

England Biodiversity Indicators 2020

This documents supports
4a. Status of UK priority species: relative abundance

Technical background document

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For further information on 4a. Status of UK priority species: relative abundance visit
<https://www.gov.uk/government/statistics/england-biodiversity-indicators>

Indicator 4a. Status of UK priority species: relative abundance

Technical background document, 2020

NB this paper should be read together with 4b [Status of UK Priority Species; distribution](#) which presents a companion statistic based on time series on frequency of occurrence (distribution) of priority species.

1. Introduction

The adjustments to the UK biodiversity indicators set as a result of the adoption of the [Strategic Plan for Biodiversity](#) (including the Aichi Targets) at the 10th Conference of Parties of the Convention on Biological Diversity mean there is a need to report progress against Aichi Target 12:

Target 12: By 2020 the extinction of known threatened species has been prevented and their conservation status, particularly of those most in decline, has been improved and sustained.

Previously, the UK biodiversity indicator for threatened species used lead partner status assessments on the status of priority species from 3-yearly UK Biodiversity Action Plan (UK BAP) reporting rounds. As a result of the devolution of biodiversity strategies to the UK's 4 nations, there is no longer reporting at the UK level of the status of species previously listed by the BAP process.

This paper presents a robust indicator of the status of threatened species in the UK, with species identified as conservation priorities being taken as a proxy for threatened species. Despite the relatively high quality and quantity of both data and analytical methods in the UK, it should be recognised from the outset that any indicator on the status of priority species will be hampered by short comings in the availability of data.

2. Species List

The species list was derived from the biodiversity lists of the 4 UK countries. A link to the list for each country is provided below:

England – [Section 41 Species](#)

Northern Ireland – [Northern Ireland Priority Species List](#)

Scotland – [Scottish Biodiversity List](#)

Wales - [Section 7 Priority species](#)

The species lists are unchanged from those used in the 2019 indicator analysis. The criteria for inclusion in each of the 4 biodiversity lists are derived largely from those used to identify the UK BAP priority species list, most recently in 2007, but there has been some divergence in approaches, see Table 1. For example, the Scottish biodiversity list and the Northern Ireland priority species list both have criteria based on rarity alone, whereas the UK BAP criteria did not consider rarity; rare species were only listed if they were considered threatened or declining.

4a. Status of UK priority species: relative abundance

For the purposes of this indicator, an inclusive approach has been taken, whereby a species only has to be included in one of the country lists to be included on the combined list. The Scottish Biodiversity list has a final criterion based on the importance of species to people, however, species designated under this criterion were not considered here. The taxonomic composition of the combined 4 country list (FCL) is shown in Table 2.

Some countries have included a small number of taxa below the species level (i.e. sub-species) on their biodiversity lists. Such infra-specific taxa were only retained on the combined 4 country biodiversity list if the associated species was not included. For example, a sub-species of the willow tit (*Poecile montanus*) is included on the Welsh list but it is a full species on the Scottish Biodiversity list, thus on the combined list only the full species was retained.

Table 1: The biodiversity lists of the 4 countries of the UK

Country	Number of Taxa on country list	Criteria for inclusion of species on list
England (Section 41 Species)	943 taxa	On the 2007 UK BAP list
		Hen Harrier
Northern Ireland (NI) Priority Species List	481 taxa	1: On the 2007 UK BAP list
		2: Rapid decline of 2% or more per year
		3: Decline of 1% or more per year and NI holds 50% or more of Irish population, or 20% or more of UK population or Irish/UK population restricted to NI
		4: Rare in NI (1-2 sites) and NI holds 50% or more of Irish population, or 20% or more of UK population or Irish/UK population restricted to NI
		5: 20% or more of a well-recognised sub-species in NI
		6: Irish Red data book species
		7: Red list Birds of Conservation concern Ireland or UK
Scottish Biodiversity List	2,090 taxa	S1: On the 2007 UK BAP list
		S2: International obligation
		S3: Species defined as 'nationally rare' in GB/UK (present in 15 or less 10km squares), which are present in Scotland
		S4: Species present in 5 or less 10km squares or sites in Scotland
		S5: Decline of 25% or more in 25 years in Scotland
		S6a: Endemic
		S6b: Endemic subspecies if also meets another criterion
Wales (Section 7 Priority species)	567 taxa	International importance, IUCN Global Red List or Red listed in 50% or more of EU countries where data is available or other source indicating international threat or decline
		International responsibility 25% or more of EU/Global population in Wales and decline of 25% or more in 25 years in Wales

4a. Status of UK priority species: relative abundance

		Decline in Wales of 50% or more in 25 years
		Other for example decline and very restricted range
UK total (combined 4 country list)	2,890 taxa	

Table 2: Taxonomic breakdown of combined 4 country biodiversity list

Taxonomic group	Number of species in group
<i>Invertebrates</i>	
insect – beetle (<i>Coleoptera</i>)	191
insect – butterfly	25
insect – dragonfly (<i>Odonata</i>)	4
insect – hymenopteran	103
insect – moth	174
insect – orthopteran	6
insect – other	4
insect – riverfly	8
insect – true bug (<i>Hemiptera</i>)	15
insect – true fly (<i>Diptera</i>)	94
other Invertebrate	233
<i>Vertebrates</i>	
amphibian	4
bird	127
fish	57
marine mammal	22
terrestrial mammal	26
reptile	10
<i>Plants and fungi</i>	
vascular plants	409
alga	254
stonewort	15
lichen	546
bryophytes	301
fungi	262
Total number of species	2,890

3. Data Sources

Robust population time series were sought for as many species on the combined 4 country biodiversity list as possible. The majority of these data have previously been published and many are used as part of the UK biodiversity indicator set currently; details of these analyses and the rules for species inclusion into the data sets are given in the following sections.

Time series in relative abundance

Tables 3 and 4 provide a summary of the relative abundance datasets included in the indicator. They show the analytical methods used to generate the species time series in each dataset. Although these vary in detail, the underlying method is similar. These datasets are generated largely from data collected by national monitoring schemes. In these schemes data are collected in a robust and consistent manner and the geographical coverage is good, with statistical approaches used to correct for biases in coverage. These datasets are ideal for producing population time series for widespread species; however, in some cases the sample size is insufficient to generate time series for cryptic, rarer or more range restricted species. Each scheme has a set of criteria to determine whether time series can be generated for each species and if they are sufficiently robust to be included in the published results of the scheme. Table 5 gives an overview of each monitoring scheme based on assessments carried out in 2013. Further information about each monitoring scheme and the data analysis and results can be found in the references given at the end of this paper.

Bird time series are well documented and several data sources are available (Table 3). Some bird species are represented in more than one dataset. The order of the rows in Table 3 shows the hierarchy used, from top to bottom, to ensure that the most appropriate and robust data for each species was included in the indicator.

The majority of species time series start around 1970 and the date of the last available update is 2018. The Rothamsted moth data starts in 1968, but to avoid over representing these time series in the overall indicator, data were only used from 1970 onwards, and the time series were expressed as a proportion of the 1970 value. Some datasets begin later than 1970, for example the butterfly time series begin in 1976. The method of incorporating this variation in time period into the indicator is discussed in the Indicator method section (4) below. Some datasets do not continue until 2018; for these species the annual estimate was held at the value of the final data point for all years from the end of the available time series to 2018.

The steep decline in many moth species has an effect on the indicator as a whole. The impact of this on the assessment was considered in the 2013 indicator publication: if moths were excluded from the indicator the short-term decrease assessed in 2013 between 2005 and 2010 was not significant, and the indicator would have been assessed as 'no change'. Over 10 years, from 2000 to 2010, the indicator in 2013 without the moth data would have been slightly positive, but not sufficiently so to be assessed as an increase. This analysis has not been repeated, but it is likely that moths are having a very similar impact on the indicator.

Table 3: Summary of the analysis methods and criteria for species selection for bird datasets

Dataset and provider	Time period	Data Type	Species selection method	Analysis method
Time series used in current bird indicator - C5	Various	Various	Unsmoothed index	Various, depending on the original dataset, all those used are described below
Statutory Conservation Agency and RSPB Annual Breeding Bird Scheme (SCARABBS)	Various	Population estimates from 2 or more national surveys	These surveys are designed to be in depth surveys for a particular species and so have sufficient data to allow population trends to be robustly estimated.	Linear interpolation was used to estimate annual values for years between national surveys.
Common Bird Census (CBC)/Breeding Bird Survey (BBS) joint trends	1970-2018	Unsmoothed index	Not applicable	Unsmoothed population time series were generated from a log-link linear regression with Poisson errors fitted to site x year data (BTO 2014a).
Breeding Bird Survey (BBS)	1995-2018	Unsmoothed index	Data from the BBS surveys were only included for species for which the BBS methodology is appropriate and which are recorded in on average 40 BBS squares per year of the survey period.	Unsmoothed time series are estimated using a similar procedure to the CBC/BBS joint trends described (BTO 2014a).
Rare Breeding Birds Panel	Various, largely 1970 - 2017	Annual estimate	Species were removed where survey effort was thought insufficient to generate a reliable trend. Additionally, species where individuals were only infrequently present in the UK (taken as species where the maximum count was 10 or less and the median was 3 or less), were also removed.	Linear interpolation was used to estimate any missing data.

4a. Status of UK priority species: relative abundance

Seabird Monitoring Panel (SMP) and Seabird censuses	1986-2018	Unsmoothed index	Very small colonies and colonies where counting error is known, or suspected, to exceed 5% are excluded from SMP time series. The accuracy of time series obtained using the SMP sample was assessed by comparing them with data from 2 complete censuses of all breeding seabirds in the UK. A time series was rejected as inaccurate where a discrepancy of more than 15% occurred between the SMP estimate and the census figure (Thompson <i>et al.</i> 1997).	For the majority of species, a combination of SMP and census data is used. The 2 census estimates are used, with linear interpolation for the intervening years. The SMP time series is anchored to the 2 nd census estimate and used in all subsequent years. For a small number of species, the census data alone is used.
Wetland Bird Survey (WeBS)	1970-2017	Unsmoothed index	For core WeBS species there is a system of observer recorded quality of visit (visibility, areas missed) within WeBS, which excludes poor quality site visits. Only sites that have a good overall level of coverage are used (at least 50% of possible visits undertaken) Further species-specific details of analytical methods are published (BTO 2017; Maclean and Ausden 2006).	As for BBS time series

Table 4: Summary of the analysis methods and criteria for species selection for other taxonomic groups

Taxonomic group	Dataset and provider	Time period and data type	Species selection method	Analysis method
Moths	UK moth trends from Rothamsted Insect Survey light trap network (1968 to 2016)	1968-2016, TRIM annual index.	Data for 766 moth species were analysed using data from Rothamsted Insect Survey light trap network (Harrower <i>et al.</i> 2019). The 766 species that were analysed are mostly macro-moths as the majority of micro-moths had to be excluded due to inconsistencies in their recording over the time period. Of the species analysed 432 species produced reliable trends based on expert assessment of the underlying data and the analysis results.	The Generalised Abundance Index (GAI) methodology proposed by Dennis <i>et al.</i> (2006) was used to produce UK abundance trends. This methodology involves estimation of standardised annual flight periods curves for each species. These flight curves are used to estimate the annual total abundance for each site whilst correcting for gaps in the surveying. Poisson regression models, with site and year explanatory variables, are then fitted to the estimated annual total abundance values to determine the abundance trends and also yearly abundance indices. Confidence intervals were produced by bootstrapping (1,000 samples).

4a. Status of UK priority species: relative abundance

Moths	Butterfly Conservation (BC)	~2000-2016. TRIM annual index.	Expert opinion (Mark Parsons – Butterfly Conservation) was used to judge whether the number of sites monitored was sufficient to represent the national time series, given each species' distribution.	Site x year Log-linear Poisson regression models in TRIM (Pannekoek and van Strien 1996) were used.
Bats	National Bat Monitoring Programme (Bat Conservation Trust)	1997-2018 Unsmoothed index.	A power analysis determined that across all surveys, a sample size of 30-40 repeat sites (surveyed for more than one year) would give sufficient data to calculate robust species time series. This would provide 90% power to detect a decline of 25% over 25 years (0.1 sig. level). Borderline cases are judged based on the quality of the time series, primarily from the confidence limits (Walsh <i>et al.</i> 2001, Bat Conservation Trust 2013).	As BBS time series (Barlow <i>et al.</i> 2015). In addition, mixed models are used to investigate factors that could influence time series (e.g. bat detector make, temperature). Over dispersion is a problem for bat detector surveys, where a single bat repeatedly flying past the observer may give rise to a large count of bat passes. Based on the results of simulations a binomial model of the proportion of observation points on each survey where the species was observed is used.
Dormice	National dormouse monitoring scheme (PTES)	1995-2018 Unsmoothed index.		As BBS time series. Time series are estimated monthly. The data for June are used following advice from PTES.
Hedgehog	Mammals on Roads (PTES)	2001-2018 Unsmoothed index		As BBS time series.
Hares	Breeding Bird Survey	1995 – 2018	Data from the BBS surveys were only included for species for which the BBS methodology is appropriate and which are recorded in on average 40 BBS squares per year of the survey period.	Unsmoothed time series are estimated using a similar procedure to the CBC/BBS joint trends described (BTO 2014a).

4a. Status of UK priority species: relative abundance

Butterflies	UK Butterfly Monitoring Scheme (BC)	1976-2018 Unsmoothed index	Indices are calculated for butterfly species that have been recorded from 5 or more sites per year. The wider countryside butterfly survey has only 3 counts during summer and requires twice as many monitored sites to achieve comparable precision to the 26-week butterfly monitoring scheme. 430 monitoring sites on average are required to achieve 80% power (5% significance level) for detecting a 25% decline in abundance over 10 years.	Annual indices were derived from a log-linear Poisson regression model fitted to site x year data where GAMs were used to impute missing values (Dennis <i>et al.</i> , 2015)
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Table 5: Overview of monitoring schemes (based on a 2013 assessment)

Taxonomic group	Dataset	~Effort	Survey design	Field method
Moths	Rothamsted moth survey (since 1968)	80	Consistent, Non-random	Light trap
Butterflies	Wider countryside butterfly survey (since 2007)	750	Consistent, Random	Transect
	UK butterfly monitoring scheme (since 1976)	1,000	Consistent, Non-random	Transect
Mammals	National Dormouse Survey (since 1993)	300	Consistent, Known sites	Nest box search
	Breeding bird survey (since 1995)	2,400	Consistent, Random	Transect
	National Bat monitoring scheme (since 1997)	1,300	Consistent, Random	Various, field/ roost counts
	Mammals on Roads (since 2001)	500	Consistent, Random	Transect
Birds	Breeding bird survey (since 1995)	3,200	Consistent, Random	Transect
	Common bird census (1970-2000)	300	Consistent, Non-random	Territory mapping
	Seabird monitoring programme, (since 1986) seabird censuses (1969 ,1985 & 2000)	Species specific	Consistent, Non-random or Total	Colony counts
	Wetland bird survey (since 1970)	3,000	Consistent, Non-random (or almost total for some species)	Site counts
	Rare birds breeding panel (since 1970)	Species specific	Some variation over time, all or most known sites	Site counts and individual records
	SCARABBS (since 1974)	Species specific	Consistent, stratified random, bespoke for species	Various, transects

4. Indicator Methods

Table 6 gives a summary of the relationship between the number of species on the combined 4 country biodiversity list (FCL) and the number of these for which population time series are available.

As far as possible, previously published methods of indicator creation were used, both because these are well-established, are likely to have undergone peer review and allow comparison of this indicator with existing species indicators for birds (C5), butterflies (C6) and bats (C8). These methods are described briefly below and references are given for further information.

Table 6: Summary of species time series included in the Species Indicator

Taxonomic group	Number of species on FCL	Number of species on FCL with data and meeting criteria for inclusion
Birds	127	103
Butterflies	25	23
Mammals	26	13
Moths	174	80
Total	352	219

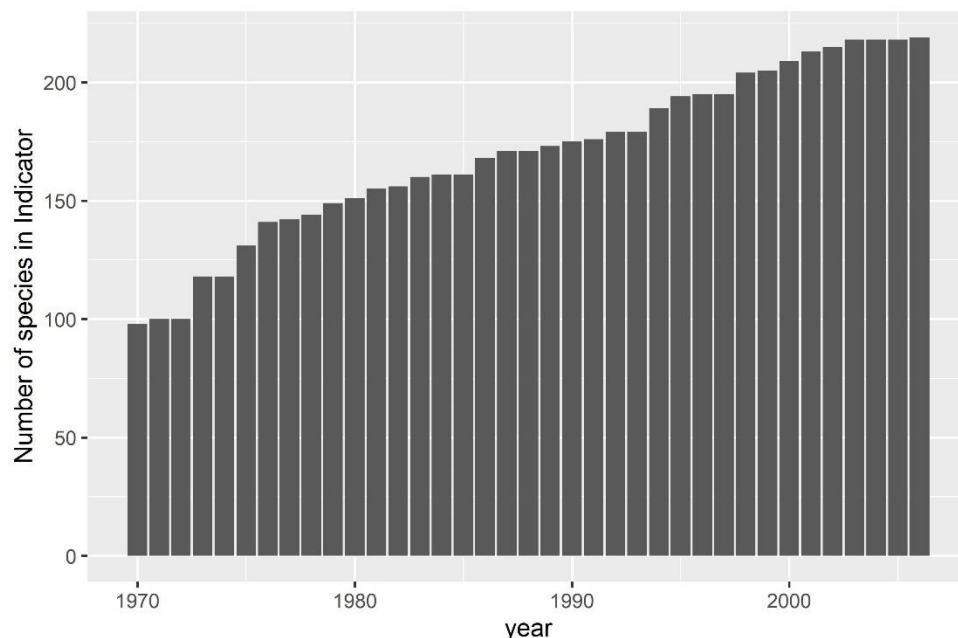
The majority of species time series had values estimated for each year. In the few cases where a species year combination was missing, these values were estimated using log-linear interpolation (Collen *et al.*, 2008). Time series were not extrapolated before the first year or after the last. Where time series ended prior to 2018 they were extended by holding the final data value constant in all subsequent years. Since the indicator is focussed on threatened species some of these species are rare and a few time series contained zero counts for one or more years. This was largely in the Rare Breeding Birds Panel data. As the composite indicator is calculated using the geometric mean it is not possible to include zero values. This issue was addressed by adding 1% of the average value of the time series to the whole series of those species' time series containing zeros (Loh *et al.*, 2005).

Each time series was expressed as a proportion of the first year of the time series, so that the first year equals 100. Extremely large or small index values can have a disproportionate influence on composite indicators. Following the methods used in the current wild bird index (C5); any index value greater than 10,000 or less than one was set to these values until the index dropped below 10,000 again or above one (Noble *et al.*, 2004). Two species had a time series that went above 10,000 and 4 species had time series that dropped below one, these are identified in the species list in Appendix 1.

Each species in the indicator was weighted equally. When creating a species indicator weighting may be used to try to address biases in a dataset, for example, if one taxonomic group is represented by far more species than another, the latter could be given a higher weight so that both taxonomic groups contribute equally to the overall indicator. Complicated weighting can, however, make the meaning and communication of the indicator less transparent. Groups with

many species on the FCL could be considered more threatened than others and therefore should contribute more to the overall indicator. Although there was some variation between taxonomic groups in the proportion of species on the list for which data were available, this proportion was substantial for all groups where at least some data were available. The main bias on the data is that some taxonomic groups are not represented at all, which cannot be addressed by weighting. For this reason, and to ensure clarity of communication, equal weighting was used.

Figure 1: Number of species contributing data in each year, 1970 to 2018



To create the composite index for a group (by data type or taxonomy) or overall, the geometric mean was calculated from the species time series data (Figure 2). Different species time series had different start dates. This was taken into consideration; for species time series entering the indicator after the first year, their first year is set to the geometric mean of those species time series already in the indicator in that year, in order that the additional time series does not influence the indicator in its year of entry. Confidence intervals for each composite indicator were created using bootstrapping (Buckland, 2005; Freeman *et al.*, 2001); in each iteration ($n = 10,000$) a random sample of species were selected with replication and the geometric mean calculated.

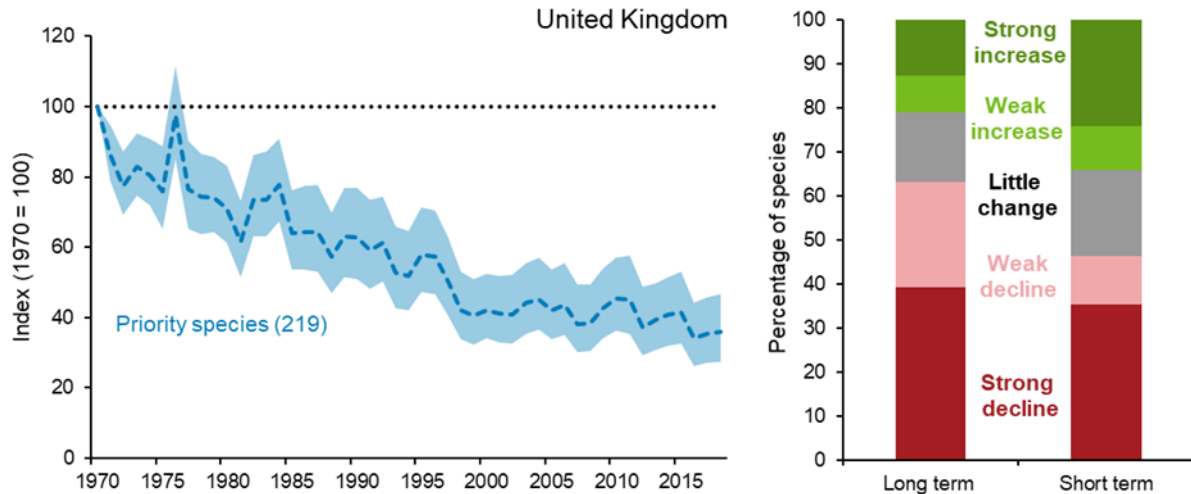
Headline Indicator - 4a.1

The headline indicator (C4ai) was generated by combining 219 time series charting changes in relative species abundance using the methods described in the preceding section.

To illustrate the interspecific variation in trends, bar-charts are published alongside the indicators. These show the percentage of species showing different trends – strong increase, weak increase, stable, weak decrease, strong decrease – over two time periods. The long-term period is that since the start of the indicator (1970 in most cases) although for species entered

into the indicator in subsequent years the period is shorter (the longest available trend is used, as long as it exceeds that used within the short-term change measure). The short-term period is the last five years of data (e.g. currently 2013-2018), where smoothed time-series were available the last five years to the penultimate year (2012-2017). Assessments are based on smoothed trends where available. The five trend class thresholds are based on average annual rates of change over the assessment period and are derived from the rates of decline used to assign species to the red and amber lists of Birds of Conservation Concern (Eaton *et al.* 2009).

Figure 2: Change in the relative abundance of priority species in the UK, 1970 to 2018



Notes:

1. The line graph shows the unsmoothed trend (dashed line) with its 95% confidence interval (shaded area).
2. The figure in brackets shows the number of species included in the composite index.
3. The bar chart shows the percentage of species within the indicator that have increased (weakly or strongly), decreased (weakly or strongly) or shown no change in abundance based on set thresholds of change.

Assessment of change – headline indicator

The assessment of change was based on the approach of Eaton *et al.* (2015). The long-term assessment was made by comparing the change and 95% confidence intervals (CI) of the composite indicator between 1970 and 2018. The overall indicator shows a consistent downward trajectory over its 48 years duration. The final value of the indicator in 2018 is 36 (95% CI: 27, 47) suggesting that on average those priority species represented in the indicator have declined by more than a half since 1970. To calculate trends over shorter-term periods, change statistics for the most recent 5-year (2013-2018) period were calculated for each species (Eaton *et al.*, 2015) based on smoothed annual time-series where available (over 2012-2017). The geometric mean of these species level short-term change metrics was calculated and 95% confidence intervals were estimated using bootstrapping ($n = 10,000$). Between 2013 and 2018 on average species had declined by 7% (95% CI: 13, 0).

4a. Status of UK priority species: relative abundance

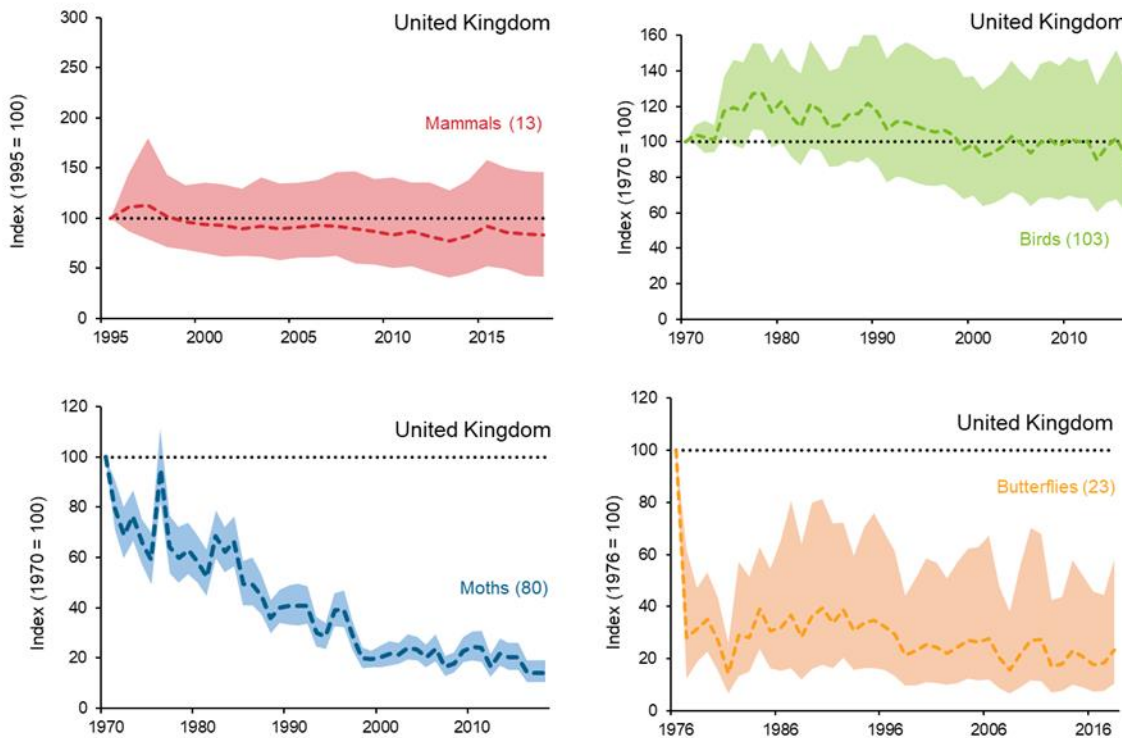
If the confidence interval is entirely below 100 the time series would be assessed as decreasing, if it was entirely above 100 the indicator would be assessed as increasing, if the confidence interval spanned 100 the indicator would be assessed as no significant change. Therefore, the long-term (1970 to 2018) change is assessed as a decrease and there has been no change over the short term (2013 to 2018).

The long-term assessment of change is currently based upon unsmoothed annual estimates of relative abundance. This means that the percentage change over time can vary substantially depending on the time period assessed. One way to reduce this variation is to make the assessment based on smoothed time series based on generalised additive models (Freeman *et al.*, 2001). These dampen the inter-annual variation in the time series and thus aid the interpretation of important patterns of change. At present this type of information is not available for all the species in the indicator presented here, however, it is hoped it will be possible to work towards generating these data and using this methodology in future iterations of the indicator.

Change in priority species by taxonomic group

The headline indicator (Figure 2) masks variation within and between taxonomic groups. Figure 3 shows trends for each taxonomic group separately. These were generated using the same methods as the overall indicator.

Figure 3: Change in relative species abundance, by taxonomic group, 1970 to 2018



Notes:

4a. Status of UK priority species: relative abundance

1. The graphs show the unsmoothed trend (dashed line) together with the 95% confidence interval (shaded area) for each of the 4 taxonomic groups included in the composite indicator.
2. The figures in brackets show the number of species included in each measure.

This index for birds has remained roughly stable since the 1970s. There are several possible explanations for this. Birds have benefited from more investment in their conservation than other groups and, as a result, some species are increasing. This includes some species increasing rapidly from small numbers, like the marsh harrier (*Circus aeruginosus*) and the red kite (*Milvus milvus*) as well as species that have benefited from changes in legislation, like geese which have benefitted from increased protection from hunting. Additionally, the definition of priority species, as provided by the 4 Country lists, includes all species for which there is specific international obligation for conservation action (owing to the use of this as a criterion in the Scottish priority list). This has resulted in a large number of waterbird species within the indicator, many of which occur in the UK as wintering populations and which have shown substantial increases since the 1970s. The overall stable time series for birds masks some species which are still rapidly declining.

5. Overall long-term change in the relative abundance and distribution of priority species

Background

Currently, the priority species indicator comprises of 2 measures; this indicator (4a) based on abundance data and 4b based on distribution data. The assessment is made separately for these 2 data types, resulting in 2, potentially conflicting priority species indicator assessments. The 4a assessment is described fully in this document, however in summary, it is based on the geometric mean index value across species, with uncertainty of the indicator calculated via bootstrapping across species. The 4b indicator is based on the mean growth rate across species, with an approach that incorporates the uncertainty in the individual species index estimates into the indicator (see the associated [technical background document](#) for further detail). Ideally, these would be combined into a single assessment, however such a combined indicator needs to address challenges about differences in the data types that contribute to 4a and 4b. Simply combining the species trends would assume equivalence across the 2 datatypes, i.e. that a 10% change in abundance is equivalent to a 10% change in distribution. This has, to date, been deemed an unreasonable assumption to make. Furthermore, combining change from different datatypes leads to a lack of clarity around what the indicator is actually measuring when using magnitude of change.

The following section describes a technique to produce a combined evaluation of priority species, using both abundance and distribution data. The key development is that rather than assessing the indicator based on magnitude of change, the indicator assessment is based on the balance of increasing versus decreasing species. This is consistent with existing indicators, in that the assessment is a statement of confidence in whether the overall line has increased, decreased or showed no overall change. It also sidesteps the challenges of combining different data types by assuming only that the confidence with which we can assign a species as increasing or decreasing can be compared across data types. The assessment described below

was based upon the indicators published in 2018, and has not been updated in 2020, so does not apply to the revised indicator published in the fiche.

Combined assessment calculations

First, for each species 1,000 index values for the first and last year in its time series (either abundance or distribution) are extracted. The values are random draws from a normal distribution informed by the mean and standard error of the indices in question, thereby propagating the uncertainty in these annual indices forward to the indicator assessment. For each of the 1,000 pairs of values, an assessment is made as to whether the species increased (1) or decreased (0) over the course of its time series. This provides a combined total of 1,000 1s and 0s per species. For simplicity, these 1,000 1s and 0s are referred to as change indices. The mean of these 1,000 change indices for each species is the best estimate of the probability that the species has increased. For example, a value of 0.2 indicates a 20% probability that the species increased, so it could be said that, with 80% confidence, the species has declined. The change indices for each species are then collated into a matrix with 1,000 rows and n columns, where n is the total number of priority species in the indicator. For each row, the balance between increasing and decreasing species are calculated as the mean of the change indices across all species. These species means estimate the proportion of species that are increasing: values > 0.5 suggest that more species increased than decreased, values < 0.5 suggest that more species decreased. This gives 1,000 values of the balance between increasing and decreasing species, which is summarised using the mean and 95% confidence intervals (CIs). The assessment is made using the 95% CIs;

- If the 95% CIs span 0.5, the trend in priority species will be assessed as no overall change.
- If the 95% CIs are below 0.5, the trend in priority species will be assessed as a decline.
- If the 95% CIs are above 0.5, the trend in priority species will be assessed as increasing.

The mean across the 1,000 iterations is the best estimate of the balance of increasing vs decreasing species. The balance between increasing and decreasing priority species over the long term is 0.45 (95% CI: 0.43 to 0.47). Therefore, the overall assessment is that 45% of species increased and 55% declined: whilst the value is close to 50:50, the small width of the 95% CIs gives confidence in the assessment that declines outnumber increases. Thus, the combined 2018 C4 priority species indicator would be assessed as a decline using this new approach.

Presentation

As noted above, concerns have been raised around combining estimates of magnitude of change between abundance and distribution trend data. As a result, to date, no combined bar plot documenting the proportion of increasing and decreasing species has been presented. Here, rather than assessing species based on the magnitude of change, assessments of species are based on the probability that they were increasing or decreasing. Species were classified into one of 5 bins based on the mean value across the 1,000 binary estimates of change for the species in question as follows:

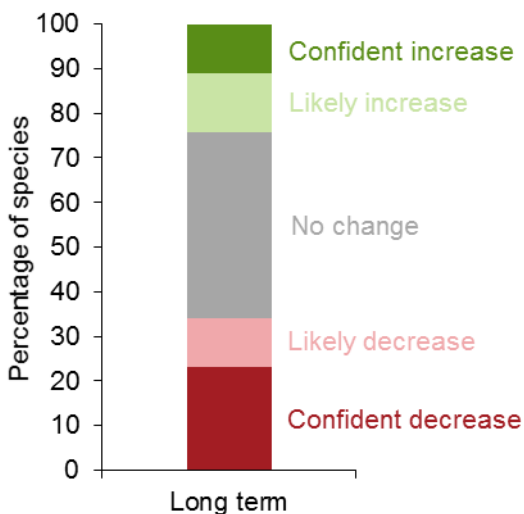
- Species were classified as a confident increase if the mean value was above 0.95.
- Species were classified as a confident decrease if the mean value was below 0.05.

4a. Status of UK priority species: relative abundance

- Species were classified as likely increasing if the mean value was above 0.75.
- Species were classified as likely decreasing if the mean value was below 0.25.
- The remaining species were classified as having no clear trend.

Of the 929 priority species included in C4a and C4b, 103 (11%) were classified as a confident increase, 122 (13%) as likely increasing, 387 (42%) as having no clear trend, 103 (11%) as likely decreasing and 214 (23%) as a confident decrease (Figure 4).

Figure 4: Overall change in the relative abundance and distribution of priority species in the UK, 1970 to 2015



Notes:

1. Based on 929 species included in the 2018 update of indicators C4a and C4b. Each species contributes once only – so either to C4a or to C4b.
2. The graph provides information on the percentage of species which have increased, decreased or remained unchanged; it does not assess the amount of change in those species.

In summary, 225 species (24%) have increased, 317 (34%) have decreased and 387 (42%) have shown no significant change in either abundance or distribution between 1970 and 2015. Overall, the long-term trend for the combined measure of priority species abundance and distribution in the UK is declining.

6. References

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Appendix 1 – Species List

A list of species included in the indicator. For each species we report the broad taxonomic group, have binary columns for each of the 4 country priority species lists, and have 2 columns showing the number of times the species scaled index estimates were truncated to 10,000 or 1.

Scientific name	Common name	England (Section 41 species)	Scottish Biodiversity List	Wales (Section 7 Priority species)	Northern Ireland Biodiversity List	Number of truncations above 10,000	Number of truncations below 1
Birds							
<i>Accipiter gentilis</i>	Northern Goshawk	N	N	N	Y	0	0
<i>Acrocephalus palustris</i>	Marsh Warbler	Y	N	N	N	0	0
<i>Acrocephalus scirpaceus</i>	Eurasian Reed-Warbler	N	Y	N	N	0	0
<i>Alauda arvensis</i>	Skylark	Y	Y	Y	Y	0	0
<i>Alcedo atthis</i>	Kingfisher	N	Y	N	N	0	0
<i>Anas acuta</i>	Pintail	N	N	N	Y	0	0
<i>Anas clypeata</i>	Shoveler	N	N	N	Y	0	0
<i>Anas querquedula</i>	Garganey	N	Y	N	Y	0	0
<i>Anser albifrons</i>	White-fronted Goose	N	Y	Y	Y	0	0
<i>Anthus trivialis</i>	Tree Pipit	Y	Y	Y	Y	0	0
<i>Apus apus</i>	Swift	N	Y	N	Y	0	0
<i>Aquila chrysaetos</i>	Golden Eagle	N	Y	N	Y	0	0
<i>Aythya ferina</i>	Pochard	N	Y	N	Y	0	0
<i>Aythya fuligula</i>	Tufted Duck	N	N	N	Y	0	0
<i>Aythya marila</i>	Scaup	Y	Y	N	Y	0	0
<i>Botaurus stellaris</i>	Great Bittern	Y	Y	Y	Y	0	0
<i>Branta bernicla subsp. bernicla</i>	Dark-Bellied Brent	Y	N	Y	N	0	0
<i>Branta bernicla subsp. hrota</i>	Pale-Bellied Brent	N	N	N	Y	0	0
<i>Branta leucopsis</i>	Barnacle Goose	N	Y	N	N	0	0
<i>Bucephala clangula</i>	Goldeneye	N	N	N	Y	0	0
<i>Burhinus oedicephalus</i>	Stone-Curlew	Y	N	N	N	0	0
<i>Calidris alpina</i>	Dunlin	N	Y	N	Y	0	0
<i>Calidris canutus</i>	Knot	N	N	N	Y	0	0
<i>Calidris maritima</i>	Purple Sandpiper	N	Y	N	N	0	0
<i>Caprimulgus europaeus</i>	Nightjar	Y	Y	Y	Y	0	0
<i>Carduelis cabaret</i>	Lesser Redpoll	Y	Y	Y	Y	0	0
<i>Carduelis cannabina</i>	Linnet	Y	Y	Y	Y	0	0
<i>Carduelis flavirostris</i>	Twite	Y	Y	Y	Y	0	0

4a. Status of UK priority species: relative abundance

Scientific name	Common name	England (Section 41 species)	Scottish Biodiversity List	Wales (Section 7 Priority species)	Northern Ireland Biodiversity List	Number of truncations above 10,000	Number of truncations below 1
<i>Carduelis spinus</i>	European Siskin	N	Y	N	N	0	0
<i>Charadrius hiaticula</i>	Ringed Plover	N	N	Y	N	0	0
<i>Charadrius morinellus</i>	Dotterel	N	Y	N	N	0	0
<i>Circus aeruginosus</i>	Marsh Harrier	N	Y	N	N	0	0
<i>Circus cyaneus</i>	Hen Harrier	Y	Y	Y	Y	0	0
<i>Corvus cornix</i>	Hooded Crow	N	Y	N	N	0	0
<i>Coturnix coturnix</i>	Quail	N	N	N	Y	0	0
<i>Crex crex</i>	Corncrake	Y	Y	Y	Y	0	0
<i>Cuculus canorus</i>	Cuckoo	Y	Y	Y	Y	0	0
<i>Cygnus columbianus</i>	Bewick's Swan	Y	Y	Y	Y	0	0
<i>Cygnus cygnus</i>	Whooper Swan	N	Y	N	Y	0	0
<i>Dendrocopos minor subsp.</i>	Lesser Spotted	Y	N	Y	N	0	0
<i>Emberiza calandra</i>	Corn Bunting	Y	Y	Y	N	0	0
<i>Emberiza cirius</i>	Cirl Bunting	Y	N	N	N	0	0
<i>Emberiza citrinella</i>	Yellowhammer	Y	Y	Y	Y	0	0
<i>Emberiza schoeniclus</i>	Reed Bunting	Y	Y	Y	Y	0	0
<i>Falco columbarius</i>	Merlin	N	Y	N	N	0	0
<i>Falco peregrinus</i>	Peregrine Falcon	N	Y	N	N	0	0
<i>Falco subbuteo</i>	Hobby	N	Y	N	N	0	0
<i>Falco tinnunculus</i>	Kestrel	N	Y	Y	N	0	0
<i>Ficedula hypoleuca</i>	Pied Flycatcher	N	N	Y	N	0	0
<i>Gavia arctica</i>	Black-Throated Diver	N	Y	N	Y	0	0
<i>Gavia stellata</i>	Red-Throated Diver	N	Y	N	N	0	0
<i>Haliaeetus albicilla</i>	White-Tailed Eagle	N	Y	N	Y	4	0
<i>Jynx torquilla</i>	Wryneck	N	Y	N	N	0	0
<i>Lagopus lagopus</i>	Red Grouse	Y	Y	Y	Y	0	0
<i>Lanius collurio</i>	Red-Backed Shrike	N	Y	Y	N	0	1
<i>Larus argentatus</i>	Herring Gull	Y	Y	Y	Y	0	0
<i>Larus ridibundus</i>	Black-Headed Gull	N	Y	Y	Y	0	0
<i>Limosa lapponica</i>	Bar-Tailed Godwit	N	Y	Y	N	0	0
<i>Limosa limosa</i>	Black-Tailed Godwit	Y	Y	N	Y	0	0
<i>Locustella luscinioides</i>	Savi's Warbler	Y	N	N	N	0	0
<i>Lullula arborea</i>	Woodlark	Y	N	Y	N	0	0
<i>Melanitta nigra</i>	Common Scoter	Y	Y	Y	Y	0	0

4a. Status of UK priority species: relative abundance

Scientific name	Common name	England (Section 41 species)	Scottish Biodiversity List	Wales (Section 7 Priority species)	Northern Ireland Biodiversity List	Number of truncation s above 10,000	Number of truncatio ns below 1
<i>Milvus milvus</i>	Red Kite	N	Y	N	N	0	0
<i>Motacilla flava</i>	Yellow Wagtail	Y	Y	Y	Y	0	0
<i>Muscicapa striata</i>	Spotted Flycatcher	Y	Y	Y	Y	0	0
<i>Numerius arquata</i>	Curlew	Y	Y	Y	Y	0	0
<i>Pandion haliaetus</i>	Osprey	N	Y	N	N	0	0
<i>Panurus biarmicus</i>	Bearded Tit	N	Y	N	N	0	0
<i>Passer domesticus</i>	House Sparrow	Y	Y	Y	Y	0	0
<i>Passer montanus</i>	Tree Sparrow	Y	Y	Y	Y	0	0
<i>Perdix perdix</i>	Grey Partridge	Y	Y	Y	N	0	0
<i>Pernis apivorus</i>	Honey Buzzard	N	Y	N	N	0	0
<i>Phalaropus lobatus</i>	Red-Necked Phalarope	N	Y	N	Y	0	0
<i>Philomachus pugnax</i>	Ruff	N	Y	N	N	0	0
<i>Phylloscopus sibilatrix</i>	Wood Warbler	Y	Y	Y	Y	0	0
<i>Pluvialis apricaria</i>	Golden Plover	N	Y	Y	Y	0	0
<i>Podiceps auritus</i>	Slavonian Grebe	N	Y	N	N	0	0
<i>Podiceps nigricollis</i>	Black-Necked Grebe	N	Y	N	Y	0	0
<i>Poecile montanus</i>	Willow Tit	Y	Y	Y	N	0	0
<i>Poecile palustris subsp.</i>	Marsh Tit	Y	Y	Y	N	0	0
<i>Porzana porzana</i>	Spotted Crake	N	Y	N	N	0	0
<i>Prunella modularis</i>	Dunnock	Y	Y	Y	Y	0	0
<i>Pyrrhocorax pyrrhocorax</i>	Chough	N	Y	Y	Y	0	0
<i>Pyrrhula pyrrhula</i>	Bullfinch	Y	Y	Y	Y	0	0
<i>Scolopax rusticola</i>	Woodcock	N	Y	N	N	0	0
<i>Stercorarius parasiticus</i>	Arctic Skua	N	Y	N	Y	0	0
<i>Sterna dougallii</i>	Roseate Tern	Y	Y	Y	Y	0	0
<i>Sterna hirundo</i>	Common Tern	N	Y	N	N	0	0
<i>Sterna paradisaea</i>	Arctic Tern	N	Y	N	N	0	0
<i>Sterna sandvicensis</i>	Sandwich Tern	N	Y	N	N	0	0
<i>Sternula albifrons</i>	Little Tern	N	Y	N	Y	0	0
<i>Streptopelia turtur</i>	Turtle Dove	Y	Y	Y	Y	0	0
<i>Sturnus vulgaris</i>	Starling	Y	Y	Y	Y	0	0
<i>Tetrao tetrix</i>	Black Grouse	Y	Y	Y	N	0	0
<i>Tetrao urogallus</i>	Capercaillie	N	Y	N	N	0	0
<i>Tringa glareola</i>	Wood Sandpiper	N	Y	N	N	0	0

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Scientific name	Common name	England (Section 41 species)	Scottish Biodiversity List	Wales (Section 7 Priority species)	Northern Ireland Biodiversity List	Number of truncations above 10,000	Number of truncations below 1
<i>Tringa totanus</i>	Redshank	N	N	N	Y	0	0
<i>Troglodytes troglodytes subsp.</i>	Fair Isle Wren	N	Y	N	N	0	0
<i>Turdus iliacus</i>	Redwing	N	Y	N	Y	0	0
<i>Turdus philomelos</i>	Song Thrush	Y	Y	Y	Y	0	0
<i>Turdus pilaris</i>	Fieldfare	N	N	N	Y	0	0
<i>Turdus torquatus</i>	Ring Ouzel	Y	Y	Y	Y	0	0
<i>Vanellus vanellus</i>	Lapwing	Y	Y	Y	Y	0	0
Butterflies							
<i>Argynnis adippe</i>	High Brown Fritillary	Y	N	Y	N	0	0
<i>Aricia artaxerxes</i>	Northern Brown Argus	Y	Y	N	N	0	0
<i>Boloria euphrosyne</i>	Pearl-Bordered Fritillary	Y	Y	Y	N	0	0
<i>Boloria selene</i>	Small Pearlbordered	Y	Y	Y	N	0	0
<i>Carterocephalus palaemon</i>	Chequered Skipper	N	Y	N	N	0	0
<i>Coenonympha pamphilus</i>	Small Heath	Y	Y	Y	Y	0	0
<i>Coenonympha tullia</i>	Large Heath	Y	Y	Y	Y	0	0
<i>Cupido minimus</i>	Small Blue	Y	Y	Y	Y	0	0
<i>Erynnis tages</i>	Dingy Skipper	Y	Y	Y	Y	0	0
<i>Euphydryas aurinia</i>	Marsh Fritillary	Y	N	Y	Y	0	0
<i>Hamearis lucina</i>	Duke of Burgundy	Y	N	N	N	0	0
<i>Hipparchia semele</i>	Grayling	Y	Y	Y	Y	0	0
<i>Lasiommata megera</i>	Wall	Y	Y	Y	Y	0	0
<i>Leptidea sinapis</i>	Wood White	Y	N	Y	N	0	0
<i>Limenitis camilla</i>	White Admiral	Y	N	Y	N	0	0
<i>Maculinea arion</i>	Large Blue	Y	N	N	N	20	0
<i>Melitaea athalia</i>	Heath Fritillary	Y	N	N	N	0	0
<i>Melitaea cinxia</i>	Glanville Fritillary	Y	N	N	N	0	0
<i>Plebejus argus</i>	Silver-Studded Blue	Y	N	Y	N	0	0
<i>Pyrgus malvae</i>	Grizzled Skipper	Y	N	Y	N	0	0
<i>Satyrium w-album</i>	White Letter Hairstreak	Y	N	Y	N	0	8
<i>Thecla betulae</i>	Brown Hairstreak	Y	N	Y	N	0	0
<i>Thymelicus acteon</i>	Lulworth Skipper	Y	N	N	N	0	0
Moths							
<i>Acronicta psi</i>	Grey Dagger	Y	Y	Y	Y	0	0
<i>Acronicta rumicis</i>	Knot Grass	Y	Y	Y	Y	0	0

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Scientific name	Common name	England (Section 41 species)	Scottish Biodiversity List	Wales (Section 7 Priority species)	Northern Ireland Biodiversity List	Number of truncations above 10,000	Number of truncations below 1
<i>Agrochola helvola</i>	Flounced Chestnut	Y	Y	Y	Y	0	0
<i>Agrochola litura</i>	Brown-Spot Pinion	Y	Y	Y	Y	0	0
<i>Agrochola lychnidis</i>	Beaded Chestnut	Y	Y	Y	Y	0	0
<i>Allophyes oxyacanthae</i>	Green-Brindled	Y	Y	Y	Y	0	0
<i>Amphipoea oculea</i>	Ear Moth	Y	Y	Y	Y	0	0
<i>Amphipyra tragopoginis</i>	Mouse Moth	Y	Y	Y	Y	0	0
<i>Apamea anceps</i>	Large Nutmeg	Y	Y	Y	N	0	0
<i>Apamea remissa</i>	Dusky Brocade	Y	Y	Y	Y	0	0
<i>Aporophyla lutulenta</i>	Deep-Brown Dart	Y	N	Y	N	0	0
<i>Arctia caja</i>	Garden Tiger	Y	Y	Y	Y	0	0
<i>Asteroscopus sphinx</i>	Sprawler	Y	N	Y	Y	0	0
<i>Atethmia centrago</i>	Centre-Barred Sallow	Y	Y	Y	Y	0	0
<i>Athetis pallustris</i>	NA	Y	N	N	N	0	1
<i>Blepharita adusta</i>	Dark Brocade	Y	Y	Y	Y	0	0
<i>Brachylochia viminalis</i>	Minor Shoulder-Knot	Y	Y	Y	Y	0	0
<i>Caradrina morpheus</i>	Mottled Rustic	Y	Y	Y	Y	0	0
<i>Celaena haworthii</i>	Haworth's Minor	Y	Y	Y	Y	0	0
<i>Chesias leqatella</i>	Streak	Y	Y	Y	Y	0	0
<i>Chesias rufata</i>	Broom-Tip Rhesen	Y	Y	Y	N	0	1
<i>Chiasmia clathrata</i>	Latticed Heath	Y	Y	Y	Y	0	0
<i>Coleophora tricolor</i>	NA	Y	N	N	N	0	0
<i>Cymatophorima diluta</i>	Oak Lutestring	Y	Y	Y	N	0	0
<i>Dasypolia templi</i>	Brindled Ochre	Y	Y	Y	Y	0	0
<i>Diarsia rubi</i>	Small Square-Spot	Y	Y	Y	Y	0	0
<i>Diloba caeruleocephala</i>	Figure Of Eight	Y	Y	Y	Y	0	0
<i>Ecliptopera silaceata</i>	Small Phoenix	Y	Y	Y	Y	0	0
<i>Ennomos erosaria</i>	September Thorn	Y	Y	Y	N	0	0
<i>Ennomos fuscantaria</i>	Dusky Thorn	Y	N	Y	N	0	0
<i>Ennomos quercinaria</i>	August Thorn	Y	Y	Y	Y	0	0
<i>Entephria caesiata</i>	Grey Mountain Carpet	Y	Y	Y	Y	0	0
<i>Epirrhoe galiata</i>	Galium Carpet	Y	Y	Y	Y	0	0
<i>Eugnorisma glareosa</i>	Autumnal Rustic	Y	Y	Y	Y	0	0
<i>Eulithis mellinata</i>	The Spinach	Y	Y	Y	N	0	3
<i>Eustroma reticulatum</i>	Netted Carpet Moth	Y	N	Y	N	0	0

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Scientific name	Common name	England (Section 41 species)	Scottish Biodiversity List	Wales (Section 7 Priority species)	Northern Ireland Biodiversity List	Number of truncations above 10,000	Number of truncations below 1
<i>Euxoa nigricans</i>	Garden Dart	Y	Y	Y	Y	0	4
<i>Euxoa tritici</i>	White-Line Dart	Y	Y	Y	N	0	4
<i>Graphiphora auqur</i>	Double Dart	Y	Y	Y	Y	0	0
<i>Hemistola chrysoprasaria</i>	Small Emerald	Y	Y	Y	N	0	0
<i>Hepialus humuli</i>	Ghost Moth	Y	Y	Y	Y	0	0
<i>Hoplodrina blanda</i>	Rustic	Y	Y	Y	Y	0	0
<i>Hydraecia micacea</i>	Rosy Rustic	Y	Y	Y	Y	0	0
<i>Hydraecia osseola subsp.</i>	NA	Y	N	N	N	0	0
<i>Idaea dilutaria</i>	Silky Wave	Y	N	Y	N	0	0
<i>Idaea ochrata subsp. cantiata</i>	NA	Y	N	N	N	0	0
<i>Lycia hirtaria</i>	Brindled Beauty	Y	Y	Y	Y	0	0
<i>Macaria wauaria</i>	V Moth	Y	Y	Y	N	0	10
<i>Malacosoma neustria</i>	The Lackey	Y	Y	Y	N	0	0
<i>Melanchra persicariae</i>	Dot Moth	Y	Y	Y	Y	0	0
<i>Melanchra pisi</i>	Broom Moth	Y	Y	Y	Y	0	0
<i>Melanthia procellata</i>	Pretty Chalk Carpet	Y	N	Y	N	0	0
<i>Mesoligia literosa</i>	Rosy Minor	Y	Y	Y	Y	0	0
<i>Mythimna comma</i>	Shoulder-Striped	Y	Y	Y	Y	0	0
<i>Orthonama vittata</i>	Oblique Carpet	Y	Y	Y	Y	0	0
<i>Orthosia gracilis</i>	Powdered Quaker	Y	Y	Y	Y	0	0
<i>Pelurga comitata</i>	Dark Spinach	Y	Y	Y	Y	0	3
<i>Perizoma albulata</i>	Grass Rivulet	Y	Y	Y	Y	0	0
<i>Pyropteron chrysidiformis</i>	Fiery Clearwing	Y	N	N	N	0	0
<i>Rhizedra lutosa</i>	Large Wainscot	Y	Y	Y	N	0	0
<i>Scopula marginepunctata</i>	Mullein Wave	Y	Y	Y	Y	0	0
<i>Scotopteryx chenopodiata</i>	Shaded Broad-Bar	Y	Y	Y	Y	0	0
<i>Siona lineata</i>	Black-Veined Moth	Y	N	N	N	0	0
<i>Spilosoma lubricipeda</i>	White Ermine	Y	Y	Y	Y	0	0
<i>Spilosoma luteum</i>	Buff Ermine	Y	Y	Y	Y	0	0
<i>Stilbia anomala</i>	Anomalous	Y	Y	Y	Y	0	1
<i>Thalera fimbrialis</i>	Sussex Emerald	Y	N	N	N	0	0
<i>Tholera cespitis</i>	Hedge Rustic	Y	Y	Y	Y	0	3
<i>Tholera decimalis</i>	Feathered Gothic	Y	Y	Y	Y	0	0
<i>Thumatha senex</i>	Round-Winged Muslin	N	Y	N	N	0	0

4a. Status of UK priority species: relative abundance

Scientific name	Common name	England (Section 41 species)	Scottish Biodiversity List	Wales (Section 7 Priority species)	Northern Ireland Biodiversity List	Number of truncations above 10,000	Number of truncations below 1
<i>Timandra comae</i>	Blood-Vein Gwyfyn	Y	Y	Y	N	0	0
<i>Trichiura crataegi</i>	Pale Eggar	Y	Y	Y	Y	0	0
<i>Tyria jacobaeae</i>	Cinnabar	Y	Y	Y	Y	0	0
<i>Watsonalla binaria</i>	Oak Hook-Tip	Y	Y	Y	N	0	0
<i>Xanthia gilvago</i>	Dusky-Lemon Sallow	Y	Y	Y	N	0	6
<i>Xanthia icteritia</i>	Sallow	Y	Y	Y	Y	0	0
<i>Xanthorhoe decoloraria</i>	Red Carpet	Y	Y	Y	Y	0	0
<i>Xanthorhoe ferrugata</i>	Dark-Barred Twin-Spot	Y	Y	Y	Y	0	0
<i>Xestia agathina</i>	Heath Rustic	Y	Y	Y	Y	0	0
<i>Xestia castanea</i>	Neglected Rustic	Y	Y	Y	Y	0	0
Mammals							
<i>Arvicola amphibius</i>	Water Vole	Y	Y	Y	N	0	0
<i>Erinaceus europaeus</i>	West European	Y	Y	Y	Y	0	0
<i>Lepus europaeus</i>	Brown Hare	Y	Y	Y	N	0	0
<i>Lepus timidus</i>	Mountain Hare	Y	Y	N	Y	0	0
<i>Muscardinus avellanarius</i>	Dormouse	Y	N	Y	N	0	0
<i>Myotis daubentonii</i>	Daubenton's Bat	N	Y	N	N	0	0
<i>Myotis nattereri</i>	Natterer's Bat	N	Y	N	N	0	0
<i>Nyctalus noctula</i>	Noctule	Y	Y	Y	N	0	0
<i>Pipistrellus pipistrellus</i>	Pipistrelle Bat	N	Y	Y	N	0	0
<i>Pipistrellus pygmaeus</i>	Soprano Pipistrelle	Y	Y	Y	Y	0	0
<i>Plecotus auritus</i>	Brown Long-Eared Bat	Y	Y	Y	Y	0	0
<i>Rhinolophus ferrumequinum</i>	Greater Horseshoe Bat	Y	N	Y	N	0	0
<i>Rhinolophus hipposideros</i>	Lesser Horseshoe Bat	Y	N	Y	N	0	0

