi-taxa surveillance, using existing volunteers. Co-locating habitat and species surveillance also has other potential advantages, such as the ability to relate habitat structure and quality to species changes, and to help understand the impacts of a series of environmental drivers.

The aim of this work was to explore the feasibility of establishing and operating a national species surveillance network for lowland heathlands across England that could co-ordinate and support recording activity.

The results will inform the future development of organised and integrated surveillance networks that can monitor trends in the status of threatened species and habitats, to support a variety of both national and local reporting requirements.

Natural England Project Officer - Kat Woods, Reptile and Amphibian Specialist, Parkside Court, Hall Park Way, Telford, TF3 4LR **katharine.woods@naturalengland.org.uk**

Contractor - D B Roy, Biological Records Centre, Centre for Ecology and Hydrology

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Roy, D.B., Cruickshanks, K., Peyton, J., Marshall, H., Lake, S., Freeman, S., Redhead, J., Botham, M. & Roy, H.E.

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Introduction

Lowland heathlands

Lowland heathlands are typically dominated by ericaceous dwarf shrubs on infertile, acidic soils occurring at altitudes below 250 m. Their origin and maintenance is the product of a long-history of human utilisation, including grazing, burning and cutting of both vegetation and turf. As such they are considered an important cultural landscape (Webb, 1998). Moreover, this long-history of human intervention has resulted in open and variable vegetation communities supporting a wide range of rare plant and animal species that are often unique to this habitat (Farrell, 1989). In the last 200 years agricultural intensification and land use change have resulted in the loss and fragmentation of over 80% of lowland heath in the UK (Anon., 2006) and similar reductions throughout Europe, so that today only 350,000 ha remain (Diemont et al., 1996). These losses have been further accelerated by the post-war cessation of traditional management practices resulting in invasion by scrub and bracken (Mitchell et al., 1997), as well as increased atmospheric nitrogen deposition encouraging invasion by grasses (Heil and Diemont, 1983). Despite this, the UK retains a significant proportion (20%) of the international total of this threatened habitat (Anon., 2006).

The cultural and conservation value of lowland heathland is now well recognised across Europe. The UK Biodiversity Action Plan required that, as well as protecting the remaining heathland, a further 11,352 ha of this habitat are re-created by 2030. Protecting existing heathland and restoring the extent remains a priority. Agri-environment schemes (AES) are a key mechanism for delivering these objectives, comprising voluntary agreements with farmers and other land managers which reward habitat creation and environmentally-sensitive management associated with traditional, extensive farming practices (Ovenden et al., 1998). However, there is evidence that current techniques to restore heathland on farmland under AES (option H03) are often ineffective (Walker et al., 2004) and their uptake is poor (Natural England, 2009). Uptake for restoration of heathland within AES forestry options (HO4) is markedly higher (~4 times), although its effectiveness has not been formally evaluated.

Effective monitoring programmes are required to assess the success of ambitious targets and aspirations for improving the quantity and quality of heathlands in England. Structured surveillance through partnership with volunteer recording communities is one potential approach to delivering the evidence base needed to underpin advice required by the Natural England Evidence Programme.

Structured surveillance through partnership using volunteers

Species monitoring programmes using volunteers have proven successful in providing evidence of the trends in biodiversity (e.g. Breeding Bird Survey, UK Butterfly Monitoring Scheme, National Bat Monitoring Programme), and provides some multi-taxa sampling at the same locations (e.g. mammals collected at BBS sample locations; other insects being collected at Wider Countryside Butterfly Survey locations). General biological recording data collected by volunteers has also demonstrated the effects of major environmental pressures. For example, evidence for a widespread northward of shifts in range margins of a number of species groups (Hickling et al. 2006, Chen et al. 2011) has provided some of the clearest indicators of the biological impacts of climate change. Atlas data has shown comparative declines in bird, butterfly and plant distributions (Thomas et al. 2004), suggesting that recent population declines may exceed historical rates. As a final example, parallel declines in pollinators (bees and hoverflies) and insect-pollinated plants in Britain and the Netherlands (Biesmeijer et al. 2006), measured from general biological recording data, suggest a threat to pollination services. However, there is a need to expand the value of volunteer-based, participatory surveys to enable reporting on the quality of habitats and to broaden the taxonomic scope beyond groups with a large pool of volunteers (e.g. beyond birds, butterflies and bats). A habitat focus to structured species surveillance offers the possibility of a manageable number of networks, with multi-taxa surveillance using existing networks of volunteers. Co-locating habitat and species surveillance has many potential advantages, including the ability to relate

habitat structure and quality to species changes, and understanding the impacts of a series of environmental drivers.

To achieve these potential benefits, however, requires a well-designed statistical approach to provide robust measures of change and an effective partnership with the voluntary recording network to gain support from participants and to deliver sufficient samples. The first pilot to test this approach is underway for ponds (led by Freshwater Habitats Trust (formerly Pond Conservation) and the Amphibian and Reptile Conservation Trust), and this proposal aims to undertake a comparable trial for heathlands.

Aim of this project

The objective of this project is to explore the feasibility of establishing and operating a national network of lowland heathlands across England that can provide a focus for recording activity by volunteer biological recorders across all relevant taxonomic groups. This trial tests the following aims of a network:

- Make use of and build on existing networks and initiatives;
- Cover the range of lowland heathland types;
- Cover the interests of a range of key taxonomic groups;
- Optimise the use of existing volunteers and build additional capacity;
- Provide the basis of an excellent set of feedback products to recorders;
- Contain enough sites to meet the needs of national and local trend detection.
- Provide the basis for reporting on biodiversity outcomes for local, national and European purposes.
- Enable causes to be linked to observed change.

Building the Network of partners

The network of partners was established through a series of discussions with key potential partners and via a workshop held on 14th February 2012 at CEH Wallingford (Appendix A). Discussions were to promote the aims of the project, and to identify issues that may prevent, deter, or encourage these organisations to participate in the network. The workshop specifically considered:

- If such a network would be useful to them;
- What they would like to see in terms of habitat coverage;
- How such a set of sites would be selected and stratified;
- How volunteers can be involved in the surveillance;
- What outcomes they would like to see from the network;
- Who should coordinate the network development and implementation;

The partners involved in discussions via email or at the workshop are given in Appendix B, together with the meeting agenda and feedback.

Design of a heathland species monitoring network

The fundamental principle behind the network design is the ability to quantify, with statistically robust estimates, the stock and change in heathland-dependent species of particular concern.

The network design has therefore considered:

- Different approaches to sampling– e.g. different sample units (e.g. individual sites, 1km squares), stratification and random sample design,
- Different statistical approaches and methods – e.g. detecting change in occupancy of sites by species vs detecting changes in abundance of species; power analysis to determine network size; use of re-sampling techniques
- Securing adequate coverage of the range of taxa associated with lowland heathlands
- Co-incidence mapping of species records of particular concern at different sites
- National as well as local reporting requirements on stock and change of species
- Securing adequate coverage of lowland heathland habitat types as well as species
- Other factors arising from discussions with stakeholders

Coincidence Mapping

Coincidence mapping was undertaken to establish the extent of overlap in the occurrence of Heathland-associated species. Data were obtained from the following national recording schemes and societies:

Botanical Society of the British Isles - Vascular Plant Database
British Dragonfly Society
Spider Recording Scheme
British Bryological Society
Bees, Wasps and Ants Recording Scheme
British Myriapod and Isopod Group
Coleoptera
Diptera
National Moth Recording Scheme
Orthoptera Recording Scheme

Identifying Heathland-associated species

Distribution data were filtered to include only the presence of a species in a 1 km x 1 km ordnance survey (OS) grid cell (from here on referred to as a 1 km cell). A GIS layer of lowland heathland was obtained from Natural England and analysed in ArcGIS (v 9.3.1) to obtain a dataset of proportion of lowland heathland (Figure 1) for every 1 km cell in England. This dataset was then exported to R (v2.14) for further analyses.

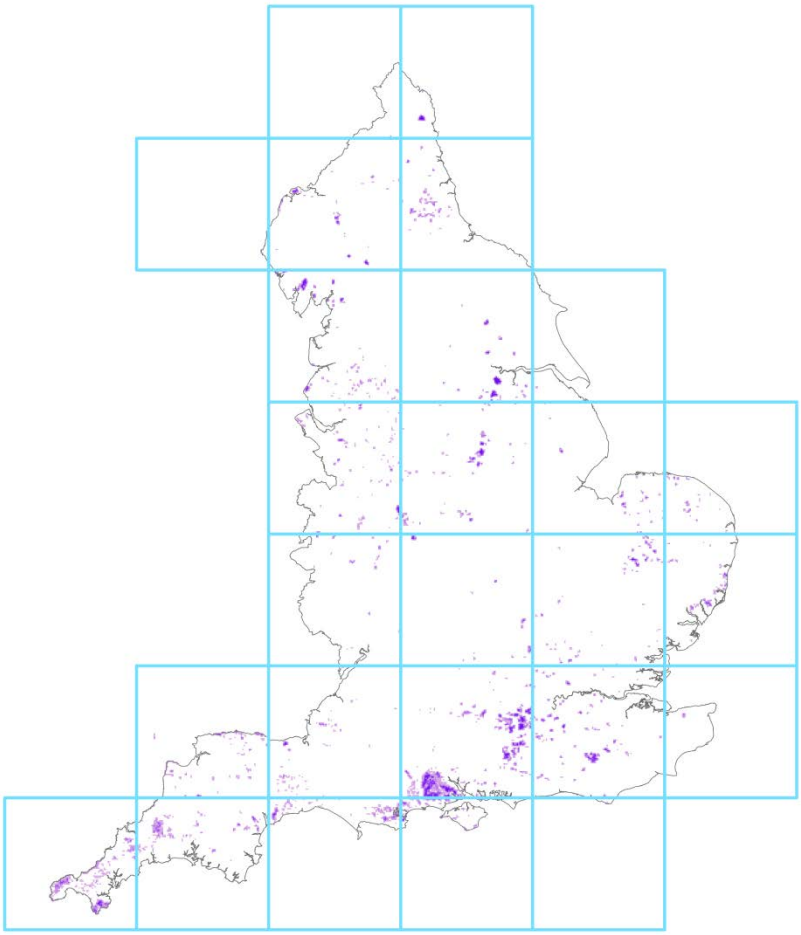


Figure 1. Lowland Heathland cover per 1 km x 1 km ordnance survey grid cell (from white = absent to purple = 100% cover). Also shown are 100 km x 100 km lines of the Ordinance Survey grid system (blue borders).

For each species in the distribution datasets, this lowland heathland dataset was combined with the species presence data to obtain a dataset giving a unique identifier to every 1 km cell in England, along with presence or absence of the species and the proportion of lowland heathland. To distinguish 'genuine' absences for a 1km cell, as opposed to pseudo-absence generated by low recorder effort, a threshold of species detection was applied. Cells in which more than five species from the same group or recording scheme as the species concerned were recorded were assumed to be genuine absences (i.e. had the species been there, it is likely that it would have been recorded), whilst others were removed from the dataset.

Since species association with a particular habitat may vary with the location in the country (due to climate, presence of other species, or variations in availability or condition of the habitat) the data was analysed on a regional basis, by splitting the dataset into 100 km by 100 km blocks (from here on referred to as a 100 km region). Regions where a species was relatively scarce (less than 30 of each of presence and 'genuine' absence records) were not analysed further due to insufficient data points to estimate a trends. For each region, a logistic regression was performed, fitting presence/absence to proportion of habitat in 1km cells. The T values of these regressions were then designated to represent a regional habitat association score. Mean habitat association scores were then calculated from all 100km regions. A further alternative score was derived from the T value of a single logistic regression fitting presence/absence to proportion of habitat in 1km cells across all England.

Species coincidence

The species most strongly associated with lowland heathland are given in Appendix B. There is a spatial relationship between the presence of species with an association value (T-value greater than 10) and the percentage cover of lowland heathland per 1km square (Figure 2). This map should be considered provisional, however, given limitations of this approach for identifying species characteristic of heathland habitats. One clear limitation is the spatial habitat layer used for this analysis, and the spatial resolution of distribution data to assess co-occurrence. In general, the approach has worked well but known heathland specialist species have a lower score than expected; in contrast generalist species which occur within heathland have tended to receive an inflated score. A potential limitation of the spatial layer of Lowland Heathland parcels is that they do not distinguish between wet and dry heathland. Many invertebrate and lower plants have a clear association for these different elements of Lowland Heathland, however. Despite these potential limitations, this analysis illustrates a promising approach to an objective classification of typical species of heathland and should be extended before a Lowland Heathland Species Surveillance network is implemented. A potential improvement would be to repeat the coincidence analysis using an improved spatial layer of heathland sites (e.g. separately identify wet versus dry heathlands). An alternative approach is to 'cluster' distributions (Hill et al. 2013) to identify groupings of species by habitat (and micro-habitats).

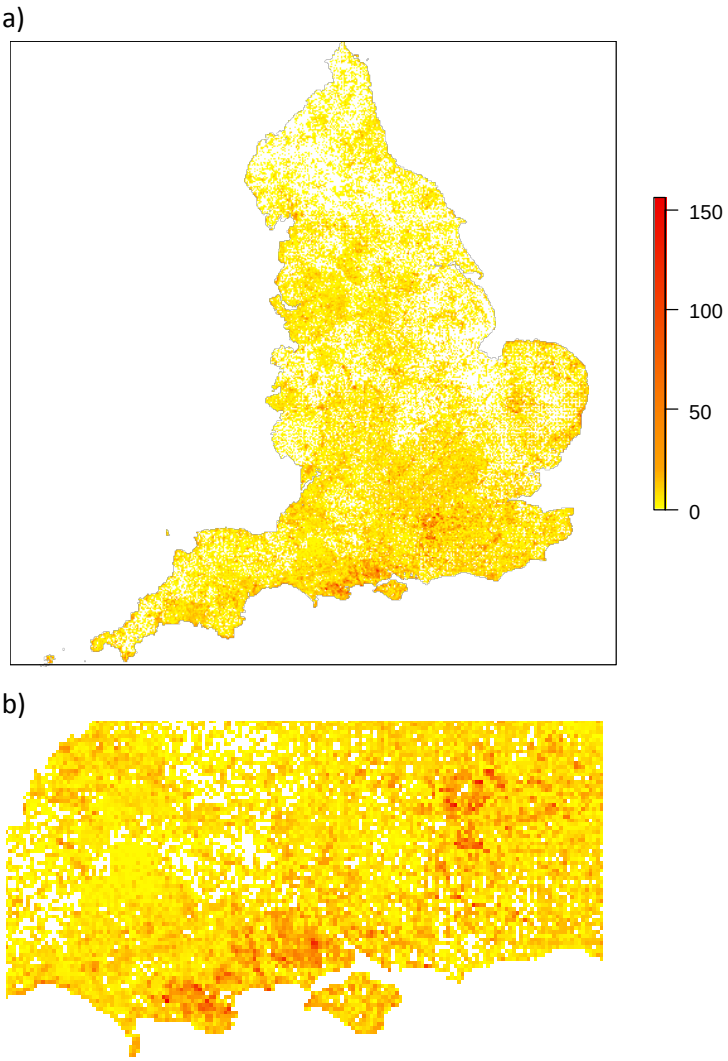


Figure 2. Coincidence of heathland associate species. The scale indicates the number of species present per 1km x 1km grid cell. a) England; b) area of southern England.

A map of the spatial coincidence of heathland associated species would provide the basis for selecting squares to sample if a formal scheme were implemented following the field trial for this project in 2013 (See results of field trial, page 27). To encompass the full variation of heathlands, 1km squares would be selected at random (within strata) from squares with some heathland-associated species (i.e. to encompass locations with low vs high species richness. However, the selection of squares would be weighted towards squares with a high coincidence of heathland-associated species to stimulate uptake from volunteer recorders (i.e. recorders are likely to favour recording of rich locations).

Power analysis

Analyses of the statistical power of a range of datasets was undertaken to detect trends in species occurring on heathland. The datasets were selected to represent a range of possible scenarios of likely sampling approaches and measures of change (Table 1). Factors were combined to define scenarios to be tested, including: counts vs frequency measures; multiple vs single sampling visits within a year; individual species/groups of species/species richness/indicator measures.

Scenarios tested for counts (abundance estimates) of individual species included multiple samples through the season as well as for a single sample taken at an optimal time of the season. Measures of frequency of occurrence were also tested. These were derived from presence/absence data from multiple sampling visits through the year, or multiple sample plots from a single sampling visit at an optimal time of the year. Similar scenarios for counts or frequency of groups of species were also tested. Finally, scenarios were tested for summary, community measures such as species richness or indicator scores.

Scenarios of recording were tested using the following datasets, that together enabled the full spectrum of options to be assessed. Datasets were chosen for their coverage of heathland and accessibility (i.e. could be obtained in a standardized format in the limited time available for analysis):

1. UK Butterfly Monitoring Scheme (UKBMS)

   The UK Butterfly Monitoring Scheme comprises a network of fixed route sites across the UK where butterfly counts are made over the season using scientifically validated methodologies. The data is used to derive annual relative abundance indices for each species at each site, which are then combined to derive individual and multi-species indices and trends. The broad purpose of the UKBMS is to assess the status and trends of UK butterfly populations for conservation and research. Current important policy and research uses of the data include butterfly indicators and assessment of climate change impacts.

   Within the UKBMS network there are 100 sites that sample lowland heathland. Of these, 40 have been recorded for the last 5 years, although 10 comprise non-transect sampling methods (e.g. timed counts). This leaves 30 sites for power analyses presented here. To illustrate power for species with different levels of affiliation to lowland heathland, we have focused on the following species: Silver-studded blue and Grayling (strong association), Small Copper (some association), Small white (generalist species).

2. West Sussex invertebrate survey (Mike Edwards)

   The West Sussex invertebrate survey was carried out in 2003/4 by Mike Edwards and Peter Hodge and included 38 lowland heathland sites across West Sussex. Surveys of each site involved the two surveyors spending a minimum of one hour and a maximum of half a day at each site recording the presence of invertebrate species and whether they judged them to be 'heathland indicator' species. Some of the survey sites were adjacent to, or very near, each other and so data from these sites were amalgamated to produce species presence/absence data across 33 distinct lowland heathland sites for use in this power analysis.

For full details see: Edwards M. & Hodge P. (2007) *Report on the Entomological Interest of West Sussex Heathlands*

3. Heathland plant surveys (Defra projects BD 1504, BD1507)

The heathland plant data combined surveys from two DEFRA projects covering 10 lowland heathland sites (BD 1504 = 6, BD1507 = 4). Surveys involved recording the presence of plant species within randomly placed quadrats (five 2 m x 2 m quadrats per site in BD 1504, six 50 cm x 50 cm quadrats per site in BD 1507). Ellenberg N scores, a measure of nitrogen preference, were extracted for each species from Hill et al. (2004). The data was used to calculate a mean Ellenberg Nitrogen value for each quadrat, as a potential measure of vegetation status (i.e. an increase in Ellenberg N value may indicate a loss of quality through eutrophication effects).

It should be noted that the plant quadrat datasets used here are derived from projects to monitor the effectiveness of agri-environment schemes aiming to restore heathland to land that was previously used for agriculture. The datasets may not represent high quality lowland heathland habitat and the power analysis should be interpreted in this context.

For full details see:
http://randd.defra.gov.uk/Default.aspx?Menu=Menu&Module=More&Location=None&Completed=0&ProjectID=12867
http://randd.defra.gov.uk/Default.aspx?Menu=Menu&Module=More&Location=None&Completed=0&ProjectID=8408

Table 1. Measures for power analysis.

Measure	Species			Sampling		Datasets included
	Individual species	Species groups	All species	Single sampling visit	Multiple sampling visits	
Count	Y	Y		Y	Y	UKBMS
Frequency (expressed as a proportion)	Y	Y		Y	Y	UKBMS
Species Richness	Y	Y	Y	Y	Y	UKBMS; M. Edwards
Mean Indicator value			Y	Y		Heathland reversion datasets

Methods

A series of power analyses were carried out, matched specifically to each scenario in Table 1, using the datasets described above to estimate the mean and variance for each of these scenario's measures (e.g. count). For each scenario we simulated how power varied when monitoring *i* heathland sites; and when the proportional change (e.g. in abundance) occurring over a ten year period was *p*. Here *i* = 5, 10, 15, 20, 30, 40, 50 sites and *p* = 5%, 10%, 25% and 50% increase or decrease.

Estimation of power to detect change over a period of years was based upon repeated Monte-Carlo simulation techniques (Morgan, 1984). Each Monte-Carlo simulation involved two general

steps: (1) using the datasets in Table 1 to simulate data from across *i* sites and with *p* change over a ten year period, and (2) simulating surveys of these sites across the same period and exploring whether these simulated surveys were able to detect the *p* change.

In the step one data were simulated across *i* sites in year 1 by randomly drawing from distributions defined by the mean and variances calculated from the datasets in Table 1. In all cases the distribution of simulated data was, in the first instance, compared against the distribution of the observed data sets to ensure a good match. Species richness and count data were drawn from a negative binomial distribution, and mean indicator value data were drawn from a normal distribution defined by the mean and variance of the log-transformed values in the data set before being back transformed. Proportion data were simulated by drawing from a normal distribution defined by the mean and variance of the log-odds of a species or group being detected at a site. These mean and variance of the log-odds did not, however, include sites where the odds were zero (as logging zero is not possible). Therefore, zeros were introduced at the observed probability by back-transforming the drawn log-odds and randomly setting them to zero based on a binomial distribution where the probability of being set to zero was equal to the proportion of sites where the odds of detecting a species or group were zero in the observed data. In all scenarios, these measures across *i* sites in year 1 were assumed to decrease or increase at a constant rate between years such that the difference between the measure in year 1 and year 10 represented the *p* proportional change. In scenarios using proportion data the simulated odds data were converted to proportions at this stage.

Step two simulated surveying each of these sites across the ten year period. Each survey was assumed to yield one measure per site and year. For scenarios using count, species, richness or mean indicator value data this survey measure was drawn from a Poisson distribution with a mean (μ) set at the value for the particular year and site simulated in step one. To test whether this simulated survey had detected the *p* proportional change introduced in step one, the survey data were analysed using a generalised linear model with a Poisson error structure and log link function including site and year as explanatory variables. A significant effect ($p < 0.05$) of year signified that the change had been detected. Scenarios using proportion data followed a similar process, adjusted for the differing nature of the data. The survey measure for each site and year was drawn from a binomial distribution with the probability of success set to the proportion simulated in step one and the number of trials set to 10. These simulated survey data were then analysed using a generalised linear model with a binomial error structure and logit link function. As before this model included site and year as explanatory variables and a significant effect of year signified the detection of the proportional change *p*.

In each scenario (Table 1) 2000 simulations (step one and two combined) were performed for each value of *i* sites and *p* proportional change. Power was calculated as the proportion of these 2000 simulations where a change was detected and could then be plotted as a function of *i* and *p*.

Results

Statistical power of 80% (0.8) is generally considered an acceptable level for assessing monitoring performance. The level of change to be detected is dependent on the target species and requirements of a monitoring programme. We use 25% or 50% change over 10 years as a pragmatic level at which to judge performance. We test the statistical power of a variety of sampling approaches and measures: abundance, frequency, species richness and community measures.

Abundance counts

In all scenarios, power was marginally higher for detecting declines than increases (blue data series on figures 3-8). Good statistical power was achieved for detecting declines in individual butterfly species when sampling multiple counts through the season. For three of the example

species (Grayling, Silver-studded blue, Small Copper), 25% declines are likely to be detected (>80% power) with as few as 5-15 sites. For Small White, approximately 45 sites are required to achieve comparable power (Figure 3, left-hand panel). Similar levels of power were achieved when only using data from a single sampling visit at the peak flight date (Figure 3, right-hand panel). Good levels of power were also achieved for counts of 'groups' of butterfly species (Figure 4). For the example of 'blues' considered here, as few as 10 sample sites are estimated to provide high levels of statistical power for detecting declines (25% declines over 10 years with >80% power). Similarly, detecting change in total butterfly numbers was also extremely efficient (Figure 5), with good power achieved for all levels of change (5% - 50%).

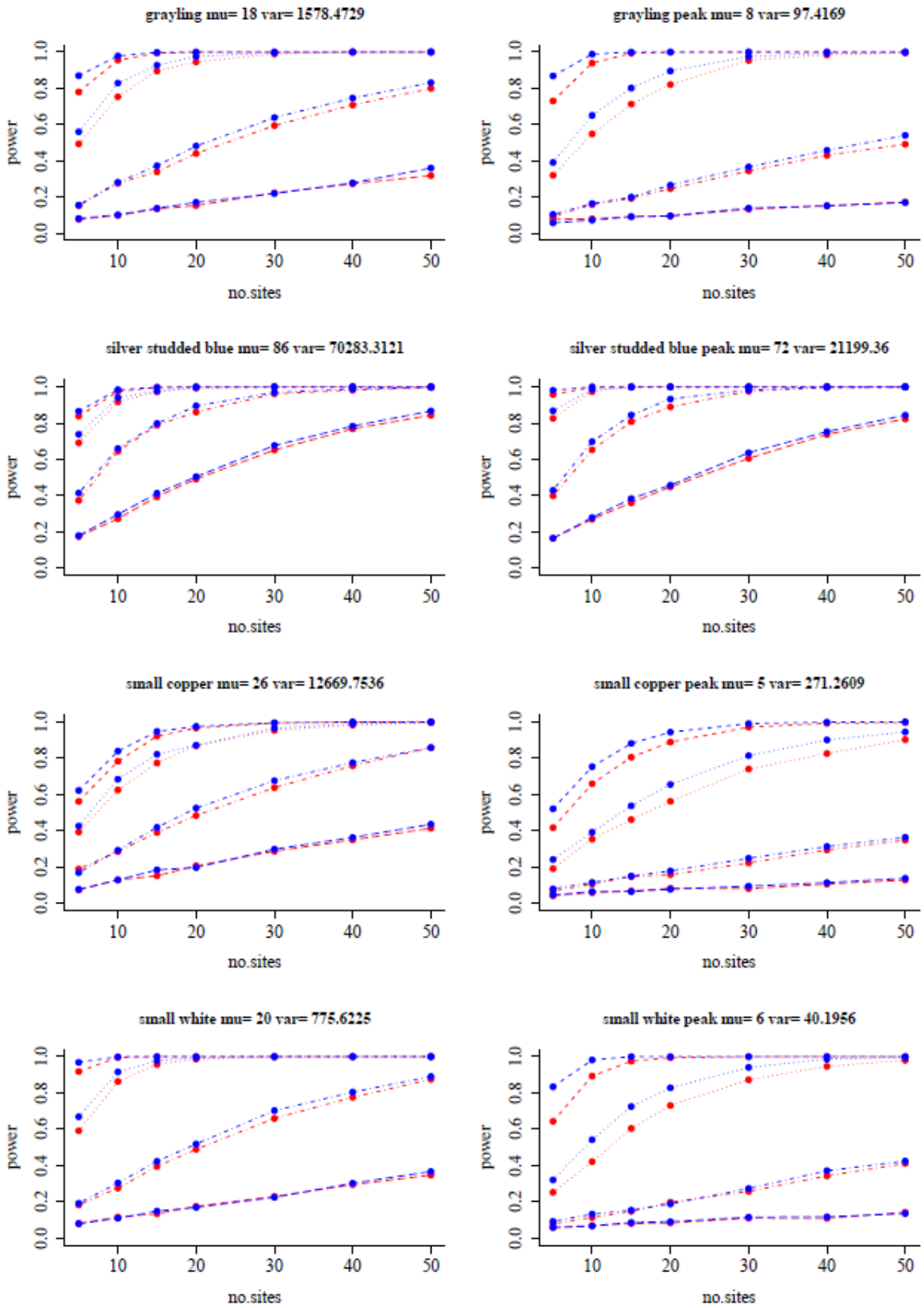


Figure 3. Power curves for *abundance of individual* butterfly species. Plots in the left hand column are based on abundance counts summed over multiple visits (April – October); the plots in the right hand column are based on counts from a single sampling visit at the peak of the flight period for each species. Each plot includes 8 data series, coded as follows: red lines indicate power for detecting increases; blue lines indicate decreases. Each pair of dashed or dotted lines represent the percentage increase/decrease; the top pair of lines represent a 50% increase/decrease, then 25%, then 10% and then 5%.

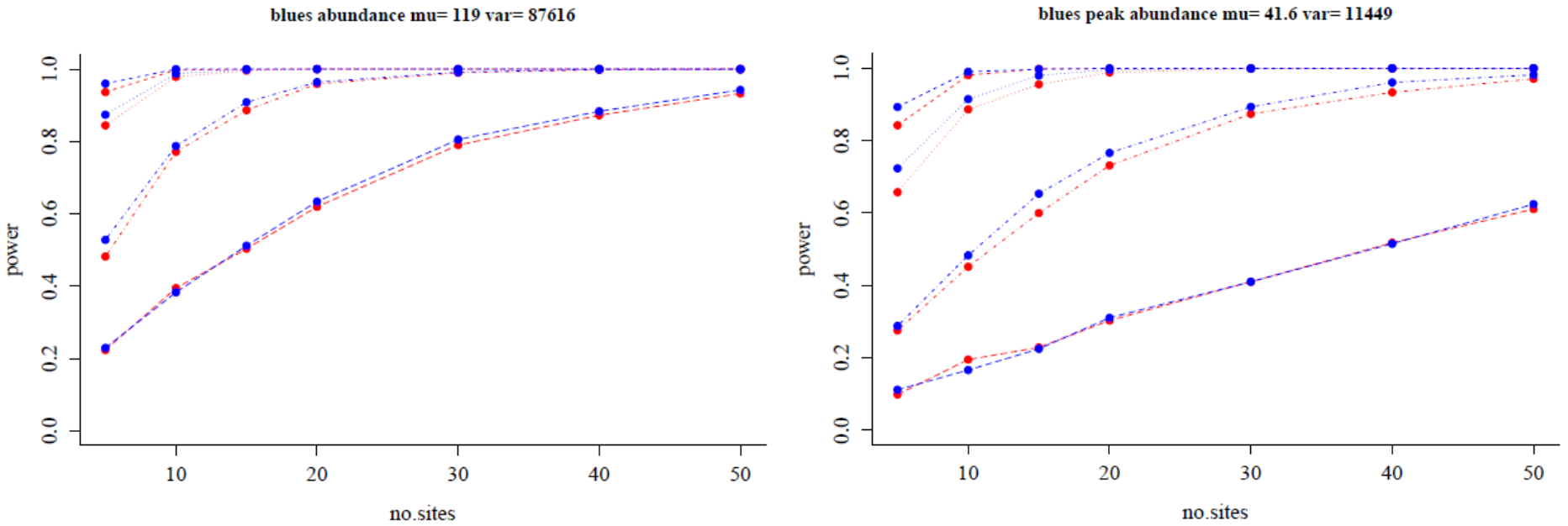


Figure 4. Power curves for *abundance of groups* of butterfly species, combing counts across blue butterflies. This grouping is for illustrative purposes, not to reflect a likely sampling approach for butterflies. The plot in the left hand column is based on abundance counts summed over multiple visits (April – October); the plot in the right hand column is based on counts from a single sampling visit at the peak of the flight period for this group of species. Each plot includes 8 data series, coded as follows: red lines indicate power for detecting increases; blue lines indicate decreases. Each pair of dashed or dotted lines represent the percentage increase/decrease; the top pair of lines represent a 50% increase/decrease, then 25%, then 10% and then 5%.

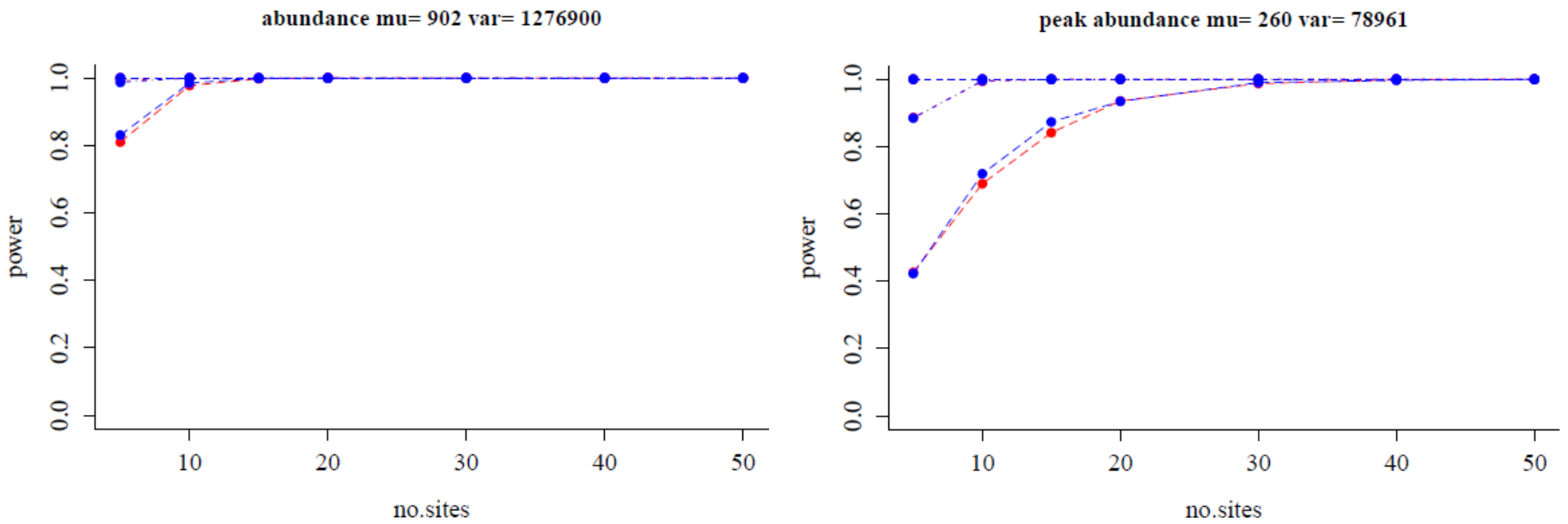


Figure 5. Power curves for *abundance of all* butterfly species, combing counts across all species. This grouping is for illustrative purposes, not to reflect a likely sampling approach for butterflies. The plot in the left hand column is based on abundance counts summed over multiple visits (April – October); the plot in the right hand column is based on counts from a single sampling visit at the peak of the flight period for this group of species. Each plot includes 8 data series, coded as follows: red lines indicate power for detecting increases; blue lines indicate decreases. Each pair of dashed or dotted lines represent the percentage increase/decrease; the top pair of lines represent a 50% increase/decrease, then 25%, then 10% and then 5%.

Frequency of occurrence

The power for detecting change in individual butterfly species was markedly worse when using data based on frequency (presence/absence with sample plots) rather than counts. Good statistical power was only achieved in one of the scenarios tested – good power (>80%) for detecting a 50% decline in Small White was achieved with approximate 45 sites (Figure 6). For Grayling, Silver-studded blue and Small Copper) more than 50 sites would be needed to detect declines of 50%.

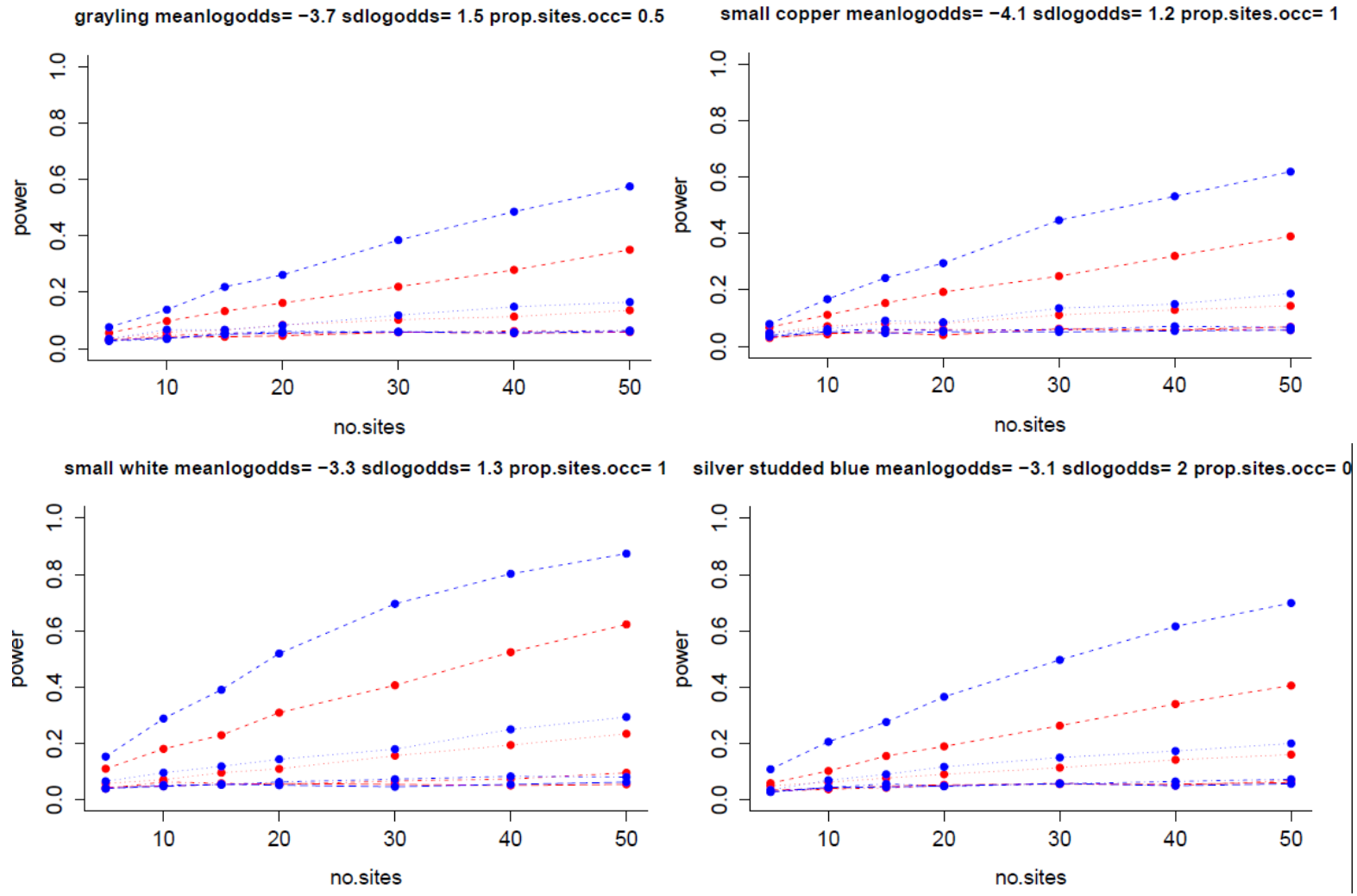


Figure 6. Power curves for *frequency of individual* butterfly species, combing counts across all species. The plot in the left hand column is based on abundance counts summed over multiple visits (April – October); the plot in the right hand column is based on counts from a single sampling visit at the peak of the flight period for this group of species. Each plot includes 8 data series, coded as follows: red lines indicate power for detecting increases; blue lines indicate decreases. Each pair of dashed or dotted lines represent the percentage increase/decrease; the top pair of lines represent a 50% increase/decrease, then 25%, then 10% and then 5%.

Species Richness

High levels of change in butterfly species richness (50% or 25% changes) were detected with good statistical power. As few as 7-10 sites were required to detect changes at these levels with greater than 80% power (Figure 7). Power curves were very similar when species richness was estimated over the whole season (multiple visits). Smaller levels of change in species richness (10%, 5%) were detected with much lower power. Approximately 45 sites were required to detect a 10% change (decline or increase) with more than 80% power (Figure 7, left-hand panel).

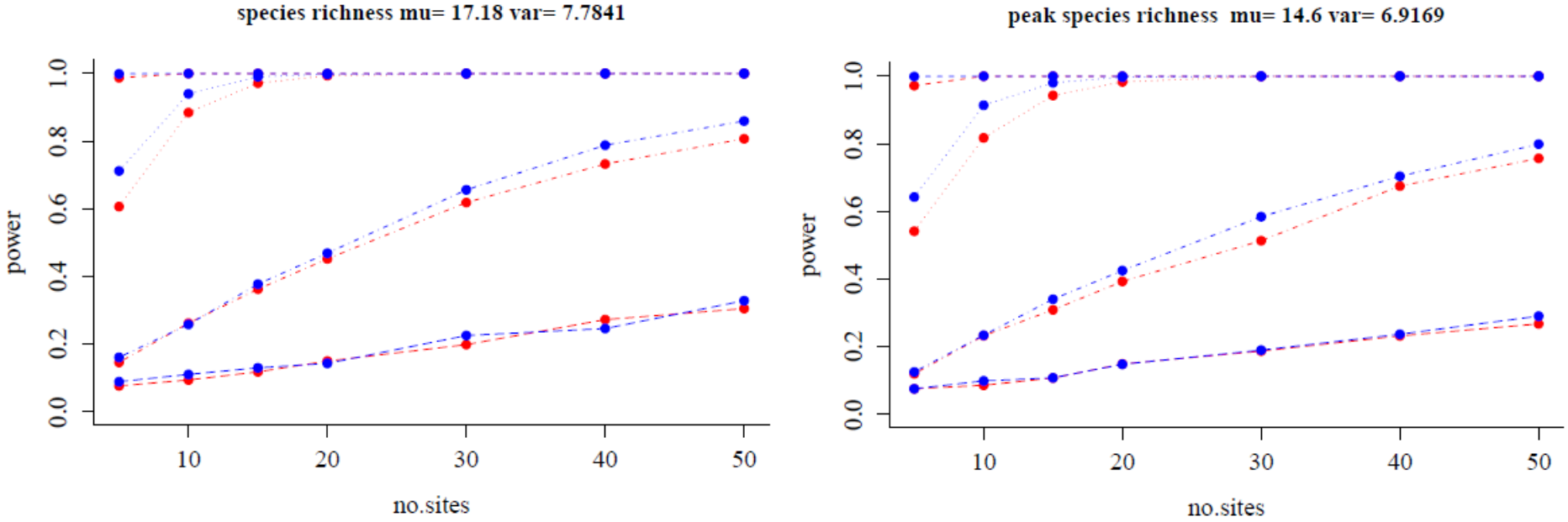


Figure 7. Power curves for overall butterfly *species richness*. The plot in the left hand column is based on multiple visits (April – October); the plot in the right hand column is based on a single sampling visit at the period of peak species richness. Each plot includes 8 data series, coded as follows: red lines indicate power for detecting increases; blue lines indicate decreases. Each pair of dashed or dotted lines represent the percentage increase/decrease; the top pair of lines represent a 50% increase/decrease, then 25%, then 10% and then 5%.

Good power was achieved for detecting changes in overall species richness of invertebrates sampled on heathlands (West Sussex invertebrate survey). Approximately 7 sites gave good power for detecting 10% changes of 10-years. To detect smaller changes of 5% over 10 years, approximately 30 sites were estimated (Figure 8, top panel). Power was reduced for detecting change in a sub-set of species that were identified as heathland indicators. For this set of species, approximately 30 sites are required to detect 10% changes with good statistical power (>80%).

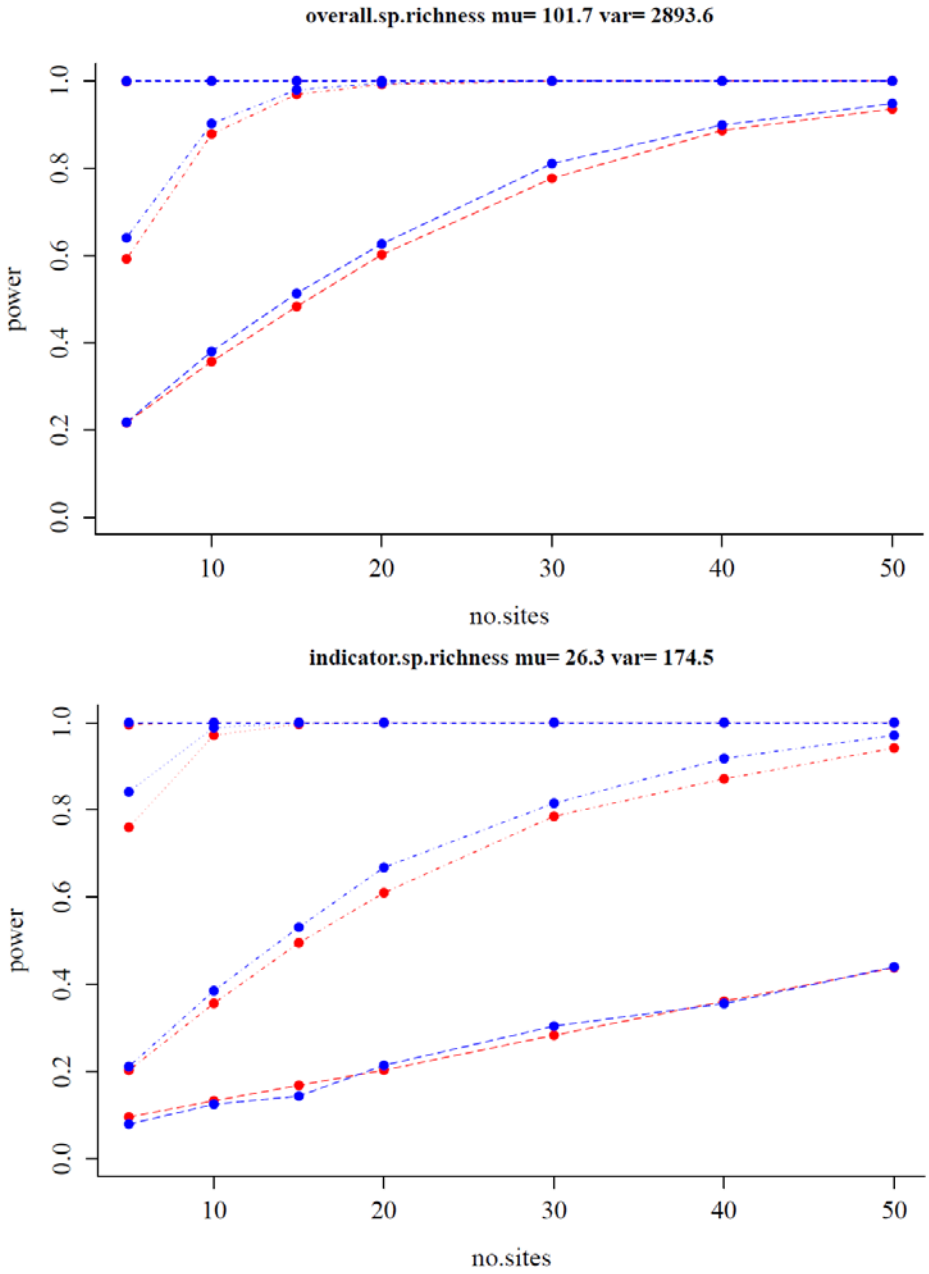


Figure 8. Power curves for overall invertebrate *species richness.* (upper panel) all species; (lower panel) Heathland indicator species. Each plot includes 8 data series, coded as follows: red lines indicate power for detecting increases; blue lines indicate decreases. Each pair of dashed or dotted lines represent the percentage increase/decrease; the top pair of lines represent a 50% increase/decrease, then 25%, then 10% and then 5%.

Indicator scores

Indicator scores can be effective measures of habitat condition when applied to samples of ecological communities. They provide a summary measure based on a suite of species. For vascular plants, Ellenberg indicator values are often used for measuring change in vegetation communities.

Based on our analysis of quadrat data from surveys of plants from heathland restoration projects, the power for detecting change in Ellenberg Nitrogen scores was low (Figure 9). Large (50%) declines in Ellenberg N scores over 10 years were detected with good power with approximately 10 sites, but at least 50 sites were required to detect smaller changes (25% or less).

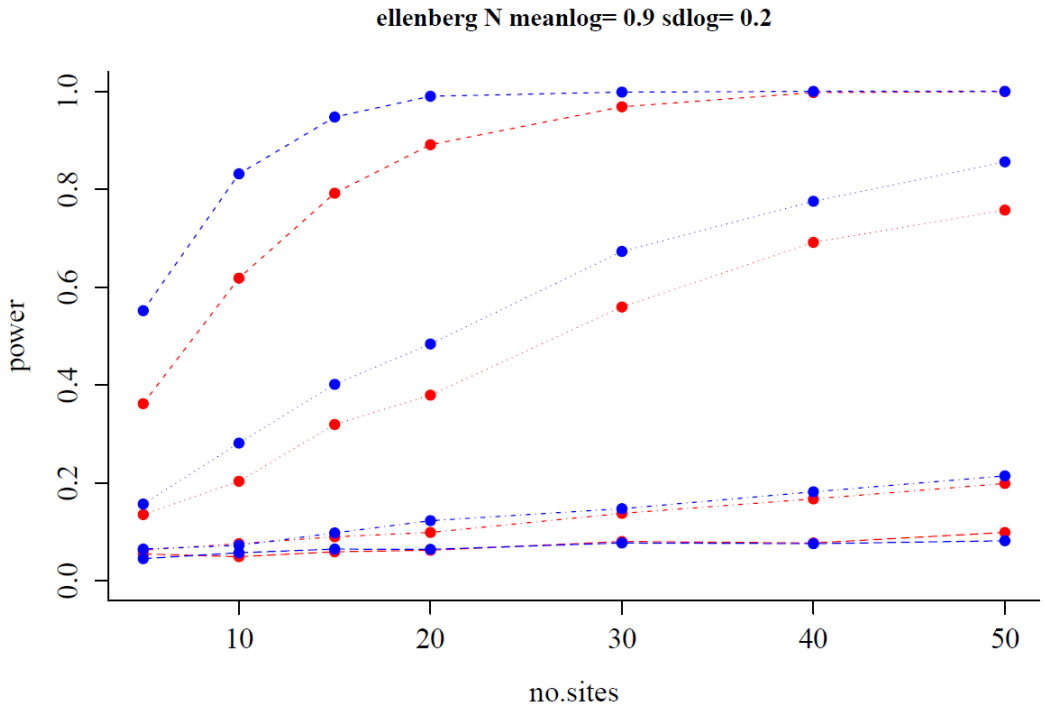


Figure 9. Power curves for Ellenberg Nitrogen indicator score. Red lines indicate power for detecting increases; blue lines indicate decreases. Each pair of dashed or dotted lines represent the percentage increase/decrease; the top pair of lines represent a 50% increase/decrease, then 25%, then 10% and then 5%.

Conclusions from scheme design work

Suitable datasets for undertaking power analysis for sampling heathlands are scarce. Having reviewed potential datasets through consultation with network partners, we have restricted our analysis to three datasets that were in a suitable condition for analysis and that were a high priority for developing a Heathland Species Surveillance network. The datasets available enabled a test of a range of potential scenarios for monitoring however, and enable recommendations to be made for a field trial.

We have undertaken a series of power analyses to test a range of scenarios for monitoring. Firstly, we have assessed the potential of datasets on population abundance which provide counts from multiple sites over multiple years (the UK Butterfly Monitoring Scheme). To test the power of approaches which do not provide counts, we have summarized the UKBMS data to provide frequency estimates (e.g. derived from presence/absence within plots). The UKBMS also enabled a comparison of the power of multiple samples within a season versus single samples at an optimum time (at peak abundance).

The main conclusion and recommendations from the power analysis undertaken here are:

1. Count data has much higher power than frequency data for assessing change in populations of individual species. A large number of sites would be needed to achieve good power when sampling presence/absence of species (i.e. >100 to detect course changes). **Recommendation 1. To promote standardised monitoring schemes within the network based on counts**
2. Single visits can be highly effective if sampled at optimal times (e.g. at peak abundance) **Recommendation 2. For target species, adopt population *counts at times of peak abundance* wherever possible.** Such protocols may be part of established schemes (e.g. NARRS, UKBMS Timed Counts) or developed through this project.

3. Summary counts (e.g. count of 'blue' butterflies) can provide efficient measures of change, with good power achieved with relatively few sites (e.g. <10). However, groups of species should be chosen which provide measures of change with a clear ecological meaning. **Recommendation 3. Test sampling schemes based on habitat-indicators as an efficient approach to monitoring taxon groups lacking a formal abundance monitoring scheme**.
4. There is low power for detecting small changes (5-10% over 10 yrs) in overall species richness. Power for detecting changes in species is improved when species richness is calculated for a subset of the biota, e.g. 'Heathland indicators'. **Recommendation 4. To establish a set of Heathland indicator species as a basis for field sampling protocols tested during the field trial.**
5. Measuring change in ecological indicator values for vegetation is relatively insensitive, based on the datasets analysed here.
6. Although not extensively covered in this project, an important consideration in monitoring species is attributing and interpreting the causes of change. A number of environmental datasets are widely available to inform analysis of change (e.g. land cover, climate) but often to not provide sufficient spatial resolution or ecological detail to clearly identify mechanisms driving change. We therefore recommend that a protocol is developed and tested during this field trial for assessing the quality of heathland sites for supporting species. This rapid assessment will enable key features to be assessed such as the cover of structurally-important species (e.g. amount of scrub, trees, grasses etc), amount of bare ground and presence of key features. **Recommendation 5: a rapid site assessment form is developed and trialled to be undertaken alongside all species sampling.**

Heathland Surveillance Network Survey elements

Following on from the recommendations, a survey design comprising 4 different elements was proposed. Input on the design of the elements was provided by a number of heathland experts and also the Natural England project steering group. The outline method for trial in the 2013 pilot phase included the following elements:

1) Selection of a heathland site of interest and a 1km square within the site either assigned or volunteer selected.
2) Habitat Transect Walk involving four stop points and a check list survey to rapidly assess habitat features and evidence of recreational pressure. Fixed point photography element included.
3) Identify at least three Target Species Plots positioned in one of five different heathland components: 1) bare ground mosaic/ecotone, 2) heather cover, 3) dry acid grassland, 4) scrub and 5) wet heath/Molinia grassland. Within these plots, habitat specific plot characteristics are recorded using a very quick assessment with fixed point photography.
4) Survey Target Species Plots - fixed plots in which to search for the target species from the list using a sweep net or by searching the plot. At this stage only presence recorded due to the lack of time to establish protocols based on counts.

The training, guidance material and availability of support and online recording were designed to make the survey widely accessible. The method for this 'entry-level' approach did not require any specialist equipment apart from a sweep net which was offered on loan to participants.

Species

This element of the Heathland Species Surveillance network is designed to improve the sampling of characteristic and typical species (and groups) that are likely to be present in good condition lowland heathland in England. The list is designed to be accessible to volunteers who have experience of biological recording and who wish to contribute to monitoring the quality of lowland heathland. The selected species and groups were derived through consultation with experts associated with National Schemes and Societies (http://www.brc.ac.uk/recording_schemes.asp). Experts were invited to provide lists of species (by e-mail) that are associated with heathland and are sufficiently distinctive for identification by motivated volunteers who may not have expertise within the particular group. Experts were also provided with the results of an analysis to identify species which had a strong spatial association with areas with a high cover of lowland heathland as estimated by a Natural England inventory GIS dataset. Additionally the list was revised during a workshop held at CEH Wallingford on 14th February 2013 in which experts were invited to consider the practicalities of cross-taxa monitoring on heathlands (see Appendix A for attendees and notes). Finally the list was reviewed by Helen Roy and Mike Edwards (BWARS and entomological consultant) to provide a final list representing species across a diverse range of functional groups. It should be noted that these are not solely indicator species but rather species often found on heathland. The species aim to act as proxies for more difficult to find or identify priority species (NERC Act Section 41 list, hereafter referred to as S41 list) that need the same or similar habitat niches.

The final species list comprised 32 species and 7 species groups across 8 invertebrate orders and 3 species and 2 species groups within Lichens. The aim was to enable volunteers to select elements of the survey and species list to undertake and focus on.

Target species

As described above, the target list is based upon an analysis of co-occurrence of species within heathland sites, together with expert input to identify characteristic and typical heathland species. The list has then been restricted to species that are relatively easy to recognise and find. The survey design aims to cover five different habitat elements of lowland heathland and the species are summarised under each heathland component below. In addition, if the approach is implemented more widely, contributors within trial areas will be given a list of additional NERC Section 41 species that have been recorded from their heathland sites, and encouraged to record these where possible.

1. **Bare ground**

Herbivores

Bug *Alydus calcaratus* (ISIS code: F111 bare sand & chalk)
Grayling *Hipparchia semele* (ISIS code: F111 bare sand & chalk)
Mottled grasshopper *Myrmeleotettix maculates* (ISIS code: F1 unshaded early successional mosaic)

Predators/Parasites

Heath tiger beetle *Cicindela sylvatica* (ISIS code: F111 bare sand & chalk)
Cleptoparasite bee *Epeolus cruciger* (ISIS code: F1 unshaded early successional mosaic)
Ammophila spp. (ISIS code: F1 unshaded early successional mosaic)
Mimesa wasps (ISIS code: F1 unshaded early successional mosaic)
wasps (ISIS code: F1 unshaded early successional mosaic)
Nomada rufipes (ISIS code: F111 bare sand & chalk)
Spider hunting wasp Pompilidae (ISIS code: F1 unshaded early successional mosaic)

Lichens (same list for each habitat element)

Red fruited Cladonias "devils matchsticks" (diversa—previously coccifera, floerkeana)

Large grey bushy Cladonias (arbuscula, ciliata, portentosa)
Cladonia uncialis subsp. biuncialis
Pycnothelia papillaria
Cetraria aculeata

2. Heather cover

Herbivores

Colletes spp. (ISIS code: F1 unshaded early successional mosaic)
Andrena spp. (ISIS code: F1 unshaded early successional mosaic)
Gorse weevil *Exapion ulicis* (ISIS code: F2 grassland & scrub matrix)
Weevil *Micrelus ericae* (ISIS code: F2 grassland & scrub matrix)
Heather beetle *Lochmaea suturalis* (ISIS code: F2 grassland & scrub matrix)
Heather bug *Orthotylus ericetorum* (ISIS code: F2 grassland & scrub matrix)
Heath damsel bug *Nabis ericetorum* (ISIS code: F2 grassland & scrub matrix)
Beautiful yellow underwing *Anarta myrtilli* (ISIS code: F2 grassland & scrub matrix)
Fox moth larva *Macrothylacia rubi* (ISIS code: F2 grassland & scrub matrix)
Emperor moth larva *Saturnia pavonia* (ISIS code: unclassified)
Silver-studded blue *Plebejus argus* (ISIS code: F2 grassland & scrub matrix)

Predators/Parasites

Hieroglyphic ladybird *Coccinella hieroglyphica* (ISIS code: F2 grassland & scrub matrix)
Heather ladybird *Chilocorus bipustulatus* (ISIS code: F2 grassland & scrub matrix)
Spider *Evarcha arcuata* (ISIS code: W312 Sphagnum bog)
Tachinids *(*fox moth parasite *Linnaemya vulpina and Tachina grossa)*
Funnel web spider *Agelena labyrinthica* (ISIS code: F2 grassland & scrub matrix)

Lichens (as defined above)

3. Dry acid grassland

Herbivores

Bug *Alydus calcaratus* (ISIS code: F1 unshaded early successional mosaic)
Bishop's mitre shieldbug *Aelia acuminate* (ISIS code: F2 grassland & scrub matrix)
Mottled grasshopper *Myrmeleotettix maculates* (ISIS code: F1 unshaded early successional mosaic)
Fox moth larva *Macrothylacia rubi* (ISIS code: F2 grassland & scrub matrix)
Small copper *Lycaena phlaeas* (ISIS code: F2 grassland & scrub matrix)
Small heath *Coenonympha pamphilus* (ISIS code: F1 unshaded early successional mosaic)
Grayling *Hipparchia semele* (ISIS code: F111 bare sand & chalk)

Predators/Parasites

Robberflies *Dysmachus spp.* (ISIS code: F1 unshaded early successional mosaic)
Funnel web spider *Agelena labyrinthica* (ISIS code: F2 grassland & scrub matrix)

Lichens (as defined above)

4. Scrub

Herbivores

Aphids
Auchenorrhyncha
Shield bug *Elasmucha grisea* (ISIS code: A1 arboreal canopy)
Gorse shield bug *Piezodorus lituratus* (ISIS code: F2 grassland & scrub matrix)
Beetle *Luperus longicornis* (ISIS code: F2 grassland & scrub matrix)

Chrysolina populi
Fox moth larva *Macrothylacia rubi* (ISIS code: F2 grassland & scrub matrix)
Emperor moth larva *Saturnia pavonia* (ISIS code: unclassified)
Silver-studded blue *Plebejus argus* (ISIS code: F2 grassland & scrub matrix)

Lichens (as defined above)

5. **Wet heath (*Molinia* grassland)**
   Bog Bush Cricket *Metrioptera brachyptera* (ISIS code: W3 permanent wet mire)
   Raft Spider *Dolomedes fimbriatus* (ISIS code: W3 permanent wet mire)
   Spider *Micrommata viridescens* (often in tops of large tussocks)
   Keeled Skimmer *Orthetrum coerulescens* (ISIS code: W3 permanent wet mire)

   Lichens (as defined above)

Site selection

The Ordnance Survey 1 km grid has been selected as the broad sampling network for the trial and ultimately for the whole network if established across England. The idea is that volunteers undertake surveys on a site that they are interested in or live or work locally to. To encourage participation and to allow for volunteer site affinity, at this stage of the project the volunteer could either choose a 1 km square or be assigned one by the co-ordinator using a home postcode or nearest town. The volunteer was then provided with a map of the 1 km grid square. As a general rule, only 1 km squares with at least 10 hectares of lowland heathland were chosen. With sites which span more than one 1 km square then volunteers were given a choice of squares with at least 10 hectares (10% of the area) of heathland habitat within them. For every 1 km square surveyed, a Habitat Transect Walk and a set of Target Species Survey plots should be completed. Within a 1 km square there may be more than one site and different people can survey different parts of a 1 km square.

Habitat Transect Walk – rapid site/habitat assessment

This is a rapid assessment to be completed on each visit to a 1km square which aims to assess features known to provide resources for key heathland species. No specialist field equipment is required to undertake this assessment.

The aims of this walk are:

1. To familiarise the volunteer with the site
2. To provide a broad check to see what features are available for the Target Species
3. To see what negative factors are occurring which may impact upon the Target Species
4. To generate a network of fixed point photographs on heathlands

On each site the volunteer needs to determine a fixed transect route through the site within the square and mark it on the map (Heathland Surveillance Network 1 (HSN1) – Appendix D). The route should be representative of the different elements of the site and can follow paths and desirable lines in order to complete a circuit. The length of the route is dependent on the size of the site and along the route, 4 fixed stopping points (A-D) need to be selected to assess the habitat. Guidelines on how to select the route and stopping points:

1. The transect walk should be between 500m and 1km long – distances should be estimated using pacing (i.e. estimate the number of your paces per 50m or 100m etc) and the map scale on form HSN1.

2. Four fixed stopping points (A-D) need to be located which are spread evenly along the route with at least 100m between them.
3. The first stop point must be at least 100m from the edge of the square or entrance to the site. For example a 500m walk could have stop points at 100m, 200m, 300m and 400m or a 1km walk could have stop points at 200m, 400m, 600m and 800m.

The fixed points (A-D) are marked on the map (HSN1) and if possible the grid reference to 6 figures e.g. SY123456 should be recorded or a GPS can be used to record the location. Furthermore, notes should be made to allow the site to be relocated in the future. At each fixed stopping point a circular area of radius 10m is identified using paces and then Habitat Information for Species Survey is completed using form HSN2 (see Appendix D). Most features are recorded using the DAFOR scale (Dominant, Abundant, Frequent, Occassional, Rare) – this applies to cover of each feature within the whole 10m radius circle. There are other elements to record, such as evidence of recreation and disturbance. If possible, at each stopping point 4 photos should be taken in each direction: firstly in the direction of travel then turn clockwise 90 degrees 3 times taking a photo each time (guidance is given as part of the online recording for information on submitting photos).

Along the route, the locations of the Target Species Survey plots should be determined within the lowland heathland components (where present): bare ground mosaic/ecotone (ideally south facing), heathland, dry acid grassland, scrub, wet heath/Molinia grass. Volunteers do not have to complete a survey in all 5 heathland component areas (as some may be absent) but covering as many as possible of the components present at least once would be desirable (see below). More than one plot in a single component is also allowed and subsequent analyses can incorporate different sampling levels for different plot types. Guidance to determining the location of the Target Species Plots is provided.

Target Species Survey Plot selection and plot characteristics

The minimum number of plots to be surveyed per 1 km square is three.

The Target Species Survey Plots are 5m x 5m square or a strip 2.5m x 10m located within different heathland components. In each plot the volunteers carry out a search to look for the target species listed. The selection of plots within the 1km-square is entirely up to the volunteer but when locating plots, the following factors should be considered:

- The plots should fit comfortably within the 1km-square
- Aim to sample a representative area of the habitat and avoid areas where management has recently taken place. The representative areas should be chosen to be placed within 5-10m from main paths to avoid edge effects but so as to not cause unnecessary disturbance within large habitat blocks (e.g. to avoid ground-nesting birds). Information on sensitive areas to avoid should be gathered from site managers where possible.
- Select locations that will be easy to relocate i.e. that are close to permanent features
- The plots should be selected to provide representation across the five heathland components within the heathland where they are present: Bare ground mosaic/ecotone, heather cover, dry acid grassland, scrub, wet heath/Molinia grass
- Ideally at least one plot should be surveyed in each of the habitat types present but more than one plot per habitat type can be recorded.

The plots should be numbered and marked on the map (HSN1) and record grid reference to 6 figures e.g. SY123456 or if possible record location using a GPS and record in the notes any feature which will help to relocate plots. Once the plots are located they need to be marked out (e.g. temporarily using corner markers) so that they can be surveyed easily. The plots also should be recorded accurately to enable future resurveys or repeat visits by other recorders. A photograph should be supplied for each plot on each visit, taken from a fixed location to allow comparison between visits (see online recording for information on submitting photos).

The table below describes the criteria to help choose the Target Species Plots and the plot characteristics which need to be recorded on each survey on form HSN3 (Appendix D): Plot characteristics.

Table 2: Guidance provided to volunteers on the selection and characteristics assessment of their Target Species Survey plots.

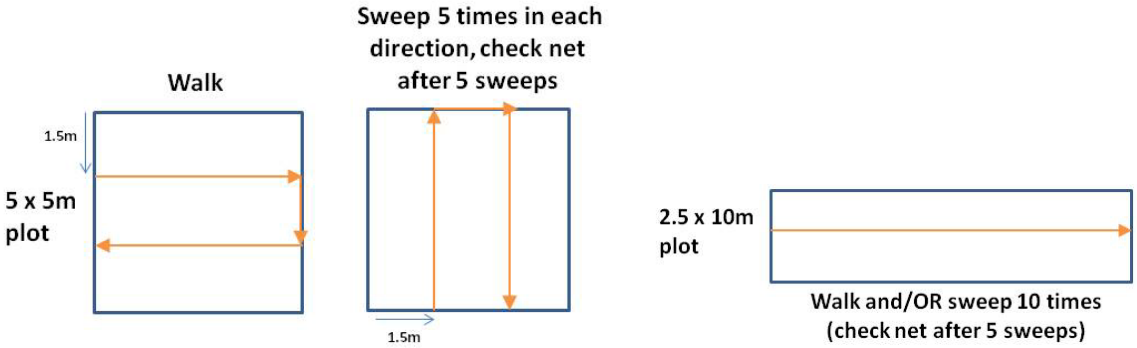
Habitat type	How to choose	Plot characteristics to record
Bare ground mosaic/ecotone	The plot should consist of more than 20% bare ground – this can include small paths, tracks consisting of sand, gravel and any other dry natural mineral substrate (with very little or no organic material e.g. leaf litter, humus, moss). Ideally this plot should be sheltered and have a southerly aspect.	Ground cover should be recorded using DAFOR for each of the following categories: Bare ground; Ground cover; Knee height; Waist height; Above the head. Also Nectar sources/forb cover (DAFOR). The ground should be scored on the level of disturbance from 1 (firm with limited disturbance) to 3 (recent and extensive disturbance).
Heather cover	The plot should consist of more than 50% heather cover.	Heather cover should be recorded within the following categories: DAFOR heather cover of each of 3 different stages: pioneer, building/mature, degenerate. Also Nectar sources/forb cover (DAFOR).
Dry acid grassland	The plot should consist of more than 50% grass/forb (herbaceous flowering plant) cover and be less than 50cm tall. Typical acid grassland species include: heath bedstraw *Galium saxatile*, sheep`s-fescue *Festuca ovina*, common bent *Agrostis capillaris*, sheep`s sorrel *Rumex acetosella*, sand sedge *Carex arenaria*, wavy hair-grass *Deschampsia flexuosa*, bristle bent *Agrostis curtisii* and tormentil *Potentilla erecta.*	Grasses/sedges, nectar sources/forb cover and bare ground cover should be recorded as groups (not individual species) using the DAFOR scale.
Scrub	The plot should consist of 5-15% scrub (gorse, birch, oak) cover.	Scrub cover should be recorded using DAFOR for each of the following categories: Bare ground, Ground cover, Knee height, Waist, Above the head. Bare ground and also Nectar sources/forb cover (DAFOR). List the three main scrub species present.
Wet heath/ Molinia grass	The plot should consist of 50% *Erica tetralix* (cross-leaved heath) and/or with *Molinia* (purple moor grass).	*Erica, Molinia,* bare ground and Nectar sources/forb cover should be recorded using DAFOR.

Target Species Surveys: Plots

Approximately 5-10 minutes should be allowed to familiarise with the plot by observing the vegetation composition from the edge to avoid disturbing species. The plot characteristics should be entered on form HSN3.

There are 2 levels to sampling the plot for invertebrates – the most basic level is to slowly walk the plot (required) and then sweep the plot (optional). See instructions and diagrams:

1. **Walk** slowly through the plot following a tramline entering the plot 1.5m from an edge across the other side, walk along the edge for 1.5m then walk back across the square. The walk should be done slowly across the plot and recording anything that you see or that flies up.
2. **Sweep**: Repeat the walk across the square from the other side and do 5 broad sweeps in front, walking one way across the square then check the net and then walk back across the plot repeating the 5 sweeps in the other direction (or 10 across a strip plot). Sweeps should be made firmly through the vegetation in front for low growing vegetation or upwards in scrub plots. Record use of sweep net sample on form HSN4 (Appendix D).



The presence of target invertebrate species or groups (e.g. Ammophila spp.) should be recorded on form HSN4. There is space on the form to record additional species. The methodology for lichens involves a 10 minute search of the plot after the invertebrate sampling. A DAFOR score should be estimated for each lichen group or species (additional spaces provided on the form HSN4 for extra species).

At the end of the survey, temperature should be noted if possible and sunshine should be estimated to the nearest 10% of the time it was sunny while the plot was recorded (e.g. if the plot took 20 minutes to survey and the sun was out for 8 minutes then but it was cloudy and in shade for the remaining 12 minutes then 40% sun would be recorded). Average wind speed should be recorded using the Beaufort scale: 0= Calm, smoke rises vertically, 1= Smoke drift indicates wind direction, 2=Wind felt on face, leaves rustle, 3=Leaves and small twigs constantly moving, 4=Dust, leaves, and loose paper lifted, small tree branches move, 5=Small trees in leaf begin to sway.

Field trial to test a Heathland Species Surveillance network

The power analysis undertaken during this project provides recommendations of the main potential approaches to test during a field trial. The network workshop discussed the potential of different approaches for a range of taxa, including both highly standardized approaches and simpler sampling methods to foster wider participation. There was no clear consensus during discussions with network partners and funders on the need to restrict a field trial to test a limited set of approaches (see break-out group summary, Appendix A). The partners consulted advocated that a range of approaches are tested during the field trial.

One clear conclusion of work to develop the network of partners has demonstrated that a 'top down' approach to establishing a network is unlikely to work. Therefore we adopt an approach that makes the most of existing schemes through promotion and supporting their expansion to new sites based on two new elements: an accessible but comprehensive assessment of heathland condition and an 'entry-level' method for monitoring a suite of heathland species. We identify two main advantages to existing monitoring programmes – 1) HeathNet may attract a new cohort of volunteer recorders who may subsequently adopt species recording protocols aligned to existing monitoring programmes; 2) HeathNet samples, if co-located within sites with existing species monitoring, will provide additional information on habitat features and additional species that might help interpret

trends (e.g. heathland cover and species complement may explain butterfly population trends on the same sites). By promoting monitoring in this way we will be able to incorporate existing data and make the most of volunteer recorders within established schemes. Furthermore, in agreement with experts for less well-recorded taxa, we will be able to offer a series of techniques to monitor a suite of species which are relatively straightforward to identify. This suite of species will be widely promoted across the network thus encouraging more people to record on their local sites. We hope that the network will be able to encourage volunteers from differing species backgrounds into a community based approach to monitoring sites. We also intend to encourage volunteers to develop their 'cross-taxa' skills beyond the entry-level species list.

The pilot survey structure therefore had three components (see Methods document for full details):

1) Promotion of existing schemes and protocols

Volunteer-based standardised schemes: Where an existing recording scheme is in place, such as the UKBMS transect scheme, the national and local co-ordinators will be contacted to promote the HSN in the pilot areas. We will also try to link in with planned training events. Other organisations with established schemes and volunteer networks are likely to include ARCTrust, BTO, BSBI/Plantlife, FSE Biodiversity Fellows Programme.

Expert recording: Where the majority of recording is currently undertaken by voluntary experts, we will promote the pilot and send out a 'wish list' of sites/species. We will also try to link in with planned training events or field visits.

2) Sampling of target species using techniques for motivated volunteers with some experience of recording

In consultation with Network partners we will identify a list of species and methods which are suitable for motivated volunteers with some recording experience. This list will aim to provide an introduction to recording schemes and their more detailed sampling protocols. Species will be selected to enhance data for trend estimation, although this will not be the primary focus. Volunteers will be able to select elements to undertake, and be supported by guidance and tailored forms for recording online.

3) Assessment of heathland site features

To be available for completion by all contributors to the heathland species surveillance network. This is likely to be a quick assessment completed on each visit to a site and will include elements from the common standards monitoring protocols such as key species presence, species dominance, bare ground cover, scrub cover, successional stage of the heather, negative indicators, key features, and management. The features monitored may be more geared towards resources for key heathland species. We anticipate that none of these methods will require field equipment but will be supported by training resources.

Pilot areas and promotion

The pilot focused around three heathland areas. The areas selected were the Dorset Heaths SPA/SAC, the Thames Basin Heaths SPA/SAC (Surrey and Hampshire) and the South Staffordshire Heaths including (Cannock Chase). These were selected based on discussions amongst the project team and discussions with network stakeholders with the aim of covering a reasonable geographic range of sites and also areas which differ in terms of established monitoring. Sites such as the Breckland Heaths, West Penwith and the Lizard were excluded due to their uniqueness. The New Forest was also discounted as this would mean that the pilot was focussed primarily on southern England. We had wished to run training at Cannock Chase but due to a Phytophthora outbreak (a plant disease - http://www.forestry.gov.uk/phytophthora), one site manager felt that it would be inappropriate.

The pilot project and training days were promoted widely via email. We sent an email with a pdf flyer attached (see Appendix C) to all of our existing contacts in each area. These contacts included local authority staff, nature conservation charities (RSPB, Wildlife Trusts, Butterfly Conservation, ARC Trust), landowners and site managers of different types, volunteer groups associated to the training location (such as Cyril Diver volunteers), 'Friends of…' groups, FSC volunteer groups (invertebrate challenge and Biodiversity Fellows), we placed an advert in the CJS surveys section[1], an article was written for the NBN newsletter[2], social media was also used via CEH (Twitter), Natural England circulated the information internally.

Volunteers were asked to book onto the training event – bookings were dealt with by a Footprint Ecology administrator.

Training events

The training day programme was flexible and relaxed to enable best use of the time based on the weather on the day. The sites were chosen to enable easy access to the heathland and an indoor space for presentation and use of facilities. At each event, at least two members of Footprint Ecology staff were present, we also invited at least one invertebrate expert and the site managers were present as well. Unfortunately we did not have an invertebrate expert present on the Highgate Common training day as he cancelled on the day before the event (see Issues).

Broadly, the day consisted of an indoor session with informal introductions with refreshments in the morning and short presentations about the background to the survey and the methods. Either before or after lunch we headed out onto the site and walked through the methods. Depending on the size of the group, we split up and undertook repeated Target Species Plot surveys with the aim of seeing as many species from the list as possible.

All course attendees were provided with a survey pack including the methods, recording forms and ID guides. At the end of the day, we collected email addresses and volunteers were asked to name a heathland site that they would be interested in surveying.

Across the three training events, 43 volunteers were trained. The highest attendance was seen at the Dorset event which accounted for over half of all attendees across all three events. The lowest number of trained volunteers was at Chobham Common and this was due to a delay in receiving permission to advertise from Surrey Biodiversity Information Centre (see Issues).

Table 3: The number of volunteers trained in each pilot area, the number of additional volunteers gathered through word of mouth (did not receive training) and the number of 1km squares allocated.

Pilot region	Number of people trained	Additional untrained volunteers	Number of squares allocated
Dorset	23	1	36
Staffordshire	14	0	13
Thames Basin	6	2	4
Other	0	4	3
Total	43	7	56

[1] http://www.countryside-jobs.com/Jobs/Surveys.htm

[2] http://www.nbn.org.uk/News/Latest-news/Heathland-Surveillance-Network-Pilot.aspx

Thames Basin Heaths (Surrey/Hampshire)- Chobham Common

The event was publicised to site managers and ecologists within all Local Authorities (13 in total). Information was also sent to Wildlife Trusts and LRCs (Hampshire, Berkshire and Surrey). We selected Chobham Common as a training venue as we have good links with the staff and they were happy to host the day. The Surrey LRC (SBIC) runs events on Chobham Common and has teams of volunteer recorders targeting different species groups. In discussion with SBIC, this seemed like a very likely pool of volunteers for HSN. We had problems establishing a data sharing agreement and therefore the invitation to SBIC recorders only went out a week before the event. Six volunteers attended the training day with two staff from Footprint Ecology, the site Warden and Mike Edwards (entomologist).

Four of the volunteer attendees were 'traditional volunteers' who had some experience of recording and had heard about the event via Surrey Wildlife Trust. The remaining two attendees were from professional bodies.

The weather was very good on the training day and we saw 15 species from the list.

Dorset Heaths - Studland

The event was widely publicized through Footprint Ecology's local contacts with conservation organisations. The Dorset training day was the most popular with 23 attending, 4 placed on a waiting list and 18 who registered interest but did not attend. Therefore, there was the potential to train 45 people.

Due to the number of people booked on to the course we had 4 members of Footprint Ecology staff present and Mike Edwards for entomological expertise with support from two other local entomologists with interest in the project. The attendees were a mix of heathland management professionals from National Trust, RSPB, Dorset Wildlife Trust and Poole Borough Council and 'traditional volunteers' from the Cyril Diver project, Bournemouth University and other volunteers associated with the conservation charities.

Despite poor weather, we managed to see a number of target species from the list.

Staffordshire- Highgate Common

The Highgate Common event was advertised via Staffordshire Invertebrate Group, Staffordshire Ecological Record (LRC), Cannock Chase volunteer groups, Friends of groups for various nature reserves and multiple Wildlife Trusts in the surrounding area.

The course was well attended with 14 people all of whom would be classed as 'traditional volunteers' apart from the site warden. Unfortunately the invertebrate expert could not attend the training day and cancelled at very short notice. Interestingly, the course was very well attended by young women (nearly half were female participants under the age of 35).

The day was generally a success although the weather was poor and combined with a lack of an expert, we saw only a few species from the list.

Volunteer support and co-ordination

The co-ordinator was available to support volunteers with gaining access permission to their sites and providing general support on the survey methods. At regular intervals (approximately every 3 weeks) the volunteers who signed up to take part were emailed to see how they were getting on and if they needed any help.

The main requirement for support was based around assigning squares and gaining access permission to carry out surveys from the site managers (see Issues).

Field equipment was provided by post to one surveyor for Cannock Chase.

Issues

A number of issues were encountered during the project (Table 4). The most time consuming issues involved communicating the aims of the survey to site managers. In two cases, the site manager felt that some of the proposed methods were too similar to the Site Condition Assessment and this could have implications for undermining information collected for statutory purposes or in the case where a controversial planning application was submitted. References to grazing measurement were also removed to avoid problems on sites where grazing has become a contentious issue.

Table 4: Summary of issues which arose during the project and how they were resolved.

Name	Location	Issue	Solution
Ruth Metcalf	Cannock Chase	No surveys permitted on Staffordshire Council's sites on Cannock due to Phytophthora	Contacted SWT who are running a project on FC land on Cannock - they were happy for consent to be given but this was a formal and long winded process.
SBIC	Chobham Common	Required a data sharing agreement before promoting to their wildlife recording teams	DSA was established but only 1 week before the training event.
Phil Playford	Hartlebury Common	Public liability insurance required by landowner (Warwickshire County Council) Hartlebury Common	KC used Footprint Ecology insurance for volunteer coverage and sent a copy to WCC staff member.
Phil Playford/ Martin Barnett	Hartlebury Common	Hartlebury consent - the land owner (Warwickshire CC) could not get permission from NE	Not resolved during the field season.
Studland surveyor	Studland	Did not want email address shared	Email removed from circulation list, Bcc used in future.
Stephen Fry	Chobham	Felt that the methods (mainly BSBI aspect) were too close to CSM. This could leave the door open for contentious issues surrounding the development and conservation pressures at Chobham.	Kat Woods spoke directly to site manager to alleviate any fears over the information derived from the surveys. We amended the instructions to remove any recording of specific management activities- mainly grazing.
Ryan Greenwood/ NE advisor	Highgate	Highgate SSSI consent form (NE) required for training day on Highgate Common.	Kat Wood spoke directly to NE adviser, consent form agreed
Dave Skingsley (Staffordshire Invertebrate Group)	Highgate	Emailed the night before the Highgate training day to tell us that he could not be present as our invertebrate specialist	We went ahead with the training day anyway – it was too late to reschedule
Amy Jayne Dutton	Parkhall Country Park	Parkhall Country Park in HLS for heathland but not on heathland layer	No solution needed - an anomaly in the GIS layers.

Results: volunteer uptake

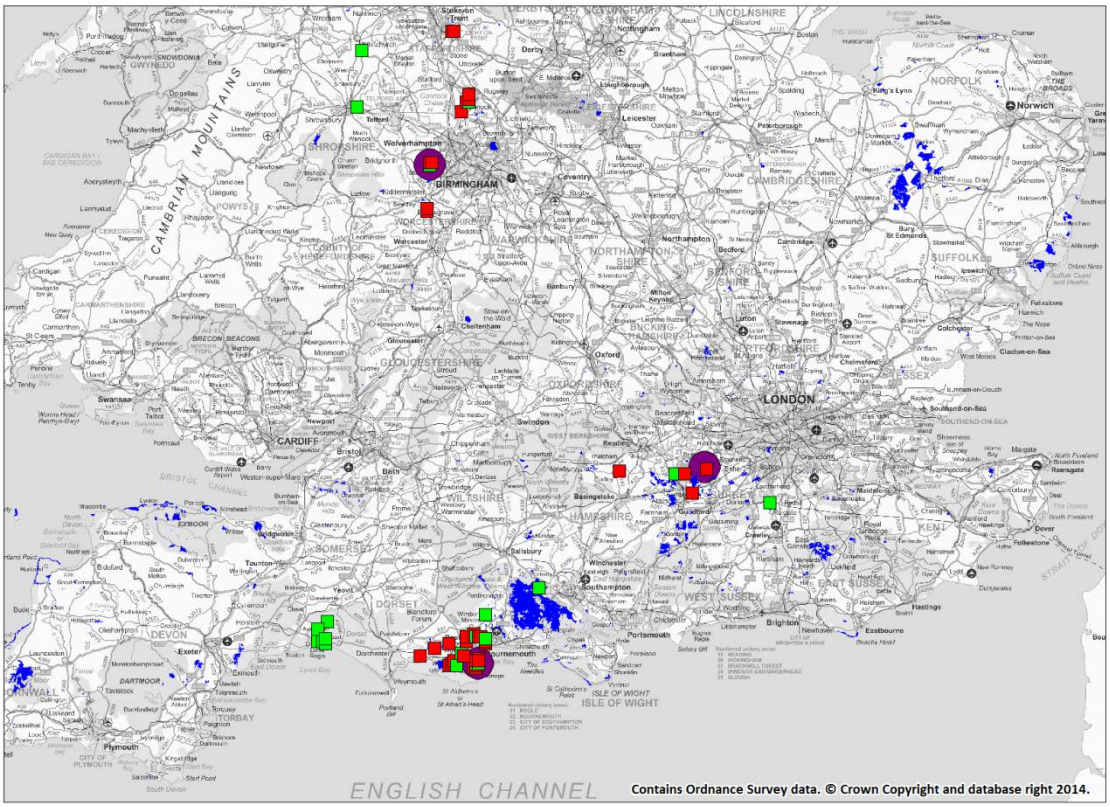
By pilot region

Overall, 38% of people who attended the training days completed a survey (Table 4). Broken down by region, the best uptake was from the Chobham Common event (50%). However, only 6 people were trained on the Chobham Common event and 3 of them undertook a survey. From the Dorset survey, 48% of trained volunteers then went on to complete a survey. The Staffordshire level of uptake was the lowest with only 21% of participants completing a survey. Additional surveys outside of the pilot areas were undertaken by CEH staff.

The distribution of allocated and surveyed squares is shown in Map 1. In total, 21 1km squares were surveyed which is 38% of the squares assigned or selected by volunteers. Volunteers in Dorset completed the most surveys, mainly due to one pair of volunteers covering 8 squares.

Table 5: The number of people taking part and the number of squares surveyed in each pilot region.

Region	Number of people involved	Participants	Number of squares allocated	Number of surveyed squares
Dorset	23	11 (48%)	36	15(42%)
Staffordshire	14	3 (21%)	13	3 (27%)
Thames Basin	6	2 (33%)	4	1 (25%)
Other	4	2 (25%)	2	2 (100%)
Total	47	18 (38%)	55	21 (38%)



Map 1: HSN 1km squares surveyed (in green) and those allocated but not surveyed (in red). Lowland heathland habitat layer shown in blue and training locations shown in purple.

Use of online recording

All data was entered online by each volunteer who collected it, except for two sites where a) the volunteer felt that the online recording system registration was too complicated and b) the volunteer (a conservation professional) did not have the time to enter the data. Other comments were received regarding the complexity of the online recording system and also the mismatch between locations identified on the map when GPS coordinates were entered (due to differences in the co-ordinate systems and projections used – British National Grid and WGS84).

Results: species recorded

Species data was collected through survey form HSN4 (www.brc.ac.uk/hsn). In total, species data was entered online for 19 monads (1km x 1km grid squares), 67 plots with 76 plot visits (only 6 plots were visited twice). The reporting rate for species was generally relatively low, with a median of 3 taxa recorded; a maximum of 8 taxa was recorded for any plot and 5 plots recorded no target species. Only eight taxa were recorded in more than 25% of monads (1km squares), and only 10 taxa being recorded from more than 10% of plots (Table 6).

Table 6. Frequency of occurrence of species within plots and monads, restricted to taxon recorded in more than 10% of monads.

Taxon	% of monads (out of 19)	% of plots (out of 67)
Auchenorrhyncha	57.89%	41.79%
Large grey bushy Cladonias	47.37%	23.88%
Agelena labyrinthica	42.11%	28.36%
Exapion ulicis	36.84%	14.93%
Myrmeleotettix maculate	36.84%	14.93%
Aphids	31.58%	17.91%
Micrelus ericae	26.32%	19.40%
Plebejus argus	26.32%	10.45%
Andrena fuscipes and/or Colletes succintus	21.05%	11.94%
Coenonympha pamphilus	15.79%	10.45%
Orthetrum coerulescens	15.79%	7.46%
Evarcha arcuata	15.79%	5.97%
Luperus longicornis	15.79%	5.97%
Robberflies	15.79%	5.97%
Cerceris wasps	15.79%	4.48%
Lycaena phlaeas	15.79%	4.48%
Metrioptera brachyptera	10.53%	7.46%
Coccinella hieroglyphica	10.53%	4.48%
Hipparchia semele	10.53%	4.48%
Aelia acuminate	10.53%	2.99%
Dolomedes fimbriatus	10.53%	2.99%
Grass-snake	10.53%	2.99%
Hoverfly	10.53%	2.99%
Mimesa wasps	10.53%	2.99%
Nabis ericetorum	10.53%	2.99%
Silver Y	10.53%	2.99%
Small White	10.53%	2.99%
Tachinids	10.53%	2.99%

Volunteer feedback

Volunteer feedback was collected in three ways:

- An online survey sent to all training course attendees
- A volunteer feedback event run for training courses attendees (for both participants and non participants)
- Direct communication from volunteers

Summary of responses from the online survey (see full results in Appendix E):

- 11 respondents
- Expectations: new challenge, learning new things
- Concerns: identification of species, time commitment
- Motivations: conservation, natural world, new species
- Nearly everyone surveyed with another person
- Species identification – difficult, not many seen, disappointing
- Methods – complex but interesting
- More training needed
- Outcomes: learned something new, gained more heathland experience

The workshop for Dorset Volunteers (see full results in Appendix F):

- Local authority staff, volunteers, site managers (7 attendees)
- Recommendations for changes to the species list, survey protocol, online recording system
- Thoughts on gaining and training volunteers via embedding the method within the site managing body
- Overall –
    - **Volunteers** want a solid purpose, to generate useful data (for local and national use) and to gain experience and knowledge
    - **Site managers** want their sites monitored and to receive data for management decisions

Overall volunteers were very enthusiastic about monitoring under-recorded species on heathlands. From feedback responses and interaction with volunteers on the training days, there was strong concern for heathland habitat and species. Furthermore, there was a high level of enthusiasm for generating useful data and expanding skills.

In general volunteers felt that the methods were quite complex with possibly too many elements to consider whilst out in the field. There was also disappointment at the lack of species seen from the list and a suggestion that help from local specialists would be a good way to improve identification skills.

Conclusions and recommendations

The process of developing and testing the HSN methodology has further highlighted the fact that heathlands are contentious, complex and emotive habitats. Conservation management is highly scrutinized and pressures for site managers and statutory organizations are significant. Development and recreation pressures are increasing whilst demands upon site managers to cater for the needs of lots of different species groups makes management planning more complex. For example, a common theme of difficulty is with regard to grazing. Site managers involved in the pilot study commented that grazing levels or other management practices suitable for one species may contradict those prescribed for another.

Whilst the complexity of heathlands poses challenges for site management, this factor combined with the urban setting and rarity of heathland, means that local people are inspired to get involved and feel protective about their local patch. The level of uptake in the pilot areas was reasonable although there are a number of recommendations outlined here to improve uptake and coverage.

In terms of survey techniques, the methodology provided a comprehensive, structured and enjoyable survey protocol but volunteers found it too complex and were disappointed with the number of species seen. Here we make suggestions for improvements to the field methodology, species list, field materials and volunteer engagement and support. These recommendations are based on feedback received through online questionnaire and face-to-face meetings with volunteer recorders (Dorset) and species experts.

Design of field methodology and species list

The field methods were broadly well-received, with some improvements suggested:

1. Remove plot characteristics element, with habitat stop point undertaken at the same location as target species plots. Improve information collected as part of the habitat survey (including presence of dead heather). Improve instruction regarding weather variable recording.
2. To implement a heathland species surveillance scheme more widely, it is recommended that supporting materials (i.e. recording forms, ID guides) etc are reviewed in consultation with experts (i.e. Field Studies Council) and build upon existing material.
3. Extend the species list to include more generalist species
4. Adopt a tiered approach to species groups, i.e. basic level, indicator groups, inventory of species groups. An entry-level species list would enable broader engagement from non-experts and may provide a spur for training and development of recorders. The option to allow experts to record a complete species list for the taxon group for which they have expertise (i.e. lichens, aculeate hymenoptera) may encourage greater involvement from expert naturalists.
5. Consider regional variation in species list to reflect differences in biota along climatic gradients
6. It was recognized that the indicator species list should ideally be 'peer-reviewed' by a wider set of experts. The definition of indicator species may be better undertaken using a consistent, repeatable method that can be applied to a range of habitat types of interest.

Final Recommendation 1: A tiered approach is developed for species lists (basic, indicator, inventory levels) to enable volunteers with a range of abilities to contribute to the network.

Final Recommendation 2: Habitat indicators are defined in a comparable way for a range of habitats of interest, and peer reviewed by experts.

Online recording

1. Facilities to enable transect routes to be recorded on the website were recommended.
2. Participants requested more reporting of existing data within the network, and the ability to download data in a variety of formats.

Final Recommendation 3: Prior to the implementation of a new surveillance scheme, online resources (information and online recording) should be well developed given this is a primary communication, recruitment and engagement tool.

Final Recommendation 4: In-field data collection (i.e. using mobile Apps) is recommended for newly established monitoring programmes to improve rate of data submission and to minimize transcription errors from field recording forms and databases.

Linking with existing species monitoring schemes

Engagement with the scheme was limited from existing monitoring schemes (i.e. UKBMS, Plant Surveillance Scheme, NARRS). Lack of time was a major reason, given the short timescale between planning and field trial. A longer lead-in time is required to engage with existing schemes that have their own priorities for development and an established short-term work programme. Engagement is likely to be more effective once the survey protocols and project rationale are more clearly defined for the Heathland Species Surveillance Network, i.e. once a 'finished product' is available. This project phase was effectively testing a method and looking at levels of interest and participation following training. Greater input from established monitoring schemes would be gained if the methods had been tested and were certain to generate the required data.

Final Recommendation 5: Engagement with existing monitoring schemes is best phased after methods development for habitat-based monitoring schemes.

Overall design of scheme, volunteer engagement and support

Local co-ordination was recognized as beneficial to foster interest in and 'ownership' of local sites. However, the value of national co-ordination was also recognized for standardizing across regions. Promotion and branding should recognize the potential to attract contributors via local and national promotion. The scheme has the potential to attract new audiences and be a vehicle for training of volunteer recorders, particularly if mentoring through local experts can be encouraged. There is potential for the scheme to combine with professional development through affiliation with ecological consultants (i.e. CIEEM) and relevant Higher Education Institutions (i.e. Bournemouth University, Imperial College).

Final Recommendation 6: The scheme should include a training and mentoring plan to widen engagement.

Although not formally part of the field trial, it is recognized that the scheme requires a strong statistical basis to provide a robust source of evidence. There is a need to quantify the bias in selection of monads to be surveyed and the location of plots within monads. Ideally, the selection of both spatial scales of a proposed hierarchical design should adopt some randomization, even if weighted towards features of interest. The overall design of the sampling scheme should be undertaken on a national basis and ideally integrate with existing sampling schemes. Ideally, the statistical design approach should be undertaken for all habitat types of interest, rather than as a separate scheme and set of locations for lowland heathlands. The Plant Surveillance Scheme, currently under design was recognized as a potential basis for selecting sampling locations.

Final Recommendation 7: Integrate the design of a heathland species surveillance network with other habitat-based sampling frameworks.

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Acronyms

AES Agri-Environment Scheme
ARC Trust Amphibian and Reptile Conservation Trust
BBS Breeding Birds Survey
BDS British Dragonfly Society
BRC Biological Records Centre
BSBI Botanical Society of the British Isles
BTO British Trust for Ornithology
BWARS Bees, Wasps and Ants Recording Society
CEH Centre for Ecology and Hydrology
CIEEM Chartered Institute of Ecology and Environmental Management
CJS Countryside Jobs Service
CSM Common Standards Monitoring
DAFOR Dominant, Abundant, Frequent, Occasional, Rare (abundance scale used in quadrat recording)
Defra Department for Environment, Food and Rural Affairs
EUNIS European Nature Information System
GIS Geographical Information System
GPS Global Positioning System
HLS Higher Level Stewardship
HSN Heathland Surveillance Network
ISIS Invertebrate Species-habitat Information System
JNCC Joint Nature Conservation Committee
LRC Local Record Centre
NARRS National Amphibian and Reptile Recording Scheme
NBN National Biodiversity Network
NE Natural England
NERC Act Natural Environment and Rural Communities Act
NFBR National Forum for Biological Recorders
NGO Non-Government Organisation
NMRS National Moth Recording Scheme
NSS National Schemes and Societies
NT National Trust
OS Ordnance Survey
RSPB Royal Society for the Protection of Birds
S41 Section 41 of the NERC Act (the list of species of principal importance for the conservation of biodiversity in England)
SAC Special Area of Conservation
SBIC Surrey Biodiversity Information Centre
SPA Special Protection Area
SSSI Site of Special Scientific Interest
SWT Staffordshire Wildlife Trust
UKBMS United Kingdom Butterfly Monitoring Scheme
VPDB Vascular Plants Data Base
WCC Warwickshire County Council

Appendix A. The Development of a lowland Heathland Structured Species Surveillance Partnership and sites network

Meeting of partners, 14th February at CEH Wallingford

List of attendees and others consulted for network development

- David Roy, Biological Records Centre
- Helen Roy, Biological Records Centre
- Marc Botham, Biological Records Centre
- Jodey Peyton, Centre for Ecology & Hydrology
- Katie Cruickshanks, Footprint Ecology
- Katharine Woods, Natural England
- Keith Porter, Natural England
- Isabel Alonso, Natural England
- John Day, Footprint Ecology
- Sophie Lake, Footprint Ecology
- John Wilkinson, Amphibian and Reptile Conservation Trust
- Martyn Ainsworth, Kew – Mycological Research and Conservation
- Janet Simpkin, British Lichen Society
- Ian Henderson, British Trust for Ornithology
- Steven Falk, Buglife
- Stuart Roberts, BWARS
- Mike Edwards, BWARS
- Dave Hubble, Coleoptera recording groups
- Martin Harvey, Dipterist Forum
- Paul Lee, Hymettus
- Deborah Proctor, Joint Nature Conservation Committee
- Sue Southway, Plantlife
- Oliver Howells, Defence Infrastructure Organisation
- Chris Spilling, British Arachnological Society
- David Brown, National Trust
- Dr Barbara Smith, Game and Wildlife Conservation Trust
- Sue Townsend, Field Studies Council
- Richard Burkmar, Field Studies Council
- Tony Davis, Butterfly Conservation
- Andrew Webb, Natural England
- Kevin Walker, Botanical Society of the British Isles
- Peter Harvey, British Arachnological Society
- Dave Smallshire, British Dragonfly Society
- Stuart Skeats, British Mycological Society
- David Noble, British Trust for Ornithology
- Tom Brereton, Butterfly Conservation
- Mark Parsons, Butterfly Conservation
- Darren Mann, Coleoptera recording groups
- Martin Drake, Dipterist Forum
- Jonathan Spencer, Forestry Commission
- Rebecca Wilson, Forestry Commission
- Chris Cheffings, Joint Nature Conservation Committee
- Stuart Warrington, National Trust

- Mathew Oates, National Trust
- Niall Moore, Non-native Species Secretariat
- Olaf Booy, Non-native Species Secretariat
- Peter Sutton, Orthoptera Recording Scheme
- Mark Eaton, RSPB
- Brian Eversham, The Wildlife Trusts
- Richard Price, British Arachnological Society
- Pam Taylor, British Dragonfly Society
- Mathew Marshall, The Wildlife Trusts

THE DEVELOPMENT OF A LOWLAND HEATHLAND STRUCTURED SPECIES SURVEILLANCE PARTNERSHIP AND SITES NETWORK

The workshop will take place at CEH Wallingford, OX10 8BB

Directions: http://www.ceh.ac.uk/sites/wallingford.html

Workshop agenda

Aims for the day:

- To build a shared understanding of the project and its aims
- To build a partnership of interested organisations
- Identify the value of the network to partners
- Identify sampling approach
- Identify contributors and training requirements

10.45 Arrive and coffee

11.00 Welcome and introductions

11.10 - 11.45 Background to the project

1. Introduction to the NE monitoring programme – Keith Porter
2. Introduction to Lowland Heathland monitoring, including summary of feedback from partners – David Roy
3. Perspectives on sampling heathlands for invertebrates – Mike Edwards

11.45 – 12.30 General discussion

12.30 – 13.30 Lunch

13.30 – 14.30 Discussion sessions (3 break-out groups will discuss three aspects of a Heathland Monitoring Network).

Question 1. What do we need to monitor?

Question 2. How will we monitor?

Question 3. Who will contribute?

14.30 – 15.00 Feedback from break-out groups and plenary discussion

15.00 – 15.30 Summing up and next steps

15.30 – 16.00 Tea and depart

Principles of a Heathland Monitoring Network

- HeathNet will be operated as a partnership between Natural England, the Centre for Ecology & Hydrology, Footprint Ecology, species-based NGOs and land-owners
- A network of fixed locations will be sampled over time using defined field protocols
- Power analysis will guide the sample size required to detect trends in widespread and localised heathland species
- Network locations will be selected at random, stratified to reflect the variation in heathland quality and types
- Field sampling protocols will be defined for a range of species groups
- Field sampling protocols will utilise those already in use by NSSs wherever possible
- Field sampling protocols will be designed to be attractive and practical for volunteers
- Field sampling protocols will be designed to maximise detection of target heathland species
- Species measures will be used to provide assessments of heathland quality
- The network will report change on an annual basis, without the need for all locations to be sampled each year

Principles of a Heathland Monitoring Network ***field trial***

- The HeathNet trial will be run as a partnership between Natural England, the Centre for Ecology & Hydrology, Footprint Ecology, species-based NGOs and land-owners
- Field sampling protocols for heathland species will be identified in consultation with network partners
- Field sampling protocols will be tested at a restricted number of locations
- Field sampling protocols will be tested by volunteer participants
- Training and support will be made available to participants

Guidance for break-out groups

(colour coded by major question, *=key questions)

***Q1: What do we need to monitor?**

- Indicator species? E.g heath tiger beetle
- Indicator groups? E.g. cladonia species, dry heath suite of invertebrate species/genera
- All species

***Q1b: How will we sample Lowland habitat**

- Wet vs dry heath
- Successional stages of heathland?

***Q4: How will the monitoring take place?**

- Existing sites within existing schemes e.g. silver studded blue transects
- New sites within existing schemes e.g. new transect locations
- New sites/sampling entirely
- Stratified-random locations or self-selected or combination?
- Target areas of known under-recording?

***Q3: What field and sampling methods do we use?**

- Standard protocols used by recording schemes
- New approaches
- Population counts
- Frequency of occupied plots – species or groups
- Species richness – whole group or
- Sampling units – plot, 1km, site
- *Tiered approach to suit ability, i.e. entry-level options?*

Q6: What level of environmental/habitat monitoring could take place?

- Simple condition assessments
- Habitat assessment, e.g. EUNIS

***Q6b. What is benefit for scheme?**

- Establishment of systematic approach
- Promotion of their groups
- New data
- New recorders

***Q7: Who will do the monitoring?**

- Experience naturalists – full species surveys
- Existing scheme volunteers for their taxa of interest
- Existing scheme volunteers for their own taxa and trained on new taxa
- New volunteers e.g. students?
- Potential for cross-taxa recording; expand suite of species?

***Q8: What level of training would be required for a pilot in 3 areas?**

***Q10: What areas should be covered in a pilot and what might the issues be?**

***Q11: What extent of co-ordination and promotion support would be required?**

- Is your scheme interested?
- How might your scheme be involved?
- Will it be directed to existing or new contributors?
- What will you do next?

Appendix B. Species identified as strongly associated with Lowland Heathland (refer to main report for details of method).

Species Name	Source	Number of 1kms	Association score
Plebejus argus	Butterflies	1191	49.162
Hipparchia semele	Butterflies	3413	44.034
Orthetrum coerulescens	BDS	751	31.125
Ceriagrion tenellum	BDS	432	30.983
Ulex minor	VPDB	443	30.941
Anarta myrtilli	NMRS	421	29.442
Callophrys rubi	Butterflies	6818	28.565
Sympetrum danae	BDS	1140	28.457
Coenonympha pamphilus	Butterflies	21365	27.598
Ematurga atomaria	NMRS	1036	27.428
Andrena fuscipes	BWARS	449	26.718
Metrioptera brachyptera	Orthoptera	407	26.453
Pilularia globulifera	VPDB	180	26.253
Nomada rufipes	BWARS	661	26.036
Lycopodiella inundata	VPDB	155	25.451
Epeolus cruciger	BWARS	368	25.438
Sphagnum compactum	Bryophyte	385	25.401
Perconia strigillaria	NMRS	253	25.218
Colletes succinctus	BWARS	562	24.932
Gentiana pneumonanthe	VPDB	173	24.851
Sphagnum tenellum	Bryophyte	447	24.529
Diacrisia sannio	NMRS	326	24.432
Ammophila pubescens	BWARS	197	24.135
Eleocharis multicaulis	VPDB	263	23.586
Chamaemelum nobile	VPDB	326	23.290
Lasioglossum prasinum	BWARS	166	23.229
Cordulegaster boltonii	BDS	1626	23.071
Ischnura pumilio	BDS	267	23.004
Mimesa equestris	BWARS	411	22.970
Eupithecia nanata	NMRS	1161	22.914
Pachycnemia hippocastanaria	NMRS	300	22.776
Lycaena phlaeas	Butterflies	28968	22.061
Sphagnum cuspidatum	Bryophyte	782	21.955
Bombus jonellus	BWARS	587	21.814
Formica sanguinea	BWARS	191	21.754
Myrmeleotettix maculatus	Orthoptera	988	21.704
Cephalozia connivens	Bryophyte	475	21.520
Lochmaea suturalis	Coleoptera	352	21.520
Potamogeton polygonifolius	VPDB	564	21.491

Species Name	Source	Number of 1kms	Association score
Boloria selene	Butterflies	2381	21.297
Eumenes coarctatus	BWARS	158	21.293
Kurzia pauciflora	Bryophyte	274	21.085
Coccinella hieroglyphica	Coleoptera	133	20.650
Ochlodes faunus	Butterflies	29197	20.589
Sphecodes pellucidus	BWARS	437	20.432
Andrena argentata	BWARS	158	20.432
Anoplius viaticus	BWARS	333	20.261
Ammophila sabulosa	BWARS	694	20.193
Viola lactea	VPDB	128	20.022
Limenitis camilla	Butterflies	4305	19.996
Aulacomnium palustre	Bryophyte	1553	19.908
Neozephyrus quercus	Butterflies	11211	19.879
Lycophotia porphyrea	NMRS	1840	19.776
Campylopus brevipilus	Bryophyte	161	19.741
Galium constrictum	VPDB	59	19.717
Rhynchospora fusca	VPDB	97	19.699
Aeshna juncea	BDS	2122	19.681
Sphagnum papillosum	Bryophyte	1022	19.662
Macrothylacia rubi	NMRS	747	19.583
Rhynchospora alba	VPDB	171	19.529
Formica fusca	BWARS	1189	19.511
Polytrichum juniperinum	Bryophyte	3507	19.465
Sphagnum palustre	Bryophyte	1558	19.433
Hypnum jutlandicum	Bryophyte	4605	19.337
Campylopus pyriformis	Bryophyte	1483	19.229
Eleogiton fluitans	VPDB	366	19.149
Coenagrion mercuriale	BDS	108	19.125
Crossocerus wesmaeli	BWARS	326	18.918
Lestes sponsa	BDS	3689	18.741
Astata boops	BWARS	445	18.676
Philanthus triangulum	BWARS	731	18.610
Libellula quadrimaculata	BDS	3392	18.591
Lasius platythorax	BWARS	270	18.521
Gladiolus illyricus	VPDB	45	18.492
Lasioglossum punctatissimum	BWARS	532	18.489
Elampus panzeri	BWARS	174	18.475
Erica cinerea	VPDB	594	18.432
Cerceris ruficornis	BWARS	168	18.410
Luperus longicornis	Coleoptera	260	18.399
Nomada baccata	BWARS	108	18.391
Hypericum elodes	VPDB	156	18.255
Eupithecia goossensiata	NMRS	127	18.218

Species Name	Source	Number of 1kms	Association score
Genista anglica	VPDB	166	18.216
Odontoschisma sphagni	Bryophyte	375	18.199
Evagetes dubius	BWARS	106	17.954
Mimesa lutaria	BWARS	219	17.912
Cleora cinctaria	NMRS	93	17.781
Gonepteryx rhamni	Butterflies	31607	17.767
Argynnis paphia	Butterflies	6498	17.750
Hedychridium roseum	BWARS	331	17.729
Cladopodiella fluitans	Bryophyte	134	17.616
Dicallomera fascelina	NMRS	127	17.593
Nemobius sylvestris	Orthoptera	177	17.568
Leucobryum glaucum	Bryophyte	891	17.530
Myrica gale	VPDB	111	17.529
Saturnia pavonia	NMRS	579	17.527
Cerceris arenaria	BWARS	696	17.479
Chilocorus bipustulatus	Coleoptera	264	17.434
Pseudoterpna pruinata subsp. atropunctaria	NMRS	384	17.416
Sphagnum subnitens	Bryophyte	678	17.252
Carex montana	VPDB	80	17.217
Ranunculus omiophyllus x tripartitus (R. x novae-forestae)	VPDB	44	17.198
Sphagnum molle	Bryophyte	76	17.176
Sphagnum denticulatum	Bryophyte	1654	17.157
Xestia castanea	NMRS	261	17.153
Cerceris rybyensis	BWARS	995	17.130
Cordulia aenea	BDS	567	17.098
Cicendia filiformis	VPDB	70	16.977
Erica vagans	VPDB	87	16.900
Stethophyma grossum	Orthoptera	70	16.855
Agrostis curtisii	VPDB	117	16.728
Campylopus introflexus	Bryophyte	5512	16.716
Drosera intermedia	VPDB	63	16.661
Miscophus concolor	BWARS	96	16.656
Selidosema brunnearia	NMRS	70	16.620
Priocnemis parvula	BWARS	324	16.612
Schoenus nigricans	VPDB	182	16.507
Illecebrum verticillatum	VPDB	57	16.484
Megachile versicolor	BWARS	574	16.459
Thyridanthrax fenestratus	Diptera	112	16.422
Cephaloziella divaricata	Bryophyte	710	16.393
Riccardia latifrons	Bryophyte	94	16.245
Cyclophora albipunctata	NMRS	565	16.227
Argynnis aglaja	Butterflies	4152	16.225
Mylia anomala	Bryophyte	202	16.204

Species Name	Source	Number of 1kms	Association score
Drosera rotundifolia	VPDB	331	16.130
Lochmaea caprea	Coleoptera	283	16.017
Mangora acalypha	Arachnids	165	15.995
Libellula depressa	BDS	4956	15.991
Erica tetralix	VPDB	717	15.939
Xestia agathina	NMRS	415	15.920
Sphagnum fimbriatum	Bryophyte	1249	15.892
Calluna vulgaris	VPDB	1958	15.833
Dolomedes fimbriatus	Arachnids	64	15.785
Pulmonaria longifolia	VPDB	166	15.734
Methocha articulata	BWARS	118	15.718
Cuscuta epithymum	VPDB	195	15.716
Panurgus calcaratus	BWARS	329	15.684
Radiola linoides	VPDB	107	15.682
Thymelicus sylvestris	Butterflies	31368	15.651
Oxybelus uniglumis	BWARS	794	15.522
Idaea muricata	NMRS	83	15.521
Pyrrhosoma nymphula	BDS	7482	15.482
Petrophora chlorosata	NMRS	3059	15.469
Evarcha arcuata	Arachnids	50	15.425
Polytrichum commune	Bryophyte	1414	15.402
Carex pilulifera	VPDB	770	15.378
Eulithis testata	NMRS	779	15.342
Clostera pigra	NMRS	69	15.335
Eriophorum angustifolium	VPDB	1104	15.312
Andrena ovatula	BWARS	492	15.225
Crossocerus quadrimaculatus	BWARS	746	15.205
Polyommatus icarus	Butterflies	33265	15.186
Littorella uniflora	VPDB	308	15.173
Pohlia nutans	Bryophyte	2839	15.167
Lepthothorax acervorum	BWARS	423	15.129
Cicindela campestris	Coleoptera	327	15.125
Hypenodes humidalis	NMRS	131	15.076
Formica rufa	BWARS	412	15.058
Pleurozium schreberi	Bryophyte	2470	15.039
Simitidion simile	Arachnids	161	14.984
Cybosia mesomella	NMRS	779	14.949
Trichophorum cespitosum	VPDB	431	14.938
Mellinus arvensis	BWARS	804	14.933
Warnstorfia fluitans	Bryophyte	524	14.831
Carex binervis	VPDB	561	14.828
Pyronia tithonus	Butterflies	47734	14.821
Lindenius albilabris	BWARS	846	14.813

Species Name	Source	Number of 1kms	Association score
Juncus bulbosus	VPDB	954	14.785
Lasius psammophilus	BWARS	131	14.779
Pardosa nigriceps	Arachnids	868	14.778
Erica ciliaris	VPDB	115	14.761
Molinia caerulea	VPDB	1189	14.688
Tetramorium caespitum	BWARS	231	14.610
Vespula rufa	BWARS	624	14.601
Anthophora bimaculata	BWARS	441	14.564
Omocestus rufipes	Orthoptera	310	14.555
Myrmosa atra	BWARS	603	14.495
Diodontus insidiosus	BWARS	100	14.486
Crossocerus ovalis	BWARS	425	14.477
Crassula tillaea	VPDB	304	14.391
Arachnospila spissa	BWARS	393	14.208
Viola lactea x riviniana	VPDB	35	14.204
Anagallis tenella	VPDB	319	14.203
Dactylorhiza incarnata subsp. pulchella	VPDB	35	14.178
Clubiona trivialis	Arachnids	123	14.170
Dicranum scoparium	Bryophyte	6429	14.081
Calopteryx virgo	BDS	2074	14.013
Sphagnum capillifolium	Bryophyte	568	14.012
Hammarbya paludosa	VPDB	51	13.939
Cephalozia bicuspidata	Bryophyte	3025	13.916
Lasius meridionalis	BWARS	55	13.902
Narthecium ossifragum	VPDB	397	13.876
Salix repens	VPDB	198	13.874
Somatochlora metallica	BDS	193	13.869
Hydrocotyle vulgaris	VPDB	1085	13.865
Sphagnum inundatum	Bryophyte	302	13.853
Splachnum ampullaceum	Bryophyte	58	13.839
Phytometra viridaria	NMRS	375	13.765
Pararge aegeria	Butterflies	46456	13.754
Archiearis parthenias	NMRS	565	13.741
Mutilla europaea	BWARS	149	13.740
Sphagnum magellanicum	Bryophyte	259	13.714
Sphagnum fallax	Bryophyte	1538	13.708
Nitella translucens	VPDB	84	13.689
Dicranella cerviculata	Bryophyte	176	13.644
Idaea straminata	NMRS	582	13.638
Oxybelus mandibularis	BWARS	73	13.570
Calypogeia muelleriana	Bryophyte	1785	13.534
Festuca filiformis	VPDB	162	13.520
Andrena barbilabris	BWARS	394	13.499

Species Name	Source	Number of 1kms	Association score
Odontoschisma denudatum	Bryophyte	129	13.477
Gymnocolea inflata	Bryophyte	1118	13.427
Vanessa cardui	Butterflies	38116	13.407
Falcaria lacertinaria	NMRS	1458	13.393
Tachysphex pompiliformis	BWARS	508	13.381
Evagetes crassicornis	BWARS	424	13.359
Agroeca proxima	Arachnids	343	13.299
Passaloecus eremita	BWARS	175	13.294
Moenchia erecta	VPDB	277	13.292
Scutellaria minor	VPDB	182	13.276
Dicranum spurium	Bryophyte	42	13.245
Sphagnum pulchrum	Bryophyte	90	13.191
Tetrix undulata	Orthoptera	1687	13.190
Machimus cingulatus	Diptera	217	13.179
Lacanobia contigua	NMRS	166	13.177
Harpalus rufipalpis	Coleoptera	105	13.132
Callitriche brutia	VPDB	54	13.094
Polygala serpyllifolia	VPDB	384	13.062
Cephalozia macrostachya var. macrostachya	Bryophyte	42	13.039
Gnaphalium sylvaticum	VPDB	209	13.030
Trifolium ornithopodioides	VPDB	318	12.973
Teesdalia nudicaulis	VPDB	276	12.947
Peponocranium ludicrum	Arachnids	283	12.912
Drosera anglica	VPDB	44	12.909
Sphecodes reticulatus	BWARS	223	12.904
Pedicularis sylvatica	VPDB	338	12.903
Carex viridula subsp. oedocarpa	VPDB	1074	12.902
Altica longicollis agg.	Coleoptera	32	12.884
Colias croceus	Butterflies	11696	12.876
Diodontus minutus	BWARS	335	12.853
Crabro scutellatus	BWARS	127	12.842
Pinguicula lusitanica	VPDB	34	12.841
Sphagnum recurvum s.l.	Bryophyte	250	12.821
Evarcha falcata	Arachnids	263	12.818
Idaea sylvestraria	NMRS	114	12.732
Cirsium dissectum	VPDB	155	12.708
Calypogeia fissa	Bryophyte	2706	12.699
Lasioglossum zonulum	BWARS	458	12.671
Myrmica ruginodis	BWARS	1525	12.601
Utricularia minor	VPDB	74	12.600
Philodromus histrio	Arachnids	45	12.579
Lasioglossum leucozonium	BWARS	1322	12.575
Polytrichum piliferum	Bryophyte	2051	12.502

Species Name	Source	Number of 1kms	Association score
Nitella opaca	VPDB	65	12.484
Pompilus cinereus	BWARS	265	12.480
Parentucellia viscosa	VPDB	277	12.465
Anagallis minima	VPDB	81	12.464
Mythimna pudorina	NMRS	422	12.431
Protodeltote pygarga	NMRS	1851	12.422
Ludwigia palustris	VPDB	27	12.415
Euphrasia anglica	VPDB	84	12.358
Campylopus flexuosus	Bryophyte	2318	12.342
Maniola jurtina	Butterflies	59486	12.292
Plateumaris discolor	Coleoptera	181	12.280
Cephalozia macrostachya	Bryophyte	41	12.274
Chlorissa viridata	NMRS	60	12.266
Deschampsia setacea	VPDB	19	12.217
Filago minima	VPDB	228	12.213
Fossombronia foveolata	Bryophyte	38	12.211
Lathrobium terminatum	Coleoptera	93	12.206
Carex echinata	VPDB	774	12.163
Lasiopogon cinctus	Diptera	60	12.163
Agrochola haematidea	NMRS	35	12.126
Symmorphus crassicornis	BWARS	64	12.098
Panurgus banksianus	BWARS	221	12.089
Bryum bornholmense	Bryophyte	184	12.066
Pterostichus diligens	Coleoptera	490	12.050
Nomada leucophthalma	BWARS	337	12.042
Hedychridium ardens	BWARS	367	11.974
Lasiocampa quercus	NMRS	1164	11.959
Crabro peltarius	BWARS	247	11.957
Pseudoterpna pruinata	NMRS	240	11.920
Drassodes cupreus	Arachnids	451	11.915
Apium inundatum	VPDB	187	11.902
Sphecodes ephippius	BWARS	1053	11.787
Carex panicea	VPDB	1360	11.728
Cladopodiella francisci	Bryophyte	49	11.725
Gonioctena viminalis	Coleoptera	65	11.717
Cryptocheilus notatus	BWARS	95	11.700
Lasius fuliginosus	BWARS	380	11.649
Chorthippus vagans	Orthoptera	45	11.593
Boloria euphrosyne	Butterflies	1555	11.580
Sphecodes gibbus	BWARS	418	11.576
Ranunculus flammula	VPDB	2055	11.521
Andrena bimaculata	BWARS	216	11.511
Smicromyrme rufipes	BWARS	152	11.491

Species Name	Source	Number of 1kms	Association score
Atylotus fulvus	Diptera	33	11.477
Poecilus lepidus	Coleoptera	26	11.477
Aira praecox	VPDB	825	11.453
Pterostichus minor	Coleoptera	363	11.444
Crossocerus varus	BWARS	579	11.437
Myrmica scabrinodis	BWARS	1260	11.437
Agrostis vinealis	VPDB	177	11.394
Riccardia multifida	Bryophyte	399	11.371
Viola canina x riviniana (V. x intersita)	VPDB	67	11.358
Chara fragifera	VPDB	18	11.333
Osmunda regalis	VPDB	213	11.327
Agalenatea redii	Arachnids	343	11.326
Anophilus nigerrimus	BWARS	632	11.322
Myzia oblongoguttata	Coleoptera	133	11.315
Frangula alnus	VPDB	254	11.309
Chaetocnema subcoerulea	Coleoptera	46	11.308
Thomisus onustus	Arachnids	29	11.307
Sphagnum squarrosum	Bryophyte	737	11.295
Viola canina	VPDB	192	11.289
Melanchra pisi	NMRS	1133	11.233
Euryopis flavomaculata	Arachnids	60	11.189
Lasius niger s.s.	BWARS	934	11.133
Lasioglossum fratellum	BWARS	300	11.126
Sphagnum flexuosum	Bryophyte	170	11.123
Ranunculus tripartitus	VPDB	40	11.107
Ectobius lapponicus	Orthoptera	130	11.097
Dictyna arundinacea	Arachnids	1063	11.062
Lindenius panzeri	BWARS	273	11.033
Sphagnum capillifolium subsp. rubellum	Bryophyte	592	11.029
Sagina subulata	VPDB	36	10.994
Eutolmus rufibarbis	Diptera	93	10.986
Pedicularis palustris	VPDB	184	10.968
Episyron rufipes	BWARS	404	10.946
Hedychrum niemelai	BWARS	197	10.933
Apatura iris	Butterflies	932	10.868
Heliothis maritima subsp. warneckei	NMRS	22	10.867
Bradycellus ruficollis	Coleoptera	141	10.864
Lasioglossum parvulum	BWARS	662	10.820
Zora spinimana	Arachnids	856	10.814
Crabro cribrarius	BWARS	429	10.797
Halictus confusus	BWARS	48	10.790
Lasioglossum villosulum	BWARS	1247	10.742
Hylaeus incongruus	BWARS	55	10.696

Species Name	Source	Number of 1kms	Association score
Hieracium trichocaulon	VPDB	66	10.677
Ornithopus perpusillus	VPDB	403	10.674
Cerastium semidecandrum	VPDB	414	10.672
Arachnospila trivialis	BWARS	160	10.649
Myriophyllum alterniflorum	VPDB	318	10.644
Priocnemis pusilla	BWARS	235	10.634
Anax imperator	BDS	6104	10.621
Persicaria minor	VPDB	111	10.617
Parastichtis suspecta	NMRS	496	10.567
Thera firmata	NMRS	975	10.530
Haplodrassus signifer	Arachnids	270	10.475
Deltote uncula	NMRS	129	10.475
Vanessa atalanta	Butterflies	48697	10.474
Scilla autumnalis	VPDB	95	10.472
Argynnis adippe	Butterflies	623	10.465
Ulex gallii	VPDB	632	10.452
Priocnemis susterai	BWARS	129	10.423
Neon reticulatus	Arachnids	321	10.410
Aelurillus v-insignitus	Arachnids	26	10.367
Dryudella pinguis	BWARS	129	10.357
Neriene furtiva	Arachnids	33	10.336
Celastrina argiolus	Butterflies	31510	10.325
Juncus pygmaeus	VPDB	17	10.324
Scymnus suturalis	Coleoptera	174	10.323
Andrena clarkella	BWARS	523	10.309
Arachnospila anceps	BWARS	708	10.307
Acupalpus parvulus	Coleoptera	83	10.303
Gymnadenia conopsea subsp. borealis	VPDB	14	10.303
Alopecosa barbipes	Arachnids	138	10.295
Calliadurgus fasciatellus	BWARS	240	10.267
Lithobius calcaratus	CentMill	178	10.238
Acupalpus dubius	Coleoptera	314	10.236
Andrena dorsata	BWARS	1265	10.230
Aphanes australis	VPDB	254	10.205
Chrysops viduatus	Diptera	116	10.201
Hylaeus brevicornis	BWARS	495	10.192
Anatis ocellata	Coleoptera	667	10.177
Brachythecium albicans	Bryophyte	3442	10.147
Polytrichastrum formosum	Bryophyte	5333	10.144
Ageniodideus cinctellus	BWARS	210	10.133
Tapinoma erraticum s.l.	BWARS	27	10.117
Mimumesa spooneri	BWARS	24	10.095
Dysmachus trigonus	Diptera	200	10.089

Species Name	Source	Number of 1kms	Association score
Stenus melanarius	Coleoptera	23	10.082
Andrena tarsata	BWARS	79	10.056
Juncus acutiflorus	VPDB	1756	10.047
Euxoa tritici	NMRS	562	10.045
Synanthedon scoliaeformis	NMRS	26	10.004

Appendix C. Flier produced to advertise project

Heathland Surveillance Network

A volunteer network that aims to collect robust information about lowland heathlands

NATURAL ENGLAND

What is HSN?

HSN is a volunteer survey network that collects information about representative species on heathlands – both common and rare. The idea is to establish a network of sites monitored by volunteers across lowland heathland in England.

The network aims to act as a hub for monitoring efforts on heathlands by joining up existing recording schemes and a new method to look at under-recorded species and site features.

This pilot project is taking place over the 2013 field season and involves the following elements:

- The trial of a Heathland Surveillance Network is a partnership between Natural England, CEH-Biological Records Centre, Footprint Ecology, species-based NGOs and land-owners.
- The field trial is based in three test regions (Dorset, Surrey/Hampshire, Staffordshire). There will be a training day in each region in June 2013.
- A pilot method has been developed to monitor a range of species groups as part of Target Survey Species with a focus on invertebrates, fungi and lichen in particular.
- Coverage of heathland sites by three existing national monitoring/recording schemes will be promoted through support from the network: UKBMS and The UK Plant Surveillance Scheme.
- Straight forward and quick methods have been developed for undertaking a heathland Site Features Assessment to inform the species data.
- Training and support including landowner permissions will be made available to participants.

How does HSN work?

To take part, you will need to register and let us know which heathland site you are interested in. We will provide you with a map of the 1km grid square into which your site mainly fits. You will plan to undertake your survey any time over the summer and **submit your records online**. Instructions, recording forms and ID guides will be available at **www.brc.ac.uk/heathnet**.

Ideally you will be able to attend one of our **training events** where we will explain the full methodology and existing recording scheme methods to look at butterflies and plants. If you can't attend a training event then we will provide comprehensive instructions and are able to talk through the methods over the phone.

What will be recorded?

In consultation with Network experts, we have drawn up a list of invertebrate, fungi and lower plant species to be included in the surveys.

The broad Target Species Survey method involves searching for these species in 10m x10m plots within broad lowland heathland habitats: heather, acid grassland, scrub and bare ground.

The Site Features Assessment involves a walk around the site with 4 stopping points to assess features and take fixed point photographs.

In addition we will promote the existing schemes such as the UKBMS and the UK Plant Surveillance Scheme to encourage data to be collected using specific methods.

What will happen to the data?

The data will be entered online by the volunteer surveyors through an Indicia/iRecord online recording form. The data will be made available to participants and also direct access will be provided for both national recording schemes and Local Environmental Records Centres.

Training

Three training events are planned for 2013 to familiarise volunteers with the project aims and survey methods. The training events are free and experts from Network organisations will be on hand to help with identification.

Surrey (Thames Basin Heaths): Saturday 8th June at Chobham Common NNR 10am-4:30pm.

Dorset Heaths: Tuesday 11th June at Studland, meet at the National Trust Discovery Centre, Knoll Beach, 10:30am-5pm.

Staffordshire: Sunday 23rd June at Highgate Common (Staffordshire Wildlife Trust), meet at Cory Community Centre (Warden's office).

Contact us

For general enquiries about taking part and please contact Katie Cruickshanks on info@footprint-ecology.co.uk or call 01929 552444
www.brc.ac.uk/heathnet

Butterfly Conservation
Surrey Wildlife Trust
Botanical Society of the British Isles
The Wildlife Trusts
National Trust
CEH Centre for Ecology & Hydrology Natural Environment Research Council
Plantlife
footprint ECOLOGY

Heathland Surveillance Network Methods

About the survey

This document details an approach that has been devised to provide information on a suite of invertebrates and lichens which are representative of heathlands. The survey also involves a method to broadly assess a site for the availability of habitat features for insects and also any disturbance which may be impacting upon the target species.

The idea of this survey method is that it can act as a common building block to focus attention on to heathland species. In addition the Heathland Surveillance Network (HSN) as a whole can promote and support existing recording and monitoring schemes to encourage people to take part and generate valuable data on heathland species for use by site managers, species based recording schemes, Local Environmental Records Centres and for Natural England's national reporting.

1. Site selection

The Ordnance Survey 1km grid has been selected as the broad sampling network for the trial and ultimately for the whole network if established across England. The idea is that you undertake your surveys on a site you are interested in or live or work locally to. So if you have a particular heathland site that you want to survey then register this site with the co-ordinator (see contact details below). You will then be provided with a map of the 1km grid square into which your chosen site fits. If your site spans more than one 1km square then you will be given a choice of squares with at least 10 hectares (10% of the area) of heathland habitat within them. For every 1km square surveyed, a Habitat Transect Walk and/or set of Target Species Survey plots will need to be completed. Within a 1km square there may be more than one site and different people can survey different parts of a 1km square.

2. Habitat Transect Walk

This is a rapid assessment to be completed on each visit to a 1km square and aims to assess features known to provide resources for key heathland species. No specialist field equipment is required to undertake this assessment.

The aims of this walk are:

1. To familiarise yourself with the site
2. To provide a broad check to see what features are available for the Target Species
3. To see what negative factors are occurring which may impact upon the Target Species
4. To see how viable it is to generate a network of fixed point photographs on heathlands

Determine a transect route through your site within the square and mark it on your map (HSN1). The route should be representative of the different elements of the site and can follow paths and desirable lines in order to complete a circuit. The length of the route is dependent on the size of the site and along the route you need to have 4 fixed stopping points (A-D) where you assess the habitat. Here are guidelines on how to select your route and stopping points:

1. Your transect walk should be between 500m and 1km long – distances should be estimated using pacing (i.e. estimate the number of your paces per 50m or 100m etc) and the map scale on form HSN1.
2. You need to determine 4 fixed stopping points (A-D) which are spread evenly along the route with at least 100m between them.
3. Your first stop point must be at least 100m from the edge of the square or entrance to the site. For example a 500m walk could have stop points at 100m, 200m, 300m and 400m or a 1km walk could have stop points at 200m, 400m, 600m and 800m.

Mark fixed points (A-D) on the map (HSN1) and if possible record grid reference to 6 figures e.g. SY123456 or if possible record location of stop point using a GPS and record in the notes any feature which help you to relocate your fixed points. At each fixed stopping point determine the circular area to search (radius 10m) using paces and then complete the Habitat Information for Species Survey within a 10m radius circular plot using form HSN2. For

features recorded using DAFOR – this applies to cover of each feature within the whole 10m radius circle. If possible, at each stopping point take 4 photos in each direction: firstly in the direction of travel then turn clockwise 90 degrees 3 times taking a photo each time (see online recording for information on submitting photos).

Along the route determine locations of your Target Species Survey plots (see section 4 below) within the lowland heathland components (where present): bare ground mosaic/ecotone (ideally south facing), heathland, dry acid grassland, scrub, wet heath/Molinia grass. You do not have to complete a survey in all component areas (as some may be absent) but covering as many as possible of the components present at least once would be desirable (see below). Locations of plots should be carefully chosen see below.

3. Target Species Survey Plot selection and plot characteristics

The Target Species Survey Plots are 5m x 5m square or a strip 2.5m x 10m areas located within different habitat types where a search will be carried out to look for the target species listed. The selection of plots within the 1km-square is entirely up to you but when locating plots, the following factors should be considered:

- The plots should fit comfortably within your 1km-square.
- The plots should be located relatively close to paths (and can include path edges) to avoid disturbance to ground nesting birds – information on sensitive areas to avoid should be gathered from site managers where possible.
- Aim to sample a representative area of the habitat and avoid areas where management has recently (i.e. within last 6 months) taken place.
- Select locations that will be easy to relocate i.e. that are close to permanent features.
- The plots should be selected to provide representation across the five habitat types within the heathland where they are present: Bare ground mosaic/ecotone, heather cover, dry acid grassland, scrub, wet heath/Molinia grass.
- Ideally at least one plot should be surveyed in each of the habitat types present but more than one plot per habitat type can be recorded.
- The minimum number of plots to be surveyed per 1km square is three.

The plots should be numbered and marked on your map (HSN1) and record grid reference to 6 figures e.g. SY123456 or if possible record location using a GPS and record in the notes any feature which will help you to relocate your plots. Once the plots are located they need to be marked out (temporarily) so that they can be surveyed easily. The plots also should be recorded accurately to enable future resurveys or repeat visits by other recorders. A photograph should be supplied for each plot on each visit, taken from a fixed location to allow comparison between visits (see online recording for information on submitting photos).

The table below describes the criteria to help you choose your plots and the plot characteristics which you need to record on each survey on form HSN3: Plot characteristics:

Table 7. Criteria to help you choose your plots and the plot characteristics

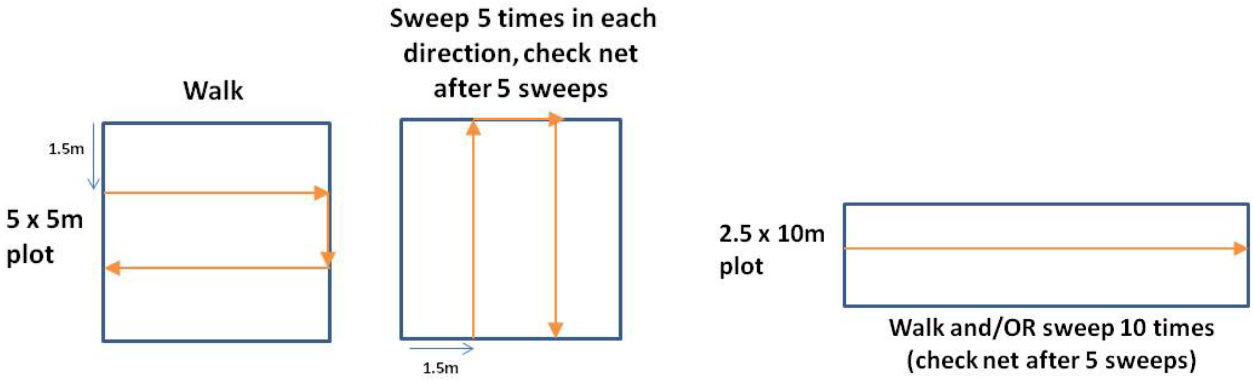
Habitat type	How to choose	Plot characteristics to record
Bare ground mosaic/ecotone	The plot should consist of more than 20% bare ground – this can include paths, tracks consisting of sand, gravel and any other dry natural mineral substrate (with very little or no organic material e.g. leaf litter, humus, moss). Ideally this plot should be sheltered and have a southerly aspect.	Ground cover should be recorded using DAFOR for each of the following categories: Bare ground; Ground cover; Knee height; Waist height; Above the head. Also Nectar sources/forb cover (DAFOR). The ground should be scored on the level of disturbance from 1 (firm with limited disturbance) to 3 (recent and extensive disturbance)
Heather cover	The plot should consist of more than 50% heather cover	Ground cover should be recorded using DAFOR for each of the following categories: Bare ground; Ground cover; Knee height; Waist height; Above the head. Heather cover should be recorded within the following categories: DAFOR heather cover of each of 3 different stages: pioneer, building/mature, degenerate. Also Nectar sources/forb cover (DAFOR).
Dry acid grassland	The plot should consist of more than 50% grass/forb (herbaceous flowing plant) cover and be less than 50cm tall. Typical acid grassland species include: heath bedstraw *Galium saxatile*, sheep`s-fescue *Festuca ovina*, common bent *Agrostis capillaris*, sheep`s sorrel *Rumex acetosella*, sand sedge *Carex arenaria*, wavy hair-grass *Deschampsia flexuosa*, bristle bent *Agrostis curtisii* and tormentil *Potentilla erecta*	Grasses/sedges, nectar sources/forb cover and bare ground cover should be recorded using DAFOR
Scrub	The plot should consist of 5-15% scrub (gorse, birch, oak) cover	Scrub cover should be recorded using DAFOR for each of the following categories: Bare ground, Ground cover, Knee height, Waist, Above the head. Bare ground and also Nectar sources/forb cover (DAFOR). List the three main scrub species present
Wet heath/ Molinia grass	The plot should consist of 50% *Erica tetralix* (cross-leaved heath) possibly with *Molinia* (purple moor grass)	*Erica, Molinia,* bare ground and Nectar sources/forb cover should be recorded using DAFOR

4. Target Species Surveys: Plots

Allow approximately 5-10 minutes to familiarise yourself with the plot by observing the vegetation composition from the edge to avoid disturbing species. Fill in the plot characteristics on form HSN3.

There are 2 levels to sampling the plot for invertebrates – the most basic level is to slowly walk the plot (required) and then sweep the plot (optional). See instructions and diagrams:

1. **Walk** slowly through the plot following a tramline entering the plot 1.5m from an edge across the other side, walk along the edge for 1.5m then walk back across the square. The walk should be done slowly across the plot and recording anything that you see or that flies up.
2. **Sweep**: Repeat the walk across the square from the other side and do 5 broad sweeps in front of you walking one way across the square then check your net and then walk back across your plot repeating the 5 sweeps in the other direction (or 10 across a strip plot). Sweeps should be made firmly through the vegetation in front of you for low growing vegetation or upwards in scrub plots. Record if you completed a sweep net sample on form HSN4.



The presence of target invertebrate species or groups (e.g. Ammophila spp.) should be recorded on form HSN4. There is space on the form to record additional species. If you wish to record lichens then carry out a 10 minute search of the plot after the invertebrate sampling. A DAFOR score should be estimated for each lichen group or species if you wish (use additional spaces on the form HS4).

Once you have completed your plot survey, record the weather during the search. Temperature should be noted if possible and sunshine should be estimated to the nearest 10% of the time it was sunny while the plot was recorded. Average wind speed should be recorded using the Beaufort scale: 0= Calm, smoke rises vertically, 1= Smoke drift indicates wind direction, 2=Wind felt on face, leaves rustle, 3=Leaves and small twigs constantly moving, 4=Dust, leaves, and loose paper lifted, small tree branches move, 5=Small trees in leaf begin to sway.

5. Timing and number of surveys

When monitoring invertebrates as part of the Target Species Survey, you should carry out the surveys when heather is in flower (June/ early July onwards). It is essential that the recording is undertaken between 10:00 and 16:00. Recording should only take place in warm and at least bright weather, with no more than moderate winds and not when it is raining. There are no time or weather restrictions on undertaking the lichen survey.

Ideally the survey should be repeated at least once (i.e. two visits to your site this summer) with at least 2 weeks between visits.

6. Site access and health and safety

When you have registered to undertake a survey within a 1km square it will be important to notify the site owner and manager that the surveys will be taking place. We will be able to help with this and can contact the relevant people on a case by case basis to ensure that site managers are informed and sensitive areas are avoided.

A risk assessment for heathland field surveys is provided as part of the training and is also available on the project website. Please read through this document and ensure that you have considered any risks on your site and have set up a buddy system for lone working.

7. Submitting data, feedback and data availability

Data are to be submitted online at www.brc.ac.uk/hsn/submit-records. The online recording system will be available towards the end of the field season. Please retain paper recording forms and we will email you to remind you to enter data during **early autumn 2013**.

As part of the survey we hope that you will submit a set of photos for each visit: 4 per stop point on the Habitat transect walk and 1 per Target Species Survey Plot. The photo uploading facility will be part of the online recording system.

This project is a pilot and therefore your thoughts on the methods will be a very important part of shaping the methods and network in the future. As part of the online data entry there will be space for you to comment on the survey and project overall.

The online data entry system will be based on Indicia which will allow you to access your data and also provide direct access for both national recording schemes and Local Environmental Records Centres, thus making the best use of the data!

8. Contacts and further information

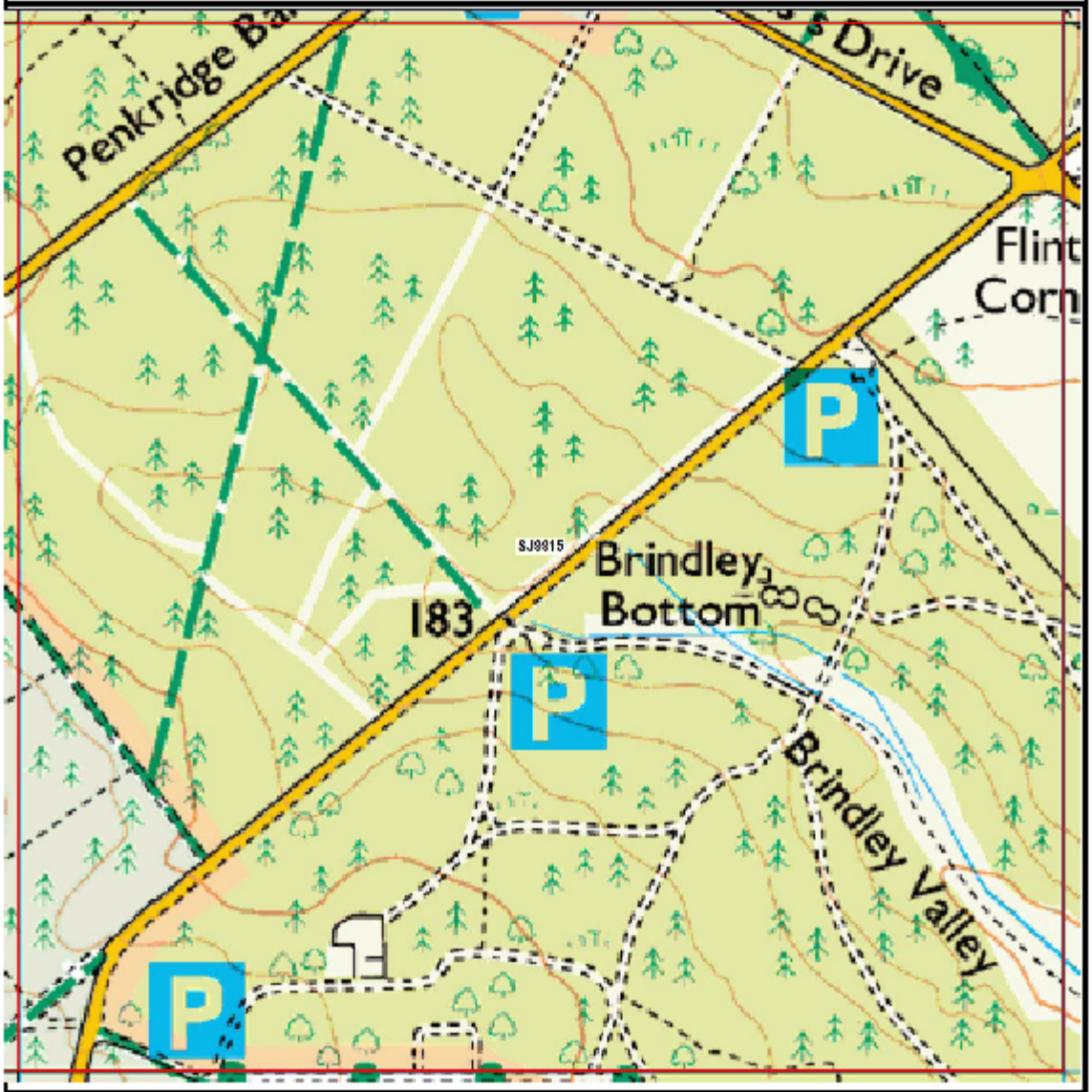
The project website is www.brc.ac.uk/hsn. To register to survey a site or for any questions about site access, methods, species identification and data entry please contact Katie Cruickshanks at Footprint Ecology 01929 552444 or katie@footprint-ecology.co.uk. We will deal with most enquiries but where possible, we will put you in touch with a local or national expert in order to connect recorders and experts with interests in a particular site and also to expand the network and strengthen links.

Thank you for taking part in the Heathland Surveillance Network Pilot Project

Heathland Surveillance Network Pilot Project			HSN1: Site map and habitat Form		
Site Name		1km square grid ref :(e.g. AB1234)		Recorder name	

On the map below:

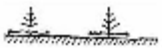
1. Clearly mark your Habitat for Species Transect walk route with a solid line and label it with 'S' at the start and 'F' for finish.
2. Mark your 4 stopping points along the route (label them A-D) where you recorded Habitat Information for Species Survey in a 10m radius circle.
3. Mark the positions of your Target Species Survey plots (using squares labelled with the plot number e.g. [1])
4. On the reverse of this map fill in the Habitat for species information for each stop point.



Scale: 2cm=100m. Notes regarding the Habitat Transect Walk route, access, location of habitat stop points and Target Species Survey Plots:

HSN2: Habitat Information for Species Survey	Date:	Transect length (m):

The DAFOR(X) scale works on % cover. Dominant = >75%, Abundant = 75 - 51%, Frequent = 50 - 26%, Occasional = 25 - 11%, Rare 10 - 1 % and please use X if absent. Heather growth stages:

Pioneer:  Building/mature: Degenerate:

Adapted from Gillingham 1972

			Stop point A	Stop point B	Stop point C	Stop point D
			Dist (m):	Dist (m):	Dist (m):	Dist (m):
	Stopping point grid ref (6 figures e.g. SY123456):					
	Feature	Feature detail				
Habitat (Record using DAFOR(X))	Heather - growth stages	Pioneer				
		Building / mature				
		Degenerate				
	Grasses and sedges	Acid grassland				
		Enriched ride side				
		Grass in heather				
	Forbs	Herbaceous flowering plants. Not shrubs such as gorse				
	Bracken					
	Scrub (<than 3m tall)	Gorse/Broom				
		Birch				
		Pine				
	Water	Permanent standing water				
	Other species	Bramble				
		Nettle/dock				
		Rhododendron				
		Other:				
	Structural diversity tick box?	Bare ground				
		Up to knee height				
		Up to waist height				
		Above the head				
	Number of trees (>3m tall): Record as 0, 1-5, 5-20, 20-50, >50					
	Path width: Record Average width (m)					
Recreational pressure Record if present or absent √/x	Horses or evidence of					
	Bikes or evidence of					
	Motorbikes or evidence of					
	Other vehicles or evidence of					
	Path braiding					
	Dogs/Dog waste					
	Litter					
	Fire evidence					
	Fly-tipping					
	Other					
	Number of people: Record number seen in 5 minute period					

HSN3: Target Species Survey—Plot characteristics	Date:	1km grid ref:

Fill in the details for each plot using the correct table based on its broad habitat—on this form there is space for up to 3 plots of each broad habitat within a 1km square. Each plot should have a different number. Therefore you may only fill in one row of each table if completing one survey in each broad habitat type. The DAFOR(X) scale works on % cover. Dominant = >75%, Abundant = 75 - 51%, Frequent = 50 - 26%, Occasional = 25 - 11%, Rare 10 - 1 % and please use X if absent.

BARE GROUND / MOSAIC PLOTS	Bare ground (DAFOR)	Vegetation up to knee height (DAFOR(X))	Vegetation up to waist height (DAFOR(X))	Vegetation above head (DAFOR(X))	Nectar sources / forbs(not gorse or shrubs)(DAFOR (X))	Ground disturbance (1-3 where 1= firm with limited disturbance to 3=recent and extensive disturbance)
Plot number:						
Plot number:						
Plot number:						

HEATHER PLOTS	Pioneer (DAFOR(X))	Building/mature (DAFOR(X))	Degenerate (DAFOR(X))	Nectar sources / forbs (not gorse or shrubs) (DAFOR(X))
Plot number:				
Plot number:				
Plot number:				

ACID GRASSLAND PLOTS	Bare ground (DAFOR(X))	Nectar sources / forbs (not gorse or shrubs)(DAFOR(X))	Grasses and sedges (DAFOR(X))
Plot number:			
Plot number:			
Plot number:			

SCRUB PLOTS	Bare ground (DAFOR (X))	Vegetation up to knee height (DAFOR(X))	Vegetation up to waist height (DAFOR(X))	Vegetation above head (DAFOR(X))	Nectar sources / forbs (not gorse or shrubs) (DAFOR(X))	Main scrub species 1 (enter common name)	Main scrub species 2 (enter common name)	Main scrub species 3 (enter common name)
Plot number:								
Plot number:								
Plot number:								

WET HEATH/MOLINIA PLOTS	Cover of Erica tetralix (cross-leaved heath) (DAFOR(X))	Cover of Molinia (Purple moor grass) (DAFOR(X))	Bare ground (DAFOR(X))	Nectar sources / forbs (not gorse or shrubs) (DAFOR(X))
Plot number:				
Plot number:				
Plot number:				

Heathland Surveillance Pilot Project				HSN4: Target Species Survey Recording Form	
Site Name		1km square grid ref :(e.g. AB1234)		Date (dd/mm/yy)	
Recorder Name		Average temperature (°C)		Wind speed (Beaufort scale 1-5)	

Enter plot number (as shown on map):						
Plot centre grid ref (6 figures e.g. SY123456):						
Start time (hh:mm):						
Plot habitat (enter BG– bare ground, H-heather AG– acid grassland , W-wet heath/Molinia, S-scrub):						
Did you use a sweep net? (Y/N)						

Code	Species group	Species grouping	Record if present (✓)				
1	ARANEAE	*Agelena labyrinthica* Funnel web spider					
2		*Dolomedes fimbriatus* Raft Spider					
3		*Evarcha arcuata* Spider					
4		*Micrommata viridescens* Spider					
5	COLEOPTERA	*Chilocorus bipustulatus* Heather ladybird					
6		*Chrysomela populi* Leaf beetle					
7		*Cicindela campestris* Green tiger beetle					
8		*Coccinella hieroglyphica* Hieroglyphic ladybird					
9		*Exapion ulicis* Gorse weevil					
10		*Lochmaea suturalis* Heather beetle					
11		*Luperus longicornis* Leaf beetle					
12		*Micrelus ericae* Weevil					
13	DIPTERA	Robberflies					
14		Tachinids					
15	HEMIPTERA	Aphids					
16		*Auchenorrhyncha*					
17		*Aelia acuminata* Bishop's mitre shieldbug					
18		*Alydus calcaratus* Bug					
19		*Piezodorus lituratus* Gorse shield bug					
20		*Nabis ericetorum* Heath damsel bug					
21		*Orthotylus ericetorum* Heather bug					
22		*Elasmucha grisea* Shield bug					
23	HYMENOPTERA	*Ammophila* spp.					
24		*Cerceris* wasps					
25		*Epeolus cruciger* Cleptoparasite Bee					
26		*Nomada ruficpes* Cleptoparasite Bee					
27		*Andrena fuscipes and/or Colletes succinctus*					
28		Mimesa wasps					
29		*Pompilidae* Spider hunting wasp					
30	LEPIDOPTERA	*Anarta myrtilli* Beautiful yellow underwing larva					
31		*Saturnia pavonia* Emperor moth larva					
32		*Macrothylacia rubi* Fox moth larva					
33		*Hipparchia semele* Grayling					
34		*Plebejus argus* Silver-studded blue					
35		*Lycaena phlaeas* Small copper					
36		*Coenonympha pamphilus* Small heath					
37	ORTHOPTERA	*Myrmeleotettix maculate* Mottled grasshopper					
38		*Metrioptera brachyptera* Bog Bush Cricket					
39	ODONATA	*Orthetrum coerulescens* Keeled Skimmer					
40	LICHENS (Record using DAFOR)	Red fruited *Cladonias* "devils matchsticks" *(diversa— previously coccifera, floerkeana)*					
41		Large grey bushy *Cladonias (arbuscula, ciliata, portentosa)*					
42		*Cladonia uncialis subsp. biuncialis*					
43		*Pycnothelia papillaria*					
44		*Cetraria aculeata*					
	Other species seen						
Percentage time sun shining during 15 minute plot survey:							

Appendix E. Online feedback survey

Heathland Surveillance Network Pilot - Feedback

Q1 **Having signed up to do the volunteering, how would you describe your feelings at the beginning of the volunteer period?** ***(Even if you didn't complete the survey).***

6 (40.0%)	Excited by a new challenge	1 (6.7%)	Looking forward to meeting new people
6 (40.0%)	Excited by a chance to learn more	2 (13.3%)	Overwhelmed with the task

Q2 **After having completed the training workshop, how apprehensive were you before doing the survey?** ***(Even if you did not complete the survey).***

6 (40.0%)	Concerned that you may not be able to correctly identify the species
1 (6.7%)	Concerned that you may not be able to locate appropriate plots
4 (26.7%)	Worried about the level of commitment
4 (26.7%)	None of the above

Q3 **Having taken part in the workshop, how satisfying did you find the experience?** (1=very satisfying, 5=very unsatisfying).

1	2	3	4	5
4 (40.0%)	1 (10.0%)	3 (30.0%)	2 (20.0%)	0 (0.0%)

Q4 **What made you volunteer for this project?**

11 (39.3%)	Interest in conservation	1 (3.6%)	Meeting new people
7 (25.0%)	Interest in the natural world	2 (7.1%)	Getting out and about (being outdoors)
6 (21.4%)	Desire to learn new species	1 (3.6%)	Something I could do with friends

Q5 **How easy was it to gain permission to survey your square?**

6 (85.7%)	Very easy
0 (0.0%)	It took some work
1 (14.3%)	Unsure/Don't know
0 (0.0%)	Very difficult
0 (0.0%)	Failed to get permission

Q6 **On a scale of 1-5 how easy was it to follow the instructions for locating the different heathland habitats for species plots within your 1km square?** (1=very easy, 5=not easy at all).

1	2	3	4	5
1 (14.3%)	3 (42.9%)	1 (14.3%)	2 (28.6%)	0 (0.0%)

Q7 **On a scale of 1-5 how helpful were the maps?** (1=very easy, 5=not easy at all).

1	2	3	4	5
1 (16.7%)	0 (0.0%)	3 (50.0%)	2 (33.3%)	0 (0.0%)

Q8 **How easy was it to lay out your plots and to relocate them?**

2 (28.6%) Did not try to relocate

3 (42.9%) Difficult to relocate

2 (28.6%) Easy to relocate

Q9 **Did you conduct the survey alone or with others?**

1 (14.3%) Alone

3 (42.9%) With other people from the workshop/project

3 (42.9%) With friends / colleagues

Q10 **Would you be willing to survey randomly allocated plots located within 10km of your home or work?**

3 (42.9%) Yes

1 (14.3%) No

3 (42.9%) Maybe

Q11 **What did you think of the number of species on the list?**

4 (57.1%) Didn't see many

1 (14.3%) Not enough on the list

1 (14.3%) Just the right amount on the list

1 (14.3%) Too many on the list

Q12 **On a scale of 1-5 how easy were the species on the list to identify? (1=very easy, 5=very difficult).**

1	2	3	4	5
2 (28.6%)	1 (14.3%)	2 (28.6%)	1 (14.3%)	1 (14.3%)

Q13 **Overall, on a scale of 1-5 how easy did you find the methodology? (1=very easy, 5=very difficult).**

1	2	3	4	5
1 (14.3%)	4 (57.1%)	0 (0.0%)	2 (28.6%)	0 (0.0%)

Q14 **On a scale of 1-5 how interesting did you find doing the survey? (1=very interesting, 5=not very interesting).**

1	2	3	4	5
3 (42.9%)	4 (57.1%)	0 (0.0%)	0 (0.0%)	0 (0.0%)

Q15 **How often would you be willing to do the survey in the future?** ***(Even if you didn't take part in 2013).***

6 (54.5%) Once per year

3 (27.3%) Twice per year

2 (18.2%) Three times per year

0 (0.0%) Every other year

Q16 **What kind of support and training do you think is needed for volunteers taking part?**

5 (13.9%) More training

7 (19.4%) Help with species ID in the field

8 (22.2%) Better survey materials (ID guides)

3 (8.3%) Simpler methodology

4 (11.1%) Online support

5 (13.9%) Surveying in pairs or groups

4 (11.1%) Help to establish pairs or groups.

Q17 **Having taken part in this project this year, how willing would you be to volunteer for this or similar projects in the future?**

4 (36.4%)	Very willing	0 (0.0%)	Not willing
1 (9.1%)	Willing	5 (45.5%)	Will depend on other commitments
1 (9.1%)	Unsure		

Q18 **What personal positive outcomes were experienced?**

6 (30.0%)	I feel pleased to have learned something new	6 (30.0%)	My confidence in heathland surveys has grown
4 (20.0%)	It felt good to have contributed to conservation	1 (5.0%)	I am glad to be able to meet new people
		3 (15.0%)	None of the above

Appendix F. Feedback from Dorset volunteers

Heathland Surveillance Network – Dorset Workshop Feedback

Katie Cruickshanks and Jim White (Footprint Ecology)

Attendees: John Newbould (NT), Karen Elborn (Poole Borough Council), Zoe Chappell (BU graduate), Toby Branston (RSPB), David Brown (NT- Cyril Diver), Rob McGibbon (Cyril Diver Volunteer)

With regards reasons for interest in the project, there is an understanding that site managers are under pressure and therefore volunteers need to do monitoring. Volunteers are frustrated with the data not being used. There is a huge opportunity for volunteers to gain greater experience.

Cyril Diver project: an excellent project but it takes a lot of energy and time. This may have distracted volunteers from the HSN project.

SPECIES:

- A fixed species list is attractive rather than identifying whatever you can see.
- Most participants were disappointed not to see many on the list
- Adding more generalist species would add interest.
- The species list is a matter of deciding whether the survey is for specific species (S41 etc) or 'heathland health'. The habitat is already better monitored than the species so it must be about the species.
- Volunteers need to feel useful even if they don't see anything from the list. Could more casual observations be supported within the recording system? E.g. Dodder. Interplot observations!
- Indicators such as presence of anthills.
- Recording families would help.
- Ask vols to rate their own ability with different groups i.e. 1-3

MAPPING AND LOCATING PLOTS:

- Problems with heathlands straddling 1km squares – how to deal with this? Why not use 'site' rather than square?
- Would like to be able to digitise the route on the online form
- Mapping – problems with projections- GPS routes did not match the map on the online system. BNG versus Google projection problems. It would be much better if you could enter your grid ref and the location would be marked and correct.

HABITATS RECORDING:

- Issues raised about recording evidence of grazing – Deer in particular.
- If too much emphasis on habs and not many species seen then vols will feel like they are doing NE's job. Also site managers do not like this idea- discussed elsewhere.
- Categories of Gorse are not comprehensive.
- Overall habitats recording should be kept simple.
- Ankle height vegetation is needed.
- Evidence of people vs count of people
- Other species needs and other option.
- Recreational pressure 'other' would be useful.

HSN 3 PLOTS:

- Better definition of 'nectar sources' as heather in flower is a nectar source. But it is a shrub – not clear.
- Bracken not included in scrub – should it be?

GENERAL:

- Missing from online: did you use a sweepnet? Start time
- Temp range would be better than exact.
- How often should they take photos?
- Feedback free text boxes not big enough.

GAINING VOLUNTEERS- SUGGESTIONS:

Attitudes of participants towards the project could go either way with an NE lead – everyone agreed that a partnership including charities would be best as volunteers wish to do work for the charities not the government.

Staff from RSPB and local authorities took part in the workshop and pilot to see if the method could be rolled out with volunteers on their sites as monitoring just isn't getting done. There will be a huge opportunity to engage communities and volunteers through the Urban WildLink project ('The Great Heath').

Experts should be paired with novices. Could novices take an admin role to co-ordinate the experienced people and pair up vols – a co-ordinator role.

Local natural history societies and friends of groups will be key.

An alternative model would be that the site manager (local authority or charity) will take responsibility for co-ordinating and motivating volunteers. By investing in trainers within the stable staff pool at the site then seasonal workers and volunteers could be trained annually. E.g. via RSPB in house training programmes, NE could support 1 or 2 annual training courses for trainers open to all heathland managers. This would bring together trainers from lots of different organisations to increase knowledge sharing.