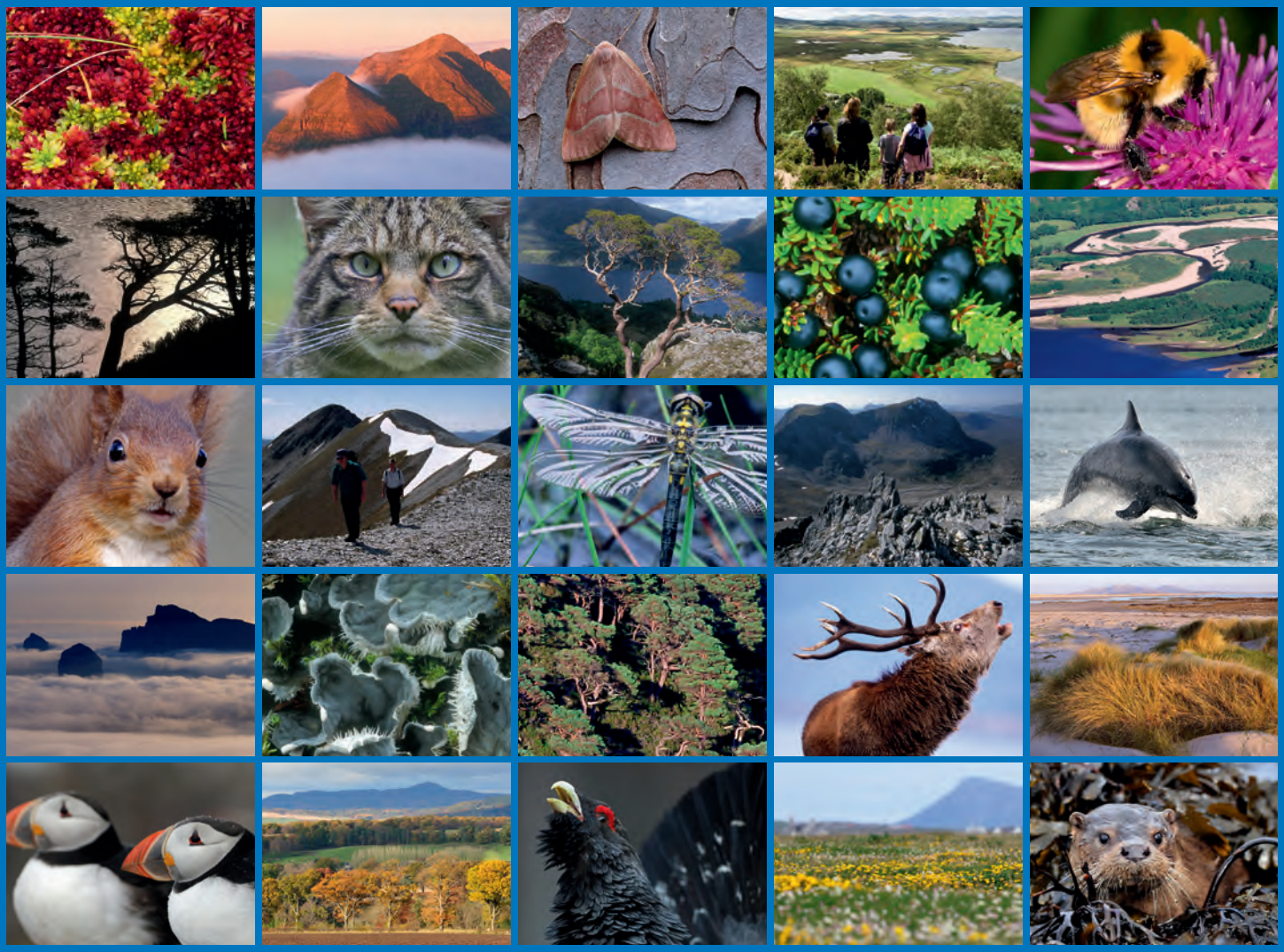
Scottish Natural Heritage
Commissioned Report No. 796

Developing Scottish bat population trends through the National Bat Monitoring Programme



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COMMISSIONED REPORT

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Developing Scottish bat population trends through the National Bat Monitoring Programme

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COMMISSIONED REPORT

Summary

Developing Scottish bat population trends through the National Bat Monitoring Programme

Commissioned Report No. 796
Project No: 14478
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Keywords

Bat populations; Scottish trends; monitoring.

Background

The National Bat Monitoring Programme (NBMP) was established in 1996 to provide early warning of bat species' declines, evidence to direct conservation action, and support government reporting obligations. It is a partnership between the Bat Conservation Trust (BCT), the Joint Nature Conservation Committee (JNCC), Defra and Natural Resources Wales (NRW) with additional funding from Natural England. It aims to identify trends from which to assess the conservation status of the UK's bat species. Surveys were carried out by volunteers to count bats in summer and winter roosts and to assess activity in summer using bat detectors. These have been undertaken annually since 1997.

In Scotland, NBMP survey participation is lower for most species than the statistical threshold required to produce country trends. In this report, existing levels of survey participation were analysed and an investigation was conducted into what level of increase in participation would be required for each survey type to allow population trends of individual species to be produced. The production of such species trends for Scotland would be of value not only for the purposes above, but may also allow the production of a composite multi-species biodiversity indicator analogous to those already established for UK and England.

Main findings

- Scotland is currently under-represented in the NBMP in all species trends in relation to the country areas of Great Britain and survey sites are not evenly distributed across SNH Areas within Scotland.
- The Hibernation Survey is particularly under-representative as the number of hibernation sites monitored in Scotland is small and most are in the southern half of Scotland.
- Proportional representation of Scotland in NBMP trends relative to country area could be achieved with relatively small increases in survey effort in Roost Counts of soprano pipistrelle, brown long-eared bat and Natterer's bat.
- Some land cover categories are not proportionately represented in Scotland for all survey types. The Uplands are under-represented in all survey types; representation of land

cover categories is more representative of lowland habitats for most surveys although there are still some biases.

- Survey coverage is currently sufficient to produce species trends for Daubenton's bat from the Waterway Survey and soprano pipistrelle from Roost Counts for Scotland with a relatively low level of error.
- With reasonable increases in survey participation, error levels of species trends in Scotland could be reduced sufficiently for common and soprano pipistrelle from the Field Survey and for common pipistrelle from Roost Counts.
- Species trends calculated from bat detector surveys (Field and Waterway Survey) are considered more robust than from Roost Count trends. With existing or increased survey coverage it would therefore be possible to produce robust species trends in Scotland for Daubenton's bat, common pipistrelle and soprano pipistrelle from the bat detector surveys.
- Survey coverage is very low in Scotland for all species monitored through the Hibernation Survey (brown long-eared bat, Natterer's bat, Daubenton's bat and whiskered/Brandt's bat) and trend analysis from this survey is not currently feasible.
- Survey coverage is low for Roost Counts of brown long-eared bat and a large increase in survey participation would be needed to allow a trend to be calculated for this species in Scotland. Survey coverage is also very low for Roost Counts of Natterer's bat and a large increase in the number of sites monitored would be required to allow a species trend to be calculated for Scotland.
- The required increases in survey effort for bat detector surveys could be achieved through improving training opportunities for volunteers by increasing the network of bat detector workshop leaders in Scotland. Other options are to provide additional resources to existing volunteers that would encourage take-up of additional sites, or through the use of paid field assistants (currently all survey work in the NBMP is completed on a wholly voluntary basis).
- The network of Roost Count sites could potentially be improved through media campaigns or targeted work to identify new roost sites.
- Alternative options for bat monitoring, such as the introduction of broadband bat detector surveys which would allow increased species coverage, are discussed. A full cost and benefit analysis of these options would be required before implementing any new monitoring method in Scotland.

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Acknowledgements

A huge thank you must go to all of our hard-working NBMP volunteers who have collected bat data that have contributed to this report. The NBMP relies on the ongoing efforts of hundreds of volunteers whose dedication allows us to produce population trends for UK bats. Without our volunteers the NBMP would not exist.

The report was written by Kate Barlow and Philip Briggs. Steve Langton completed the statistical analysis.

1. BACKGROUND

Following widespread concern about declines in bat populations (Stebbings & Griffith, 1986; Stebbings, 1988) and protection given to the species in the UK and throughout Europe, the Bat Conservation Trust (BCT) established the National Bat Monitoring Programme (NBMP) in 1996. The purpose of the NBMP was to provide information on UK bat species trends as evidence to direct conservation action and support for government reporting obligations (Bat Conservation Trust, 2001). The NBMP is now the UK's principal tool for assessing population change in bats. It is a partnership between the BCT, the Joint Nature Conservation Committee (JNCC), Defra and Natural Resources Wales (NRW) with additional funding from Natural England, and relies on volunteers to carry out its surveys. Surveys involve counts of bats in summer and winter roosts and measuring summer bat activity using bat detectors. Full details of the survey methods can be found on the Bat Conservation Trust website[1].

Population trends are produced at a UK level for 10 bat species or species groups. There are 18 species of bat in the UK, 17 of which are known to be breeding. At least nine of these are present in Scotland. Whiskered and Brandt's bat are considered as a group within the NBMP as they are monitored at hibernation sites and are difficult to identify visually to species level in winter roosts. Bats roost in a variety of habitats: some species rely on buildings and other structures for summer roosts, some species winter in underground hibernation sites such as caves, mines and cellars, whereas other species are woodland specialists and roost in trees in both summer and winter. The general natural history of the UK's bats has been published extensively (e.g. Altringham, 2003).

The programme also provides information for Habitats Directive Article 17 reporting[2], the UK Biodiversity Framework[3] and Biodiversity Indicators (i.e. UK Mammals of the wider countryside (bats) and England Species in the wider countryside (farmland)[4]. Information from the NBMP is used to guide conservation action to sustain bat populations and the habitats on which they depend. Where possible, the NBMP also seeks to provide an improved understanding of the factors affecting bat populations and distributions (e.g. Langton *et al*., 2010; Boughey *et al*., 2011a,b).

Until 2013 the annual online NBMP report[5] published species population trends at a UK level for most of the species monitored (with the exception of lesser horseshoe bat for which both England and Wales trends are produced). Differences between countries were considered as part of the trend analysis and reported on in individual species pages. A power analysis that was completed as part of the first five years of the programme suggested that, as a general rule, a sample size of 30 to 40 repeat survey sites are required to produce statistically robust species trends for a region (Bat Conservation Trust, 2001). In 2014 species population trends were published at a country level for England and Wales for the first time alongside the UK population trends, where sufficient data were available. In Scotland, the survey participation is lower than the statistical threshold for the majority of species and survey types, and country level trends have therefore not been published for Scotland to date.

[1] http://nbmp.bats.org.uk/Surveys.aspx
[2] http://jncc.defra.gov.uk/page-6387
[3] http://jncc.defra.gov.uk/page-6189
[4] http://jncc.defra.gov.uk/biyp
[5] http://www.bats.org.uk/pages/nbmp_annual_report.html

2. OBJECTIVES

The objective of this project is to review the current level of bat surveillance in Scotland through the NBMP; to determine what levels of increase in survey participation would be required to ensure robust Scottish and GB trends can be produced; and to make recommendations on how these increases could be achieved.

The key aims are:

- To review and map the current NBMP survey coverage in Scotland.
- To assess the existing number and distribution of monitoring sites for priority surveys and species in Scotland, and their relative contributions to GB trends.
- To assess the existing number and distribution of monitoring sites for priority surveys and species in Scotland in relation to land cover in Scotland.
- To specify an optimal sampling strategy for Scotland.
- To compare existing and optimal sampling strategies to identify gaps in coverage by SNH area.
- To make recommendations on a range of possible options to address current deficiencies in survey coverage.

3. METHODS

To review the current level of survey coverage by the NBMP for relevant bat species in Scotland, the NBMP database was interrogated to extract information on the location, number, and distribution of all sites surveyed since 1997. The core NBMP survey types (Table 1) are counts of bats in summer roosts of species that roost in buildings (Roost Count); counts of bats at winter roosts in underground sites (Hibernation Survey); and summer bat detector surveys, which record the number of bat 'passes' observed (Field Survey and Waterway Survey) (detailed descriptions of each survey methodology can be found on the NBMP web pages[6]). Seven bat species or species groups are monitored through the core surveys of the NBMP in Scotland:

- Common pipistrelle (*Pipistrellus pipistrellus*)
- Soprano pipistrelle (*P. pygmaeus*)
- Brown long-eared bat (*Plecotus auritus*)
- Natterer's bat (*Myotis nattereri*)
- Daubenton's bat (*M.daubentonii*)
- Whiskered/Brandt's bat[7] (*M. mystacinus/brandtii*)
- Noctule (*Nyctalus noctula*)

Table 1. Summary of NBMP surveys and species in Scotland. For full details of survey methodology and rationale refer to Bat Conservation Trust (2001).

Survey	Survey type	Species	Survey period
Roost Count	Counts of bats in summer roosts (sites selected by volunteers)	Common pipistrelle	1997-2012
		Soprano pipistrelle	1997-2012
		Pipistrelle (unidentified)	1997-2012
		Brown long-eared bat	1997-2012
		Natterer's bat	2000-2012
Hibernation Survey	Counts of bats in winter roosts (at known hibernation sites selected by volunteers)	Brown long-eared bat	1997-2012
		Natterer's bat	1997-2012
		Daubenton's bat	1997-2012
		Whiskered/Brandt's bat	1997-2012
Field Survey	Summer bat detector transect survey in 1km squares, counts of bat "'passes' at set points and route sections (random stratified sampling by land-use type, see Bat Conservation Trust (2001) for details)	Common pipistrelle	1998-2012
		Soprano pipistrelle	1998-2012
		Noctule	1998-2012

[6] http://www.bats.org.uk/pages/survey_and_species_coverage.html

[7] The status of Brandt's bat in Scotland is unclear and there is only one confirmed record (from Perthshire) in1874.

Survey	Survey type	Species	Survey period
Waterway Survey	Summer bat detector survey, counts of bat "passes" at set points on 1km transect along waterways (random stratified sampling by Centre for Ecology & Hydrology (formerly ITE) national land classes from a pool of Environment Agency River Habitat Survey sites, see Bat Conservation Trust (2001) for details)	Daubenton's bat	1997-2012

The number and location of all sites recorded in the database during the monitoring period of the programme to date (1997-2012) were extracted for each species and survey type. Some of these sites are yet to contribute to species trend analysis. To contribute to the species trend analyses, sites must be surveyed within the date range specified for each survey type and for more than one year within the monitoring period (so that a change can be determined). For trends based on count data collected at roosts and hibernation sites, the species must have been recorded at the site at least once for it to contribute to that species trend. For trends based on bat detector data, all sites that meet the survey criteria (e.g. appropriate date period, correct time of night, etc.) contribute to the species trends whether or not the species has been recorded at that site. Each site was allocated to the relevant SNH Area with South Highland and the Northern Isles and North Highland considered together as these two areas are not separated in the existing NBMP database. The number of sites (both total in the database and the number currently contributing to species trends) are reported by SNH Area for each survey type.

Species identification is made by volunteers in the field using heterodyne bat detectors during the Field and Waterway Surveys (see Waters & Barlow (2013) for an overview of different types of bat detectors). Volunteers are encouraged to take part in training workshops and to use online training resources to ensure that identification skills are standardised across surveys. It is possible, however, that some errors are made during identification of bat calls in the field, although analysis using mixed models has shown that whilst there is a significant component of variation associated with observer differences, the identification skills of volunteers are accounted for in the models as covariates and the overall impact on calculation of trends is negligible.

To determine how representative the survey coverage in Scotland is in the context of the wider monitoring programme, the number of sites for each survey type and species were assessed in terms of their relative contribution to the overall species trend estimations. For the purpose of this report, these analyses were completed for Great Britain (GB) only; sites in Northern Ireland and the Channel Islands were excluded due to very small sample sizes. The analyses in this report therefore refer to the representation of Scotland within the overall sampling in GB (the NBMP annual report online publishes UK trends). The number of sites was compared to those in England and Wales (combined) in relation to the relative geographical areas of the three countries) using Chi-squared analysis (e.g. Fowler & Cohen, 1990). The expected values from the Chi-squared analyses of country area representation were then used as a simple estimator for optimal number of sites by survey type and species to ensure that Scotland would be suitably represented in species trends at the GB level.

The relative contribution of sites from different land cover types within Scotland was assessed to determine how representative the existing number of sites was in relation to land use in Scotland. Data on land cover type was taken from the Land Cover Map for 2000 (LCM2000)[8], with the predominant land cover type within each 1x1km Field Survey square and the 1x1km square in which the Waterway Survey transect is located being used to represent that square. For Waterway Surveys, volunteers are allocated sites using a six figure grid reference and construct a 1km linear transect with the grid reference as the central point, or as close as possible to the central point. In most cases the majority of transects will fall within the 1km square in which the allocated site is located. The distribution of Roost Count sites was compared with the distribution of land cover types within Scotland based on a 3x3km square around the roost location. The larger square is to account for a likely core foraging area from a roost for bat species monitored in Scotland (e.g. Entwistle *et al.,* 1996; Nicholls & Racey, 2006). Analysis of land cover representation in Scotland was not completed for Hibernation Survey sites due to the very small number of sites for this survey type in Scotland. The proportions of each land cover type around survey sites was compared to the overall proportion in Scotland for each land cover type separately (Fuller *et al.,* 2002) using Wilcoxon signed-rank tests as the distribution of most land cover types is generally skewed and therefore not normally distributed (e.g. Fowler & Cohen, 1990).

3.1 Statistical methods

NBMP individual species population trends for each survey were analysed using General Additive Models (GAMs) following the methods of Fewster *et al.* (2000) where a smoothed line is fitted that describes the trend over time[9]. These and all other analyses were fitted using GenStat (VSN International Ltd., 2011), using specially written GenStat procedures which have been extensively tested using simulated data.

Poisson GAMs were used on the count data (Fewster *et al.*, 2000) from the Roost Counts and Hibernation Surveys, using the number of bats counted as the response variable[10]. Negative binomial models have also been tried but seemed to offer no consistent advantage compared to an over-dispersed Poisson model. Initially the same approach was used on the Field and Waterway Surveys, but the numbers of bat passes were extremely over-dispersed compared to a Poisson distribution due to repeated passes from the same individual bat. It is extremely difficult to achieve consistent recording of the number of passes between observers when there is near continuous activity and, perhaps because of this, the random error in the estimates was very high. Binomial GAMs were therefore used on the proportion of sampling points where bats are present and this approach has produced much tighter confidence limits for the indices. It must be remembered, however, that indices calculated in this way estimate change in the proportion of suitable habitat where the species is observed, which is not necessarily linearly related to change in absolute population size estimated by the Poisson models.

Standard errors for both the Poisson and binomial models were calculated using between-site bootstrapping, due to temporal correlation in residuals. The bootstrapping process also ensures that the confidence limits are not distorted by other correlation patterns between observations from the same site; this means that duplicate counts from each site in each year can both be included in the GAM models, without the need for calculation of summary statistics.

[8] http://www.countrysidesurvey.org.uk/archiveCS2000/Final_reports/M07_final_report.htm
[9] http://www.bats.org.uk/pages/bat_population_trend_analysis.html
[10] http://www.bats.org.uk/pages/detailed_explanation_of_gams.html

Other approaches to trend estimation are possible. Methods based on Generalised Estimating Equations (GEE) are sometimes used, often using TRIM[11], which is a package written to apply the method to bird population data. Mixed models have also been used (Ingersoll *et al.*, 2013), but require care to avoid bias in the variance parameters. Detailed consideration of these alternatives for estimation of bat trends is beyond the scope of the current report.

In order to develop an optimal sampling strategy for calculating a Scottish trend, the precision of the trend estimates based on the current Scottish survey data was first assessed. The approach used was based on a similar study for Wales[12]. The time available for this project was sufficient to apply similar methods to the Scottish data, but did not allow for any substantial modification of the methods. The Poisson or binomial GAM models normally used for NBMP trend analysis were fitted to all species and survey types in Scotland, except where there were clearly insufficient data. The standard base year for NBMP trend analysis (1999) was used for the GAM analyses except where numbers of sites were small; in these cases, the trend was estimated backwards with a base year of 2011.

The standard error for the smoothed GAMs was calculated over a 10 year period to estimate precision (i.e. standard error) excluding 2001 when sample sizes were very small for all surveys (see Table 11). This was due to the foot and mouth outbreak in this year, which prevented access to some sites. Use of a 10 year period avoided estimates from the end of the series, which tend to be more variable because they lack the anchoring effect of the following year's data. Where there was no 10 year run of data, the 10 year standard error was estimated based on the period for which data were available. The standard error was only estimated for those species and surveys for which there were at least 10 sites in at least one year of survey, to avoid highly unreliable results based on very few sites; results are presented where the number of sites is only just above this threshold, but should be treated with caution. The level of error for each species and survey type was categorised into 'high' error (standard error for the 10 year trend is 20% or more), 'medium' error (standard error for the 10 year trend is between 10% and 19.99%) or 'low' error (standard error for the 10 year trend is less than 10%). The standard error estimations were then used to make a simple extrapolation to estimate the number of sites needed to improve the precision of the trends. As asymptotic standard errors are inversely proportional to the square root of the sample size, sample sizes that could reduce the existing 10 year standard errors for Scotland to medium and/or low error levels were estimated. Although the standard errors of the trend over 10 years provide a good impression of the likely precision of that trend, it should be noted that this is a somewhat pragmatic approach, and that results may sometimes be misleading if small numbers of sites are involved. If sample sizes are very small, one outlier or the addition of an extra year of data may have a large impact on the standard error so these analyses should be interpreted cautiously.

All analyses assume that trends occurring in sample sites reflect trends occurring in the general population. Ideally this assumption would be underpinned by random (or stratified random) site selection. Unfortunately, the locations of most bat roost and hibernation sites are unknown, and so sites cannot be selected at random. Instead the sample is based on all known sites where volunteers are able and willing to conduct a survey. For the Field and Waterway Surveys, an element of randomness is built in when allocating sites to observers, but volunteers tend to be clustered in space, and most observers are only able to survey sites relatively close to their homes. In addition, other factors, such as access limitations and the willingness of volunteers to continue sampling 'unattractive' sites, may lead to further

[11] http://www.cbs.nl/en-GB/menu/themas/natuur-milieu/methoden/trim/default.htm
[12] Report to NRW: Optimising bat monitoring in Wales – an assessment of the NBMP in Wales, April 2012, Bat Conservation Trust

bias. Monitoring of sites where the species of interest is not present can help to identify whether populations are expanding into new areas, but may be unattractive to volunteers.

In order to assess the impact of these possible biases in site selection, the observed distribution of sites was compared with the expected distribution based on random selection in proportion to land area. This was done first at country level to examine whether the survey effort in Scotland differed from that in the rest of Britain. The expected number of sites for Scotland (i.e. 0.34 times the total number in Britain, since Scotland's land area is 34% of that of Britain) was compared to the observed number, with the statistical significance of the difference assessed by means of a Chi-squared test with one degree of freedom. Coverage was then examined by land cover category within Scotland, this time comparing the proportion of each land cover type in the area of the survey, roost or hibernation site with the proportion of that land cover type in Scotland as a whole. Because the proportions are continuous variables which can take any value between 0 and 1, statistical significance was assessed by means of Wilcoxon's signed rank test and t-tests. Since the distribution of the proportions was frequently very skewed, the Wilcoxon test was considered more reliable and is presented here.

Both the Chi-squared and Wilcoxon tests are intended to help pinpoint the most substantial differences from randomness. Because of the large total number of tests, some would be expected to be significant by chance alone, even if the sampling was effectively at random, and so isolated results of borderline significance should be treated with caution.

Statistics were also calculated to describe the number of sites contributing to trend estimation. To ensure that these statistics were comparable between surveys and species, the Poisson GAM criteria normally used for calculating which sites contribute to trends were used for all surveys. These criteria require that the surveys were completed within the specified date range, that the species was present at the site in at least one year, and that valid surveys were completed in at least two different years. This is in contrast to the binomial GAM criteria which include all sites that meet the basic survey criteria whether or not the species has been recorded at the site (this is in order to produce an unbiased estimate of the percentage of observation points with bats).

4. RESULTS

4.1 Current survey coverage in Scotland

A summary of current NBMP survey coverage in Scotland for each survey type by species is provided in the following sections. Figures 1 to 15 show the distribution of the sites across Scotland. For each survey type, maps show the locations of sites that contribute to species trend analysis and are currently active (surveyed at least once between 2010 and 2012); sites which contribute to trends but are not currently active; sites which do not currently contribute to species trend analysis; and sites where target species have been recorded. The proportion of sites in each SNH Area (Table 2) is given for each survey type in a series of separate tables (Tables 4, 5, 7, 9). A full list of sites, locations, the last year of survey, number of years of data collected at the site and whether data from the site contributes to species trends is provided in Annex 1.

Table 2. SNH Areas in Scotland

	Area	
SNH Area	km^2	%
Argyll and the Outer Hebrides	10112	12.8
Forth	5761	7.3
'Highlands & Northern Isles'	28662	36.4
Southern Scotland	11181	14.2
Strathclyde and Ayrshire	6752	8.6
Tayside and Grampian	16374	20.8

Note: The 'Highlands & Northern Isles' in this case represents two SNH areas: South Highland, and the Northern Isles and North Highland. There are no records of resident bats in Shetland. Orkney has a very restricted bat fauna.

4.1.1 Field Survey

As of 2012, there were 131 Field Survey sites in the NBMP database in Scotland (see Annex 1). This is 16% of the 818 sites currently in the database for this survey across the UK. Data from 66 of these sites contributed to the species trend calculations from data up to 2012 in the most recent assessment of species trends[13].

The distribution of Field Survey sites in Scotland is clustered and there are large gaps in coverage in some areas, particularly the Highlands & Northern Isles and Southern Uplands (Figure 1). There are a considerable number of sites (65) that have only been surveyed in one year and do not currently contribute to the species population trends. The total number of sites where each of the three species of the Field Survey has been recorded is shown in Table 3, as well as the number of sites from 2012 to give an indication of typical survey coverage in a year. The presence of noctule is much lower than common or soprano pipistrelle due to the species reaching the northerly limit of its range in southern Scotland and therefore having a restricted distribution. It is relatively scarce in Scotland. Figures 2-4 show the distribution of each species recorded at Field Survey sites in Scotland. Table 4 shows that the distribution of Field Survey sites is not proportional to SNH Areas; some areas such as Forth are over-represented and others such as Tayside and Grampian are under-represented.

[13] http://www.bats.org.uk/pages/nbmp_annual_report.html

Table 3. Number of Field Survey sites in Scotland where each species monitored through this survey was recorded (including number of these surveyed in 2012)

Species	Number of sites with species present	Number of sites surveyed in 2012 with species recorded
Common pipistrelle	75	18
Soprano pipistrelle	69	16
Noctule	12	4

Table 4. Number and percentage of Field Survey sites and number and percentage that contribute to NBMP trends by SNH Area in Scotland

	Area	Field Survey			
SNH Area	%	Total sites	% of all sites	Trend	% of trend sites
Argyll and the Outer Hebrides	12.8	12	9.2	2	3.0
Forth	7.3	17	13.0	12	18.2
'Highlands& Northern Isles'	36.4	55	42.0	27	40.9
Southern Scotland	14.2	11	8.4	6	9.1
Strathclyde and Ayrshire	8.6	18	13.7	14	21.2
Tayside and Grampian	20.8	18	13.7	5	7.6

Note: The 'Highlands & Northern Isles' in this case represents two SNH areas: South Highland, and the Northern Isles and North Highland. There are no records of resident bats in Shetland. Orkney has a very restricted bat fauna. Trend = number of sites meeting criteria for inclusion in trend analysis to 2012.

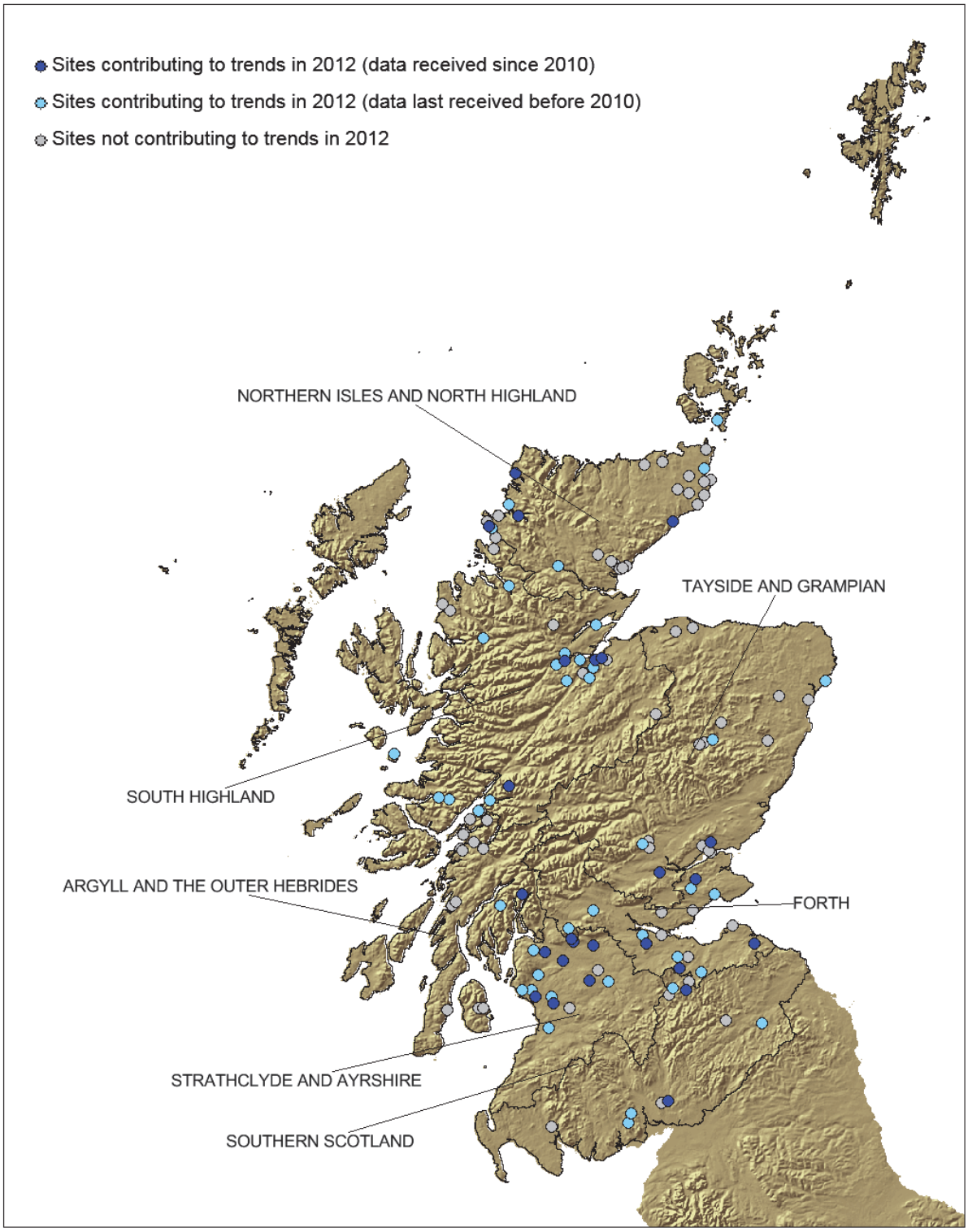

Figure 1. Distribution of Field Survey sites in Scotland showing which sites contribute to species trends. © Crown copyright and database rights 2014 Ordnance Survey 100017908.

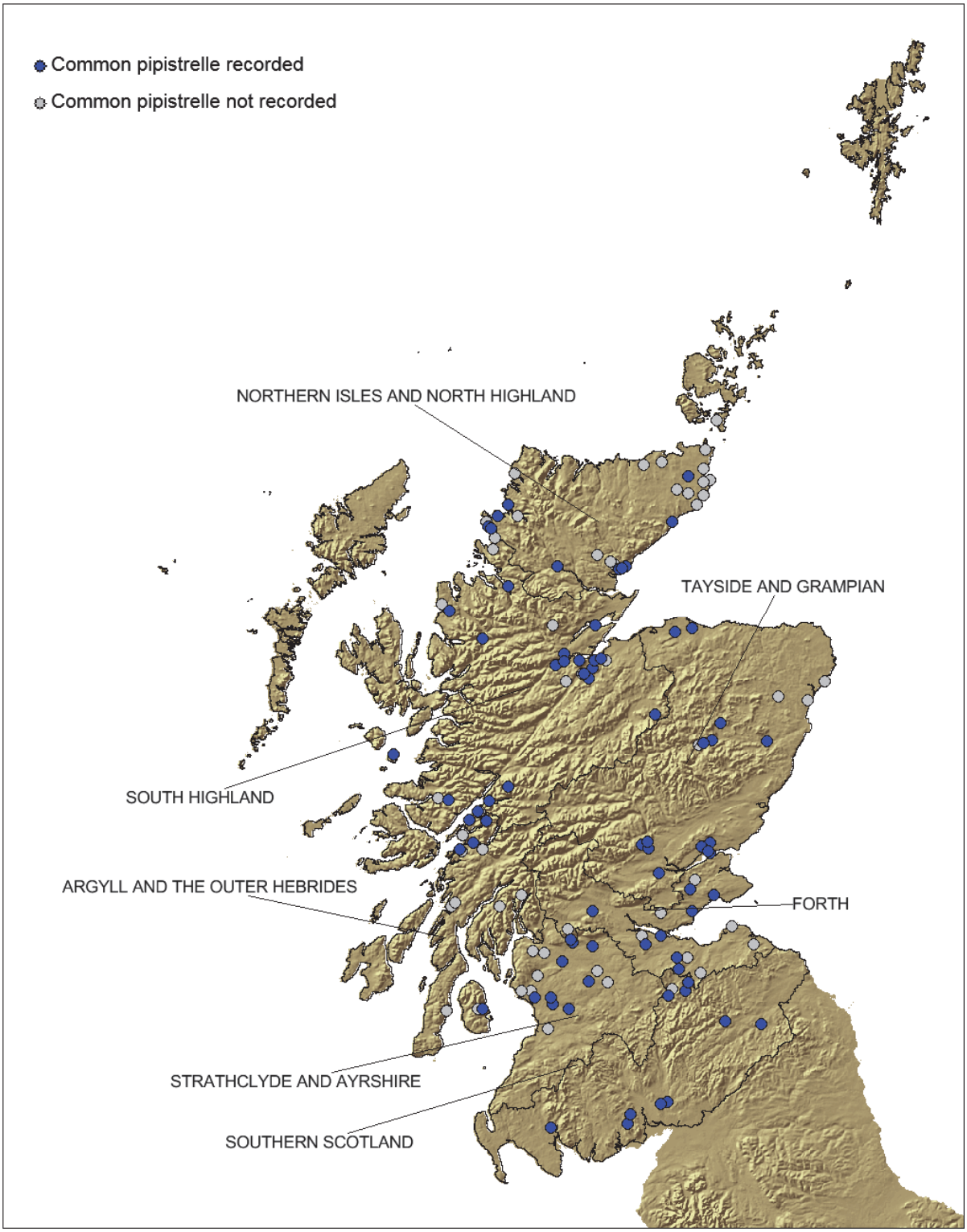

Figure 2. Distribution of Field Survey sites in Scotland showing records of common pipistrelle. © Crown copyright and database rights 2014 Ordnance Survey 100017908.

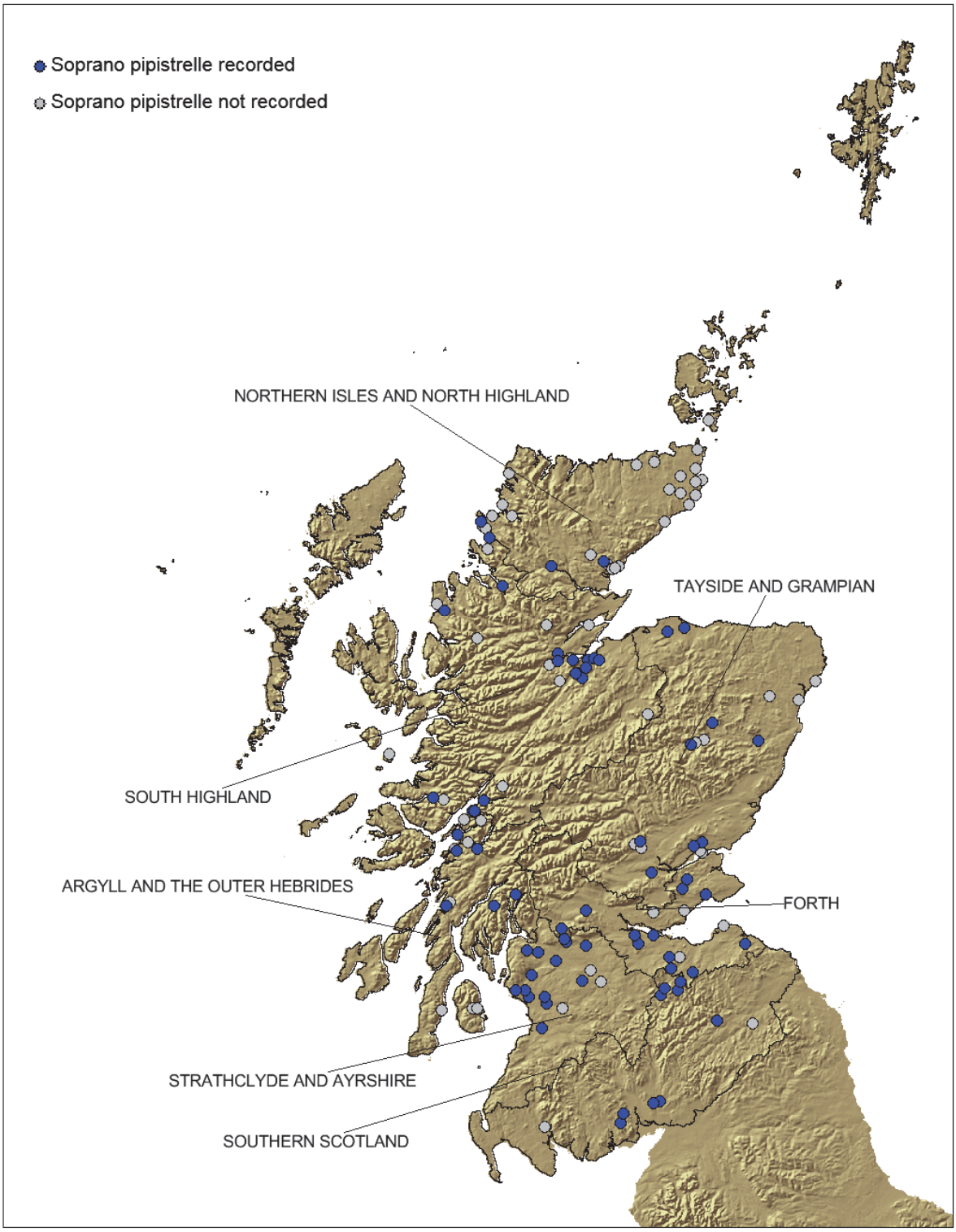

Figure 3. Distribution of Field Survey sites in Scotland showing records of soprano pipistrelle. © Crown copyright and database rights 2014 Ordnance Survey 100017908.

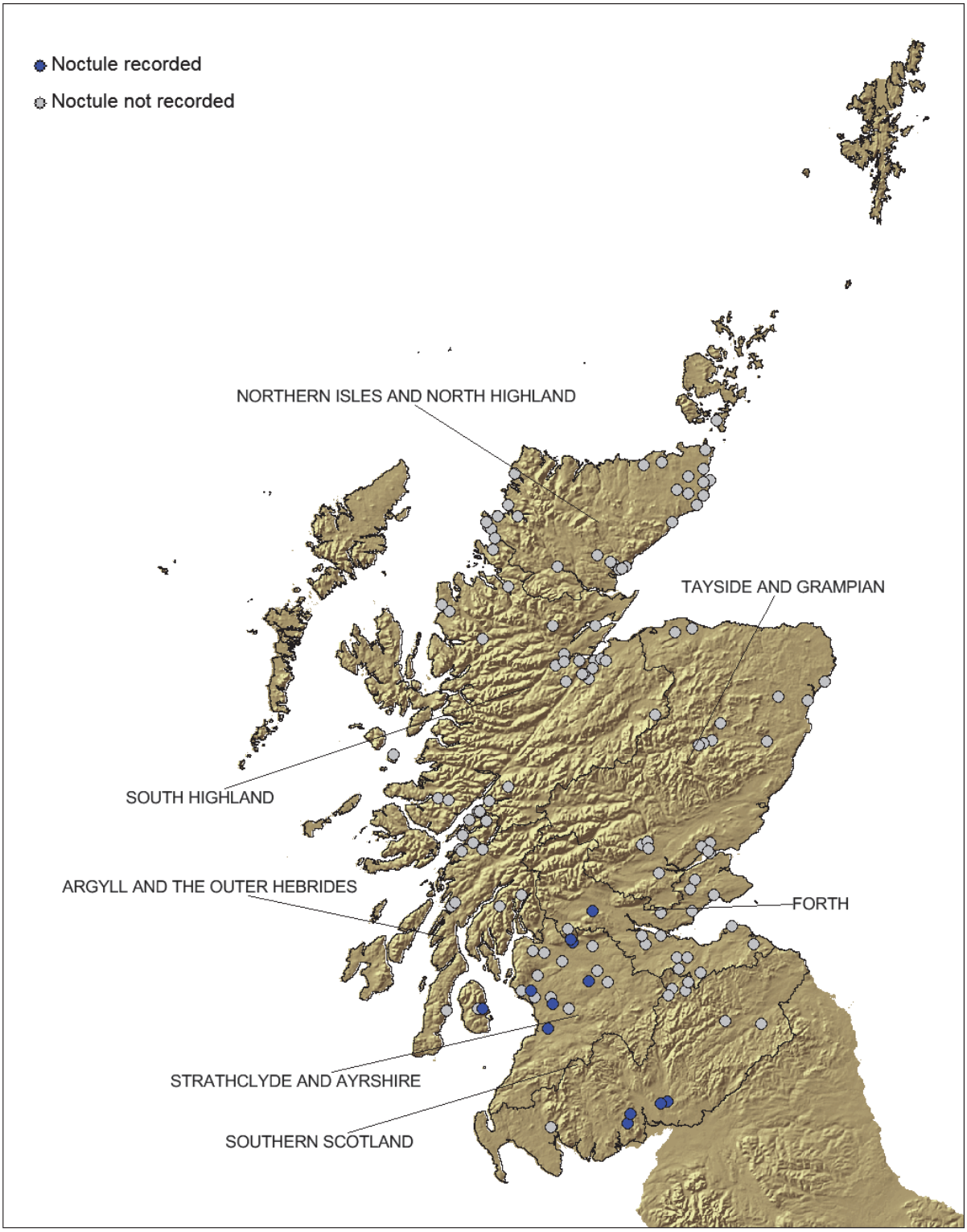

Figure 4. Distribution of Field Survey sites in Scotland showing records of noctule. © Crown copyright and database rights 2014 Ordnance Survey 100017908.

4.1.2 Waterway Survey

There are 184 Waterway Survey sites in the NBMP database in Scotland (see Annex 1 for a full list of sites). This is 15% of the 1257 sites currently in the database for this survey in the UK (Figure 5). In total, 140 sites in Scotland have had Daubenton's bat recorded in at least one survey (Figure 6). Data from 108 sites contributed to the trend estimation for Daubenton's bat in Scotland to 2012. The distribution of Waterway Survey sites in Scotland are clustered (Figure 5) and it is likely that the gaps in coverage are partly due to the difficult terrain and low human population in some of these areas. Similar to the Field Survey, there are a significant number of Waterway Survey sites (76) that have not contributed to the population trend for Daubenton's bat as they have only been surveyed in a single year. Table 5 shows that as for the Field Survey, the distribution of Waterway Survey sites is not proportional to SNH area.

Table 5. Number and percentage of Waterway Survey sites and number and percentage that contribute to NBMP trends by SNH Area in Scotland

	Area	Waterway Survey			
SNH Area	%	Total sites	% of all sites	Trend	% of trend sites
Argyll and the Outer Hebrides	12.8	5	2.7	0	0.0
Forth	7.3	35	19.0	24	22.2
'Highlands& Northern Isles'	36.4	53	28.8	29	26.9
Southern Scotland	14.2	20	10.9	16	14.8
Strathclyde and Ayrshire	8.6	35	19.0	20	18.5
Tayside and Grampian	20.8	36	19.6	19	17.6

Note: The 'Highlands & Northern Isles' in this case represents two SNH areas: South Highland, and the Northern Isles and North Highland. There are no records of resident bats in Shetland. Orkney has a very restricted bat fauna. Trend = number of sites meeting criteria for inclusion in trend analysis to 2012.

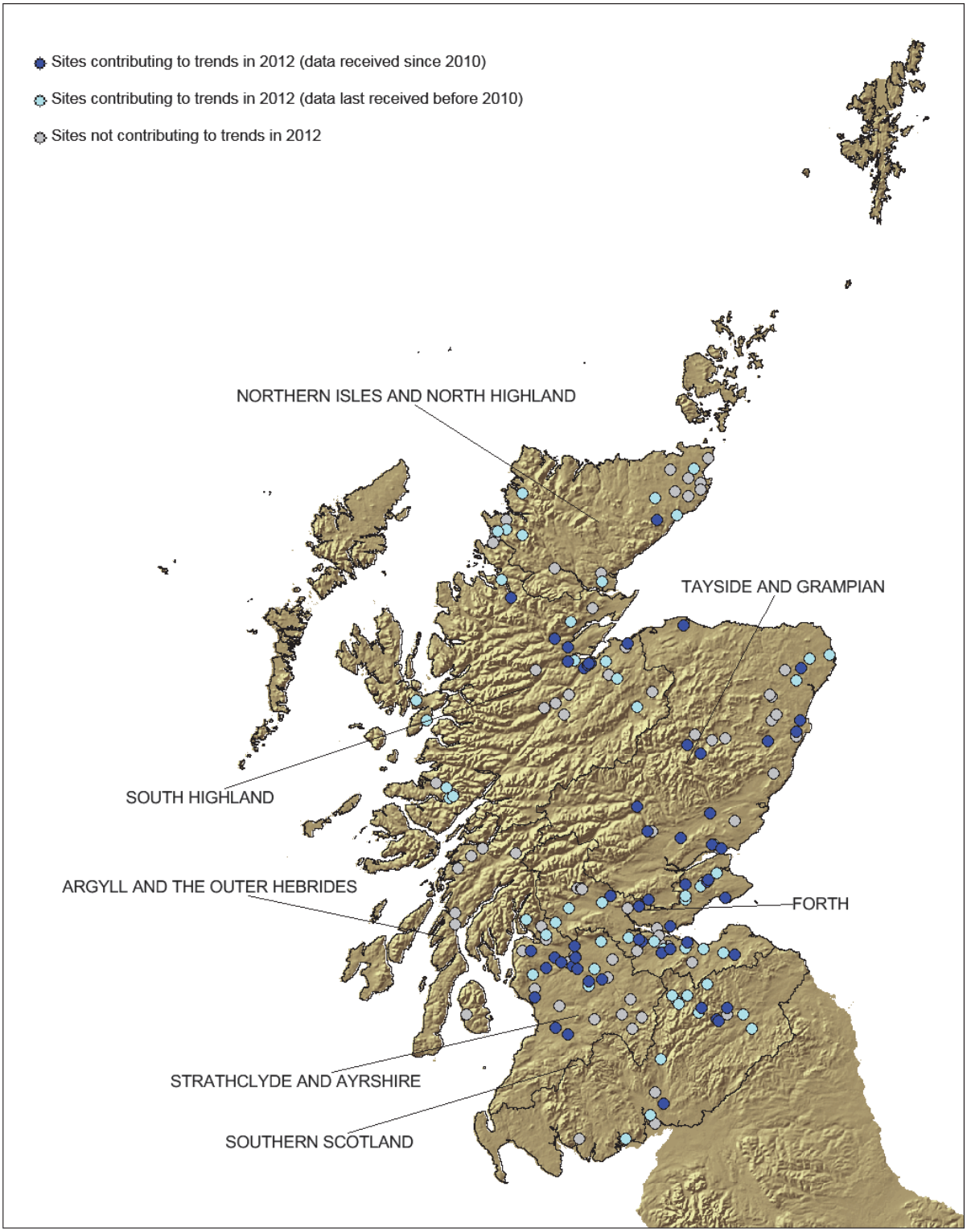

Figure 5. Distribution of Waterway Survey sites in Scotland. © Crown copyright and database rights 2014 Ordnance Survey 100017908.

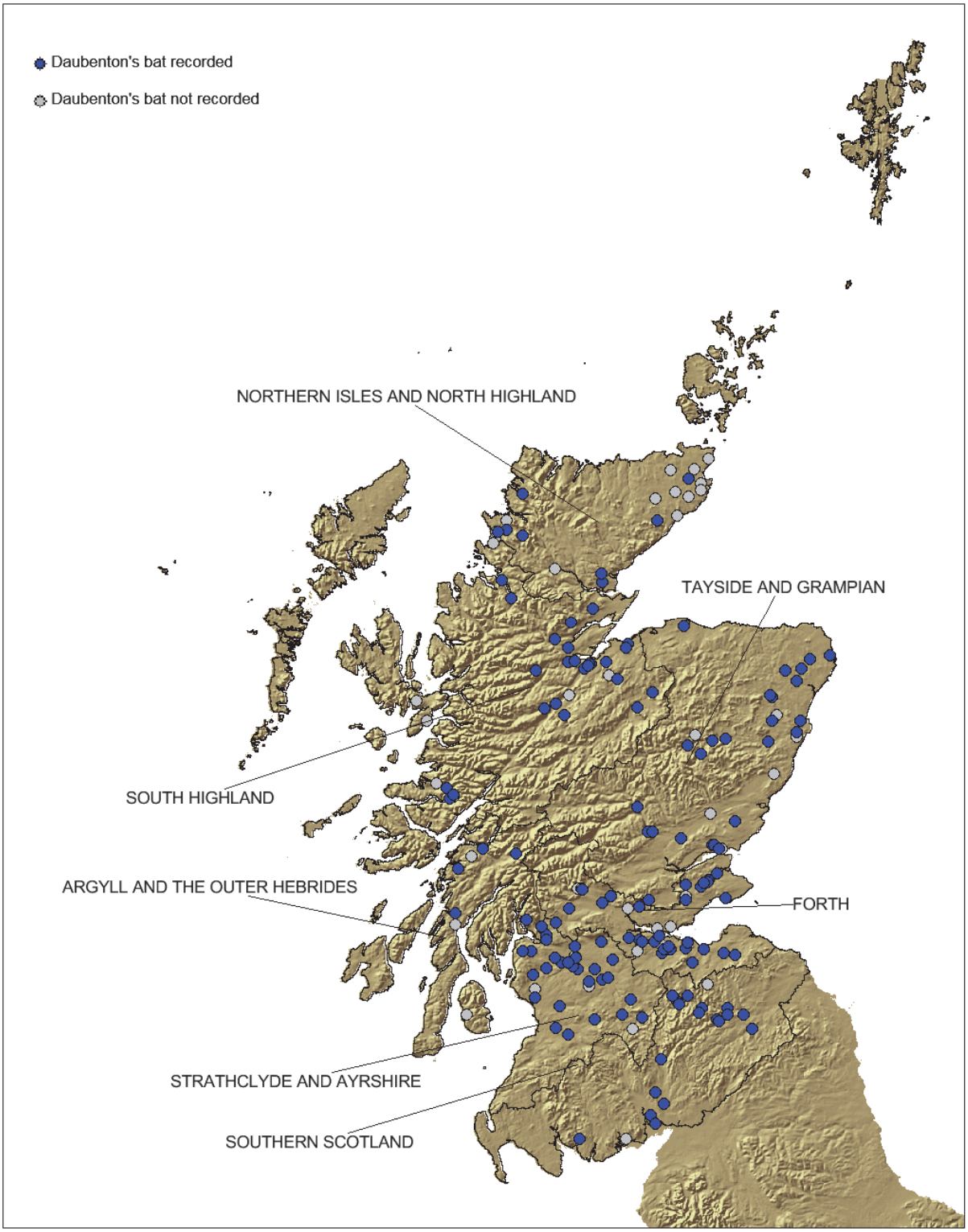

Figure 6. Distribution of Waterway Survey sites in Scotland showing records of Daubenton's bat. © Crown copyright and database rights 2014 Ordnance Survey 100017908.

4.1.3 Hibernation Survey

There are 42 Hibernation Survey sites in the NBMP database in Scotland (see Annex 1 for a full list of sites). This is 4% of the 1037 sites currently in the database for this survey in the UK. Data from Hibernation Surveys in Scotland contributed to trend calculations for four species: Natterer's bat, Daubenton's bat, whiskered/Brandt's bat (which are considered as a species group as they are difficult to identify to species level in hibernation) and brown long-eared bat (Table 6). In 2012, data were received from 19 Hibernation Survey sites (Table 6). Table 7 shows the distribution of Hibernation Survey sites by SNH area. As shown in the site distribution maps for each species (Figures 7-10), the majority of hibernation sites are found in the southern half of Scotland.

Table 6. Number of Hibernation Survey sites in Scotland where each species monitored through this survey was recorded (including number of these surveyed in 2012 and the number contributing to species trends)

Species	Number sites with species present	Number of sites surveyed in 2012 that have recorded species	No. sites contributing to 2012 trend
Natterer's bat	20	11	18
Daubenton's bat	25	12	21
Whiskered/Brandt's bat	1	1	1
Brown long-eared bat	21	8	16

Table 7. Number and percentage of Hibernation Survey sites and number and percentage that contribute to NBMP trends by SNH Area in Scotland

	Area	Hibernation Survey			
SNH Area	%	Total sites	% of all sites	Trend	% of trend sites
Argyll and the Outer Hebrides	12.8	7	16.7	4	16.0
Forth	7.3	12	28.6	8	32.0
'Highlands& Northern Isles'	36.4	4	9.5	2	8.0
Southern Scotland	14.2	11	22.2	7	28.0
Strathclyde and Ayrshire	8.6	7	16.7	3	12.0
Tayside and Grampian	20.8	1	2.4	1	4.0

Note: The 'Highlands & Northern Isles' in this case represents two SNH areas: South Highland, and the Northern Isles and North Highland. There are no records of resident bats in Shetland. Orkney has a very restricted bat fauna. Trend = number of sites meeting criteria for inclusion in trend analysis to 2012.

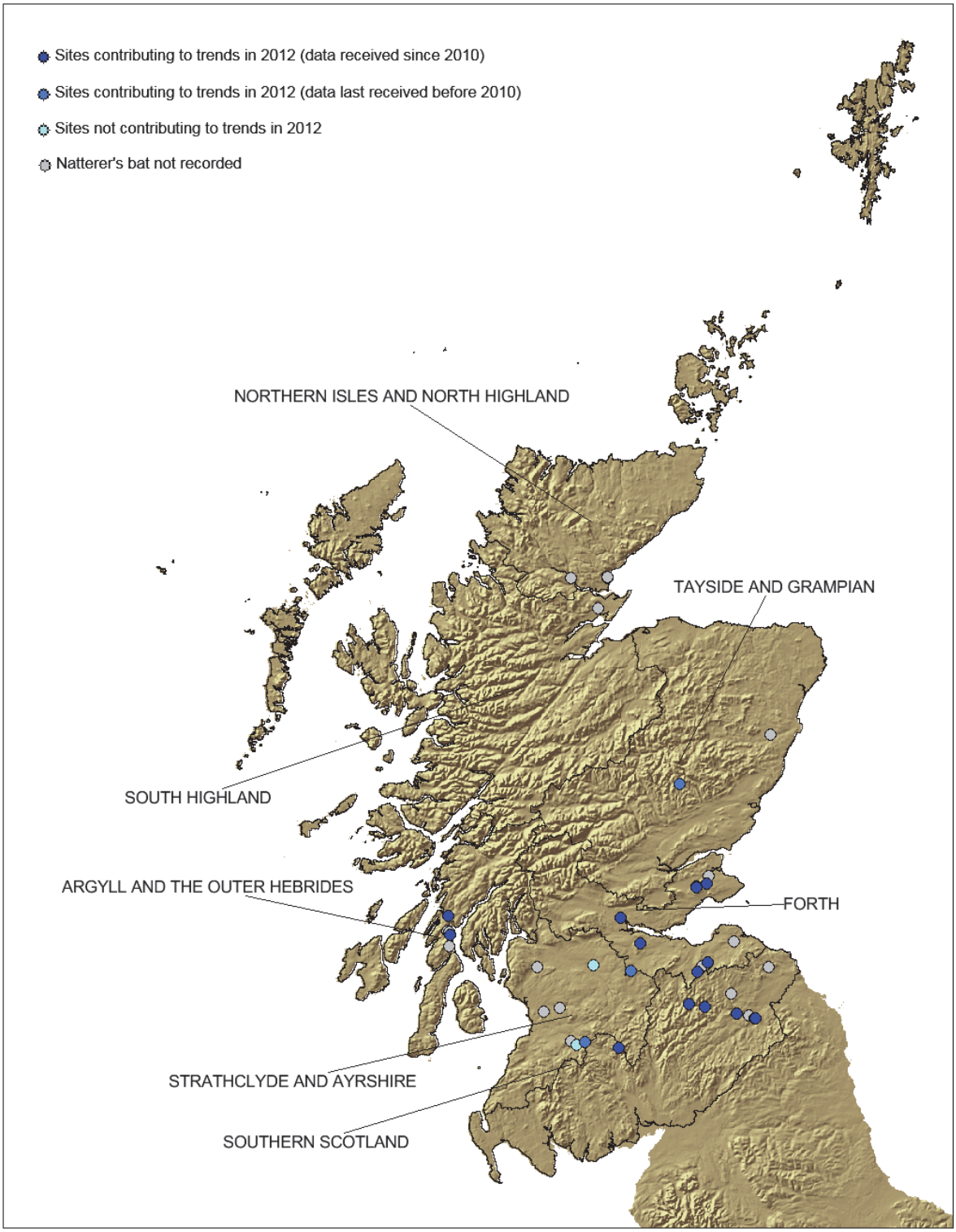

Figure 7. Distribution of Hibernation Survey sites in Scotland showing presence of Natterer's bat. © Crown copyright and database rights 2014 Ordnance Survey 100017908.

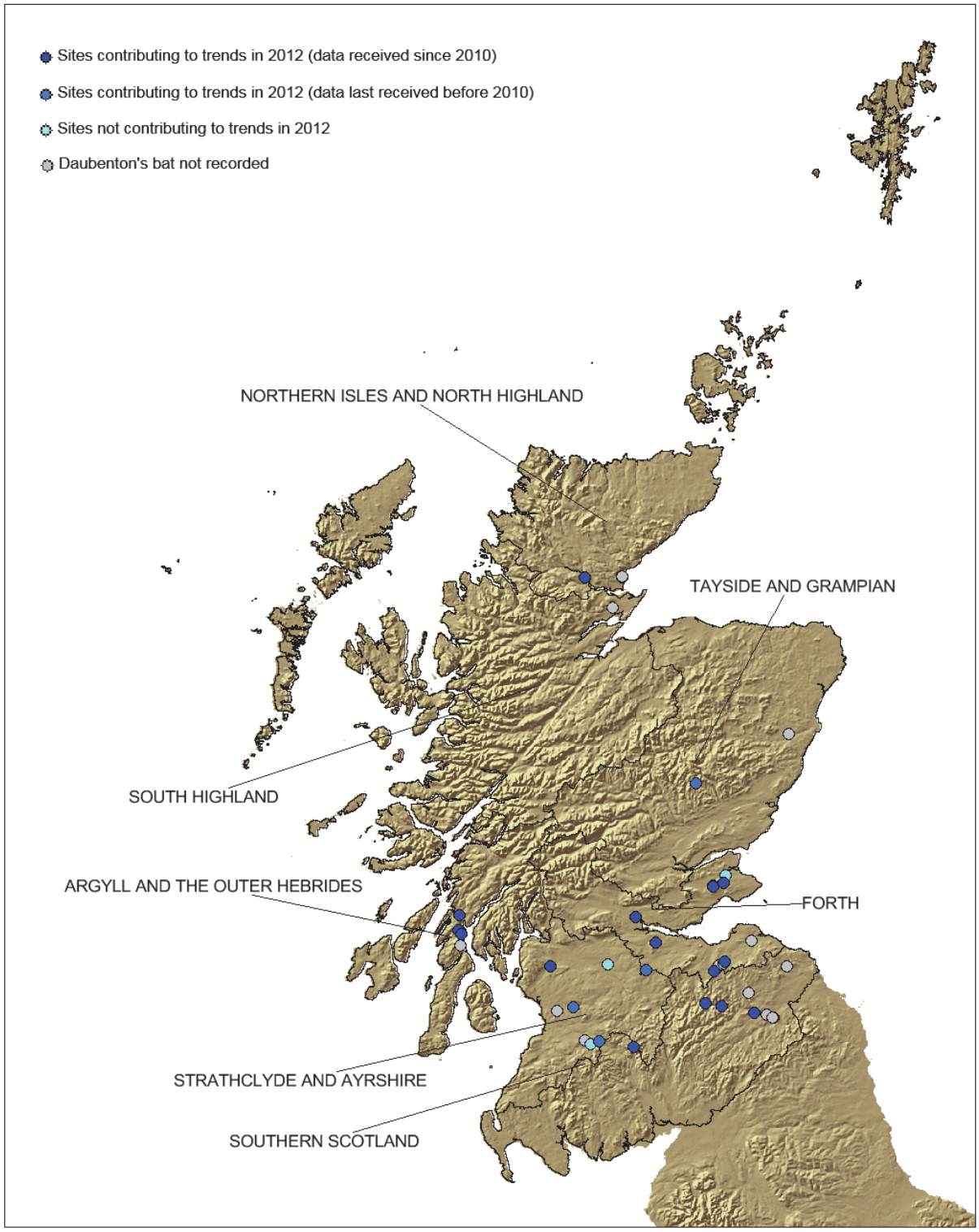

Figure 8. Distribution of Hibernation Survey sites in Scotland showing presence of Daubenton's bat. © Crown copyright and database rights 2014 Ordnance Survey 100017908.

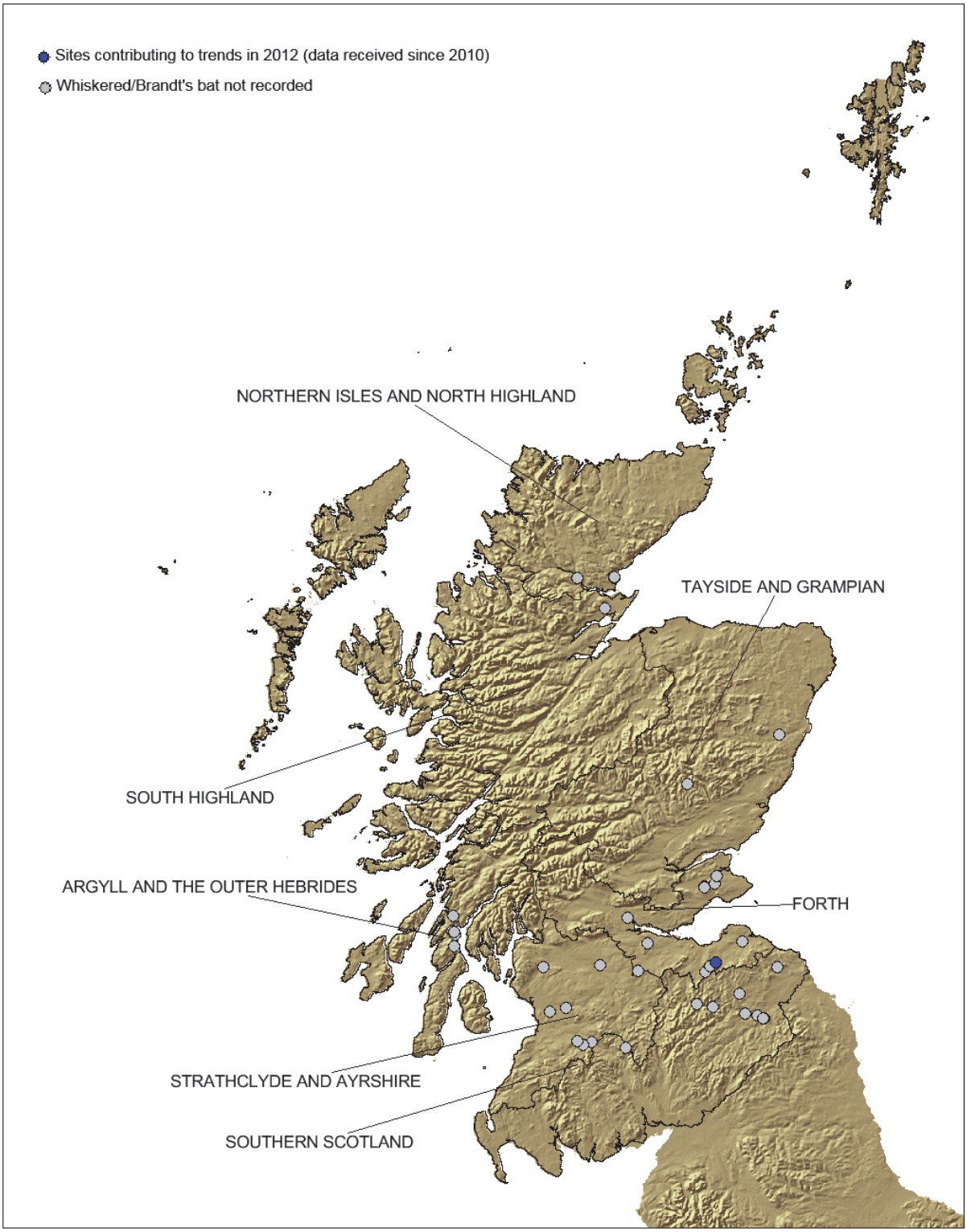

Figure 9. Distribution of Hibernation Survey sites in Scotland showing presence of whiskered/Brandt's bat. © Crown copyright and database rights 2014 Ordnance Survey 100017908.

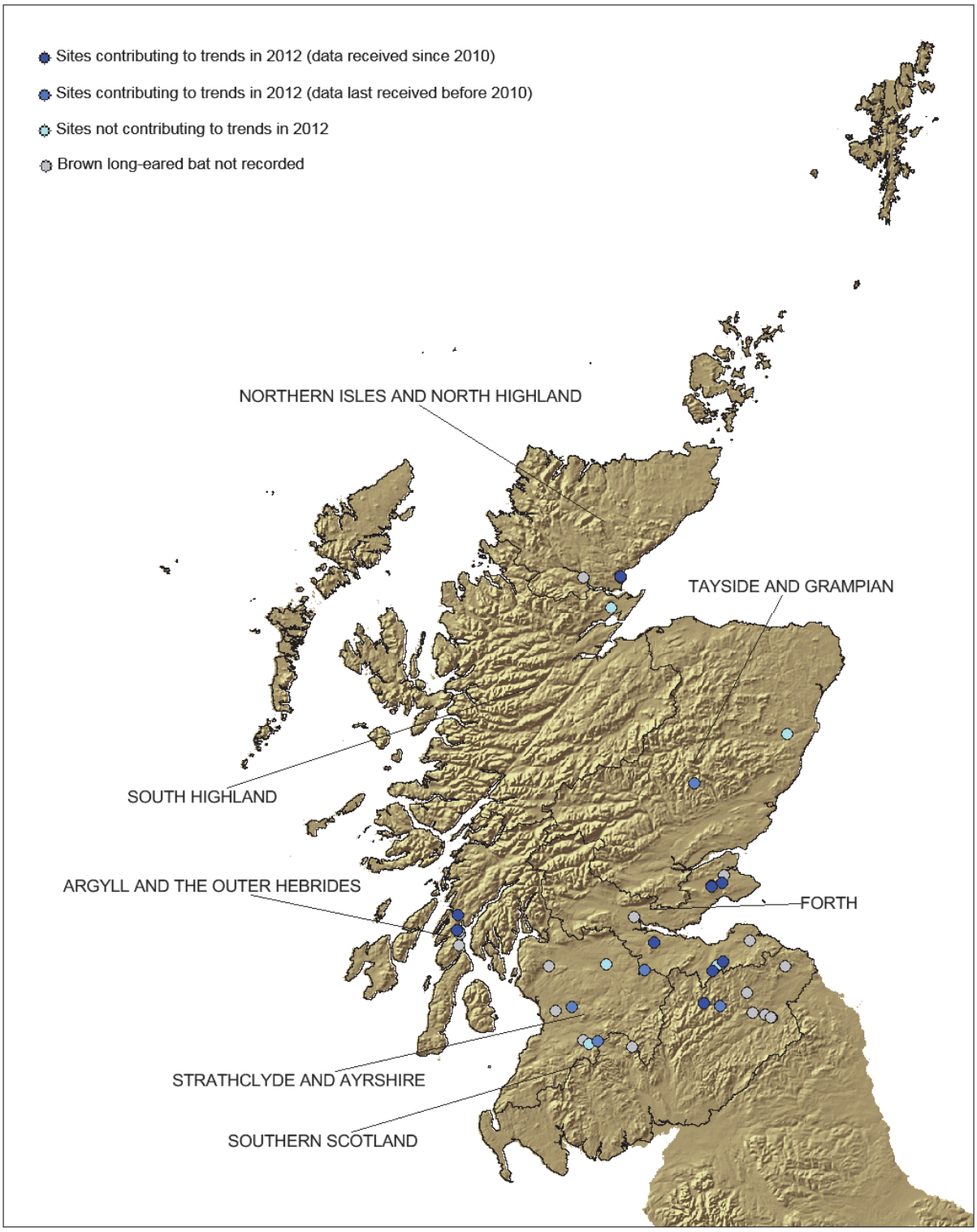

Figure 10. Distribution of Hibernation Survey sites in Scotland showing presence of brown long-eared bat. © Crown copyright and database rights 2014 Ordnance Survey 100017908.

4.1.4 Roost counts

Data from Roost Counts in Scotland contribute to NBMP trend estimations for four species: common pipistrelle, soprano pipistrelle, Natterer's bat and brown long-eared bat (see Annex 1 for a full list of sites). The number and distribution of sites for each species are shown in Table 8 and Figures 11-15. Table 9 shows the distribution of Roost Count sites by SNH Area. Soprano pipistrelle has the largest number of sites (79) that contributed to trend analysis. However, only 24 of these sites were monitored in 2012. The overall distribution of sites monitored since 2010 has been very limited with large gaps in coverage (see Figure 12). The number of sites for common pipistrelle was also relatively high (76) with 56 sites that contributed to trend analysis in 2012 and for this species there is a more even coverage of sites monitored in recent years across Scotland than for soprano pipistrelle. There are also a considerable number of pipistrelle roosts (88) that are monitored but have not been identified to species. For brown long-eared bat, 30 of the 45 sites contributed to the trend analysis in 2012 and the sites are reasonably evenly distributed across Scotland. The number of sites was very small for Natterer's bat (seven) and it is possible that this is limited by the number of known roosts for this species in Scotland. All seven Natterer's bat sites contributed to trend analysis.

Table 8. Number of Roost Count sites in Scotland where each species monitored through this survey was recorded (including the proportion of total sites in the database, the number of these surveyed in 2012 and the number of sites contributing to trends)

Species	Number sites with species present	% of total sites in NBMP database	Number of sites surveyed in 2012	No. sites contributing to 2012 trend
Common pipistrelle	74	13.6	27	56
Soprano pipistrelle	97	24.0	24	79
Pipistrelle unsure	87	12.0	8	-
Natterer's bat	7	7.5	4	7
Brown long-eared bat	42	21.4	11	30

Table 9. Number and percentage of Roost Count sites and number and percentage that contribute to NBMP trends by SNH Area in Scotland

	Area	Roost Counts			
SNH Area	%	Total sites	% of all sites	Trend	% of trend sites
Argyll and the Outer Hebrides	12.8	26	8.5	18	10.5
Forth	7.3	58	18.9	38	22.1
'Highlands & Northern Isles'	36.4	87	28.3	43	25.0
Southern Scotland	14.2	34	11.1	22	12.8
Strathclyde and Ayrshire	8.6	56	18.2	29	16.9
Tayside and Grampian	20.8	46	15.0	22	12.8

Note: The 'Highlands & Northern Isles' in this case represents two SNH areas: South Highland, and the Northern Isles and North Highland. There are no records of resident bats in Shetland. Orkney has a very restricted bat fauna. Trend = number of sites meeting criteria for inclusion in trend analysis to 2012.

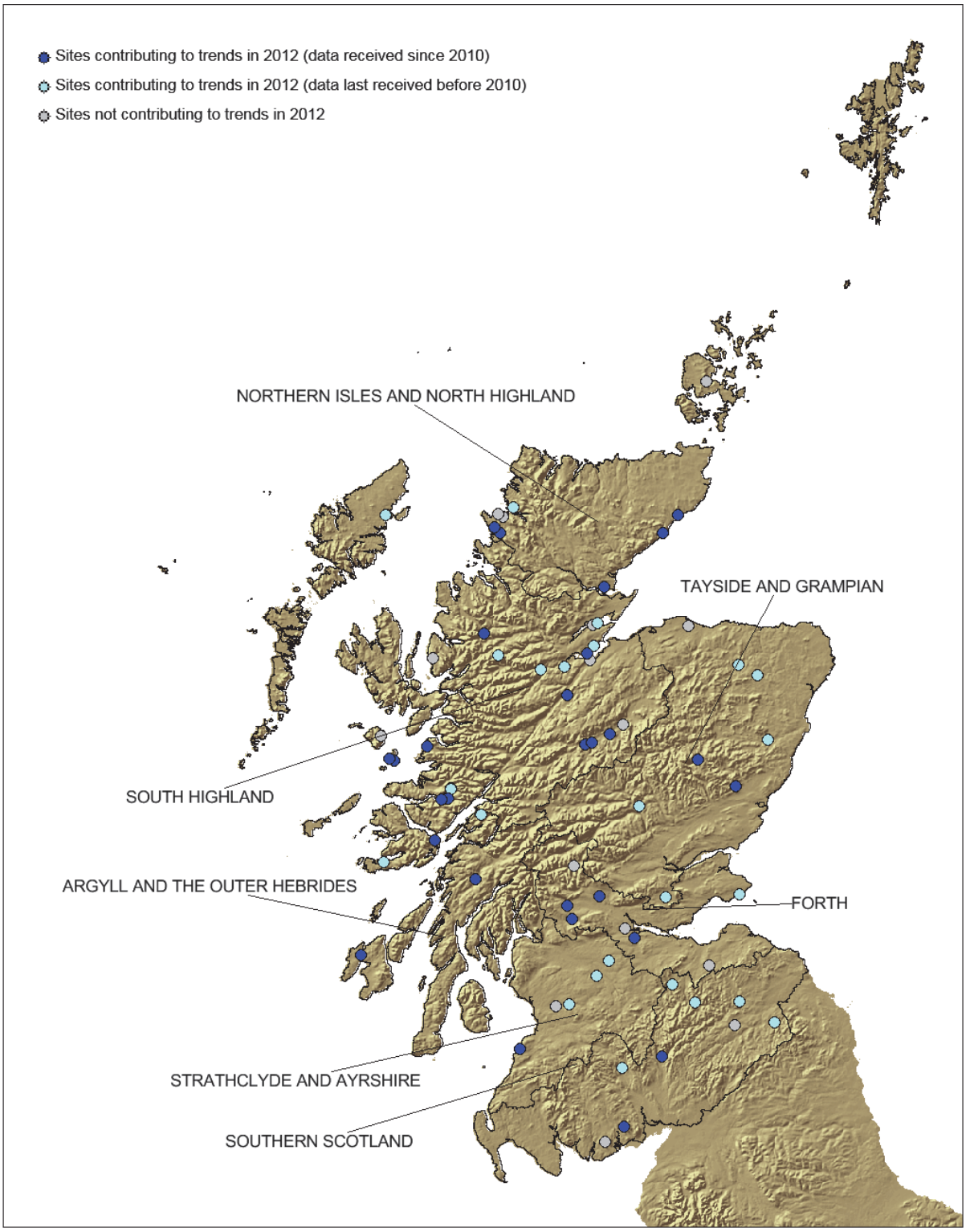

Figure 11. Distribution of Roost Count sites in Scotland showing presence of common pipistrelle. © Crown copyright and database rights 2014 Ordnance Survey 100017908.

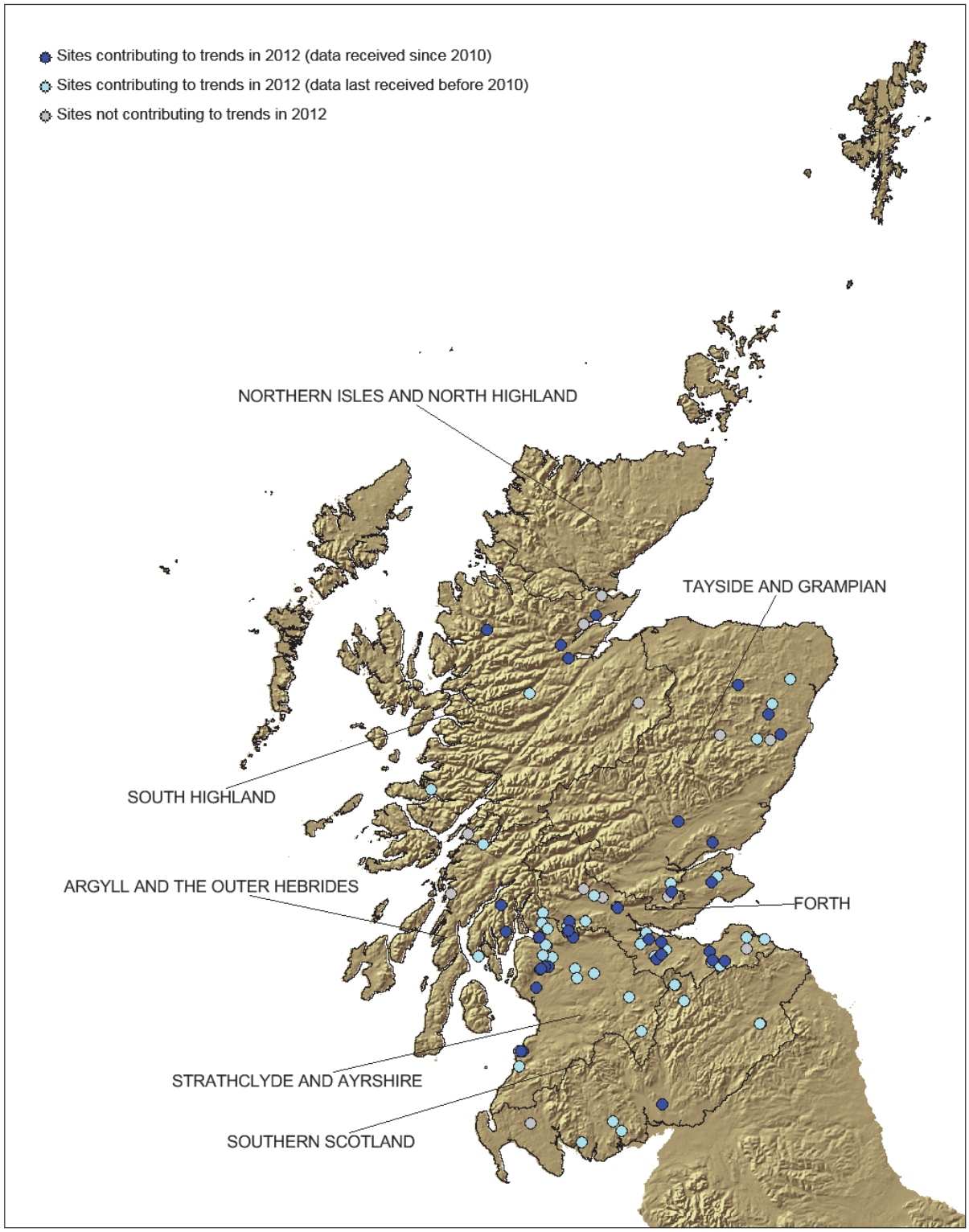

Figure 12. Distribution of Roost Count sites in Scotland showing presence of soprano pipistrelle. © Crown copyright and database rights 2014 Ordnance Survey 100017908.

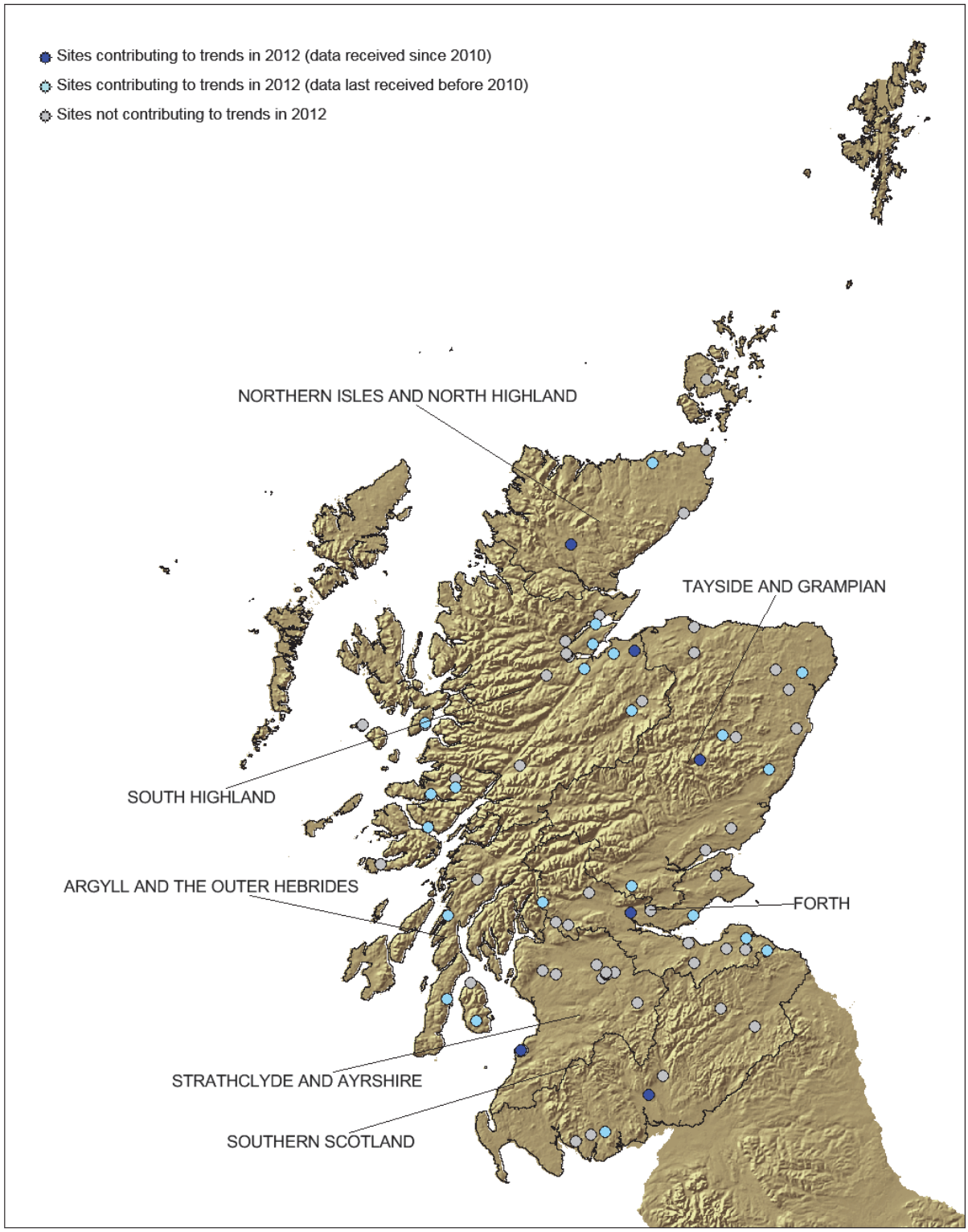

Figure 13. Distribution of Roost Count sites in Scotland showing presence of unidentified pipistrelle. © Crown copyright and database rights 2014 Ordnance Survey 100017908.

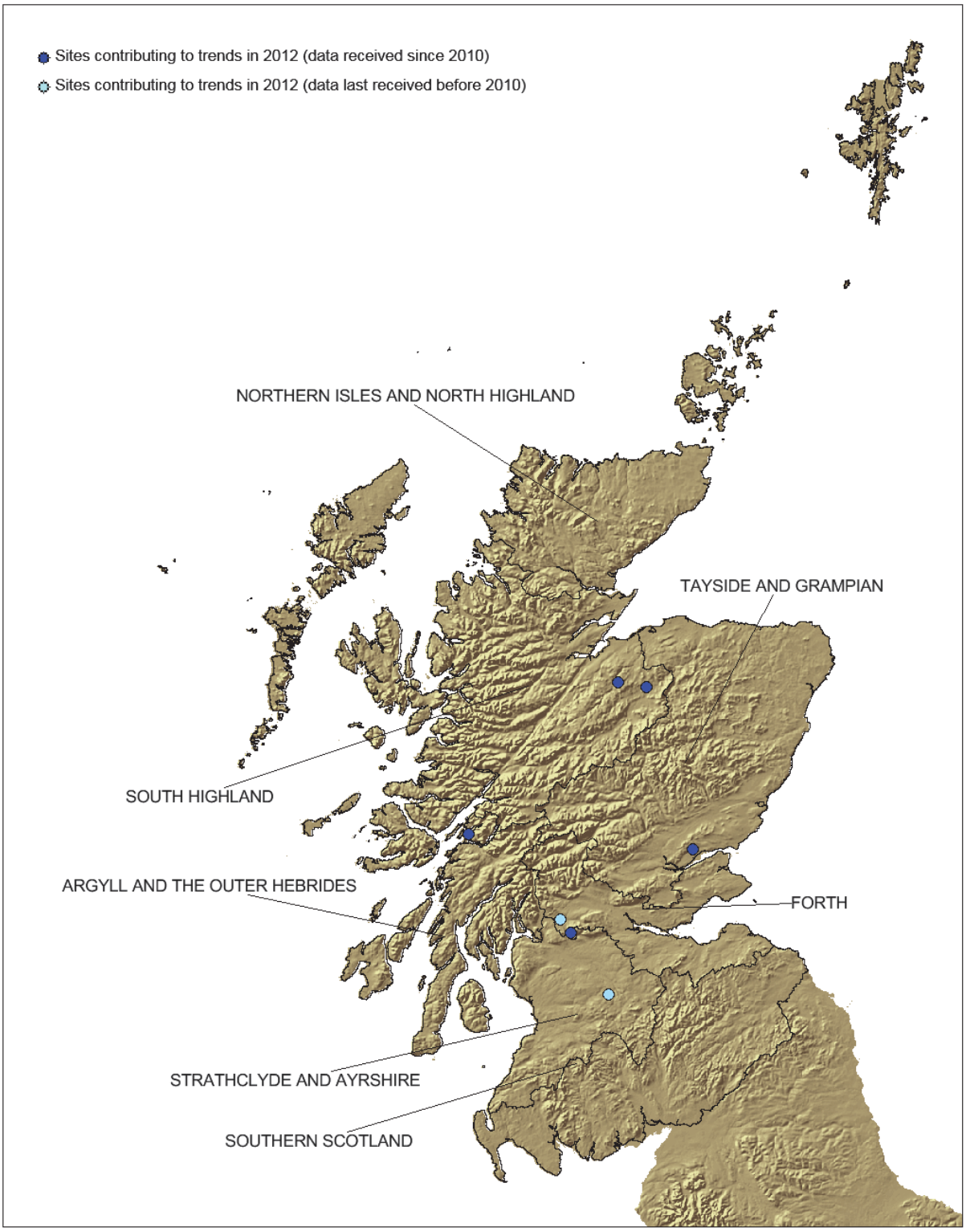

Figure 14. Distribution of Roost Count sites in Scotland showing presence of Natterer's bat.

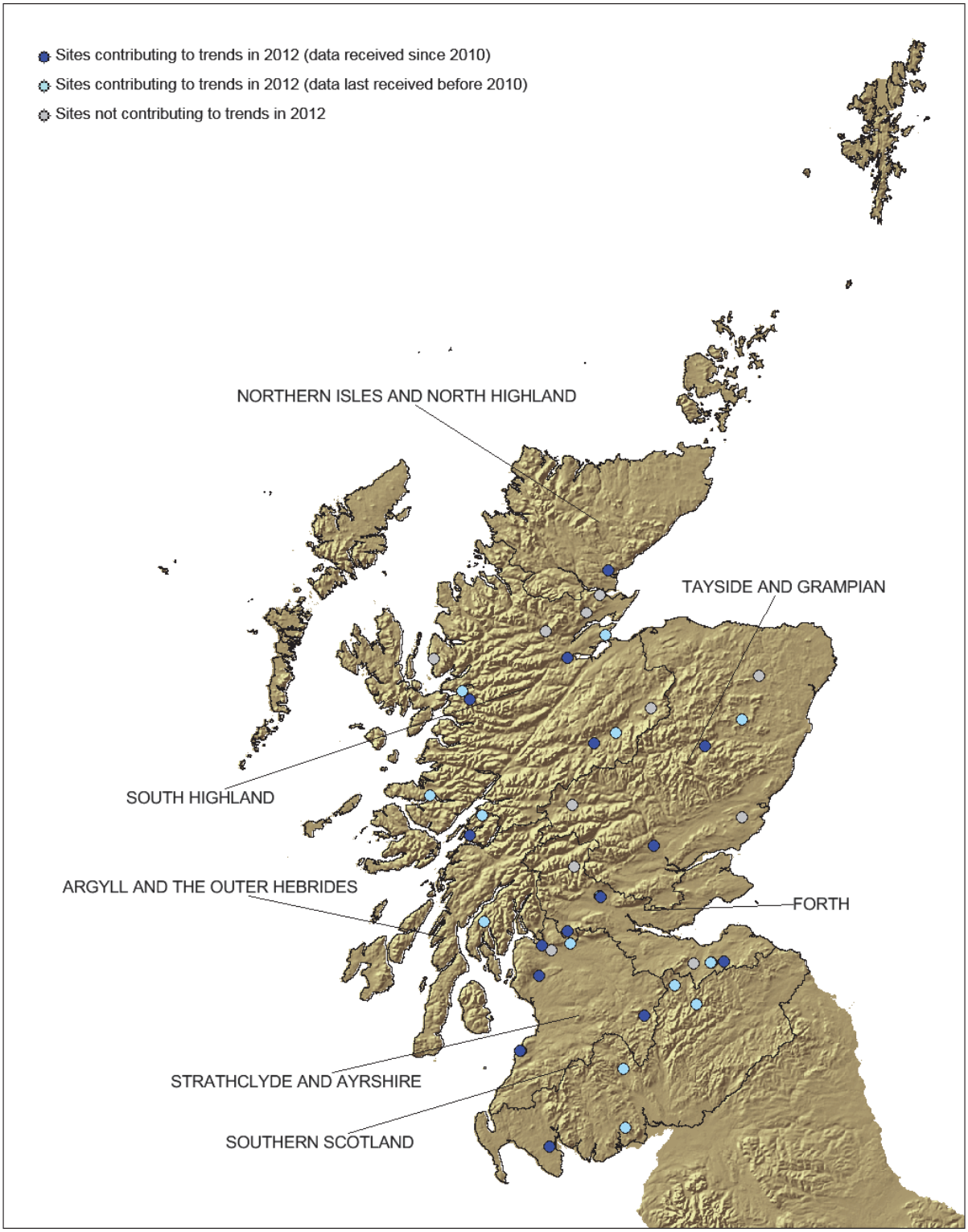

Figure 15. Distribution of Roost Count sites in Scotland showing presence of brown long-eared bat. © Crown copyright and database rights 2014 Ordnance Survey 100017908.

4.2 Assessment of sample sizes in Scotland

In this section, the representation of Scottish NBMP sites relative to overall NBMP species trends in Great Britain is assessed by land area. The representation of sites in Scotland by land cover is also investigated. Scotland, England and Wales make up 34%, 57% and 9% of the land area of Great Britain, respectively[14]. The relative land cover areas in Scotland as a whole are summarised in Table 10 (LCM2000 subclasses, Fuller *et al.* 2002). Note that in all surveys, the number of sites visited was very low in 2001 due to the outbreak of Foot and Mouth Disease in the UK and therefore data from this year are not representative of the general pattern of survey coverage.

Table 10. Percentages of areas of the main land cover types in Scotland from LCM2000

Land cover type	% area in Scotland
Arable	9.4
Broadleaved/ mixed woodland	3.4
Built up and gardens	1.9
Coastal	0.4
Coniferous woodland	10.9
Improved grassland	13.3
Standing open water	1.8
Semi-natural	19.4
Upland (mountain, heath and bog)	39.5

4.2.1 Field Survey

Across all years of the Field Survey (1998-2012), 13% of sites that contributed to species trends were in Scotland, compared to 83% in England and 5% in Wales. Scotland was therefore significantly under-represented by the number of sites in proportion to its 34% land area (χ^2=71.90, df=1, p<0.001).

Table 11 and Figure 16 show how the relative representation by country varied among years. The relative contribution of each country to the trend has fluctuated over the survey period with Scotland contributing between 8% and 19% of sites to the GB trend over the 15 years of monitoring. The proportion of sites surveyed in Scotland (and the number of sites surveyed in Scotland) appears to have declined between 2009 and 2012.

[14] http://thecommonwealth.org/our-member-countries/united-kingdom

Table 11. Percentage representation of Field Survey sites in the NBMP in Great Britain by country for all years of survey

Year	Total no. sites contributing to trends	% Scotland	% England	% Wales
1998	130	8.5	86.9	4.6
1999	157	18.5	77.1	4.5
2000	184	15.8	79.3	4.9
2001	36	11.1	86.1	2.8
2002	150	10.7	85.3	4.0
2003	151	12.6	82.8	4.6
2004	184	10.3	84.8	4.9
2005	210	10.0	85.7	4.3
2006	225	11.1	84.9	4.0
2007	231	12.1	83.1	4.8
2008	220	11.4	85.0	3.6
2009	209	11.5	83.3	5.3
2010	206	9.2	88.3	2.4
2011	225	8.0	87.6	4.4
2012	182	7.7	89.6	2.7

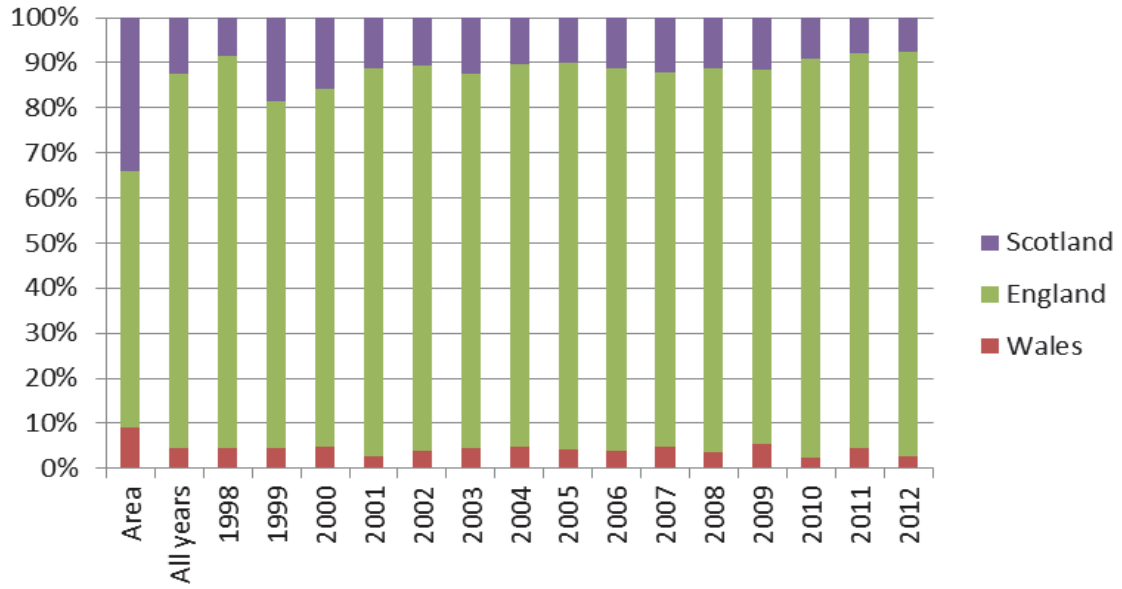

Figure 16. Variation in proportional representation of land areas in Scottish Field Survey over time. The graph also shows the relative proportion of land areas in Great Britain (Area) and the relative proportions across all years of survey (All years)

Three land cover types: broadleaved/mixed woodlands, built up and gardens and improved grassland were significantly over-represented in Field Survey squares in Scotland (Table 12). Coniferous woodland and the uplands were significantly under-represented. The distributions of proportions are highly skewed, particularly for Arable, which leads to no significant difference being shown in the test between the proportion of Arable represented in Field Survey sites and in Scotland despite the numerical differences in proportions shown in Table 12. Figure 17 shows how land cover representation varied between years of the survey.

Table 12. Comparison between the average proportions and coverage by Field Survey squares of broad land cover types in Scotland

Land cover type	% area in Scotland	% of all Field Survey sites	Representation of land cover
Arable	9.4	14.6	NS
Broadleaved/ mixed woodland	3.4	8.2	Over*
Built up and gardens	1.9	6.0	Over*
Coastal	0.4	0.6	-
Coniferous woodland	10.9	9.5	Under**
Improved grassland	13.3	30.8	Over***
Standing open water	1.8	0.9	-
Semi-natural	19.4	19.3	NS
Upland (mountain, heath and bog)	39.5	10.0	Under***

Note: *0.01<*p*<0.05, **0.001<*p*<0.01, ***$p<0.001$ from Wilcoxon tests

No results are shown for coastal and standing open water due to the very small number of sites with these land cover types present.

Figure 17. Variation in proportional representation of land cover types in Scottish Field Survey squares over time. The graph also shows the relative proportion of land cover types in Scotland (Scotland area) and the relative proportions across all years of survey (All sites).

As the Field Survey is primarily carried out in lowland areas and the analysis of land cover types across Scotland showed a significant under-representation of uplands, a further analysis was completed to investigate the relative contribution of different habitats within only lowland land cover areas in Scotland (Table 13, Figure 18). In lowland areas, although coniferous woodland remained significantly under-represented, improved grassland remained over-represented and semi-natural habitats became under-represented, the land

cover classes represented in the Field Survey squares in the lowlands showed a closer match overall with the lowland land cover types for Scotland as a whole.

Table 13. Comparison between the average proportions and coverage by Field Survey squares of broad land cover types in Scotland (excluding Uplands)

Land cover type	% area in Scotland	% of all Field Survey sites	Representation of land cover
Arable	15.6	16.2	NS
Broadleaved/ mixed woodland	5.7	9.2	NS
Built up and gardens	3.1	6.7	NS
Coastal	0.6	0.6	-
Coniferous woodland	17.9	10.6	Under**
Improved grassland	21.9	34.3	Over*
Standing open water	3.0	1.0	-
Semi-natural	32.1	21.5	Under***

Note: *0.01<*p*<0.05, **0.001<*p*<0.01, ***p<0.001 from Wilcoxon tests

No results are shown for coastal and standing open water due to the very small number of sites with these land cover types present.

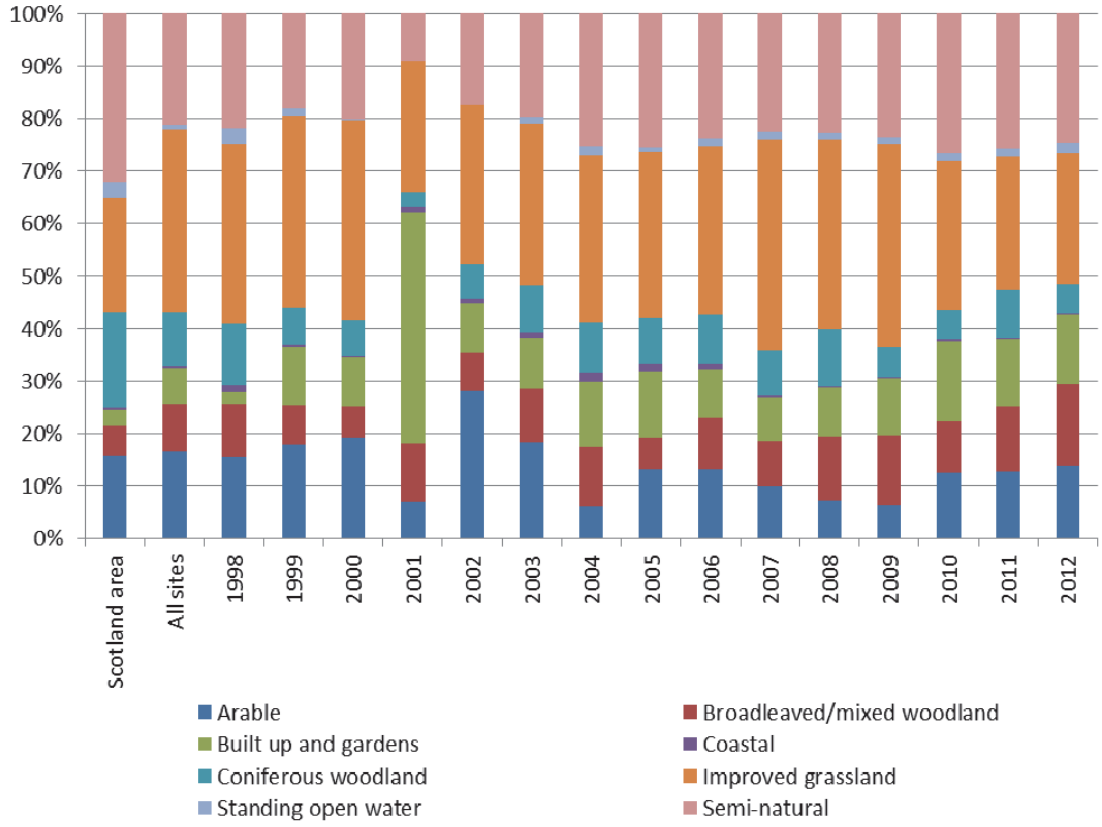

Figure 18. Variation in proportional representation of land cover types (excluding Uplands) in Scottish Field Survey squares over time. The graph also shows the relative proportion of land cover types in Scotland (Scotland area) and the relative proportions across all years of survey (All sites)

4.2.2 Waterway Survey

Across all years of the Waterway Survey (1997-2012), 14% of sites that contributed to trends were in Scotland, compared to 80% in England and 6% in Wales. The contribution from Scotland was therefore significantly under-represented relative to the 34% of Great Britain land area Scotland occupies (χ^2=91.45, df=1, p<0.001). Table 14 and Figure 19 show the percentage of sites in each country for each year. The actual number of sites that contributed to the Waterway Survey trends from Scotland in any one year varied from 6 (12%) in 2001 to 51 (15%) in 2007 and has remained relatively stable over the period of monitoring.

Table 14. Percentages of Waterway Survey sites in the NBMP in Great Britain by country for all years of survey

Year	Total no. sites	% Scotland	% England	% Wales
1997	162	13.6	77.8	8.6
1998	167	13.2	83.2	3.6
1999	181	12.7	84.5	2.8
2000	241	15.4	78.8	5.8
2001	51	11.8	88.2	0.0
2002	179	16.2	78.2	5.6
2003	189	11.6	83.1	5.3
2004	263	10.6	85.6	3.8
2005	307	13.0	82.7	4.2
2006	350	10.6	82.9	6.6
2007	344	14.8	78.5	6.7
2008	317	11.7	82.3	6.0
2009	322	14.0	80.1	5.9
2010	295	12.9	82.7	4.4
2011	303	11.9	83.5	4.6
2012	266	12.0	83.8	4.1

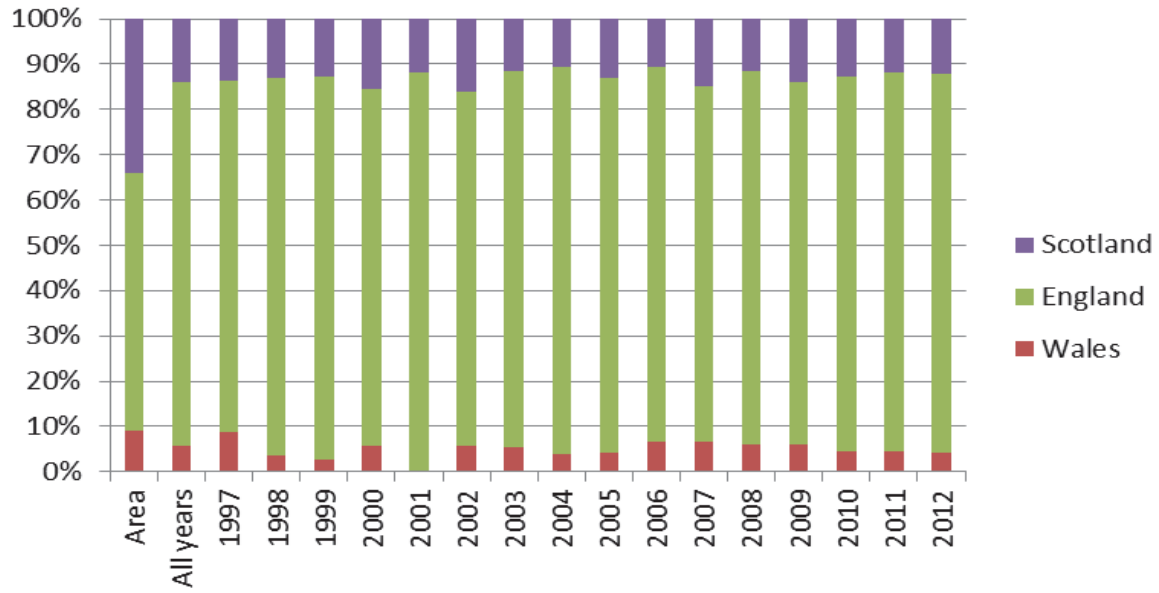

Figure 19. Variation in proportional representation of land areas in Scottish Waterway Survey over time. The graph also shows the relative proportion of land areas in Great Britain (Area) and the relative proportions across all years of survey (All years)

Table 15 shows the proportional representation of land cover types in Scottish Waterway Survey sites compared to the actual proportions of these in Scotland. Figure 20 shows how the proportions of coverage varied between years of the survey. The representation of land cover in the Waterway Survey squares was a poor match with the land cover figures for Scotland as a whole. Improved grassland was significantly over-represented and others, such as upland and coniferous woodland, were significantly under-represented (Table 15).

Table 15. Comparison between the average proportions and coverage by Waterway Survey squares of broad land cover types in Scotland

Land cover type	% area in Scotland	% of all Waterway Survey sites	Representation of land cover
Arable	9.4	19.5	Over*
Broadleaved/ mixed woodland	3.4	9.5	Over***
Built up and gardens	1.9	11.0	Over*
Coastal	0.4	0.0	-
Coniferous woodland	10.9	9.2	Under***
Improved grassland	13.3	24.2	Over***
Standing open water	1.8	1.0	-
Semi-natural	19.4	15.6	Under**
Upland (mountain, heath and bog)	39.5	10.0	Under***

Note: *$0.01<p<0.05$, **$0.001<p<0.01$, ***$p<0.001$ from Wilcoxon tests

No results are shown for coastal and standing open water due to the very small number of sites with these land cover types present.

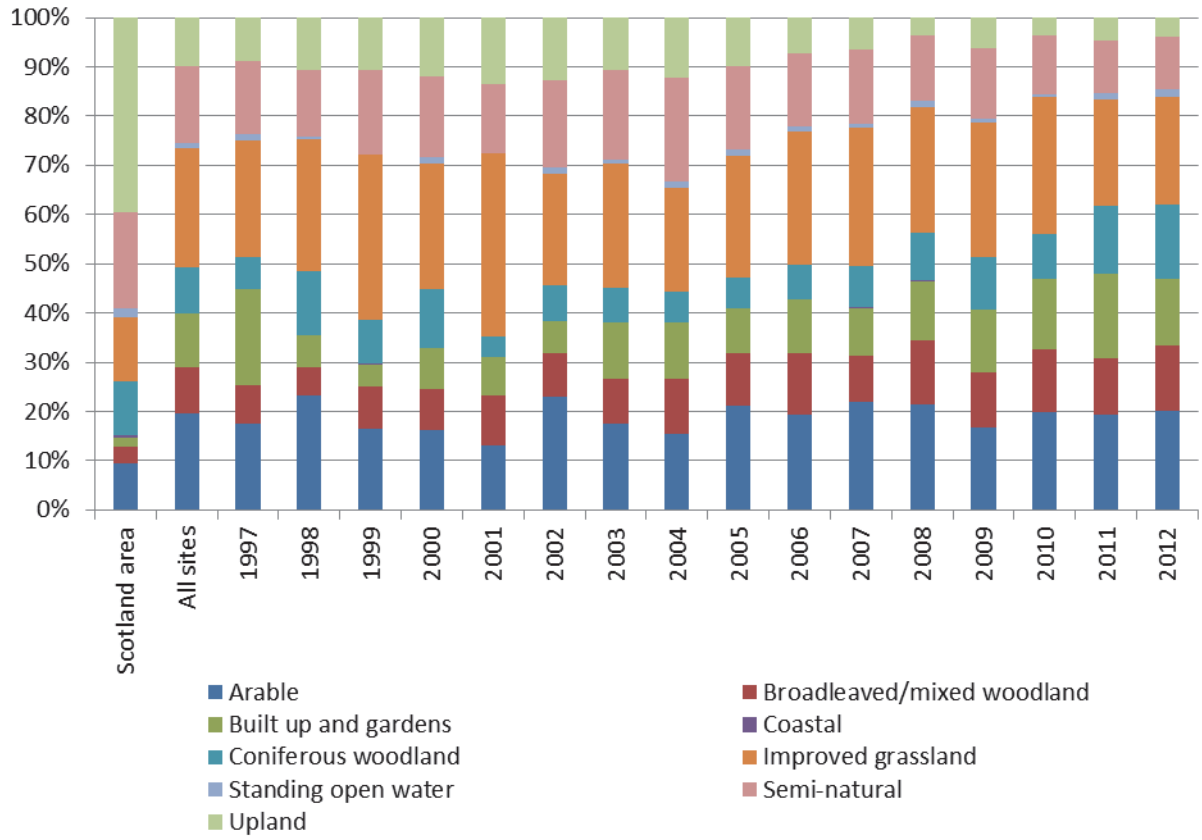

Figure 20. Variation in proportional representation of land cover types in Scottish Waterway Survey squares over time. The graph also shows the relative proportion of land cover types in Scotland (Scotland area) and the relative proportions across all years of survey (All sites)

As the Waterway Survey is primarily carried out in lowland areas and the analysis of land cover types across Scotland showed a significant under-representation of uplands, a further analysis was completed to investigate the relative contribution of habitats within only lowland land cover areas in Scotland (Table16, Figure 21). Although some land cover types remained significantly under- or over-represented (Table 16), the land cover classes represented in the Waterway Survey squares in the lowlands showed a closer match with the land cover figures for Scotland as a whole. As for the Field Survey, the distributions of proportions of different land cover types resulted in some non-significant differences that might be expected from the numerical values shown in Table 16.

Table 16. Comparison between the average proportions and coverage by Waterway Survey squares of broad land cover types in Scotland (excluding Uplands)

Land cover type	% area in Scotland	% of all Waterway Survey sites	Representation of land cover
Arable	15.6	22.2	NS
Broadleaved/ mixed woodland	5.7	10.3	Over**
Built up and gardens	3.1	12.5	NS
Coastal	0.6	0.1	-
Coniferous woodland	17.9	9.9	Under***
Improved grassland	21.9	27.3	NS
Standing open water	3.0	1.1	-
Semi-natural	32.1	16.7	Under***

Note: *0.01<*p*<0.05, **0.001<*p*<0.01, ***p<0.001 from Wilcoxon tests

No results are shown for coastal and standing open water due to the very small number of sites with these land cover types present.

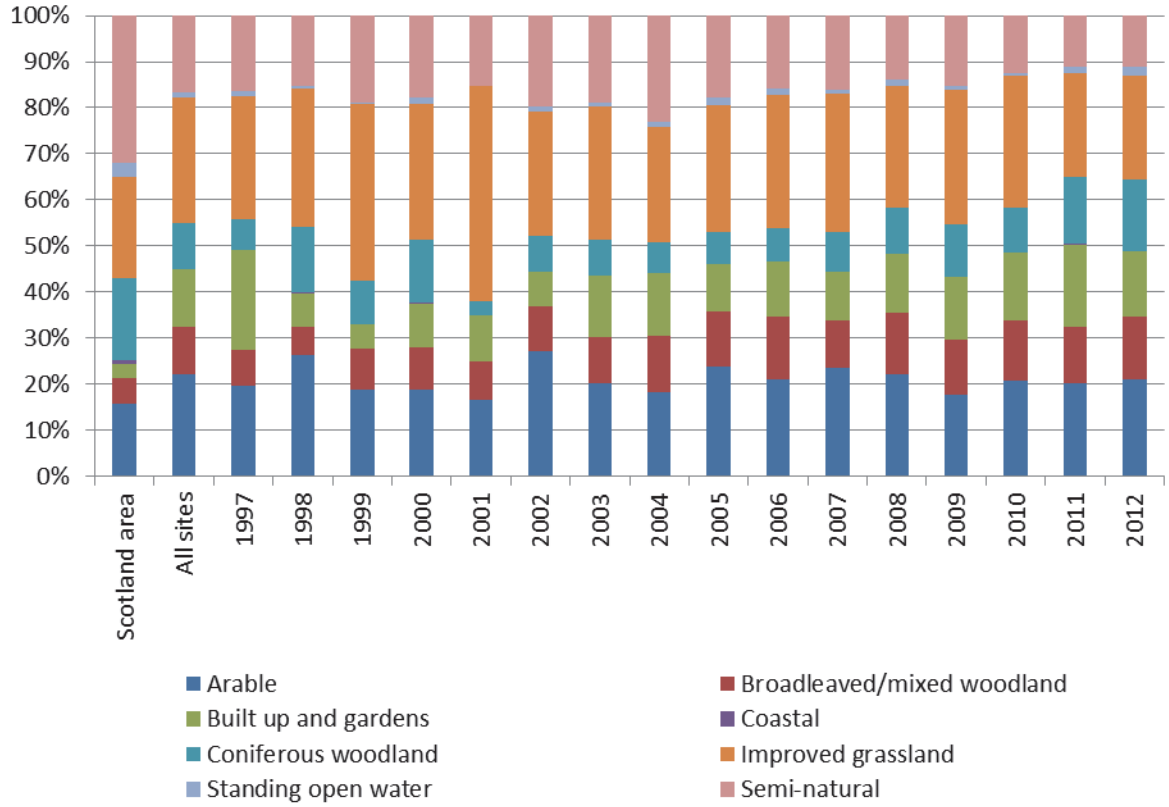

Figure 21. Variation in proportional representation of land cover types (excluding Uplands) in Scottish Waterway Survey squares over time. The graph also shows the relative proportion of land cover types in Scotland (Scotland area) and the relative proportions across all years of survey (All sites)

4.2.3 Hibernation Survey

Considering all the Hibernation Surveys, 4% of sites that contributed to trends were in Scotland, compared to 67% in England and 29% in Wales. The contribution from Scotland was significantly under-represented and the most under-represented of all survey types, in

relation to the 34% of Great Britain land area in Scotland (χ^2=177.34, df=1, p<0.001). Across all years of monitoring the contribution from Scottish sites has remained relatively stable (Table 17 and Figure 22).

Table 17. Percentages of all Hibernation Survey sites in the NBMP in Great Britain by country for all years of survey

Year	Total no. sites	% Scotland	% England	% Wales
1997	209	1.0%	62.7%	36.4%
1998	208	2.4%	68.3%	29.3%
1999	224	1.3%	71.0%	27.7%
2000	234	3.4%	69.2%	27.4%
2001	227	2.2%	84.6%	13.2%
2002	340	2.1%	67.4%	30.6%
2003	349	1.1%	71.1%	27.8%
2004	349	2.0%	69.3%	28.7%
2005	323	3.1%	84.2%	12.7%
2006	325	3.1%	84.9%	12.0%
2007	318	3.8%	83.0%	13.2%
2008	365	3.0%	83.6%	13.4%
2009	428	4.0%	70.6%	25.5%
2010	431	1.9%	71.2%	26.9%
2011	432	4.4%	70.4%	25.2%
2012	370	4.1%	80.3%	15.7%

Figure 22. Variation in proportional representation of land areas in Scottish Hibernation Survey over time. The graph also shows the relative proportion of land areas in Great Britain (Area) and the relative proportions across all years of survey (All years)

4.2.4 Roost Counts

Considering all the Roost Count sites for the four species monitored through this survey in Scotland (common and soprano pipistrelle, brown long-eared bat and Natterer's bat), 15% of sites that contributed to trends were in Scotland compared to 77% in England and 8% in Wales. The contribution from Scotland was therefore significantly under-represented in relation to the 34% of Great Britain land area in Scotland (χ^2=147.7, df=1, p<0.001). Table 18 and Figure 23 show the contribution by country area for all Roost Count sites by year. Across all years of monitoring the contribution from Scottish sites has remained relatively stable.

Table 18. Percentages of all Roost Count sites in the NBMP in Great Britain by country for all years of survey

Year	Total no. sites	% Scotland	% England	% Wales
1997	336	10.7	81.5	7.7
1998	423	13.0	80.1	6.9
1999	534	14.2	78.7	7.1
2000	552	13.9	79.3	6.7
2001	449	14.3	78.6	7.1
2002	629	13.4	78.5	8.1
2003	621	14.2	78.3	7.6
2004	596	14.9	77.5	7.6
2005	659	14.7	77.5	7.7
2006	661	14.1	78.8	7.1
2007	613	12.4	79.0	8.6
2008	653	12.7	80.2	7.0
2009	621	12.7	79.5	7.7
2010	606	13.0	78.4	8.6
2011	555	11.2	80.9	7.9
2012	453	13.2	79.2	7.5

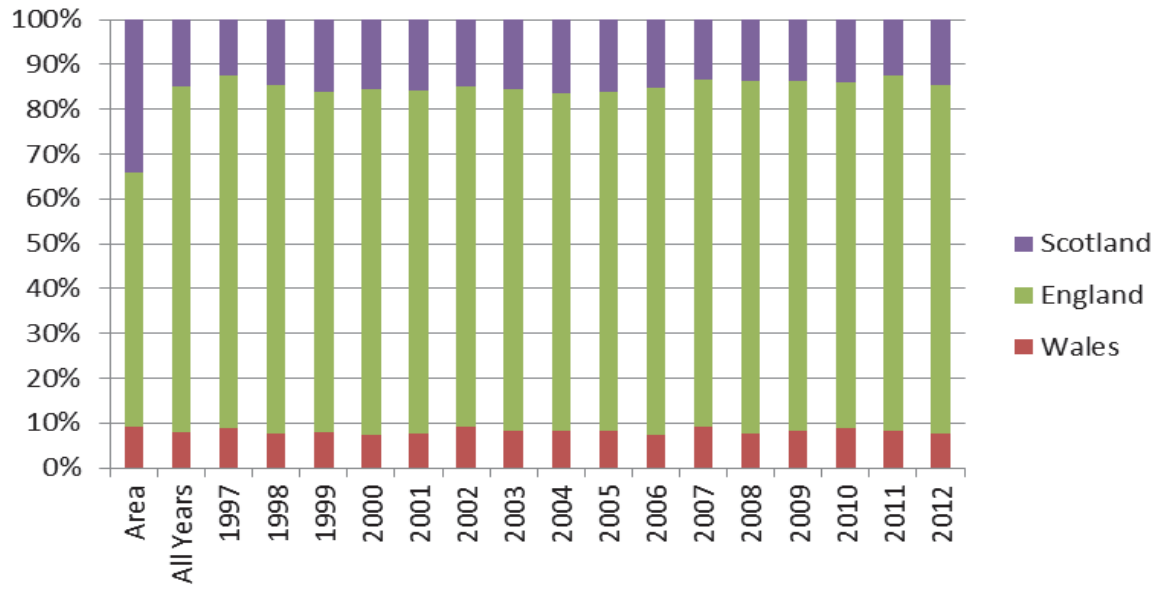

Figure 23. Variation in proportional representation of land areas in Scottish Roost Counts sites over time. The graph also shows the relative proportion of land areas in Great Britain (Area) and the relative proportions across all years of survey (All years)

Considering the four species separately, Scotland was significantly under-represented in all species trends: common pipistrelle (χ^2=59.03, df=1, p<0.001), soprano pipistrelle (χ^2=8.85, df=1, p<0.01), Natterer's bat (χ^2=12.81, df=1, p<0.001) and brown long-eared bat (χ^2=5.72, df=1, p<0.05).

Table 19 shows the representation of land cover types within the current distribution of Roost Count sites relative to the actual proportions of these land cover types in Scotland. Figure 24 shows how these proportions varied over time. The land cover in the 3x3km area around Roost Count sites was a poor match with the land cover figures for Scotland as a whole, except for coastal and standing open water habitats. Semi-natural grassland and upland habitats were significantly under-represented and the remaining main land cover types significantly over-represented (Table 19). As for the other survey types, the distributions of proportions of different land cover types resulted in some non-significant differences that might be expected from the numerical values shown in Table 19.

Table 19. Comparison between the average proportions and coverage in 3x3km area around Roost Count sites of broad land cover types in Scotland

Land cover type	% area in Scotland	% of all Roost Count sites	Representation of land cover
Arable	9.4	16.8	NS
Broadleaved/ mixed woodland	3.4	9.1	Over***
Built up and gardens	1.9	5.2	Over*
Coastal	0.4	0.7	-
Coniferous woodland	10.9	11.1	Over**
Improved grassland	13.3	23.6	Over***
Standing open water	1.8	1.9	-
Semi-natural	19.4	18.7	Under*
Upland (mountain, heath and bog)	39.5	12.8	Under***

Note: *0.01<*p*<0.05, **0.001<*p*<0.01, ***$p<0.001$ from Wilcoxon tests

No results are shown for coastal and standing open water due to the very small number of sites with these land cover types present.

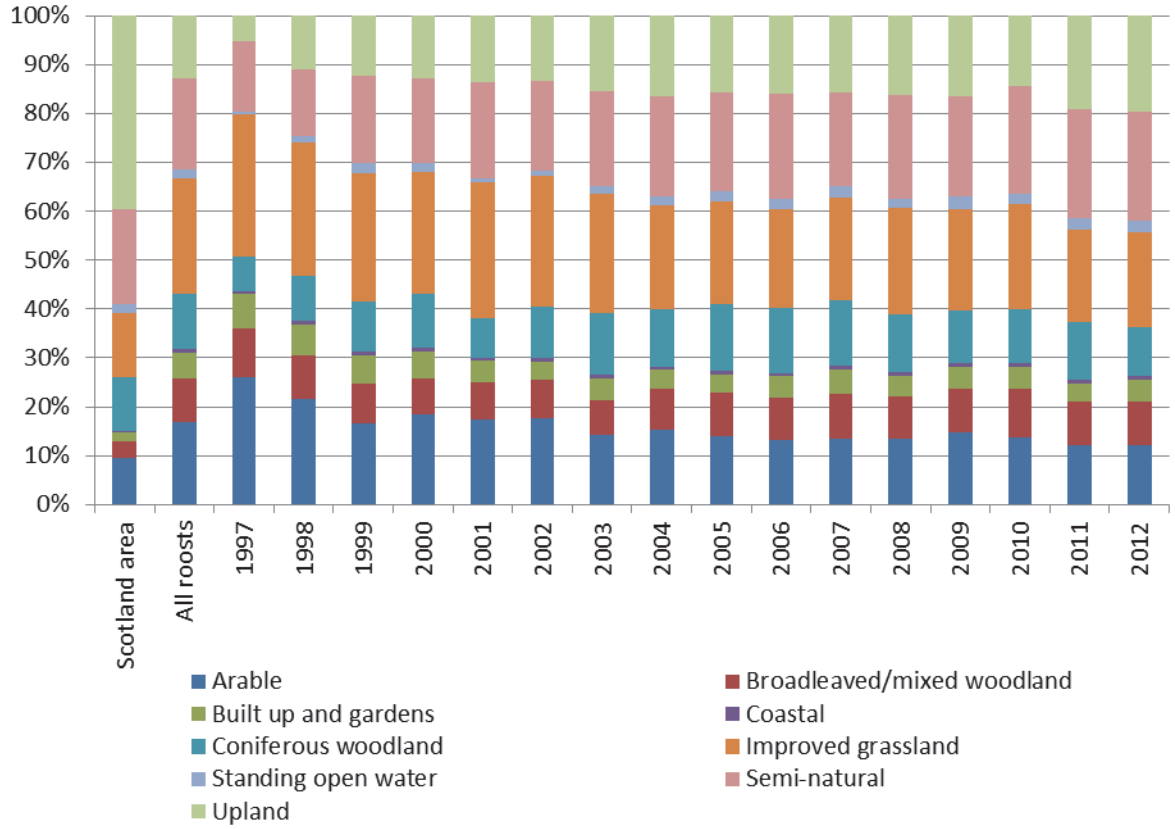

Figure 24. Variation in proportional representation of land cover types around Scottish Roost Counts sites over time. The graph also shows the relative proportion of land cover types in Scotland (Scotland area) and the relative proportions across all years of survey (All sites)

As the Roost Count sites are primarily in lowland areas and the analysis of land cover types across Scotland showed a significant under-representation of uplands, a further analysis was completed to investigate the relative contribution of habitats within only lowland land cover areas in Scotland (Table 20, Figure 25). Although the broadleaved/mixed woodland category remained over-represented, semi-natural grassland remained under-represented

and coniferous woodland became under-represented (suggesting that bat roosts could be more likely to be located close to coniferous woodland in the uplands compared to the lowlands), the land cover classes represented in the 3x3km area around Roost Count sites in the lowlands showed a closer match with the land cover figures for Scotland as a whole.

Table 20. Comparison between the average proportions and coverage in 3x3km area around Roost Count sites of broad land cover types in Scotland (excluding uplands)

Land cover type	% area in Scotland	% of all Roost Count sites	Representation of land cover
Arable	15.6	19.7	NS
Broadleaved/mixed woodland	5.7	10.6	Over***
Built up and gardens	3.1	6.2	NS
Coastal	0.6	0.8	-
Coniferous woodland	17.9	12.5	Under***
Improved grassland	21.9	27.5	NS
Standing open water	3.0	2.0	-
Semi-natural	32.1	21.8	Under***

Note: *0.01<*p*<0.05, **0.001<*p*<0.01, ***p<0.001 from Wilcoxon tests

No results are shown for coastal and standing open water due to the very small number of sites with these land cover types present.

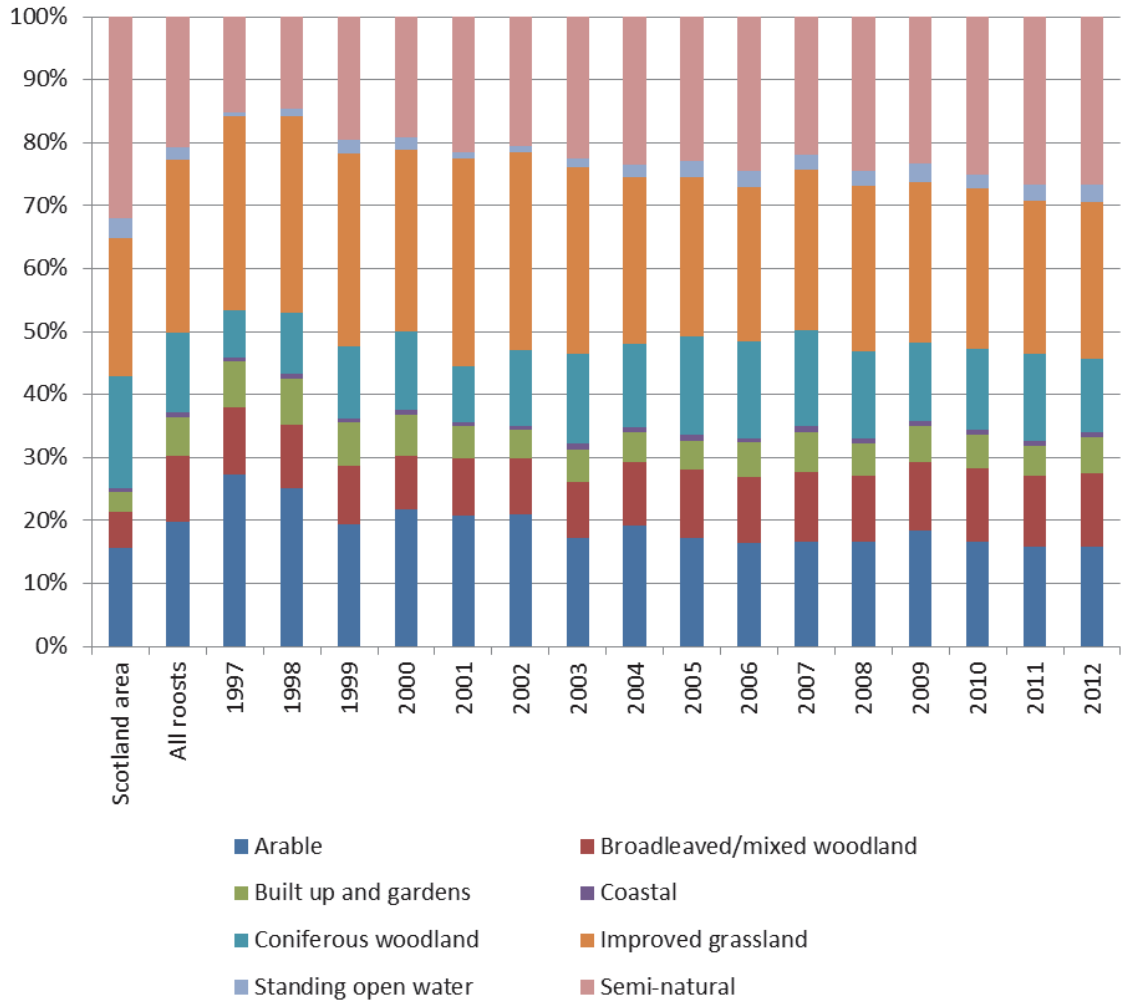

Figure 25. Variation in proportional representation of land cover types (excluding Uplands) around Scottish Roost Counts sites over time. The graph also shows the relative proportion of land cover types in Scotland (Scotland area) and the relative proportions across all years of survey (All sites)

4.3 Proportionate representation in GB species trends

Table 21 summarises the number of sites that would ensure equal representation by land area of Scotland compared to England and Wales in NBMP species trends for each survey type. Assuming that the number of sites remains approximately the same in the rest of GB, increasing the number of sites in Scotland would ensure that Scotland was proportionately represented in relation to country area in GB species trends. Soprano pipistrelle and brown long-eared bat Roost Counts are reasonably well represented. All other surveys would require considerably higher survey coverage in Scotland to achieve representation.

Table 21. Estimated number of sites required by survey type and species to ensure Scotland is proportionately represented in species trends

Survey type	Species	Current number of Scottish sites contributing to trends	Number of Scottish sites needed for appropriate representation in GB trends
Roost Count	Common pipistrelle	56	107
	Soprano pipistrelle	79	80
	Brown long-eared bat	30	33
	Natterer's bat	7	18
Hibernation Survey	All	25	60
Field Survey	Common pipistrelle, soprano pipistrelle, noctule	66	180
Waterway Survey	Daubenton's bat	108	436

4.4 Optimal sampling strategies for Scottish trends

There were sufficient data (between 3 and 49 sites each year, see Table 22) to allow trend calculation and therefore to estimate standard errors for a 10 year period using GAM analysis for the following species and surveys in Scotland (Table 22):

- common pipistrelle from the Field Survey and Roost Count
- soprano pipistrelle from the Field Survey and Roost Count
- brown long-eared bat from the Roost Counts and Hibernation Survey
- Natterer's bat from the Hibernation Survey
- Daubenton's bat from the Waterway Survey and Hibernation Survey

There were insufficient data (between 1 and 13 sites each year, see Table 21) to estimate trends and standard errors for the remaining species and survey types. It was therefore not possible to predict the optimal sample sizes required to produce robust Scottish trends for these species:

- Natterer's bat from Roost Counts
- whiskered/Brandt's bat from Hibernation Survey
- noctule from the Field Survey

It should be noted that whilst the standard errors of the trend over 10 years provide a good impression of the likely precision of that trend, they can sometimes be misleading due to the small number of sites involved. The results of these analyses should therefore be interpreted with some caution. There was considerable variation in the levels of error between species and surveys (Table 21) ranging from 10% to over 1000%. The species trend for Daubenton's bat from the Waterway Survey and for soprano pipistrelle from Roost Counts showed low level errors and the species trend for common pipistrelle showed a medium level error from the Roost Count. The remaining species and surveys showed high level errors or were not calculated.

Table 22. Precision of GAM trend estimates over a 10 year period for NBMP surveys in Scotland

Species	Survey type	Number of sites per year			Standard error of 10 year trend	Error level
		min	max	mean		
Daubenton's bat	Waterway Survey	18	49	32.9	9.8	Low
Daubenton's bat	Hibernation Survey	7	15	10.4	48.0	High
Whiskered/Brandt's bat	Hibernation Survey	only 1 site where present			-	-
Natterer's bat	Hibernation Survey	5	13	8.4	55.4	High
Natterer's bat	Roost Count	3	5	3.8	-	-
Common Pipistrelle	Roost Count	14	32	25.4	11.0	Medium
Common Pipistrelle	Field Survey	8	22	13.9	36.2	High
Soprano Pipistrelle	Roost Count	22	39	32.0	9.7	Low
Soprano Pipistrelle	Field Survey	4	22	14.0	68.5	High
Noctule	Field Survey	1	7	4.1	-	-
Brown long-eared bat	Roost Count	7	18	12.0	46.9	High
Brown long-eared bat	Hibernation Survey	3	10	7.1	>1000	High

Table 23 shows the estimated number of sites required for summer Roost Count and summer bat detector surveys to improve trend precision. All error levels for Hibernation Surveys were high or not calculated. Due to the low likelihood of recruiting additional sites into this survey (due to lack of known sites in Scotland), estimates for the number of sites required for country levels trends were not considered here.

A trend with a low level error means that the confidence limits around the trend after 10 years would be up to approximately ±20%. A steady Red Alert decline[15] would give a 24% decrease after 10 years and therefore there would be a reasonable chance of detecting a Red Alert decline in 10 years from a trend with a low level error. The sample size estimates were highly variable between species and surveys. For example, an estimated 35 sites monitored per year would be required to reduce the estimated error level from medium to low for common pipistrelle Roost Counts, whereas an estimated 265 sites per year would be required to reduce the estimated error level from high to low for brown long-eared roost counts (Table 23).

[15] http://www.bats.org.uk/pages/detecting_population_change.html

Table 23. Estimates of the annual number of sites needed to improve trend precision in Scotland to specified levels of error

Species	Survey type	Current mean number of sites per yr	Current error level	Estimated number of sites for a medium error level	Estimated number of sites for a low error level
Common Pipistrelle	Roost count	25	Medium	-	35
Common Pipistrelle	Field survey	14	High	45	185
Soprano Pipistrelle	Field Survey	14	High	20	65
Brown long-eared bat	Roost count	12	High	65	265

5. DISCUSSION

The NBMP was originally designed to detect population trends at a UK level, but with an aspiration to report at a series of finer scales, for example at a country level scale to contribute to country biodiversity strategies. Reporting of trends at a country or regional scale is possible providing the sample sizes for the scale in question are sufficient. Power analyses were completed in the early years of the NBMP (Bat Conservation Trust, 2001). From these analyses it is was recommended that at a broad level across the programme, a core of 30-40 sites would need to be surveyed annually, ideally 40 repeat sites, for any given species and survey type to provide sufficient data for trends to be calculated that would detect changes in populations effectively.

This review of current NBMP survey coverage in Scotland has highlighted where current coverage for some species and survey types in Scotland is reasonable and also that there are significant gaps in coverage for other species. The number of sites are currently very small for some surveys, notably Roost Counts for Natterer's bat, for noctule in the Field Survey and all Hibernation Surveys (covering brown long-eared bat, Natterer's bat, Daubenton's bat and whiskered/Brandt's bat).

We assessed survey coverage in Scotland in two ways. First, we assessed whether coverage of each survey type or species was sufficient to ensure that Scotland could be proportionately represented in GB trends, and also how well this coverage reflected land cover types in Scotland. Second, we assessed the precision of Scottish trends based on existing survey data and the improvements required in survey coverage so that a Red Alert was likely to be detected. In the following section, we compare the existing survey coverage with optimal sampling strategies for proportional representation by area in species trends and to provide robust Scottish species trends.

5.1 Comparison of existing and optimal sampling strategies

5.1.1 Field Survey

Of the 131 Field Survey sites in Scotland in the NBMP database, data from 66 currently contribute to species trends for common pipistrelle, soprano pipistrelle and noctule. A further 65 sites have been surveyed only once. Common and soprano pipistrelles have been recorded at just over half of all sites surveyed, whereas noctule, which reaches the northern limit of its distribution in the southern part of Scotland, has only been recorded at a total of 12 sites. The number of Field Survey sites that have been surveyed in Scotland dropped between 2010 and 2012 with a mean of 14 sites per year over the period of monitoring.

Scotland is under-represented in the GB species trends calculated from Field Survey data. Given the very small number of sites where noctule has been recorded as present, a robust species trend for noctule cannot be calculated currently from NBMP survey data. Scottish species trends for common and soprano pipistrelle were both estimated to have a high level of error based on current data. A large number of additional sites was estimated to be required to increase the precision level to a low level of error (185 and 65 sites surveyed per year respectively). A smaller, but still considerable number of sites is needed to provide trends for common and soprano pipistrelle with medium (up to +/- 40% confidence limits) error levels (45 and 20 sites per year respectively).

If it were possible to increase survey effort in Scotland to ensure that 45 Field Survey sites were surveyed annually in Scotland, this would enable estimation of Scottish trends for common and soprano pipistrelle with a low to medium error level. It would also make a significant improvement to the contribution of Scottish sites to GB species trends for all three Field Survey species present in Scotland. Currently, Field Survey coverage best represents pipistrelle bats in lowland habitats, as upland areas are significantly under-represented.

5.1.2 Waterway Survey

Of the 184 Waterway Survey sites in Scotland in the NBMP database, data from 108 currently contribute to species trends for Daubenton's bat. A further 76 sites have been surveyed only once. Daubenton's bat has been recorded in a large proportion of all sites surveyed (76%). The number of Waterway Survey sites that have been surveyed in Scotland annually has remained relatively stable in the latter years and averages 33 sites per year over the period of monitoring. The low error level found in the 10 year analysis suggests that a relatively robust species trend for Scotland could be calculated based on the current survey level.

5.1.3 Field and Waterway Survey sites with single year coverage

In the early years of the NBMP, two different approaches were made to cover sites in under-represented areas. Payments were made to experienced surveyors already living in under-represented areas to survey a range of sites in areas with low coverage. One site was always surveyed for free by the surveyor, and then payments were made to cover travel expenses per site for additional sites. A second approach was for the Senior Field Officer from the NBMP team to visit areas where survey coverage was low and take a vehicle and three other experienced surveyors to locations where the team then surveyed a range of sites in that area (Bat Conservation Trust, 2001).

This proved successful in collecting baseline data from sites in these areas. The majority of these sites have not, however, been revisited again (Figure 26) so they do not currently contribute to the trend analysis described in this report. In subsequent years, additional sites have also been set up and surveyed in a single year only by other NBMP volunteers. The majority of sites that have been surveyed only once were set up in the first few years of the NBMP (Figure 26). These sites are spread widely across Scotland (Figures 27 and 28). Some of these sites would provide a contribution towards filling gaps in survey coverage in Field and Waterway Surveys in the Highlands, for example, where coverage is currently low. It would be necessary to recruit and train volunteers to make repeat visits to these sites in at least one further year to collect the minimum data needed for these sites to contribute to species trend analysis.

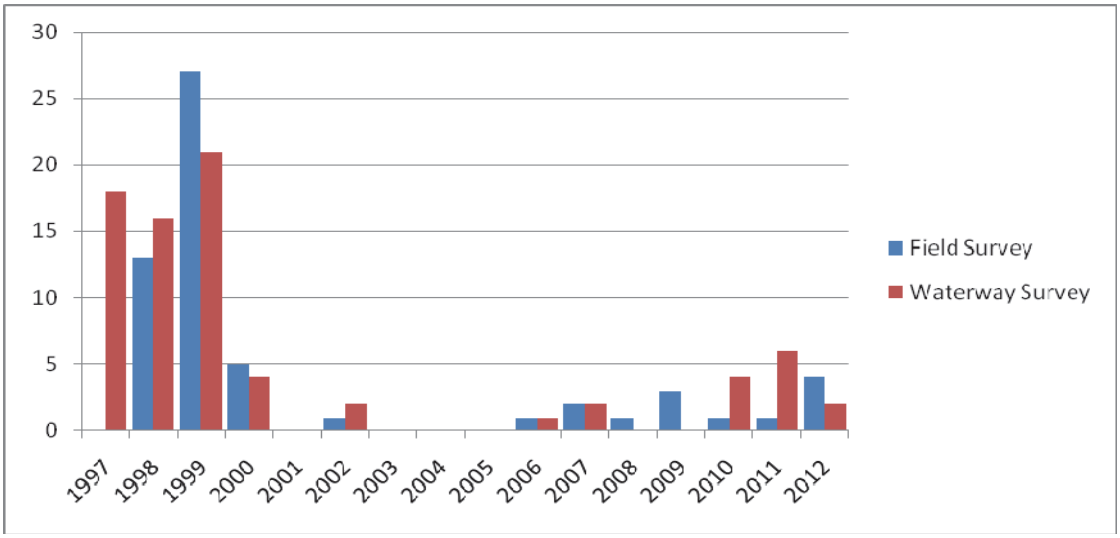

Figure 26. Number of new Field Survey and Waterway Survey sites established in each year that have not been revisited in subsequent years

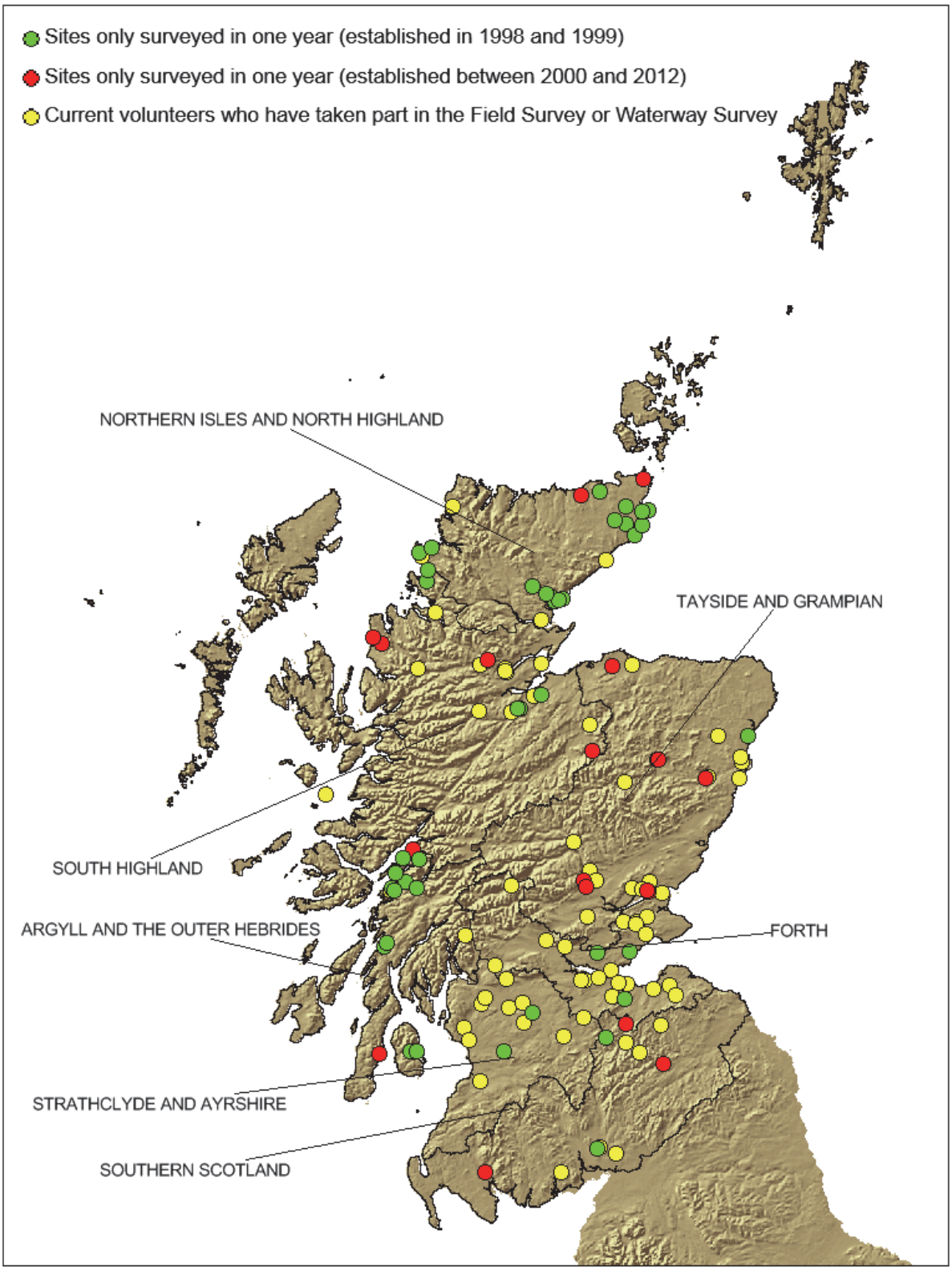

Figure 27. Distribution of Field Survey sites only surveyed in one year showing the period in which they were surveyed. Yellow dots indicate locations of current NBMP volunteers who have taken part in the survey in the past so could potentially be approached about taking on lapsed sites. © Crown copyright and database rights 2014 Ordnance Survey 100017908.

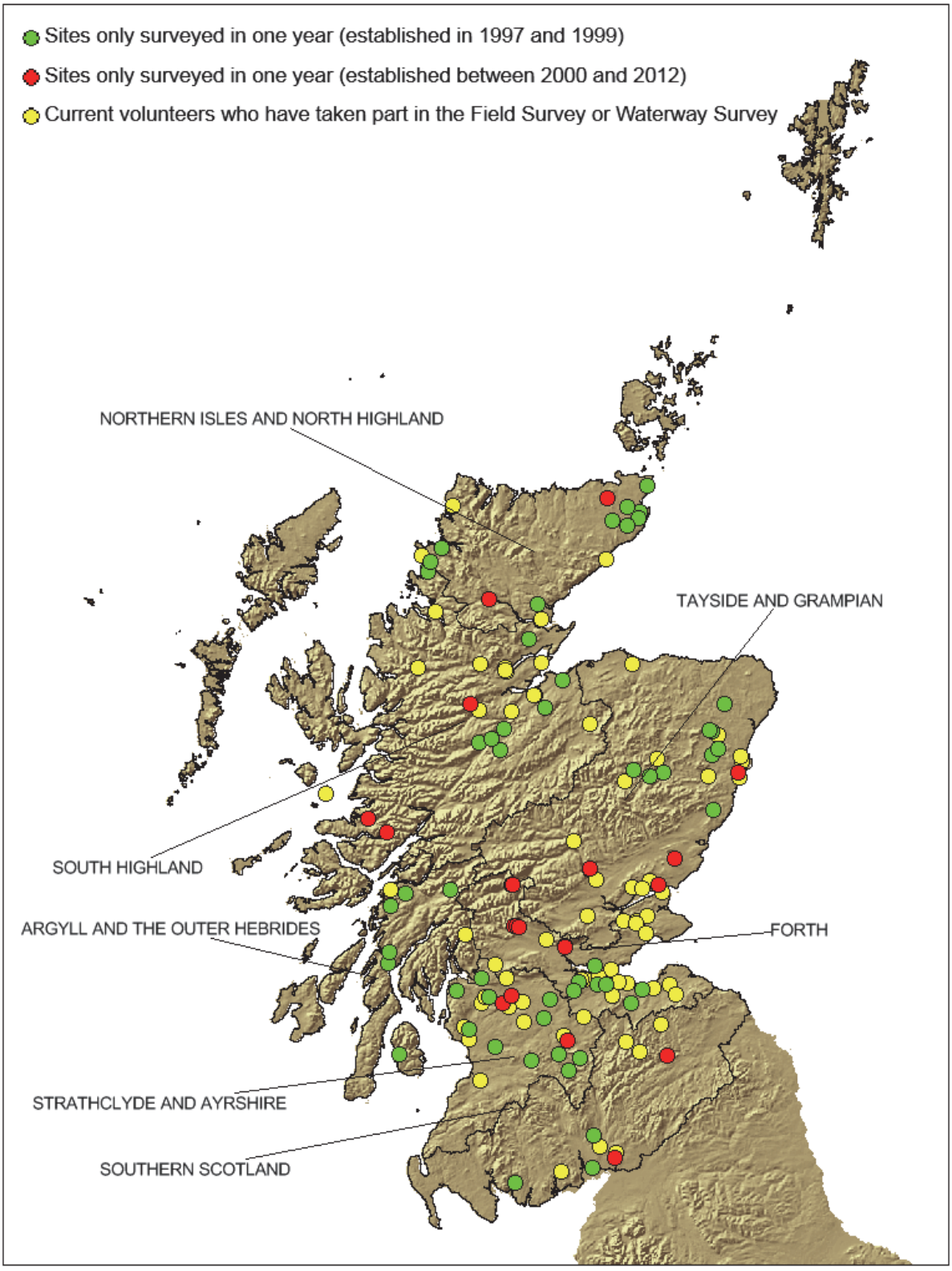

Figure 28. Distribution of Waterway Survey sites only surveyed in one year showing the period in which they were surveyed. Yellow dots indicate locations of current NBMP volunteers who have taken part in the survey in the past so could potentially be approached about taking on lapsed sites. © Crown copyright and database rights 2014 Ordnance Survey 100017908.

5.1.4 Hibernation Survey

The number of hibernation sites that have been surveyed in Scotland is low with data from a total of 43 sites. The maximum number of sites (from all years of survey) that have contributed to species trends is 21 for the Daubenton's bat trend. The minimum is a single site contributing to the whiskered/Brandt's bat trend. All species trends for Scotland calculated from hibernation data would have high error levels due to these small sample sizes and Scotland is significantly under-represented in GB species trends from Hibernation Surveys. Because hibernation sites are located and surveyed by licensed bat workers, usually organised at the bat group level, it would not be a straightforward task to simply increase the number of hibernation sites surveyed. It would be necessary to identify whether there are additional known sites in Scotland that are surveyed but for which data are not submitted to the NBMP through direct correspondence with bat groups or to encourage searches for additional hibernation sites. Options for investigating these approaches are discussed in the following section but, because of the challenges in increasing the number of sites surveyed for the Hibernation Survey and the low level of existing survey coverage in Scotland, detailed analysis on the numbers of sites required to allow species trends to be calculated was not investigated in this report.

5.1.5 Roost Count

There is considerable variation in the survey coverage of the four species monitored through the Roost Count in Scotland (common pipistrelle, soprano pipistrelle, Natterer's bat and brown long-eared bat).

Currently, 56 of the 74 common pipistrelle sites in the database contribute to this species trend for Scotland. Common pipistrelle is under-represented in the GB species trend from Scottish Roost Count data and the precision of a Scottish trend for this species would have a medium error rate. Increasing the number of common pipistrelle roosts surveyed annually from the current mean of 25 to 35 would improve the precision of the trend and would contribute to improving representation in the GB trend, although a larger increase would be needed to reach proportional representation by country area.

Scotland is reasonably well represented in the GB species trend for soprano pipistrelle calculated from Roost Count data. A Scottish species trend would have a low level of error based on current survey data and it therefore would be possible to provide a Scottish trend for soprano pipistrelle based on the current level of survey coverage from the Roost Count. For survey coverage to remain at a level suitable enough to continue the production of robust annual population trend estimates, the reduction in the number of sites monitored in recent years would need to be reversed in the longer-term. It is not clear why the number of sites monitored has gone down; follow up within individual roost owners would be required to understand the causes and to attempt to re-recruit these roosts into the monitoring programme.

At 87 Roost Count sites in Scotland, the species is identified as 'pipistrelle unsure', which means that the bats have not been identified to species level and are presumed to be one of the pipistrelle species until identification can be made. Of these, 30 sites met the minimum requirements for inclusion in trend analysis if the species were known, although only eight were actually surveyed in 2012. Carrying out identification of the species at the sites where bats are still present and the householder is still willing to take part in the survey would be invaluable. This would enable these counts to be included in species trend analysis for the appropriate species and hence increase the sample sizes. Identifying species at these roosts across the UK is an ongoing process, with identification carried out either by bat group members visiting the roost in order to identify the bats using a bat detector, or by the NBMP team through sonogram analysis of recordings made by the volunteer. If species

identification could be confirmed for these roosts, data could be added to the relevant species trend analysis. This would assume that the species in the roost had remained the same throughout the monitoring period. It is possible that the species in a specific roost location may change, but this is unlikely.

Currently, 30 of the 42 sites in the database contribute to the species trend for brown long-eared bat from Scotland. Brown long-eared bat is reasonably well represented in the GB species trend from Roost Count data with only a small increase in number of sites per year (from 30 to 33) required to reach proportional representation by country area. The precision of a Scottish trend for this species would have a high level of error, however, suggesting that a larger number of sites would be required to achieve adequate precision. Increasing the number of brown long-eared bat roosts surveyed annually from the current mean of 12 to 65 would be required to improve the precision of the trend to a medium level of error. For a low level of error, it is estimated that 265 sites would need to be surveyed annually. It would be necessary to identify a very large and unrealistic number of additional brown long-eared roost sites for monitoring in Scotland to reach either target.

The number of Natterer's bat sites that have been surveyed in Scotland for the Roost Count is very small overall at seven sites, all of which contribute to the GB trend for this species. Natterer's bat is under-represented in the GB trend and an increase to 18 sites contributing data to the trend would be required to ensure that Scotland is proportionally represented by area. Due to the small existing number of sites surveyed, it was not possible to estimate trend precision for this species in Scotland. It is likely that a substantial increase in the number of sites surveyed is required to allow a robust Scottish trend. It would be necessary to identify a large (but currently unknown) number of additional Natterer's bat roost sites in Scotland to reach this target.

5.2 Summary

In summary, it would be possible to provide Scottish trends for some species and survey types with either existing datasets or by improving survey coverage as follows:

- Common pipistrelle: increasing Field Survey coverage to 45 sites annually and increasing Roost Counts to 35 sites annually
- Soprano pipistrelle: increasing Field Survey coverage to 45 sites annually and maintaining current coverage (32 sites annually on average) for Roost Counts
- Daubenton's bat: maintain existing Waterway Survey coverage (33 sites annually on average)
- Brown long-eared bat: increase Roost Count coverage to 65 sites annually (likely to be difficult to achieve)

For both the Field and Waterway Surveys, targeting sites in 1x1km squares where the dominant habitat falls into either the upland or coniferous woodland land cover categories could also assist in increasing coverage of these under-represented habitats in Scotland. However, a careful approach would be needed if this were done to ensure that appropriate sites were targeted for survey to avoid any further biases in land type coverage. Also, additional sites in semi-natural grassland habitats are required for the Waterway Survey. It may be possible to target these land cover categories using data from the Countryside Survey maps when selecting new survey squares.

Semi-natural grassland and upland habitats are also significantly under-represented at Roost Count sites. The positive selection biases towards land cover categories such as built up and gardens and improved grassland in this survey are perhaps to be expected, given that these habitats tend to be found in proximity to the buildings where most roosts surveyed

are found. It is, however, more difficult to rectify these problems, as Roost Count sites are self-selected compared to the random-stratified sampling approach taken for Field and Waterway Surveys. Sites are included in the programme where roost owners or bat groups know of roost sites, monitor them regularly and submit data to the NBMP. A recent study looking at habitat associations of bat species using NBMP data on roost location showed that roosts of several species, including common pipistrelle, soprano pipistrelle and lesser horseshoe bat (in England and Wales) selected roost sites closer to broadleaved woodland than would be expected by chance (Boughey *et al.*, 2011b), which may also help to explain the over-representation of the broadleaved/mixed woodland and coniferous woodland land cover categories for Roost Counts.

Increasing the coverage of existing summer bat detector surveys according to these recommendations could therefore allow robust species trends to be produced for three species: common pipistrelle, soprano pipistrelle and Daubenton's bat. There are inherent biases in relying on monitoring data from Roost Counts alone due to the self-selection of sites for these surveys and due to roost switching behaviour shown by some bat species (Barlow *et al*. 2015). For example regular movements of bats between roost sites both within and between years for some mobile species, particularly pipistrelles may mean that species trends from Roost Counts are less reliable than from bat detector surveys (Bat Conservation Trust, 2001). For example, it seems probable that a roost is more likely to be noticed when its population is high, or that individual colonies are more likely to be lost, than rediscovered and counted. Both of these scenarios would lead to a downward bias in the trend. Further analysis is required to fully understand the differences seen in trends between survey types for pipistrelle bats (Barlow *et al.* 2015). In addition, whilst it is therefore useful to have trend information for brown long-eared bats from Roost Counts, it would be preferable to also collect monitoring data from a second survey type for comparison of trends as is the case at the UK level (where a species trend is also calculated from the Hibernation Survey).

6. RECOMMENDATIONS

In this section we make recommendations on a range of options that could be implemented to address the current gaps in survey coverage in Scotland. We have divided this into two parts. The first are detailed recommendations that work towards increasing volunteer participation in the NBMP and describing options that fit into or build on the current structure of the programme. The second looks at more radical departures from existing methods to allow more comprehensive monitoring of bats in Scotland.

6.1 Improving survey coverage within the current NBMP framework

There are a number of tasks that could be completed through practices already used within the NBMP to improve survey coverage in Scotland. These would work by increasing the number of volunteers taking part in surveys. This can be achieved through training and recruitment drives and increasing the number of sites in the NBMP network in Scotland for different survey types. The following options, which could all contribute to increasing volunteer participation, and all of which would require additional investment in the programme in Scotland, are discussed in detail in this section in relation to each survey:

- Training new bat detector workshop leaders and supporting them to deliver training workshops in Scotland
- Targeting bat detector training workshops to areas where there are clusters of Field and Waterway sites which have only been surveyed in a single year to encourage new volunteers to take on these sites
- Providing travel expenses for existing NBMP volunteers who take on additional Field and Waterway Survey sites in their areas to encourage existing volunteers to take on sites which have only been surveyed in a single year (not currently within NBMP practices but has been used in the past to increase survey coverage)
- Undertake media campaigns alongside bat groups and targeted organisations to identify additional summer roost sites with the aim of increasing survey coverage for Roost Counts
- Liaise with bat groups and other organisations to identify additional hibernation sites in Scotland

6.1.1 Field and Waterway Surveys

To encourage new volunteers to take part in summer bat detector surveys and to assist more experienced volunteers to refresh their skills, BCT run workshops in using bat detectors, teaching participants how to understand and interpret bat calls heard through a heterodyne bat detector, and introducing the monitoring techniques. This is mainly done through the Using Your Ears (UYE) workshop and also through workshops targeted specifically at providing volunteers with the skills they need to take part in the Field and Waterway Surveys. The key aim of these workshops is to encourage volunteers to take part in surveys, standardise the implementation of the survey methods and improve the species identification skills of NBMP volunteers. Workshops are currently organised and delivered by the NBMP team across the UK, with help from a team of Regional Bat Detector Workshop Leaders (RBDWLs), experienced volunteers who are trained by the NBMP team to deliver the workshops and agree to deliver at least one workshop each year.

A key barrier to improving survey coverage and volunteer participation in NBMP bat detector surveys in Scotland is the lack of RBDWLs and therefore there are limited opportunities to run bat detector workshops in Scotland. Currently there are only two active RBDWLs in Scotland (located in southern Scotland and the Central Belt including the Scottish Bat Officer), plus two further RBDWLs who are not currently able to run bat detector workshops. A key recommendation is therefore to organise and run a Training for Trainers weekend in

Scotland for up to six experienced bat volunteers (depending on level of interest and availability) to be trained as new RBDWLs.

The new RBDWLs would then require support and assistance in targeting locations for bat detector workshops in areas where survey coverage is low. The key recommendation for NBMP bat detector workshops is to focus these in areas where there are clusters of existing Field and Waterway sites that have a single year of survey and to match up new volunteers who attend workshops with these survey sites as far as possible.

Targeting specific Field and Waterway Survey sites for re-survey is a further option using existing volunteers. As was done in the early years of the NBMP, experienced surveyors, who could be existing NBMP volunteers or bat group members, for example, could be contacted and asked if they are able to survey sites that require further years of data. This approach would require more intensive survey management than current levels to match up volunteers and sites, liaise with specific volunteers and arrange payments for travel expenses.

The combination of recruiting new volunteers through improving training for volunteers in Scotland and paying existing volunteers to survey additional sites is likely to have a reasonable level of success in reaching target levels of survey coverage required to calculate Scottish trends from summer bat detector surveys. Any increase in Field Survey sites is more likely to increase representation of lowland land cover categories rather than the uplands, as volunteers are more likely to live close to, and be able to access, lowland habitats more easily. Additional financial investment in the programme would be required in Scotland to achieve this to cover the increased time spent on managing surveys and volunteers in Scotland.

6.1.2 Roost Counts

In order to increase survey coverage of species monitored through Roost Counts, it will be necessary to identify new roost locations or to bring existing known roosts that are not currently monitored into the programme. Options for identifying new roosts include:

- Targeted national or local media campaigns asking for householders to tell us about bats in their homes
- Liaison with bat groups to identify known roosts not currently monitored as part of the NBMP
- Identification of and development of relationships with organisations that own and manage buildings which are likely to support bat roosts e.g. Historic Scotland and National Trust for Scotland (NTS) to help to identify and recruit new sites into the programme
- Identification of and development of relationships with organisations that hold bat records published through the NBN and following up on species records that identify locations of roost sites e.g. SNH Bat records for Scotland 1970-2007 from SNH casework, Scottish record centres and recording groups

Each of these options would require an investment of time to trawl through records or to gather information on roosts, follow on work to recruit volunteers into the programme, to monitor any newly identified roosts and to provide management and support for those volunteers. Liaising with larger organisations such as NTS may need a more significant investment of time to assist in the development of a programme of monitoring across a range of sites. Consideration would be required to determine the most time and cost effective methods for bringing new roosts into the monitoring programme.

6.1.3 Hibernation Surveys

Hibernation Surveys are mainly co-ordinated through bat groups or bat workers who are collectively responsible for surveying groups of sites in each area under licence. This is in contrast to the Field and Waterway surveys in which the NBMP team corresponds directly with a large number of individual volunteers who each survey one or a small number of sites. The hibernation sites monitored for the NBMP therefore tend to be clustered in areas where bat workers or the bat group know of and are able to access hibernation sites. It is possible that there may also be areas where sites are surveyed and the data do not currently contribute to the NBMP, or that there are fewer hibernation sites in the northern part of Scotland for example due to the geology or lack of suitable man-made structures.

In order to increase survey coverage of species monitored through Hibernation Surveys, it would be necessary to identify new hibernation sites or to bring existing known sites that are not currently monitored into the programme. For example, bat groups may have knowledge of hibernation sites in their area, organisations who own buildings that could support potential winter roosts for bats may know of some roosts, e.g. NTS, Historic Scotland and caving groups, and a survey of all ice houses recorded in Scotland could be instigated. This approach is likely to require considerably more investment of time than for Roost Counts and is less likely to achieve significant increases in sample sizes. For example, whiskered bat is rare in Scotland and has only been recorded at a single hibernation site, where two bats were recorded in 2005 and a further two in 2011. It is therefore unlikely that trend information will be obtainable for this species in the near future. If substantial numbers of new hibernation sites were identified, however, and brought into the NBMP, it may be possible to eventually investigate trends for Daubenton's bat, Natterer's bat and brown long-eared bat from this survey.

6.2 Representation of Scotland in species trends

Scotland is under-represented in all NBMP species trends based on current survey coverage. An alternative approach to increasing the level of survey coverage in Scotland to reach representative levels would be to include weighting in the analysis of trends to allow for uneven coverage and differences in sampling densities across the UK. Weighting involves adjusting the contribution of sites according to sampling density in the trend calculations and could be done either by country or regional geographic area, by waterway length where relevant for example for the Waterway Survey, or by relative population estimates where available. This approach is taken, for example, in the analysis of Breeding Bird Survey data (e.g. Baillie *et al.*, 2013). It is not currently used for bat trend analysis, although differences between countries and environmental zones are tested for each species as part of the trend analysis (Bat Conservation Trust, 2013). Whilst weighting might reduce the risk of bias, it can also inflate the variance of estimators, particularly where survey coverage is very uneven.

6.3 Summary

Within the current NBMP framework, if the measures recommended in this section were to be implemented successfully, the ability to report on Scottish bat species trends would be improved considerably. Based on this assessment, however, there will still be gaps in the monitoring of Scottish species, as outlined in Table 24, which summarises the likelihood of the recommendations resulting in sufficient data being available to calculate Scottish trends. For completeness, this table also includes additional species present in Scotland for which no trends are currently calculated as part of the NBMP overall. Based on this assessment, it may then be possible to construct a bat status indicator for Scotland based on trends of three common and widespread species: common pipistrelle, soprano pipistrelle and Daubenton's bat.

Table 24. Current trend status for bat species in Scotland and estimated future potential for species trends within the current NBMP

Species	Survey type	Current error level of trend in Scotland	Likelihood of attaining sufficient survey coverage to calculate species trend for Scotland
Common pipistrelle	Field Survey	High error level	High
	Roost Count	Medium error level	High
Soprano pipistrelle	Field Survey	Medium error level	High
	Roost Count	Low error level	High
Nathusius' pipistrelle	Nathusius' pipistrelle Survey (distribution only)	-	-
Noctule	Field Survey	Not calculable	Low-Medium
Leisler's bat	No current survey	-	-
Daubenton's bat	Waterway Survey	Low error level	High
	Hibernation Survey	High error level	Low
Natterer's bat	Roost Count	Not calculable	Low
	Hibernation Survey	High error level	Low
Whiskered/Brandt's bat	Hibernation Survey (species considered together)	Not calculable	Very low
Brown long-eared bat	Roost Count	High error level	Low
	Hibernation Survey	Very high error level	Low

6.4 Alternative approaches to bat monitoring in Scotland

In this section we outline some alternative approaches to bat monitoring in Scotland outside the existing NBMP processes which could either improve coverage for existing surveys and species or potentially provide a more comprehensive species coverage. These possible options would require a departure from existing monitoring methods and a significant level of investment.

6.4.1 Paid NBMP surveyors

In addition to working towards increasing coverage of existing NBMP surveys through volunteers in Scotland, an alternative approach would be to employ summer field assistants. This approach has been used by monitoring programmes such as the Breeding Bird Survey. The field assistants would be employed for a summer season to complete Field and Waterway Surveys in areas where survey coverage is low. A potential model would be two field assistants contracted from June to August to allow for bat detector training and fieldwork planning in June and survey work in July (Field Survey) and August (Waterway Survey). The field assistants would require transport to allow them to cover survey sites around Scotland. Potentially, the provision of a campervan would allow fieldwork to be completed effectively in a range of areas as the field assistants would have transport and accommodation for any location and be more able to cover a wide geographical area. Alternatively a vehicle could be provided for transport and 'holiday let' accommodation used as field bases in a number of different areas over the survey period. Two field assistants would be a minimum to meet Health and Safety requirements to avoid lone working. A maximum of 10 sites per survey type could be covered by two field assistants assuming good weather conditions (five nights survey per week for four weeks in each month, two visits required per site).

This option would contribute to improved coverage and trends in Scotland for common pipistrelle, soprano pipistrelle, noctule and Daubenton's bat. The long-term sustainability of the costs of contracting field assistants to survey sites would need to be considered when assessing this as an alternative approach to increasing volunteer survey coverage.

6.4.2 Broadband bat detector surveys

The introduction of a broadband bat detector survey is an alternative option which may facilitate the long-term sustainability of bat monitoring in Scotland. Using broadband bat detectors has the advantage over the existing heterodyne bat detector surveys currently utilised in the NBMP in that all call frequencies and therefore all species are monitored simultaneously. Thus a broadband survey technique which takes advantage of the recent technological developments of bat detectors would allow all bat species in Scotland to be monitored through bat detector surveys, for example allowing data to be collected on Leisler's bat. A number of options could be considered including 1) introducing broadband detectors to the existing transect approach to monitoring 2) introducing alternative approaches such as car surveys, or 3) monitoring with static bat detectors.

Bat detector surveys using car-based transects could be considered to increase the geographical area to survey effort ratio. The model of car-based surveys has been successfully trialled through the iBats programme (www.ibats.org.uk/ Jones *et al.*, 2013) and in Ireland (Roche *et al.*, 2011) using time expansion bat detectors. There are a number of challenges to using car surveys to collect monitoring data including the management of large volumes of data, resources required for sound analysis of bat calls and interpretation of the results to take into account any biases of sampling in roadside habitats. Automatic identification tools that reduce the time required to process large amounts of bat call data are under development (e.g. Walters *et al.*, 2012) although species identification is not yet completely reliable and consistent. Broadband bat detector surveys would allow monitoring of species not currently monitored comprehensively through the NBMP in Scotland, for example Leisler's bat and whiskered bat, although accurate identification of *Myotis* species is difficult from bat call recordings.

Another approach to broadband surveys is to use static broadband bat detectors to monitor bat activity at single point locations. This approach has been tested in the USA (Rodhouse *et al.*, 2012) and is currently being trialled in Norfolk (http://www.batsurvey.org/). The use of static bat detectors allows volunteers who have no experience of bat, or even wildlife surveying to participate as training can be provided to set up the detector in the field. No knowledge of bat identification is required and the equipment can be deployed and collected during daylight hours minimising any Health and Safety issues associated with working at night. A single static detector has a much smaller geographic coverage than a car transect survey, however, and a greater density of sampling sites (requiring additional equipment) may therefore be required than car transects to collect bat activity data from a similar area.

Possible advantages of broadband detector survey options include:

- Potential to get a wider range of volunteers involved in bat monitoring (no species identification skills using bat detectors required)
- Potential for improved coverage of areas and/or land cover types currently under-represented in Scotland by using different approaches to transect surveys such as car surveys
- Improved objectivity to species identification using automatic software as it does not rely on the skills of volunteers (although see discussion above on species identification accuracy)

There are, however, a number of other considerations to take into account before introducing broadband bat detector surveys. Some of the challenges of monitoring bats using acoustic surveys are considered by Walters *et al.* (2013) and in the case of the NBMP would include:

- A need to introduce any new survey method alongside the existing programme for a long period of overlap to allow comparison, calibration and eventual merging of trend data where possible for overlapping surveys (seven years was used in the transition from BTO's Common Bird Census to Breeding Bird Survey; Freeman *et al.*, 2007)
- Full costs of introducing a new survey type need to be assessed, for example provision and maintenance of equipment, survey and volunteer management, training of volunteers in use of equipment, data processing storage and time, etc.
- New database systems would be required to provide suitable storage for bat call and location data
- Development of modelling techniques may be needed to allow robust interpretation of data from car transects or static detectors. These bat monitoring techniques are relatively new and to date there are few tried and tested models of monitoring programmes and subsequent trend analysis based on the methods.

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ANNEX 1: COMPLETE LIST OF NBMP SITES IN SCOTLAND BY SURVEY TYPE

In the following tables, SNH areas are abbreviated as follows: AOH = Argyll and The Outer Hebrides, SA = Strathclyde and Ayrshire, SH/NINH = South Highland / Northern Isles and Northern Highland, SS = Southern Scotland, TG = Tayside and Grampian. Although data were recorded on numbers of bats /bat passes, only summary information on species presence at any individual site is given here.

Field Survey

(Sites surveyed within the correct survey period, with minimum 6 walks/spots surveyed and in more than one year contribute to trend analysis and are shown in bold).

Site code	Grid ref	County	SNH area	Approx. elevation (m)	Last year	No. of years	Species recorded: Common pipistrelle	Soprano pipistrelle	Noctule
220103	**NS1197**	**Argyll and Bute**	**AOH**	**53**	**2008**	**2**	**N**	**Y**	**N**
220104	**NN2404**	**Argyll and Bute**	**AOH**	**375**	**2011**	**4**	**N**	**Y**	**N**
220002	NR8297	Argyll and Bute	AOH	19	1998	1	N	Y	N
220018	NM9535	Argyll and Bute	AOH	0	1998	1	Y	N	N
220019	NM8731	Argyll and Bute	AOH	119	1998	1	Y	N	N
220020	NM9349	Argyll and Bute	AOH	10	1998	1	Y	N	N
220026	NN0348	Argyll and Bute	AOH	10	1998	1	Y	N	N
220027	NM8940	Argyll and Bute	AOH	5	1999	1	N	Y	N
220041	NM8830	Argyll and Bute	AOH	114	1999	1	N	Y	N
220056	NN0131	Argyll and Bute	AOH	9	1999	1	N	Y	N
220063	NR8499	Argyll and Bute	AOH	90	1999	1	N	N	N
220094	NR7934	Argyll and Bute	AOH	-9999	2000	1	N	N	N
220120	**NT6474**	**East Lothian**	**Forth**	**126**	**2011**	**2**	**N**	**Y**	**N**
220022	**NT3257**	**Edinburgh**	**Forth**	**244**	**2006**	**3**	**N**	**Y**	**N**
220009	**NT1866**	**Falkirk**	**Forth**	**235**	**2006**	**3**	**Y**	**Y**	**N**
220039	**NS9779**	**Falkirk**	**Forth**	**69**	**2000**	**2**	**N**	**Y**	**N**
220034	**NO2913**	**Fife**	**Forth**	**60**	**2012**	**6**	**N**	**Y**	**N**
220064	**NO2607**	**Fife**	**Forth**	**79**	**2008**	**6**	**Y**	**Y**	**N**
220067	**NO4004**	**Fife**	**Forth**	**60**	**2005**	**4**	**Y**	**Y**	**N**
220066	**NT1959**	**Midlothian**	**Forth**	**291**	**2010**	**7**	**Y**	**Y**	**N**
220082	**NS6794**	**Stirling**	**Forth**	**60**	**2009**	**5**	**Y**	**Y**	**Y**
220086	**NS5283**	**Stirling**	**Forth**	**20**	**2003**	**2**	**N**	**Y**	**N**
220098	**NS5477**	**Stirling**	**Forth**	**113**	**2012**	**8**	**Y**	**Y**	**Y**
220043	**NS9974**	**West Lothian**	**Forth**	**206**	**2011**	**5**	**Y**	**Y**	**N**
220122	NT5185	East Lothian	Forth	10	2011	1	N	N	N
220031	NT2466	Edinburgh	Forth	423	1999	1	N	N	N
220032	NT0893	Fife	Forth	231	1999	1	N	N	N
220037	NT2794	Fife	Forth	75	1999	1	Y	N	N
220131	NT0879	West Lothian	Forth	31	2012	1	Y	Y	N
220001	**NS4242**	**East Ayrshire**	**SA**	**70**	**2007**	**3**	**Y**	**Y**	**N**
220074	**NS4338**	**East Ayrshire**	**SA**	**29**	**2011**	**11**	**Y**	**Y**	**Y**
220011	**NS5575**	**East Dunbartonshire**	**SA**	**54**	**2012**	**11**	**Y**	**Y**	**Y**
220101	**NS6773**	**Glasgow**	**SA**	**64**	**2012**	**8**	**Y**	**Y**	**N**
220050	**NS3455**	**North Ayrshire**	**SA**	**52**	**2008**	**9**	**N**	**Y**	**N**
220051	**NS2446**	**North Ayrshire**	**SA**	**120**	**2007**	**2**	**N**	**Y**	**N**
220059	**NS3046**	**North Ayrshire**	**SA**	**29**	**2009**	**9**	**N**	**Y**	**Y**
220068	**NS4023**	**North Ayrshire**	**SA**	**45**	**2007**	**3**	**N**	**Y**	**Y**
220102	**NS3242**	**North Ayrshire**	**SA**	**12**	**2012**	**8**	**Y**	**Y**	**N**
220042	**NS7651**	**North Lanarkshire**	**SA**	**103**	**2005**	**2**	**N**	**N**	**N**
220038	**NS4964**	**Renfrewshire**	**SA**	**11**	**2012**	**14**	**Y**	**Y**	**N**

Site code	Grid ref	County	SNH area	Approx. elevation (m)	Last year	No. of years	Species recorded: Common pipistrelle	Soprano pipistrelle	Noctule
220061	**NS3170**	**Renfrewshire**	**SA**	**148**	**2004**	**5**	**N**	**Y**	**N**
220115	**NS3869**	**Renfrewshire**	**SA**	**103**	**2011**	**3**	**N**	**Y**	**N**
220105	**NS6552**	**South Lanarkshire**	**SA**	**210**	**2012**	**7**	**Y**	**Y**	**Y**
220040	NS5335	East Ayrshire	SA	219	1999	1	Y	N	N
220065	NS0135	North Ayrshire	SA	88	1999	1	Y	N	Y
220036	NS7058	North Lanarkshire	SA	38	1999	1	N	N	N
220055	NR9835	South Lanarkshire	SA	376	1999	1	N	N	N
220007	**NH1690**	**Highland**	**SH/NINH**	**0**	**2007**	**4**	**Y**	**Y**	**N**
220010	**NH5132**	**Highland**	**SH/NINH**	**293**	**2006**	**2**	**N**	**N**	**N**
220016	**ND1529**	**Highland**	**SH/NINH**	**119**	**2012**	**6**	**Y**	**N**	**N**
220023	**NM4788**	**Highland**	**SH/NINH**	**12**	**2006**	**4**	**Y**	**N**	**N**
220024	**NC0625**	**Highland**	**SH/NINH**	**40**	**2005**	**2**	**Y**	**N**	**N**
220025	**NH5049**	**Highland**	**SH/NINH**	**210**	**2004**	**2**	**Y**	**Y**	**N**
220052	**NH6740**	**Highland**	**SH/NINH**	**187**	**2003**	**5**	**Y**	**Y**	**N**
220053	**NH6534**	**Highland**	**SH/NINH**	**269**	**2006**	**4**	**Y**	**Y**	**N**
220058	**NM7462**	**Highland**	**SH/NINH**	**0**	**2005**	**6**	**N**	**Y**	**N**
220060	**NH6845**	**Highland**	**SH/NINH**	**30**	**2010**	**6**	**Y**	**Y**	**N**
220072	**ND3461**	**Highland**	**SH/NINH**	**19**	**2006**	**3**	**N**	**N**	**N**
220078	**NC0426**	**Highland**	**SH/NINH**	**0**	**2011**	**9**	**Y**	**N**	**N**
220080	**NH5945**	**Highland**	**SH/NINH**	**72**	**2004**	**3**	**Y**	**Y**	**N**
220083	**NH6966**	**Highland**	**SH/NINH**	**54**	**2002**	**2**	**Y**	**N**	**N**
220084	**NH7246**	**Highland**	**SH/NINH**	**44**	**2010**	**3**	**Y**	**Y**	**N**
220087	**NH0158**	**Highland**	**SH/NINH**	**146**	**2009**	**2**	**Y**	**N**	**N**
220088	**NN0560**	**Highland**	**SH/NINH**	**0**	**2005**	**2**	**Y**	**Y**	**N**
220089	**NC1639**	**Highland**	**SH/NINH**	**9**	**2004**	**3**	**Y**	**N**	**N**
220093	**NM9854**	**Highland**	**SH/NINH**	**50**	**2005**	**2**	**Y**	**Y**	**N**
220100	**NM8061**	**Highland**	**SH/NINH**	**0**	**2006**	**4**	**Y**	**N**	**N**
220109	**NC4602**	**Highland**	**SH/NINH**	**146**	**2009**	**3**	**Y**	**Y**	**N**
220110	**NH4542**	**Highland**	**SH/NINH**	**229**	**2008**	**2**	**Y**	**N**	**N**
220116	**NN1669**	**Highland**	**SH/NINH**	**209**	**2012**	**4**	**Y**	**N**	**N**
220117	**NC2058**	**Highland**	**SH/NINH**	**1**	**2012**	**4**	**N**	**N**	**N**
220118	**NC2232**	**Highland**	**SH/NINH**	**107**	**2012**	**3**	**N**	**N**	**N**
220123	**NH5044**	**Highland**	**SH/NINH**	**20**	**2012**	**2**	**Y**	**Y**	**N**
220099	**ND4290**	**Orkney Islands**	**SH/NINH**	**0**	**2006**	**4**	**N**	**N**	**N**
220004	NH7545	Highland	SH/NINH	148	1998	1	N	Y	N
220013	ND0965	Highland	SH/NINH	64	1998	1	N	N	N
220014	ND2546	Highland	SH/NINH	94	1998	1	N	N	N
220015	ND1848	Highland	SH/NINH	99	1998	1	N	N	N
220017	ND3854	Highland	SH/NINH	31	1998	1	N	N	N
220021	NH6237	Highland	SH/NINH	118	1998	1	Y	N	N
220044	NC8003	Highland	SH/NINH	251	1999	1	N	N	N
220045	NC8300	Highland	SH/NINH	6	1999	1	Y	N	N
220046	NC8702	Highland	SH/NINH	65	1999	1	Y	N	N
220047	NC8501	Highland	SH/NINH	36	1999	1	Y	N	N
220048	NC7009	Highland	SH/NINH	242	1999	1	N	N	N
220049	NC7805	Highland	SH/NINH	242	1999	1	N	Y	N
220054	NH6137	Highland	SH/NINH	65	1999	1	N	Y	N
220069	ND3039	Highland	SH/NINH	84	1999	1	N	N	N
220070	ND3445	Highland	SH/NINH	76	1999	1	N	N	N
220071	ND3453	Highland	SH/NINH	18	1999	1	N	N	N
220073	ND2556	Highland	SH/NINH	30	1999	1	Y	N	N
220075	NC0329	Highland	SH/NINH	90	1999	1	N	Y	N

Site code	Grid ref	County	SNH area	Approx. elevation (m)	Last year	No. of years	Species recorded: Common pipistrelle	Soprano pipistrelle	Noctule
220076	NC1032	Highland	SH/NINH	49	1999	1	Y	N	N
220077	NC0712	Highland	SH/NINH	108	1999	1	N	N	N
220079	NC0819	Highland	SH/NINH	71	1999	1	N	Y	N
220090	NC9863	Highland	SH/NINH	98	2000	1	N	N	N
220091	NM9954	Highland	SH/NINH	129	2000	1	N	Y	N
220092	ND3572	Highland	SH/NINH	42	2000	1	N	N	N
220095	NJ0512	Highland	SH/NINH	627	2002	1	Y	N	N
220107	NG8175	Highland	SH/NINH	0	2007	1	Y	Y	N
220108	NG7679	Highland	SH/NINH	18	2007	1	N	N	N
220113	NH4366	Highland	SH/NINH	449	2009	1	N	N	N
220006	**NX9072**	**Dumfries and Galloway**	**SS**	**118**	**2009**	**5**	**Y**	**Y**	**Y**
220035	**NY1279**	**Dumfries and Galloway**	**SS**	**48**	**2012**	**9**	**Y**	**Y**	**Y**
220057	**NX8866**	**Dumfries and Galloway**	**SS**	**97**	**2009**	**6**	**Y**	**Y**	**Y**
220029	**NT2346**	**Scottish Borders**	**SS**	**273**	**2010**	**5**	**Y**	**Y**	**N**
220081	**NT1547**	**Scottish Borders**	**SS**	**244**	**2002**	**2**	**N**	**Y**	**N**
220097	**NT6926**	**Scottish Borders**	**SS**	**65**	**2007**	**2**	**Y**	**N**	**N**
220005	NY0878	Dumfries and Galloway	SS	106	1998	1	Y	Y	Y
220106	NX4264	Dumfries and Galloway	SS	2	2006	1	Y	N	N
220012	NT1343	Scottish Borders	SS	310	1998	1	Y	Y	N
220085	NT2551	Scottish Borders	SS	287	2000	1	Y	Y	N
220119	NT4728	Scottish Borders	SS	178	2009	1	Y	Y	N
220028	**NK0732**	**Aberdeenshire**	**TG**	**35**	**2008**	**3**	**N**	**N**	**N**
220033	**NO3997**	**Aberdeenshire**	**TG**	**189**	**2000**	**2**	**Y**	**N**	**N**
220096	**NO3835**	**Angus**	**TG**	**94**	**2012**	**10**	**Y**	**Y**	**N**
220030	**NO0717**	**Perth and Kinross**	**TG**	**85**	**2011**	**6**	**Y**	**Y**	**N**
220111	**NN9734**	**Perth and Kinross**	**TG**	**475**	**2009**	**2**	**Y**	**N**	**N**
220003	NO3495	Aberdeenshire	TG	250	2011	1	Y	N	N
220062	NJ9721	Aberdeenshire	TG	53	1999	1	N	N	N
220124	NO3194	Aberdeenshire	TG	352	2012	1	N	Y	N
220126	NJ4407	Aberdeenshire	TG	278	2012	1	Y	Y	N
220130	NJ7923	Aberdeenshire	TG	119	2012	1	N	N	N
220132	NO7296	Aberdeenshire	TG	46	2012	1	Y	Y	N
220128	NO3333	Angus	TG	90	2012	1	Y	Y	N
220129	NO3730	Angus	TG	45	2012	1	Y	N	N
220127	NO3829	Dundee City	TG	0	2012	1	Y	N	N
220121	NJ1762	Moray	TG	23	2010	1	Y	Y	N
220125	NJ2764	Moray	TG	33	2012	1	Y	Y	N
220112	NO0036	Perth and Kinross	TG	319	2008	1	Y	Y	N
220114	NO0132	Perth and Kinross	TG	193	2009	1	Y	N	N

Waterway Survey

(Sites surveyed within the correct survey period and in more than one year contribute to trend analysis and are shown in bold).

Site code	Grid ref	County	SNH area	Approx. elevation (m)	Last year	No. of years	Daubenton's bat recorded
210493	NM8620	Argyll and Bute	AOH	83	1998	1	Y
210510	NN2129	Argyll and Bute	AOH	56	1998	1	Y
210522	NR8486	Argyll and Bute	AOH	121	1998	1	N
210537	NR8493	Argyll and Bute	AOH	7	1998	1	Y
210668	NN0132	Argyll and Bute	AOH	2	2011	1	Y
210585	**NS9597**	**Clackmannanshire**	**Forth**	**21**	**2012**	**14**	**Y**
210629	**NT4669**	**East Lothian**	**Forth**	**70**	**2008**	**6**	**Y**
210665	**NT5368**	**East Lothian**	**Forth**	**98**	**2011**	**2**	**Y**
210179	**NT1071**	**Edinburgh**	**Forth**	**75**	**2007**	**3**	**Y**
210180	**NT3471**	**Edinburgh**	**Forth**	**11**	**2007**	**5**	**Y**
210193	**NT2372**	**Edinburgh**	**Forth**	**70**	**2009**	**5**	**Y**
210262	**NT2475**	**Edinburgh**	**Forth**	**13**	**2010**	**5**	**Y**
210541	**NT1471**	**Edinburgh**	**Forth**	**72**	**2012**	**5**	**Y**
210628	**NS8978**	**Falkirk**	**Forth**	**80**	**2006**	**4**	**Y**
210199	**NO2301**	**Fife**	**Forth**	**115**	**2008**	**2**	**Y**
210404	**NT1485**	**Fife**	**Forth**	**29**	**2012**	**3**	**N**
210536	**NO3713**	**Fife**	**Forth**	**18**	**2011**	**8**	**Y**
210566	**NO4217**	**Fife**	**Forth**	**1**	**2009**	**8**	**Y**
210588	**NO2303**	**Fife**	**Forth**	**160**	**2007**	**2**	**N**
210590	**NO4702**	**Fife**	**Forth**	**14**	**2011**	**6**	**Y**
210597	**NO2310**	**Fife**	**Forth**	**47**	**2012**	**5**	**Y**
210656	**NO3209**	**Fife**	**Forth**	**31**	**2008**	**2**	**Y**
210660	**NO3612**	**Fife**	**Forth**	**41**	**2012**	**3**	**Y**
210611	**NS5396**	**Stirling**	**Forth**	**18**	**2007**	**5**	**Y**
210612	**NS7399**	**Stirling**	**Forth**	**12**	**2008**	**4**	**Y**
210202	**NS9776**	**West Lothian**	**Forth**	**37**	**2012**	**6**	**Y**
210377	**NT0476**	**West Lothian**	**Forth**	**74**	**2008**	**5**	**Y**
210571	**NS9577**	**West Lothian**	**Forth**	**70**	**2011**	**7**	**Y**
210640	**NT0969**	**West Lothian**	**Forth**	**76**	**2012**	**10**	**Y**
210671	NS8896	Clackmannanshire	Forth	10	2011	1	N
210177	NT2763	Edinburgh	Forth	95	1997	1	Y
210205	NT3471	Edinburgh	Forth	12	1997	1	Y
210194	NT1373	Falkirk	Forth	30	1997	1	Y
210260	NS4466	Falkirk	Forth	3	1997	1	Y
210322	NT0684	Fife	Forth	28	1998	1	N
210666	NO3411	Fife	Forth	35	2010	1	Y
210201	NS9675	West Lothian	Forth	59	1997	1	N
210573	NT0874	West Lothian	Forth	83	1999	1	N
210593	NS9470	West Lothian	Forth	121	1999	1	N
210676	NT0779	West Lothian	Forth	3	2012	1	Y
210247	**NS5220**	**East Ayrshire**	**SA**	**87**	**2010**	**4**	**Y**
210248	**NS4524**	**East Ayrshire**	**SA**	**42**	**2010**	**4**	**Y**
210206	**NS6859**	**Glasgow**	**SA**	**36**	**2005**	**2**	**Y**
210639	**NS5859**	**Glasgow**	**SA**	**53**	**2012**	**8**	**Y**
210641	**NS5561**	**Glasgow**	**SA**	**14**	**2012**	**8**	**Y**
210643	**NS5673**	**Glasgow**	**SA**	**35**	**2012**	**9**	**Y**
210659	**NS5766**	**Glasgow**	**SA**	**14**	**2011**	**2**	**Y**
210362	**NS3070**	**Inverclyde**	**SA**	**142**	**2010**	**13**	**Y**
210644	**NS3242**	**North Ayrshire**	**SA**	**8**	**2012**	**8**	**Y**

Site code	Grid ref	County	SNH area	Approx. elevation (m)	Last year	No. of years	Daubenton's bat recorded
210196	**NS3960**	**Renfrewshire**	**SA**	**26**	**2012**	**11**	**Y**
210203	**NS4863**	**Renfrewshire**	**SA**	**2**	**2012**	**5**	**Y**
210442	**NS3156**	**Renfrewshire**	**SA**	**90**	**2008**	**11**	**Y**
210661	**NS4466**	**Renfrewshire**	**SA**	**2**	**2010**	**2**	**Y**
210381	**NS7276**	**South Lanarkshire**	**SA**	**48**	**2004**	**2**	**Y**
210591	**NS6549**	**South Lanarkshire**	**SA**	**230**	**2004**	**2**	**N**
210645	**NS7353**	**South Lanarkshire**	**SA**	**41**	**2012**	**5**	**Y**
210646	**NS6552**	**South Lanarkshire**	**SA**	**192**	**2011**	**7**	**Y**
210509	**NS4587**	**West Dunbartonshire**	**SA**	**20**	**1999**	**2**	**Y**
210603	**NS2789**	**West Dunbartonshire**	**SA**	**127**	**2006**	**2**	**Y**
210638	**NS3980**	**West Dunbartonshire**	**SA**	**10**	**2008**	**3**	**Y**
210249	NS4737	East Ayrshire	SA	36	1997	1	Y
210581	NS8532	East Ayrshire	SA	184	1999	1	Y
210582	NS9123	East Ayrshire	SA	239	1999	1	N
210583	NS6829	East Ayrshire	SA	243	1999	1	Y
210584	NS9730	East Ayrshire	SA	208	1999	1	Y
210655	NS5263	Glasgow	SA	16	2006	1	Y
210673	NS5667	Glasgow	SA	16	2011	1	N
210578	NS2570	Inverclyde	SA	197	1999	1	Y
210523	NS3247	North Ayrshire	SA	67	1998	1	N
210572	NR9132	North Ayrshire	SA	22	1999	1	N
210586	NS7965	North Lanarkshire	SA	186	1999	1	Y
210258	NS7654	South Lanarkshire	SA	27	1997	1	Y
210626	NS9041	South Lanarkshire	SA	185	2000	1	Y
210551	NS3977	West Dunbartonshire	SA	0	1998	1	Y
210604	NS3685	West Dunbartonshire	SA	4	1999	1	Y
210182	**NC2521**	**Highland**	**SH/NINH**	**82**	**2007**	**6**	**Y**
210184	**NC1524**	**Highland**	**SH/NINH**	**64**	**2005**	**4**	**Y**
210185	**NC1023**	**Highland**	**SH/NINH**	**29**	**2004**	**3**	**Y**
210204	**NH6442**	**Highland**	**SH/NINH**	**15**	**2012**	**3**	**Y**
210335	**NM7968**	**Highland**	**SH/NINH**	**5**	**2005**	**7**	**Y**
210416	**NH5468**	**Highland**	**SH/NINH**	**201**	**2004**	**4**	**Y**
210454	**ND0543**	**Highland**	**SH/NINH**	**123**	**2005**	**2**	**N**
210462	**NH6543**	**Highland**	**SH/NINH**	**17**	**2011**	**8**	**Y**
210533	**NH1294**	**Highland**	**SH/NINH**	**25**	**2008**	**4**	**Y**
210574	**NH5253**	**Highland**	**SH/NINH**	**10**	**2010**	**10**	**Y**
210579	**NH8234**	**Highland**	**SH/NINH**	**255**	**2004**	**4**	**Y**
210587	**ND1833**	**Highland**	**SH/NINH**	**39**	**2007**	**2**	**N**
210589	**NM8363**	**Highland**	**SH/NINH**	**14**	**2000**	**2**	**N**
210595	**NH8855**	**Highland**	**SH/NINH**	**7**	**2010**	**5**	**Y**
210600	**ND2861**	**Highland**	**SH/NINH**	**9**	**2007**	**2**	**N**
210602	**NG6709**	**Highland**	**SH/NINH**	**19**	**2000**	**2**	**N**
210605	**NH1883**	**Highland**	**SH/NINH**	**10**	**2012**	**7**	**Y**
210610	**NC2546**	**Highland**	**SH/NINH**	**23**	**2004**	**3**	**Y**
210615	**ND0630**	**Highland**	**SH/NINH**	**170**	**2011**	**8**	**Y**
210616	**NH6643**	**Highland**	**SH/NINH**	**2**	**2012**	**10**	**Y**
210617	**NG6121**	**Highland**	**SH/NINH**	**22**	**2003**	**3**	**N**
210621	**NH7544**	**Highland**	**SH/NINH**	**102**	**2007**	**2**	**Y**
210627	**NH6240**	**Highland**	**SH/NINH**	**16**	**2012**	**5**	**Y**
210630	**NH7393**	**Highland**	**SH/NINH**	**83**	**2005**	**2**	**Y**
210631	**NM8162**	**Highland**	**SH/NINH**	**8**	**2005**	**4**	**Y**
210633	**NH5645**	**Highland**	**SH/NINH**	**3**	**2005**	**2**	**Y**
210649	**NH5244**	**Highland**	**SH/NINH**	**4**	**2012**	**8**	**Y**

Site code	Grid ref	County	SNH area	Approx. elevation (m)	Last year	No. of years	Daubenton's bat recorded
210653	**NH9417**	**Highland**	**SH/NINH**	**199**	**2007**	**2**	**Y**
210669	**NH4458**	**Highland**	**SH/NINH**	**55**	**2012**	**2**	**Y**
210183	NC1530	Highland	SH/NINH	76	1997	1	N
210186	NC0819	Highland	SH/NINH	48	1997	1	N
210191	NH3816	Highland	SH/NINH	59	1997	1	Y
210207	NH7298	Highland	SH/NINH	78	1997	1	Y
210209	NC0716	Highland	SH/NINH	30	1997	1	N
210259	NH8753	Highland	SH/NINH	17	1997	1	Y
210350	NH5012	Highland	SH/NINH	273	1998	1	Y
210452	ND3252	Highland	SH/NINH	2	1998	1	N
210453	ND1747	Highland	SH/NINH	79	1998	1	N
210456	ND3248	Highland	SH/NINH	35	1998	1	N
210459	NH5324	Highland	SH/NINH	118	1998	1	N
210461	NM9427	Highland	SH/NINH	83	1998	1	N
210570	NC0923	Highland	SH/NINH	25	1998	1	N
210580	NH7736	Highland	SH/NINH	297	1999	1	N
210592	NH6777	Highland	SH/NINH	167	1999	1	Y
210594	NH4519	Highland	SH/NINH	33	1999	1	Y
210598	ND2555	Highland	SH/NINH	16	1999	1	Y
210599	ND3767	Highland	SH/NINH	9	1999	1	N
210601	ND2544	Highland	SH/NINH	102	1999	1	N
210613	NM7371	Highland	SH/NINH	7	2000	1	N
210618	NH3339	Highland	SH/NINH	100	2000	1	Y
210632	NM8364	Highland	SH/NINH	27	2002	1	Y
210657	NC4401	Highland	SH/NINH	6	2007	1	N
210658	ND1460	Highland	SH/NINH	23	2007	1	N
210208	**NY1078**	**Dumfries and Galloway**	**SS**	**41**	**2012**	**6**	**Y**
210410	**NX8757**	**Dumfries and Galloway**	**SS**	**33**	**2000**	**2**	**N**
210480	**NY0271**	**Dumfries and Galloway**	**SS**	**4**	**2000**	**2**	**Y**
210648	**NT0805**	**Dumfries and Galloway**	**SS**	**107**	**2009**	**4**	**Y**
210178	**NT3650**	**Scottish Borders**	**SS**	**308**	**2009**	**2**	**N**
210181	**NT2443**	**Scottish Borders**	**SS**	**177**	**2009**	**2**	**Y**
210577	**NT1840**	**Scottish Borders**	**SS**	**199**	**2009**	**7**	**Y**
210614	**NT1938**	**Scottish Borders**	**SS**	**173**	**2009**	**3**	**Y**
210620	**NT4836**	**Scottish Borders**	**SS**	**120**	**2010**	**2**	**Y**
210622	**NT3133**	**Scottish Borders**	**SS**	**187**	**2007**	**2**	**Y**
210623	**NT3336**	**Scottish Borders**	**SS**	**139**	**2012**	**8**	**Y**
210624	**NT1543**	**Scottish Borders**	**SS**	**192**	**2009**	**2**	**Y**
210625	**NT5832**	**Scottish Borders**	**SS**	**66**	**2008**	**8**	**Y**
210637	**NT6323**	**Scottish Borders**	**SS**	**57**	**2007**	**2**	**Y**
210651	**NT4229**	**Scottish Borders**	**SS**	**146**	**2012**	**6**	**Y**
210652	**NT4328**	**Scottish Borders**	**SS**	**145**	**2011**	**6**	**Y**
210257	NY0566	Dumfries and Galloway	SS	1	1997	1	Y
210477	NX5957	Dumfries and Galloway	SS	3	1998	1	Y
210552	NY0585	Dumfries and Galloway	SS	60	1998	1	Y
210609	NT4832	Scottish Borders	SS	97	2000	1	Y
210654	**NJ9002**	**Aberdeen City**	**TG**	**4**	**2012**	**6**	**Y**
210395	**NJ9033**	**Aberdeenshire**	**TG**	**29**	**2009**	**2**	**Y**
210473	**NO3289**	**Aberdeenshire**	**TG**	**350**	**2012**	**7**	**Y**
210567	**NJ9846**	**Aberdeenshire**	**TG**	**31**	**2003**	**2**	**Y**
210568	**NJ9340**	**Aberdeenshire**	**TG**	**66**	**2010**	**4**	**Y**
210569	**NK1048**	**Aberdeenshire**	**TG**	**8**	**2003**	**2**	**Y**
210635	**NO7396**	**Aberdeenshire**	**TG**	**40**	**2012**	**4**	**Y**

Site code	Grid ref	County	SNH area	Approx. elevation (m)	Last year	No. of years	Daubenton's bat recorded
210650	**NO2494**	**Aberdeenshire**	**TG**	**278**	**2012**	**7**	**Y**
210667	**NJ9209**	**Aberdeenshire**	**TG**	**8**	**2012**	**3**	**Y**
210636	**NO3934**	**Angus**	**TG**	**65**	**2012**	**10**	**Y**
210187	**NO4532**	**Dundee City**	**TG**	**25**	**2011**	**2**	**N**
210197	**NO3853**	**Dundee City**	**TG**	**128**	**2011**	**2**	**N**
210606	**NO4034**	**Dundee City**	**TG**	**59**	**2005**	**2**	**Y**
210647	**NJ2266**	**Moray**	**TG**	**3**	**2010**	**2**	**Y**
210190	**NO0042**	**Perth and Kinross**	**TG**	**47**	**2012**	**6**	**Y**
210439	**NO0101**	**Perth and Kinross**	**TG**	**158**	**2012**	**8**	**Y**
210619	**NO2038**	**Perth and Kinross**	**TG**	**51**	**2011**	**8**	**Y**
210642	**NN9457**	**Perth and Kinross**	**TG**	**76**	**2012**	**7**	**Y**
210677	**NN7803**	**Perth and Kinross**	**TG**	**81**	**2012**	**3**	**Y**
210188	NO7677	Aberdeenshire	TG	59	1997	1	N
210192	NJ7523	Aberdeenshire	TG	56	1997	1	Y
210198	NJ7424	Aberdeenshire	TG	60	1997	1	Y
210200	NO4798	Aberdeenshire	TG	146	1997	1	Y
210575	NJ2900	Aberdeenshire	TG	333	1999	1	N
210576	NO3997	Aberdeenshire	TG	189	1999	1	Y
210596	NJ8339	Aberdeenshire	TG	25	1999	1	Y
210607	NJ7509	Aberdeenshire	TG	93	1999	1	Y
210608	NJ7812	Aberdeenshire	TG	77	1999	1	N
210670	NO9099	Aberdeenshire	TG	110	2011	1	N
210634	NO5348	Angus	TG	79	2002	1	Y
210675	NO4332	Dundee City	TG	36	2012	1	Y
210672	NJ0326	Moray	TG	189	2011	1	Y
210662	NN5808	Perth and Kinross	TG	125	2010	1	N
210663	NN6008	Perth and Kinross	TG	101	2010	1	N
210664	NN6107	Perth and Kinross	TG	69	2010	1	Y
210674	NO0342	Perth and Kinross	TG	61	2011	1	Y

Hibernation Survey

(**Y** in bold indicates site contributes to trend analysis for the species –surveyed in more than one year, survey dates are between 1st December and 31st March, and species present in at least one year).

							Species recorded:			
Site code	Grid ref	County	SNH Area	Approx. elevation (m)	Last year	No of years	Daubenton's bat	Natterer's bat	Whiskered/Brandt's bat	Brown long-eared bat
20008	NR89	Argyll and Bute	AOH	40	2011	8	**Y**	**Y**	N	**Y**
20014	NR87	Argyll and Bute	AOH	109	2011	7	**Y**	**Y**	N	N
20009	NR88	Argyll and Bute	AOH	150	2011	9	**Y**	N	N	**Y**
20016	NR88	Argyll and Bute	AOH	150	2011	7	N	N	N	**Y**
20015	NR89	Argyll and Bute	AOH	40	2011	6	N	N	N	N
20017	NR88	Argyll and Bute	AOH	63	2009	4	N	N	N	N
20018	NR87	Argyll and Bute	AOH	199	2009	5	N	N	N	N
20003	NT46	Midlothian	Forth	207	2012	21	**Y**	**Y**	**Y**	**Y**
20022	NO30	Fife	Forth	172	2012	7	**Y**	**Y**	N	**Y**
20023	NO30	Fife	Forth	146	2012	7	**Y**	**Y**	N	**Y**
20024	NO41	Fife	Forth	116	2012	6	**Y**	**Y**	N	**Y**
20027	NO27	Fife	Forth	574	2009	2	**Y**	**Y**	N	**Y**
20029	NT35	Midlothian	Forth	269	2010	3	**Y**	**Y**	N	**Y**
20001	NS95	West Lothian	Forth	320	2006	15	**Y**	**Y**	N	**Y**
20002	NT07	West Lothian	Forth	203	2012	20	**Y**	**Y**	N	**Y**
20025	NO41	Fife	Forth	104	2007	1	Y	N	N	N
20035	NT46	Midlothian	Forth	219	2009	1	Y	N	N	N
20030	NT36	Midlothian	Forth	174	2008	1	N	N	N	Y
20036	NT57	East Lothian	Forth	32	2012	5	N	N	N	N
20007	NS61	East Ayrshire	SA	350	1999	2	**Y**	**Y**	N	**Y**
20013	NS61	East Ayrshire	SA	187	2000	1	Y	Y	N	Y
20033	NS76	East Ayrshire	SA	60	2009	1	Y	Y	N	Y
20005	NS53	East Ayrshire	SA	98	2000	2	**Y**	N	N	**Y**
20019	NS36	Renfrewshire	SA	39	2012	8	**Y**	N	N	N
20004	NS43	East Ayrshire	SA	75	1998	1	N	N	N	N
20006	NS51	East Ayrshire	SA	230	1998	1	N	N	N	N
20020	NH59	Highland	SH/NINH	20	2012	8	**Y**	N	N	N
20021	NH89	Highland	SH/NINH	3	2012	8	N	N	N	**Y**
20026	NH77	Highland	SH/NINH	96	2008	1	N	N	N	Y

							Species recorded:			
Site code	Grid ref	County	SNH Area	Approx. elevation (m)	Last year	No of years	Daubenton's bat	Natterer's bat	Whiskered/Brandt's bat	Brown long-eared bat
20041	NH89	Highland	SH/NINH	0	2012	1	N	N	N	N
20010	NT33	Scottish Borders	SS	251	2012	5	**Y**	**Y**	N	**Y**
20012	NT33	Scottish Borders	SS	194	2005	2	**Y**	**Y**	N	**Y**
20031	NS81	Dumfries and Galloway	SS	407	2012	5	**Y**	**Y**	N	N
20032	NS89	Dumfries and Galloway	SS	10	2012	4	**Y**	**Y**	N	N
20039	NT33	Scottish Borders	SS	210	2012	3	**Y**	**Y**	N	N
20042	NT53	Scottish Borders	SS	66	2012	2	**Y**	**Y**	N	N
20037	NT72	Scottish Borders	SS	73	2012	3	N	**Y**	N	N
20034	NT76	Scottish Borders	SS	146	2011	2	N	N	N	N
20038	NT72	Scottish Borders	SS	59	2009	1	N	N	N	N
20043	NT63	Scottish Borders	SS	44	2012	2	N	N	N	N
20044	NT54	Scottish Borders	SS	137	2012	1	N	N	N	N
20040	NJ70	Aberdeenshire	TG	95	2012	1	N	N	N	Y

Roost Count

(Sites that contribute to trend analysis for the species are those that meet the following criteria: surveyed in more than one year, survey dates are in June, and complete counts were carried out. “N/A” under “Last year” indicates that counts carried out at the roost have yet to meet the criteria for inclusion in trend analysis).

Site code	Grid ref	County	SNH area	Approx. elevation (m)	Last year	No. of years	Species	Contributes to trend
2150012	NN05	Argyll and Bute	AOH	155	2006	5	Brown long-eared bat	Y
2150014	NM94	Argyll and Bute	AOH	35	2012	10	Brown long-eared bat	Y
2150031	NS08	Argyll and Bute	AOH	26	2007	3	Brown long-eared bat	Y
2150038	NT46	East Lothian	Forth	133	2010	2	Brown long-eared bat	Y
2150022	NT36	Midlothian	Forth	128	2005	2	Brown long-eared bat	Y
2150023	NT36	Midlothian	Forth	152	2005	2	Brown long-eared bat	Y
2150008	NS58	Stirling	Forth	27	2010	9	Brown long-eared bat	Y
2150037	NN70	Stirling	Forth	46	2010	3	Brown long-eared bat	Y
2150033	NT26	Midlothian	Forth	115	N/A		Brown long-eared bat	N
2150036	NN52	Stirling	Forth	140	2007	1	Brown long-eared bat	N
2150035	NS57	Glasgow	SA	98	1999	2	Brown long-eared bat	Y
2150013	NS35	North Ayrshire	SA	49	2011	6	Brown long-eared bat	Y
2150005	NS37	Renfrewshire	SA	39	2012	12	Brown long-eared bat	Y
2120260	NS20	South Ayrshire	SA	43	2012	3	Brown long-eared bat	Y
2150006	NS93	South Lanarkshire	SA	214	2012	7	Brown long-eared bat	Y
2150004	NS47	Renfrewshire	SA	30	2002	1	Brown long-eared bat	N
2150039	NS21	South Ayrshire	SA	33	N/A		Brown long-eared bat	N
2150002	NN69	Highland	SH/NINH	269	2012	9	Brown long-eared bat	Y
2150009	NM66	Highland	SH/NINH	21	2006	5	Brown long-eared bat	Y
2150017	NG92	Highland	SH/NINH	0	2012	7	Brown long-eared bat	Y
2150018	NG82	Highland	SH/NINH	32	2009	3	Brown long-eared bat	Y
2150021	NH54	Highland	SH/NINH	26	2010	7	Brown long-eared bat	Y
2150026	NH76	Highland	SH/NINH	139	2007	4	Brown long-eared bat	Y
2150029	NH80	Highland	SH/NINH	232	2008	4	Brown long-eared bat	Y
2150032	NH79	Highland	SH/NINH	6	2012	8	Brown long-eared bat	Y
2150015	NJ01	Highland	SH/NINH	301	2002	1	Brown long-eared bat	N
2150024	NH67	Highland	SH/NINH	176	2004	1	Brown long-eared bat	N
2150025	NH78	Highland	SH/NINH	20	2004	1	Brown long-eared bat	N
2150040	NG74	Highland	SH/NINH	8	2012	1	Brown long-eared bat	N
2150041	NH36	Highland	SH/NINH	92	2012	1	Brown long-eared bat	N
2150003	NX86	Dumfries and Galloway	SS	100	2003	3	Brown long-eared bat	Y
2150028	NX89	Dumfries and Galloway	SS	93	2007	2	Brown long-eared bat	Y
2150030	NX45	Dumfries and Galloway	SS	36	2011	5	Brown long-eared bat	Y
2150001	NT14	Scottish Borders	SS	220	2002	2	Brown long-eared bat	Y
2150007	NT23	Scottish Borders	SS	177	2002	2	Brown long-eared bat	Y
2150010	NJ50	Aberdeenshire	TG	291	2002	2	Brown long-eared bat	Y
2150016	NO39	Aberdeenshire	TG	235	2012	10	Brown long-eared bat	Y
2150020	NO03	Perth and Kinross	TG	104	2010	3	Brown long-eared bat	Y
2150034	NN70	Perth and Kinross	TG	45	2001	5	Brown long-eared bat	Y
2150027	NJ63	Aberdeenshire	TG	155	2006	1	Brown long-eared bat	N
2150011	NO55	Angus	TG	52	2002	1	Brown long-eared bat	N
2150042	NN55	Perth and Kinross	TG	207	N/A		Brown long-eared bat	N
2120029	NS53	Argyll and Bute	AOH	62	1999	3	Common pipistrelle	Y
2120147	NM42	Argyll and Bute	AOH	44	2004	7	Common pipistrelle	Y
2120170	NR26	Argyll and Bute	AOH	20	2010	4	Common pipistrelle	Y
2120188	NM73	Argyll and Bute	AOH	34	2012	13	Common pipistrelle	Y
2120233	NM91	Argyll and Bute	AOH	46	2012	4	Common pipistrelle	Y

Site code	Grid ref	County	SNH area	Approx. elevation (m)	Last year	No. of years	Species	Contributes to trend
2120110	NB43	Na H-Eileanan An Iar	AOH	9	2008	5	Common pipistrelle	Y
2120138	NS97	Falkirk	Forth	112	2010	6	Common pipistrelle	Y
2120230	NN70	Falkirk	Forth	46	2010	3	Common pipistrelle	Y
2120157	NO50	Fife	Forth	10	2008	3	Common pipistrelle	Y
2120046	NS58	Stirling	Forth	81	2012	15	Common pipistrelle	Y
2120172	NS59	Stirling	Forth	50	2012	9	Common pipistrelle	Y
2120137	NS88	Falkirk	Forth	24	2002	1	Common pipistrelle	N
2120244	NT36	Midlothian	Forth	174	2010	1	Common pipistrelle	N
2120030	NS76	North Lanarkshire	SA	119	1998	2	Common pipistrelle	Y
2120133	NS21	South Ayrshire	SA	33	2010	11	Common pipistrelle	Y
2120255	NS21	South Ayrshire	SA	33	2012	2	Common pipistrelle	Y
2120074	NS75	South Lanarkshire	SA	90	2008	5	Common pipistrelle	Y
2120264	NS43	East Ayrshire	SA	48	2012	1	Common pipistrelle	N
2120014	NH54	Highland	SH/NINH	71	2003	5	Common pipistrelle	Y
2120018	NH70	Highland	SH/NINH	240	2012	13	Common pipistrelle	Y
2120041	NM86	Highland	SH/NINH	26	2011	13	Common pipistrelle	Y
2120052	NM48	Highland	SH/NINH	44	2012	15	Common pipistrelle	Y
2120056	NH52	Highland	SH/NINH	25	2012	15	Common pipistrelle	Y
2120063	NH70	Highland	SH/NINH	240	2012	13	Common pipistrelle	Y
2120066	ND13	Highland	SH/NINH	50	2011	12	Common pipistrelle	Y
2120087	NM76	Highland	SH/NINH	20	2010	8	Common pipistrelle	Y
2120089	ND12	Highland	SH/NINH	48	2012	12	Common pipistrelle	Y
2120091	NM86	Highland	SH/NINH	15	2006	7	Common pipistrelle	Y
2120094	NM86	Highland	SH/NINH	28	2002	3	Common pipistrelle	Y
2120098	NH33	Highland	SH/NINH	107	2002	2	Common pipistrelle	Y
2120109	NH06	Highland	SH/NINH	80	2012	13	Common pipistrelle	Y
2120115	NN05	Highland	SH/NINH	155	2006	5	Common pipistrelle	Y
2120118	NH14	Highland	SH/NINH	327	2009	9	Common pipistrelle	Y
2120128	NN69	Highland	SH/NINH	258	2012	10	Common pipistrelle	Y
2120130	NN69	Highland	SH/NINH	265	2012	10	Common pipistrelle	Y
2120139	NH65	Highland	SH/NINH	63	2006	3	Common pipistrelle	Y
2120140	NM76	Highland	SH/NINH	20	2008	4	Common pipistrelle	Y
2120145	NH78	Highland	SH/NINH	33	2011	10	Common pipistrelle	Y
2120159	NC13	Highland	SH/NINH	27	2004	2	Common pipistrelle	Y
2120164	NH64	Highland	SH/NINH	49	2011	7	Common pipistrelle	Y
2120177	NH76	Highland	SH/NINH	6	2006	3	Common pipistrelle	Y
2120179	NC12	Highland	SH/NINH	45	2012	8	Common pipistrelle	Y
2120180	NC02	Highland	SH/NINH	38	2012	9	Common pipistrelle	Y
2120185	NM69	Highland	SH/NINH	26	2012	9	Common pipistrelle	Y
2120224	NM48	Highland	SH/NINH	207	2012	6	Common pipistrelle	Y
2120068	NH64	Highland	SH/NINH	6	1998	1	Common pipistrelle	N
2120142	NH66	Highland	SH/NINH	54	2002	1	Common pipistrelle	N
2120144	NH80	Highland	SH/NINH	257	2002	1	Common pipistrelle	N
2120205	NC13	Highland	SH/NINH	61	2006	1	Common pipistrelle	N
2120206	NC13	Highland	SH/NINH	30	2006	1	Common pipistrelle	N
2120210	NM39	Highland	SH/NINH	40	2006	1	Common pipistrelle	N
2120234	NC02	Highland	SH/NINH	38	N/A		Common pipistrelle	N
2120262	NG74	Highland	SH/NINH	8	2012	1	Common pipistrelle	N
2120265	NC02	Highland	SH/NINH	52	2012	1	Common pipistrelle	N
2120242	HY31	Orkney Islands	SH/NINH	5	2010	1	Common pipistrelle	N
2120196	NX89	Dumfries and Galloway	SS	107	2007	2	Common pipistrelle	Y
2120228	NT00	Dumfries and Galloway	SS	122	2012	3	Common pipistrelle	Y
2120229	NX86	Dumfries and Galloway	SS	100	2012	4	Common pipistrelle	Y

Site code	Grid ref	County	SNH area	Approx. elevation (m)	Last year	No. of years	Species	Contributes to trend
2120048	NT23	Scottish Borders	SS	178	2002	3	Common pipistrelle	Y
2120062	NT14	Scottish Borders	SS	221	2003	6	Common pipistrelle	Y
2120132	NT53	Scottish Borders	SS	155	2002	2	Common pipistrelle	Y
2120178	NT72	Scottish Borders	SS	112	2009	4	Common pipistrelle	Y
2120064	NX75	Dumfries and Galloway	SS	133	1998	1	Common pipistrelle	N
2120197	NT52	Scottish Borders	SS	149	2005	1	Common pipistrelle	N
2120013	NJ54	Aberdeenshire	TG	123	2004	7	Common pipistrelle	Y
2120038	NO79	Aberdeenshire	TG	80	2009	10	Common pipistrelle	Y
2120070	NO38	Aberdeenshire	TG	411	2012	12	Common pipistrelle	Y
2120190	NJ63	Aberdeenshire	TG	155	2006	2	Common pipistrelle	Y
2120176	NO56	Angus	TG	145	2012	7	Common pipistrelle	Y
2120035	NO10	Perth and Kinross	TG	115	2000	4	Common pipistrelle	Y
2120199	NN95	Perth and Kinross	TG	145	2006	2	Common pipistrelle	Y
2120219	NJ26	Moray	TG	5	2007	1	Common pipistrelle	N
2120217	NN52	Perth and Kinross	TG	146	2007	1	Common pipistrelle	N
5100021		Perth and Kinross	TG	25	N/A		Common pipistrelle	N
2090004	NM94	Argyll and Bute	AOH	35	2012	12	Natterer's bat	Y
2090001	NS48	Stirling	Forth	56	2001	5	Natterer's bat	Y
2090006	NS58	Glasgow	SA	47	2012	8	Natterer's bat	Y
2090005	NS74	South Lanarkshire	SA	200	2006	5	Natterer's bat	Y
2090002	NH83	Highland	SH/NINH	328	2010	4	Natterer's bat	Y
2090007	NJ02	Highland	SH/NINH	362	2012	4	Natterer's bat	Y
2090003	NO23	Perth and Kinross	TG	43	2012	6	Natterer's bat	Y
2120042	NM86	Argyll and Bute	AOH	16	2006	7	Pipistrelle unsure	Y
2120055	NR79	Argyll and Bute	AOH	38	1999	2	Pipistrelle unsure	Y
2120105	NR74	Argyll and Bute	AOH	27	2000	2	Pipistrelle unsure	Y
2120031	NM32	Argyll and Bute	AOH	9	1997	1	Pipistrelle unsure	N
2120032	NM32	Argyll and Bute	AOH	9	1997	1	Pipistrelle unsure	N
2120218	NM91	Argyll and Bute	AOH	46	N/A		Pipistrelle unsure	N
2120235	NS89	Clackmannanshire	Forth	30	2012	4	Pipistrelle unsure	Y
2120214	NT57	East Lothian	Forth	23	2004	7	Pipistrelle unsure	Y
2120231	NT77	East Lothian	Forth	208	2008	2	Pipistrelle unsure	Y
2120053	NT29	Fife	Forth	32	1999	3	Pipistrelle unsure	Y
2120167	NS39	Stirling	Forth	12	2006	4	Pipistrelle unsure	Y
2120020	NT47	East Lothian	Forth	90	1997	1	Pipistrelle unsure	N
2120022	NT57	East Lothian	Forth	127	1997	1	Pipistrelle unsure	N
2120023	NT57	East Lothian	Forth	131	1997	1	Pipistrelle unsure	N
2120208	NT27	Edinburgh	Forth	17	2006	1	Pipistrelle unsure	N
2120065	NT09	Fife	Forth	122	N/A		Pipistrelle unsure	N
2120241	NO41	Fife	Forth	19	2009	1	Pipistrelle unsure	N
2120213	NT26	Midlothian	Forth	115	N/A		Pipistrelle unsure	N
2120002	NN60	Stirling	Forth	66	1997	1	Pipistrelle unsure	N
2120085	NR92	North Ayrshire	SA	144	2001	3	Pipistrelle unsure	Y
2120257	NS21	South Ayrshire	SA	13	2012	2	Pipistrelle unsure	Y
2120258	NS21	South Ayrshire	SA	35	2012	2	Pipistrelle unsure	Y
2120125	NS66	Glasgow	SA	20	N/A		Pipistrelle unsure	N
2120148	NS45	Glasgow	SA	156	2001	1	Pipistrelle unsure	N
2120222	NS58	Glasgow	SA	77	2007	1	Pipistrelle unsure	N
2120106	NR95	North Ayrshire	SA	41	N/A		Pipistrelle unsure	N
2120073	NS75	North Lanarkshire	SA	72	1999	1	Pipistrelle unsure	N
2120075	NS75	North Lanarkshire	SA	125	1999	1	Pipistrelle unsure	N
2120076	NS75	North Lanarkshire	SA	50	1999	1	Pipistrelle unsure	N
2120099	NS75	North Lanarkshire	SA	63	1999	1	Pipistrelle unsure	N

Site code	Grid ref	County	SNH area	Approx. elevation (m)	Last year	No. of years	Species	Contributes to trend
2120221	NS75	North Lanarkshire	SA	51	2007	1	Pipistrelle unsure	N
2120248	NS35	Renfrewshire	SA	45	2011	1	Pipistrelle unsure	N
2120251	NS21	South Ayrshire	SA	59	2010	1	Pipistrelle unsure	N
2120252	NS21	South Ayrshire	SA	84	2012	1	Pipistrelle unsure	N
2120256	NS20	South Ayrshire	SA	18	2010	1	Pipistrelle unsure	N
2120261	NS20	South Ayrshire	SA	43	2010	1	Pipistrelle unsure	N
2120239	NS75	South Lanarkshire	SA	119	2009	1	Pipistrelle unsure	N
2120240	NS93	South Lanarkshire	SA	231	2009	1	Pipistrelle unsure	N
2120123	NS48	West Dunbartonshire	SA	23	2000	1	Pipistrelle unsure	N
2120015	NG60	Highland	SH/NINH	19	1999	2	Pipistrelle unsure	Y
2120016	NH65	Highland	SH/NINH	61	1998	2	Pipistrelle unsure	Y
2120019	NH74	Highland	SH/NINH	110	1999	3	Pipistrelle unsure	Y
2120067	NH66	Highland	SH/NINH	55	2000	3	Pipistrelle unsure	Y
2120092	NM66	Highland	SH/NINH	16	2000	2	Pipistrelle unsure	Y
2120100	NM66	Highland	SH/NINH	98	2006	6	Pipistrelle unsure	Y
2120101	NC51	Highland	SH/NINH	131	2012	13	Pipistrelle unsure	Y
2120116	ND06	Highland	SH/NINH	79	2002	2	Pipistrelle unsure	Y
2120121	NH63	Highland	SH/NINH	19	2002	3	Pipistrelle unsure	Y
2120201	NM64	Highland	SH/NINH	18	2008	2	Pipistrelle unsure	Y
2120202	NH81	Highland	SH/NINH	228	2007	2	Pipistrelle unsure	Y
2120236	NH95	Highland	SH/NINH	103	2011	2	Pipistrelle unsure	Y
2120040	NH77	Highland	SH/NINH	37	1998	1	Pipistrelle unsure	N
2120047	NH54	Highland	SH/NINH	20	1998	1	Pipistrelle unsure	N
2120058	NH45	Highland	SH/NINH	143	1998	1	Pipistrelle unsure	N
2120069	ND23	Highland	SH/NINH	70	N/A		Pipistrelle unsure	N
2120084	NH54	Highland	SH/NINH	99	N/A		Pipistrelle unsure	N
2120093	NG60	Highland	SH/NINH	0	1999	1	Pipistrelle unsure	N
2120113	ND37	Highland	SH/NINH	40	2000	1	Pipistrelle unsure	N
2120114	NH54	Highland	SH/NINH	162	N/A		Pipistrelle unsure	N
2120117	NN28	Highland	SH/NINH	60	2000	1	Pipistrelle unsure	N
2120119	NG20	Highland	SH/NINH	53	2000	1	Pipistrelle unsure	N
2120150	NM87	Highland	SH/NINH	11	2002	1	Pipistrelle unsure	N
2120151	NH92	Highland	SH/NINH	207	2002	1	Pipistrelle unsure	N
2120163	NH33	Highland	SH/NINH	48	2011	1	Pipistrelle unsure	N
2120243	HY31	Orkney Islands	SH/NINH	53	2010	1	Pipistrelle unsure	N
2120216	NX76	Dumfries and Galloway	SS	50	2003	7	Pipistrelle unsure	Y
2120238	NY08	Dumfries and Galloway	SS	53	2010	2	Pipistrelle unsure	Y
2120005	NY09	Dumfries and Galloway	SS	163	1997	1	Pipistrelle unsure	N
2120187	NX65	Dumfries and Galloway	SS	145	2005	1	Pipistrelle unsure	N
2120203	NX55	Dumfries and Galloway	SS	53	N/A		Pipistrelle unsure	N
2120154	NT62	Scottish Borders	SS	61	2002	1	Pipistrelle unsure	N
2120155	NT62	Scottish Borders	SS	61	2002	1	Pipistrelle unsure	N
2120169	NT43	Scottish Borders	SS	139	2003	1	Pipistrelle unsure	N
2120004	NO77	Aberdeenshire	TG	115	1999	2	Pipistrelle unsure	Y
2120057	NO49	Aberdeenshire	TG	168	2000	2	Pipistrelle unsure	Y
2120071	NJ93	Aberdeenshire	TG	46	1999	2	Pipistrelle unsure	Y
2120168	NO38	Aberdeenshire	TG	411	2012	9	Pipistrelle unsure	Y
2120103	NN80	Perth and Kinross	TG	125	2000	2	Pipistrelle unsure	Y
2120037	NJ80	Aberdeenshire	TG	108	N/A		Pipistrelle unsure	N
2120078	NO59	Aberdeenshire	TG	127	1999	1	Pipistrelle unsure	N
2120102	NG20	Aberdeenshire	TG	17	1999	1	Pipistrelle unsure	N
2120104	NJ24	Aberdeenshire	TG	95	1999	1	Pipistrelle unsure	N
2120107	NJ73	Aberdeenshire	TG	49	2000	1	Pipistrelle unsure	N

Site code	Grid ref	County	SNH area	Approx. elevation (m)	Last year	No. of years	Species	Contributes to trend
2120223	NJ82	Aberdeenshire	TG	112	2007	1	Pipistrelle unsure	N
2120195	NO54	Angus	TG	164			Pipistrelle unsure	N
2120220	NJ26	Moray	TG	4	2007	1	Pipistrelle unsure	N
2120054	NO33	Perth and Kinross	TG	11	1998	1	Pipistrelle unsure	N
2120059	NN03	Argyll and Bute	AOH	0	1999	2	Soprano pipistrelle	Y
2120080	NS20	Argyll and Bute	AOH	50	2000	2	Soprano pipistrelle	Y
2120088	NS18	Argyll and Bute	AOH	76	2011	12	Soprano pipistrelle	Y
2120095	NS38	Argyll and Bute	AOH	33	2000	2	Soprano pipistrelle	Y
2120186	NS37	Argyll and Bute	AOH	12	2010	12	Soprano pipistrelle	Y
2120191	NR96	Argyll and Bute	AOH	107	2008	4	Soprano pipistrelle	Y
2120192	NS39	Argyll and Bute	AOH	13	2009	5	Soprano pipistrelle	Y
2120193	NS19	Argyll and Bute	AOH	31	2011	6	Soprano pipistrelle	Y
2120096	NM94	Argyll and Bute	AOH	14	N/A		Soprano pipistrelle	N
2120189	NM80	Argyll and Bute	AOH	8	2005	1	Soprano pipistrelle	N
2120082	NT57	East Lothian	Forth	15	2009	11	Soprano pipistrelle	Y
2120083	NT67	East Lothian	Forth	20	2009	9	Soprano pipistrelle	Y
2120166	NT36	East Lothian	Forth	98	2012	10	Soprano pipistrelle	Y
2120237	NT46	East Lothian	Forth	133	2010	2	Soprano pipistrelle	Y
2120086	NS98	Falkirk	Forth	44	2002	4	Soprano pipistrelle	Y
2120160	NS97	Falkirk	Forth	130	2005	3	Soprano pipistrelle	Y
2120090	NO41	Fife	Forth	54	2001	5	Soprano pipistrelle	Y
2120209	NO31	Fife	Forth	86	2012	11	Soprano pipistrelle	Y
2120024	NT36	Midlothian	Forth	124	2011	14	Soprano pipistrelle	Y
2120025	NT46	Midlothian	Forth	208	2002	6	Soprano pipistrelle	Y
2120181	NT36	Midlothian	Forth	152	2006	2	Soprano pipistrelle	Y
2120001	NS58	Stirling	Forth	87	2008	12	Soprano pipistrelle	Y
2120003	NS58	Stirling	Forth	46	2012	16	Soprano pipistrelle	Y
2120049	NS58	Stirling	Forth	46	2003	5	Soprano pipistrelle	Y
2120122	NN60	Stirling	Forth	85	2003	2	Soprano pipistrelle	Y
2120129	NS89	Stirling	Forth	31	2006	6	Soprano pipistrelle	Y
2120152	NS68	Stirling	Forth	116	2006	5	Soprano pipistrelle	Y
2120153	NS58	Stirling	Forth	20	2004	3	Soprano pipistrelle	Y
2120183	NS97	Stirling	Forth	80	2006	2	Soprano pipistrelle	Y
2120184	NS58	Stirling	Forth	27	2011	8	Soprano pipistrelle	Y
2120200	NS89	Stirling	Forth	30	2012	8	Soprano pipistrelle	Y
2120021	NT07	West Lothian	Forth	87	2010	13	Soprano pipistrelle	Y
2120026	NT07	West Lothian	Forth	83	2012	12	Soprano pipistrelle	Y
2120051	NT06	West Lothian	Forth	104	2000	3	Soprano pipistrelle	Y
2120174	NT17	West Lothian	Forth	59	2005	2	Soprano pipistrelle	Y
2120194	NT06	West Lothian	Forth	160	2012	7	Soprano pipistrelle	Y
2120225	NT06	West Lothian	Forth	103	2012	5	Soprano pipistrelle	Y
2120135	NT57	East Lothian	Forth	125	2002	1	Soprano pipistrelle	N
2120182	NT36	Midlothian	Forth	128	2005	1	Soprano pipistrelle	N
2120198	NN60	Stirling	Forth	83	2005	1	Soprano pipistrelle	N
2120028	NS55	East Renfrewshire	SA	130	2006	5	Soprano pipistrelle	Y
2120204	NS55	Glasgow	SA	38	2007	2	Soprano pipistrelle	Y
2120211	NS57	Glasgow	SA	171	2012	6	Soprano pipistrelle	Y
2120212	NS57	Glasgow	SA	171	2012	5	Soprano pipistrelle	Y
2120077	NS34	North Ayrshire	SA	61	2012	13	Soprano pipistrelle	Y
2120081	NS92	North Ayrshire	SA	253	2001	3	Soprano pipistrelle	Y
2120027	NS35	Renfrewshire	SA	35	2012	11	Soprano pipistrelle	Y
2120039	NS46	Renfrewshire	SA	21	2000	3	Soprano pipistrelle	Y
2120108	NS36	Renfrewshire	SA	68	2012	12	Soprano pipistrelle	Y

Site code	Grid ref	County	SNH area	Approx. elevation (m)	Last year	No. of years	Species	Contributes to trend
2120111	NS37	Renfrewshire	SA	49	2004	4	Soprano pipistrelle	Y
2120127	NS36	Renfrewshire	SA	56	2004	6	Soprano pipistrelle	Y
2120161	NS36	Renfrewshire	SA	36	2012	8	Soprano pipistrelle	Y
2120162	NS35	Renfrewshire	SA	66	2010	7	Soprano pipistrelle	Y
2120253	NS20	South Ayrshire	SA	85	2012	9	Soprano pipistrelle	Y
2120254	NS20	South Ayrshire	SA	40	2011	5	Soprano pipistrelle	Y
2120045	NS84	South Lanarkshire	SA	119	2005	3	Soprano pipistrelle	Y
2120072	NS65	South Lanarkshire	SA	99	2001	3	Soprano pipistrelle	Y
2120097	NS38	West Dunbartonshire	SA	49	2000	2	Soprano pipistrelle	Y
2120141	NS37	Renfrewshire	SA	58	2003	1	Soprano pipistrelle	N
2120249	NS36	Renfrewshire	SA	69	2011	1	Soprano pipistrelle	N
2120250	NS46	Renfrewshire	SA	79	2011	1	Soprano pipistrelle	N
2120259	NS20	South Ayrshire	SA	13	2011	1	Soprano pipistrelle	N
2120017	NH54	Highland	SH/NINH	22	2010	14	Soprano pipistrelle	Y
2120043	NM66	Highland	SH/NINH	35	2004	5	Soprano pipistrelle	Y
2120061	NH06	Highland	SH/NINH	19	2012	8	Soprano pipistrelle	Y
2120120	NH67	Highland	SH/NINH	68	2010	2	Soprano pipistrelle	Y
2120165	NH22	Highland	SH/NINH	132	2007	3	Soprano pipistrelle	Y
2120246	NH45	Highland	SH/NINH	23	2012	2	Soprano pipistrelle	Y
2120044	NH78	Highland	SH/NINH	33	1998	1	Soprano pipistrelle	N
2120124	NH66	Highland	SH/NINH	40	2000	1	Soprano pipistrelle	N
2120207	NH91	Highland	SH/NINH	222	N/A		Soprano pipistrelle	N
2120006	NX55	Dumfries and Galloway	SS	9	1999	3	Soprano pipistrelle	Y
2120036	NX86	Dumfries and Galloway	SS	17	2003	5	Soprano pipistrelle	Y
2120143	NY07	Dumfries and Galloway	SS	133	2012	8	Soprano pipistrelle	Y
2120215	NX76	Dumfries and Galloway	SS	40	2003	6	Soprano pipistrelle	Y
2120050	NT14	Scottish Borders	SS	220	2003	6	Soprano pipistrelle	Y
2120060	NT23	Scottish Borders	SS	185	2000	3	Soprano pipistrelle	Y
2120079	NT14	Scottish Borders	SS	220	2003	4	Soprano pipistrelle	Y
2120112	NT62	Scottish Borders	SS	69	2002	3	Soprano pipistrelle	Y
2120136	NT62	Scottish Borders	SS	64	2002	2	Soprano pipistrelle	Y
2120149	NT14	Scottish Borders	SS	221	2003	2	Soprano pipistrelle	Y
2120227	NX26	Dumfries and Galloway	SS	110	2008	1	Soprano pipistrelle	N
2120171	NT14	Scottish Borders	SS	220	2003	1	Soprano pipistrelle	N
2120007	NJ52	Aberdeenshire	TG	177	2012	13	Soprano pipistrelle	Y
2120008	NJ71	Aberdeenshire	TG	114	1998	2	Soprano pipistrelle	Y
2120009	NO69	Aberdeenshire	TG	79	1998	2	Soprano pipistrelle	Y
2120010	NJ70	Aberdeenshire	TG	95	2012	14	Soprano pipistrelle	Y
2120011	NJ83	Aberdeenshire	TG	61	2000	4	Soprano pipistrelle	Y
2120245	NJ71	Aberdeenshire	TG	104	2012	3	Soprano pipistrelle	Y
2120158	NO33	Angus	TG	93	2011	5	Soprano pipistrelle	Y
2120033	NO10	Perth and Kinross	TG	123	2012	14	Soprano pipistrelle	Y
2120034	NO11	Perth and Kinross	TG	143	2003	6	Soprano pipistrelle	Y
2120146	NO14	Perth and Kinross	TG	144	2012	10	Soprano pipistrelle	Y
2120263	NO49	Aberdeen City	TG	187	2012	1	Soprano pipistrelle	N
2120012	NO79	Aberdeenshire	TG	95	1998	1	Soprano pipistrelle	N
2120175	NO10	Perth and Kinross	TG	120	2006	1	Soprano pipistrelle	N
2120226	NN70	Perth and Kinross	TG	39	2007	1	Soprano pipistrelle	N

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