

# England Biodiversity Indicators 2020

This documents supports

*4b. Status of UK priority species: distribution*

**Technical background document**

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## Indicator 4b. Status of UK priority species: distribution

### Technical background report, 2020

Prepared<sup>1</sup> by Rob Boyd, Jack Hatfield, Gary Powney, Charlotte Outhwaite, Tom August, Nick Isaac; Biological Records Centre, Centre for Ecology and Hydrology.

NB this paper should be read together with Indicator 4a [Status of UK priority species: relative abundance](#) which presents a companion statistic based on time series of the relative abundance 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 one of the 2 indicators which aim to provide a robust measure of the status of threatened species in the UK, with 'species identified as conservation priorities' being taken as a proxy for 'threatened species'. Although biodiversity monitoring in the UK is probably as good as anywhere else in the world, and a wide range of data and novel analytical approaches have been used, 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The UK BAP list has been superseded by the biodiversity lists of the 4 UK countries (Section 41 of the Natural Environmental and Rural Communities (NERC) Act 2006 in England, Environment (Wales) Act 2016 section 7 in Wales, Northern Ireland priority species list in Northern Ireland and the Scottish biodiversity list in Scotland). As a result, there is no single list of species that represents the UK's species of conservation priority. The criteria for inclusion in each of the 4 biodiversity lists are derived 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

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<sup>1</sup> NB some text re-used from 2013 BIYP Indicator C4b prepared by the Species Indicator Initiative working group and we wish to acknowledge the input from the authors of that original document.

on rarity alone, whereas the UK BAP criteria did not consider rarity; rare species were only listed if they were considered threatened or declining.

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 listed as a result of 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 grass rivulet moth (*Perizoma albulata*) is included on the Scottish biodiversity list but it is a full species on the Northern Ireland priority species 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

Country	Number of Taxa on country list	Criteria for inclusion of species on list
		International responsibility 25% or more of EU/Global population in Wales and decline of 25% or more in 25 years in Wales
		Decline in Wales of 50% or more in 25 years
		Other for example decline and very restricted range
<b>UK total (combined 4 country list)</b>	<b>2,890</b>	

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
<b>Total number of species</b>	<b>2,890</b>

### 3. Data Sources

Biological records data were collated to produce an indicator of change based on trends in occupancy of a set of priority species in the UK. Biological records are observations of species in a known place in space and time. Most records are made by volunteer recorders and whilst these data may be collected following a specific protocol, the majority of records in these datasets are opportunistic. The intensity of recording varies in both space and time (Isaac *et al.* 2014), which is a challenge for estimating robust quantitative trends. Fortunately, a range of methods now exist for producing such trends using unstructured biological records data (e.g. Szabo *et al.*, 2010; Hill, 2012; Isaac *et al.*, 2014). Bayesian occupancy models have been shown to be more robust and more powerful than these other methods when analysing this kind of data (Isaac *et al.*, 2014), specifically because the occupancy model explicitly models the data collection process and produces annual estimates for each species of the proportion of occupied sites (van Strien *et al.*, 2013).

By using occupancy models to analyse occurrence records, greater taxonomic coverage was achieved for the 2015 4b indicator. Further improvements to the occupancy modelling framework have enabled the inclusion of more taxonomic groups (for example, lichens, craneflies and weevils) and more species from groups previously included in the indicator. The Bayesian occupancy approach is described in detail in the [Bayesian indicator development technical report](#). Although improvements to the modelling process meant that more species could be included, estimates could not be established for all priority species.

For the occupancy models, occurrence records were extracted at the 1km grid square scale with day precision. Data were collated through the Biological Records Centre and include data from the following recording schemes: Aquatic Heteroptera Recording Scheme, Bees, Wasps and Ants Recording Society, British Arachnological Society Spider Recording Scheme, British Bryological Society, British Isles Neuropterida Recording Scheme, British Lichen Society, Centipede Recording Scheme, British Myriapod and Isopod Group, Millipede Recording Scheme, Bruchidae & Chrysomelidae Recording Scheme, Conchological Society of Great Britain and Ireland, Cranefly Recording Scheme, British Dragonfly Society, Empididae & Dolichopodidae Recording Scheme, Fungus Gnat Recording Scheme, Gelechiid Recording Scheme, Ground Beetle Recording Scheme, Hoverfly Recording Scheme, , National Moth Recording Scheme, Orthoptera Recording Scheme, Riverfly Recording Schemes: Ephemeroptera, Plecoptera and Trichoptera, Soldierflies and Allies Recording Scheme, Staphylinidae Recording Scheme, Terrestrial Heteroptera Recording Scheme - Shield bugs and allied species and the Weevil and Bark Beetle Recording Scheme + Scolytidae, as well as a number of local record centres.

Data from between 1970 and 2018 were extracted as this represents a core period of recording for many of the taxonomic groups. However, some datasets finished at different years within this time period. Since the 2019 C4b indicator the Biological Records Centre has received substantial data updates for Ants, Bees, Wasps, Spider and Dragonflies. This has enabled the improvement of model estimates for certain years.

For 4b in 2020, priority species of freshwater fish and Hypogean Crustacea were removed due to current data issues and the low number of contributing species.

### 4. Generating species' trends

Recent studies have highlighted the value of Bayesian occupancy models for estimating species occurrence in the presence of imperfect detection (van Strien *et al.*, 2013; Isaac *et al.*, 2014). This approach uses 2 hierarchically coupled sub-models, an occupancy sub-model (i.e. presence verses absence), and a detection sub-model (i.e. detection verses non-detection), together these

sub-models estimate the conditional probability that a species is detected when present. A Bayesian occupancy model, following van Strien *et al.* (2013) and Isaac *et al.* (2014), with improvements based on Outhwaite *et al.* (2018) was applied to all priority species from those taxonomic groups for which data were available. For each site-year combination the model estimates presence or absence for the species in question given variation in detection probability: from this the proportion of occupied sites ('occupancy') was estimated for each year. These annual occupancy estimates were scaled so the value for 1970 was set to 100. The annual value of the composite indicator was calculated as the arithmetic mean of scaled species-specific occupancy estimates and uncertainty in the species-specific annual occupancy estimates was propagated through to the final indicator. A detailed description of the occupancy model, and the creation of the composite indicator, can be found in the [technical document on the Bayesian indicator development](#).

### 5. Thresholds for species-specific trends

Species were grouped into one of 5 categories based on both their short-term (over the most recent 5 years of data) and long-term (all years) mean annual change in occupancy (Table 3).

**Table 3: Thresholds used to define individual species trends**

**Category:**

A **strong increase** is defined as an increase of more than 2.81% per annum; this is equivalent to an increase of more than 100% over 25 years.

A **weak increase** is defined as an increase of between 1.16% and 2.81% per annum; this is equivalent to an increase of between 33% and 100% over 25 years.

A **stable** trend is assigned when the change is between +1.16 % and -1.14% per annum; this is equivalent to a change of between +33% and -25% over 25 years.

A **weak decrease** is defined as a decrease of between 1.14% and 2.73% per annum; this is equivalent to a decrease of between 25% to 50% over 25 years.

A **Strong decrease** is defined as a decrease of more than 2.73% per annum; this is equivalent to a decrease of more than 50% over 25 years.

Asymmetric percentage change thresholds are used to define these classes as they refer to proportional change, where a doubling of a species index (an increase of 100%) is counterbalanced by a halving (a decrease of 50%).

The threshold values for each category were based on those of the wild bird indicator; whether an individual species is increasing or decreasing has been decided by its rate of annual change over the time period (long or short) of interest. If the rate of annual change would lead to an occupancy increase or decrease of between 25% and 49% over 25 years, the species is said to have shown a 'weak increase' or a 'weak decline' respectively. If the rate of annual change would lead to a population increase or decrease of 50% or more over 25 years, the species is said to have shown a 'strong increase' or a 'strong decline' respectively. These thresholds are used in the [Birds of Conservation Concern](#) (PDF 1.6MB) status assessment for birds in the UK. See the [technical document on the Bayesian indicator development](#) for further detail on the calculation of the species-specific trends.

## 6. Indicator Methods

Table 4 shows the number of species on the combined 4 Countries List within the taxonomic groups for which data were collated, and the number of species in each group whose modelled trends met the inclusion criteria for the indicator. As mentioned above, the Bayesian approach incorporates species-specific uncertainty in the indicator, a detailed description of this method can be found in the [Bayesian indicator development technical report](#).

**Table 4: Summary of species time-series included in the Priority Species Bayesian measure**

Taxonomic group	Number of species on FCL	Number of species on FCL meeting criteria for inclusion in the indicator
Ladybirds <sup>2</sup>		0
Carabids	34	3
NonmarineMolluscs	82	28
Hoverflies	21	8
Leaf and seed beetles	21	4
Gelechiids	2	0
Fungus gnats	8	0
Mayflies	2	2
Empid & dolichopodid flies	8	0
Dragonflies	4	3
Craneflies	30	8
Centipedes	1	0
Bryophytes	301	48
Bees	60	56
Aquatic Bugs	6	3
Ants	9	6
Wasps	34	31
Weevils	14	5
Caddisflies	4	0
Soldierflies	16	8
SoldierBeetles <sup>2</sup>		0
Shield Bugs	1	1

<sup>2</sup> Other taxonomic groups were investigated for inclusion in the FCL, however these groups did not make it through to the list.

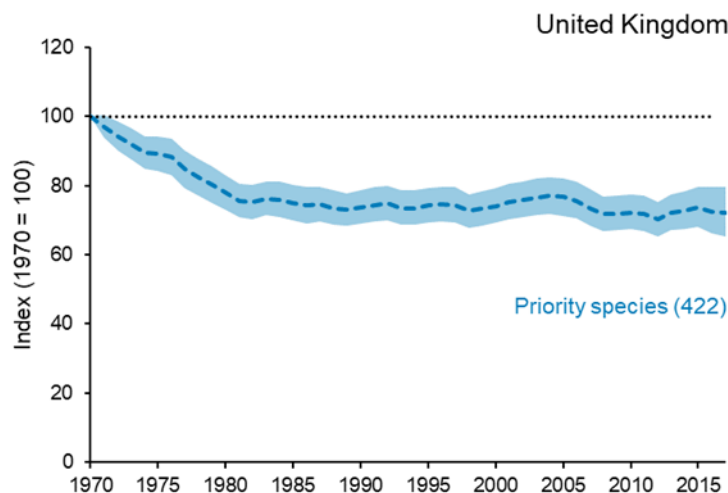
Rove Beetles	7	0
Stoneflies	2	1
PlantBugs <sup>2</sup>		0
Orthoptera	6	3
Lacewings	2	0
Lichens	545	72
Moths	172	117
Spiders	40	15
<b>Total</b>	<b>1,432</b>	<b>422</b>

Models were run for all species on the FCL within the taxonomic groups for which data could be collated. In order to reduce the influence of species with highly uncertain annual occupancy estimates, species with fewer than 50 total records or a gap between records greater than 10 years or less than 10 years of estimates were excluded from the indicator. Species' contribution to the indicator was restricted until after their first occurrence record. This additional filter further reduced the contribution of uncertain estimates to the indicator and was taken due to the fact that some of the recording schemes have greatly expanded over the time period with many additional sites added. In addition, following the advice of the recording schemes and the methodology used in D1c hoverfly, bee, wasp and ant estimates prior to 1980 did not contribute to the indicator. Species also only contributed up until the last year for which scheme data was available. For example, no lichens directly contribute to the 2016 index value as scheme data is only available to 2015.

## 7. Headline 4b Indicator

The headline indicator was generated by combining time series of change in the proportion of occupied sites for 422 species (Figure 1).

**Figure 1: Change in the occupancy (proportion of occupied sites) of priority species in the UK between 1970 and 2017**



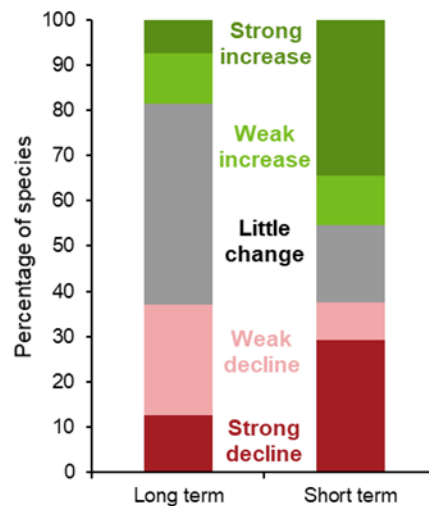


**Notes:**

1. The graph shows the unsmoothed trend (dashed line) with variation around the line (shaded area) within which users can be 90% confident that the true value lies (credible interval).
2. The figure in brackets shows the number of species included in the composite index.

The index of distribution of priority species in the UK fell by more than 20% between 1970 and 1981; this was then followed by a relatively stable period until 2010 when it dipped to its lowest point in 2012, before showing an increase between 2012 and 2017. Occupancy of priority species was assessed as declining between 1970 and 2017. The index was 28% lower in 2017 than in 1970, this is considered a significant change. The indicator increased by 3% between 2012 and 2017 and therefore, it was assessed as stable when taking into account the 90% credibility interval. The balance of increasing and decreasing species showed that in both the long and short term, the percentage of decreasing species is similar (37% for the long term and 38% for the short term) whereas there is a greater percentage of species increasing in the short term (45%) compared with the long term (19%) (see Figure 2 below).

**Figure 2: The proportion of priority species in each trend category based on mean change in occupancy over both a) the long term (all years) and b) the short term (the most recent 5 years)**

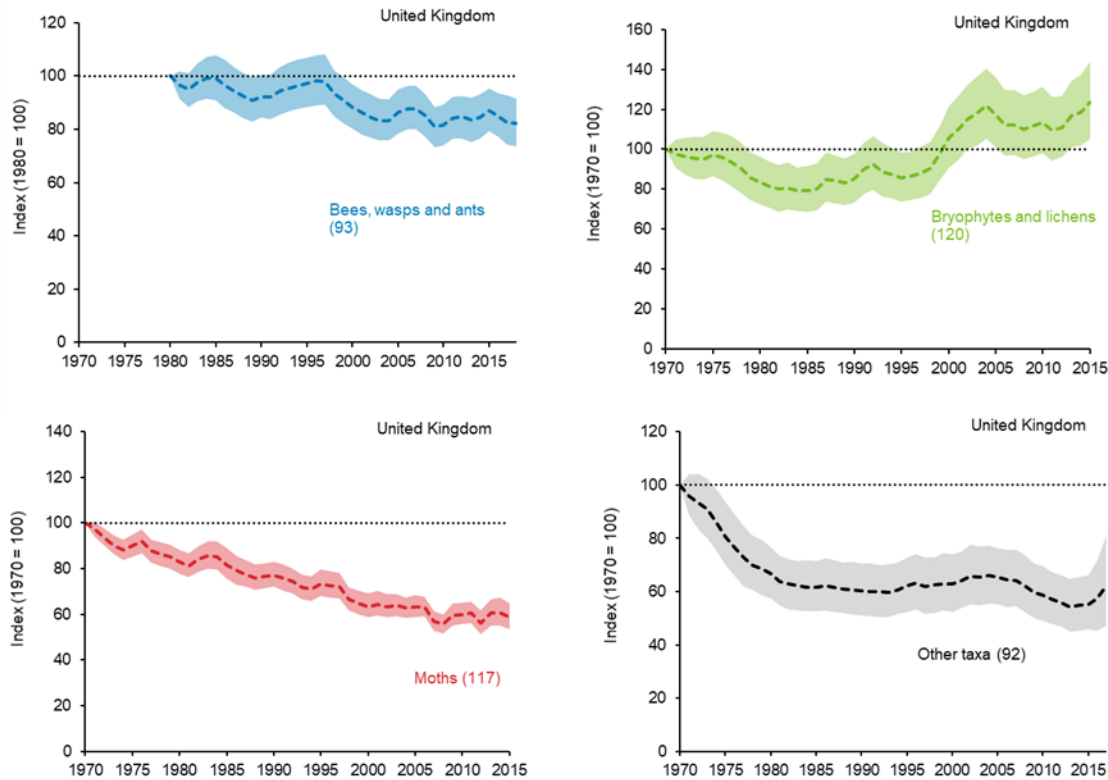


**Note:** The bar chart shows the percentage of species within the indicator that have increased, decreased or shown little change in distribution (measured as the proportion of occupied sites), based on set thresholds of change.

## 8. Change in priority species by taxonomic group

The headline indicator (Figure 1) masks variation within and between taxonomic groups. Figure 3 shows indicators for each taxonomic group separately. These were generated using the same methods as the overall indicator.

**Figure 3: Change in distribution of UK priority species, by taxonomic group, 1970<sup>3</sup> to 2017**



**Notes:**

1. The graphs show the unsmoothed trend (dashed line) and variation around the line (shaded area) within which users can be 90% confident that the true value lies for each of the taxonomic groups included in the composite indicator.
2. The figures in brackets show the number of species included in each measure.
3. The indicator for bees, wasps and ants starts in 1980.
4. Other taxa include a number of insect groups, molluscs and spiders.

The trends of the taxonomic groups included within a multi-species indicator are often obscured by its composite nature. Indicator lines have been generated for a number of sub groups using the same method so that the trends for these groups can be seen more clearly (see Figure C4bii). The bees, wasps and ants group experienced an overall decline, with an index value in 2018, 82% of that in 1980. These are counterbalanced by increases in bryophytes and lichens, which had an index value of 124 in 2015. The moths have undergone the most dramatic decline with an index value in the final year 59% of the value in 1970. Similar strong declines in moths were noted in C4a. The underpinning causes of this decrease are not completely understood.

Since 2019, data updates to the Biological Records Centre database were received for 5 taxonomic groups: Ants, Bees, Wasps, Spiders and Dragonflies.

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

In the 2018 publication, both indicators 4a and 4b were combined for assessment. This has not been updated in 2019 or 2020, so does not apply to the revised indicators. The following text from section 9.1 has been retained for information on how the combined assessment was calculated.

### 9.1 Background

Currently, the priority species indicator comprises of 2 measures; this indicator (4b) based on distribution data and 4a based on abundance data. The assessment is made separately for these 2 data types, resulting in 2, potentially conflicting priority species indicator assessments. The 4b assessment is described fully in this document, however in summary, it 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. Indicator 4a is based the geometric mean index value across species, with uncertainty of the indicator calculated via bootstrapping across species (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.

### 9.2 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.

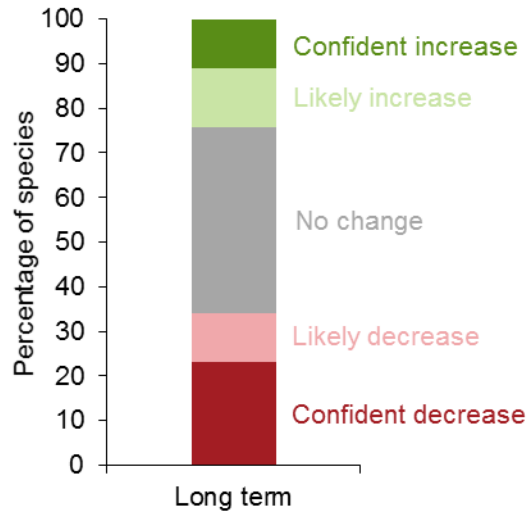
### 9.3 Presentation

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.
- 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 4a and 4b, 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 5).

**Figure 5: 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 4a and 4b. Each species contributes once only – so either to 4a or to 4b.
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.

## 10. References

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## Appendix 1 – Species List

Species	Group
<i>Carabus intricatus</i>	Coleoptera
<i>Cicindela sylvatica</i>	Coleoptera
<i>Poecilus kugelanni</i>	Coleoptera
<i>Acicula fusca</i>	Molluscs
<i>Anisus vortex</i>	Molluscs
<i>Anodonta anatina</i>	Molluscs
<i>Anodonta cygnea</i>	Molluscs
<i>Aplexa hypnorum</i>	Molluscs
<i>Arianta arbustorum</i>	Molluscs
<i>Azeca goodalli</i>	Molluscs
<i>Cecilioides acicula</i>	Molluscs
<i>Cochlodina laminata</i>	Molluscs
<i>Ena obscura</i>	Molluscs
<i>Helicella itala</i>	Molluscs
<i>Leiostyla anglica</i>	Molluscs
<i>Limax cinereoniger</i>	Molluscs
<i>Monacha cantiana</i>	Molluscs
<i>Musculium lacustre</i>	Molluscs
<i>Omphiscola glabra</i>	Molluscs
<i>Pisidium henslowanum</i>	Molluscs
<i>Pupilla muscorum</i>	Molluscs
<i>Radix auricularia</i>	Molluscs
<i>Segmentina nitida</i>	Molluscs
<i>Spermodea lamellata</i>	Molluscs
<i>Theodoxus fluviatilis</i>	Molluscs
<i>Valvata macrostoma</i>	Molluscs

<i>Vertigo alpestris</i>	Molluscs
<i>Vertigo antivertigo</i>	Molluscs
<i>Vertigo moulinsiana</i>	Molluscs
<i>Zenobiella subrufescens</i>	Molluscs
<i>Zonitoides excavatus</i>	Molluscs
<i>Sphegina sibirica</i>	Diptera
<i>Anasimyia transfuga</i>	Diptera
<i>Brachyopa insensilis</i>	Diptera
<i>Cheilosia chrysocoma</i>	Diptera
<i>Cheilosia latifrons</i>	Diptera
<i>Doros profuges</i>	Diptera
<i>Parasyrphus nigritarsis</i>	Diptera
<i>Heringia pubescens</i>	Diptera
<i>Donacia impressa</i>	Coleoptera
<i>Donacia marginata</i>	Coleoptera
<i>Donacia thalassina</i>	Coleoptera
<i>Donacia vulgaris</i>	Coleoptera
<i>Baetis niger</i>	Ephemeroptera
<i>Potamanthus luteus</i>	Ephemeroptera
<i>Anaciaeschna isoceles</i>	Odonata
<i>Coenagrion hastulatum</i>	Odonata
<i>Coenagrion mercuriale</i>	Odonata
<i>Dictenidia bimaculata</i>	Diptera
<i>Lipsothrix nervosa</i>	Diptera
<i>Nephrotoma cornicina</i>	Diptera
<i>Nephrotoma guestfalica</i>	Diptera
<i>Nephrotoma scurra</i>	Diptera
<i>Nigrotipula nigra</i>	Diptera
<i>Tipula cava</i>	Diptera
<i>Tipula melanoceros</i>	Diptera
<i>Abietinella abietina</i>	Mosses
<i>Aphanorrhagma patens</i>	Mosses
<i>Aulacomnium androgynum</i>	Mosses
<i>Bartramia ithyphylla</i>	Mosses
<i>Brachydontium trichodes</i>	Mosses
<i>Bryoerythrophyllum caledonicum</i>	Mosses
<i>Bryum archangelicum</i>	Mosses
<i>Bryum donianum</i>	Mosses
<i>Bryum torquescens</i>	Mosses
<i>Buxbaumia viridis</i>	Mosses
<i>Calypogeia integristipula</i>	Liverworts

<i>Cephaloziella massalongi</i>	Liverworts
<i>Cephaloziella nicholsonii</i>	Liverworts
<i>Dendrocryphaea lamyana</i>	Mosses
<i>Dicranum spurium</i>	Mosses
<i>Didymodon acutus</i>	Mosses
<i>Didymodon nicholsonii</i>	Mosses
<i>Eipterygium tozeri</i>	Mosses
<i>Fissidens rivularis</i>	Mosses
<i>Fossombronia foveolata</i>	Liverworts
<i>Gymnomitrium concinnatum</i>	Liverworts
<i>Hamatocaulis vernicosus</i>	Mosses
<i>Lejeunea mandonii</i>	Liverworts
<i>Leptodon smithii</i>	Mosses
<i>Marsupella sprucei</i>	Liverworts
<i>Metzgeria pubescens</i>	Liverworts
<i>Microbryum curvicollum</i>	Mosses
<i>Microbryum rectum</i>	Mosses
<i>Orthotrichum sprucei</i>	Mosses
<i>Oxyrrhynchium schleicheri</i>	Mosses
<i>Pallavicinia lyellii</i>	Liverworts
<i>Palustriella commutata s.l.</i>	Mosses
<i>Petalophyllum ralfsii</i>	Liverworts
<i>Plasteurhynchium striatulum</i>	Mosses
<i>Platygyrium repens</i>	Mosses
<i>Pohlia andalusica</i>	Mosses
<i>Rhabdoweisia fugax</i>	Mosses
<i>Rhynchostegium megapolitanum</i>	Mosses
<i>Rhytidium rugosum</i>	Mosses
<i>Schistostega pennata</i>	Mosses
<i>Scleropodium cespitans</i>	Mosses
<i>Scleropodium touretii</i>	Mosses
<i>Scopelophila cataractae</i>	Mosses
<i>Seligeria acutifolia</i>	Mosses
<i>Seligeria calcarea</i>	Mosses
<i>Tomentypnum nitens</i>	Mosses
<i>Tortula marginata</i>	Mosses
<i>Tortula protobryoides</i>	Mosses
<i>Andrena cineraria</i>	Hymenoptera
<i>Andrena coitana</i>	Hymenoptera
<i>Andrena denticulata</i>	Hymenoptera
<i>Andrena ferox</i>	Hymenoptera



## 4b Status of UK priority species: distribution

<i>Andrena fuscipes</i>	Hymenoptera
<i>Andrena helvola</i>	Hymenoptera
<i>Andrena marginata</i>	Hymenoptera
<i>Andrena nigroaenea</i>	Hymenoptera
<i>Andrena nitida</i>	Hymenoptera
<i>Andrena praecox</i>	Hymenoptera
<i>Andrena ruficrus</i>	Hymenoptera
<i>Andrena semilaevis</i>	Hymenoptera
<i>Andrena tarsata</i>	Hymenoptera
<i>Anthidium manicatum</i>	Hymenoptera
<i>Anthophora furcata</i>	Hymenoptera
<i>Anthophora retusa</i>	Hymenoptera
<i>Bombus barbutellus</i>	Hymenoptera
<i>Bombus campestris</i>	Hymenoptera
<i>Bombus distinguendus</i>	Hymenoptera
<i>Bombus humilis</i>	Hymenoptera
<i>Bombus muscorum</i>	Hymenoptera
<i>Bombus ruderarius</i>	Hymenoptera
<i>Bombus ruderatus</i>	Hymenoptera
<i>Bombus rupestris</i>	Hymenoptera
<i>Bombus sylvarum</i>	Hymenoptera
<i>Colletes daviesanus</i>	Hymenoptera
<i>Colletes floralis</i>	Hymenoptera
<i>Colletes fodiens</i>	Hymenoptera
<i>Colletes halophilus</i>	Hymenoptera
<i>Epeolus variegatus</i>	Hymenoptera
<i>Eucera longicornis</i>	Hymenoptera
<i>Hylaeus brevicornis</i>	Hymenoptera
<i>Hylaeus hyalinatus</i>	Hymenoptera
<i>Lasioglossum angusticeps</i>	Hymenoptera
<i>Lasioglossum fulvicorne</i>	Hymenoptera
<i>Lasioglossum nitidiusculum</i>	Hymenoptera
<i>Lasioglossum rufitarse</i>	Hymenoptera
<i>Lasioglossum smeathmanellum</i>	Hymenoptera
<i>Lasioglossum villosulum</i>	Hymenoptera
<i>Nomada armata</i>	Hymenoptera
<i>Nomada fabriciana</i>	Hymenoptera
<i>Nomada goodeniana</i>	Hymenoptera
<i>Nomada leucophthalma</i>	Hymenoptera
<i>Nomada obtusifrons</i>	Hymenoptera
<i>Nomada roberjeotiana</i>	Hymenoptera

<i>Nomada striata</i>	Hymenoptera
<i>Osmia aurulenta</i>	Hymenoptera
<i>Osmia bicornis</i>	Hymenoptera
<i>Osmia caerulescens</i>	Hymenoptera
<i>Osmia parietina</i>	Hymenoptera
<i>Osmia uncinata</i>	Hymenoptera
<i>Osmia xanthomelana</i>	Hymenoptera
<i>Sphecodes ferruginatus</i>	Hymenoptera
<i>Sphecodes gibbus</i>	Hymenoptera
<i>Sphecodes pellucidus</i>	Hymenoptera
<i>Stelis punctulatissima</i>	Hymenoptera
<i>Gerris gibbifer</i>	Hemiptera
<i>Hebrus ruficeps</i>	Hemiptera
<i>Plea minutissima</i>	Hemiptera
<i>Formica aquilonia</i>	Hymenoptera
<i>Formica exsecta</i>	Hymenoptera
<i>Formica fusca</i>	Hymenoptera
<i>Formica rufibarbis</i>	Hymenoptera
<i>Formicoxenus nitidulus</i>	Hymenoptera
<i>Temnothorax interruptus</i>	Hymenoptera
<i>Ammophila sabulosa</i>	Hymenoptera
<i>Ancistrocerus parietum</i>	Hymenoptera
<i>Anoplius concinnus</i>	Hymenoptera
<i>Cerceris quadricincta</i>	Hymenoptera
<i>Cerceris quinquefasciata</i>	Hymenoptera
<i>Ceropales maculata</i>	Hymenoptera
<i>Chrysis fulgida</i>	Hymenoptera
<i>Crabro peltarius</i>	Hymenoptera
<i>Crossocerus megacephalus</i>	Hymenoptera
<i>Crossocerus quadrimaculatus</i>	Hymenoptera
<i>Diodontus tristis</i>	Hymenoptera
<i>Dipogon subintermedius</i>	Hymenoptera
<i>Dipogon variegatus</i>	Hymenoptera
<i>Dryudella pinguis</i>	Hymenoptera
<i>Ectemnius cephalotes</i>	Hymenoptera
<i>Ectemnius continuus</i>	Hymenoptera
<i>Evagetes crassicornis</i>	Hymenoptera
<i>Harpactus tumidus</i>	Hymenoptera
<i>Hedychridium ardens</i>	Hymenoptera
<i>Lindenius albilabris</i>	Hymenoptera
<i>Mimumesa dahlbomi</i>	Hymenoptera

<i>Mutilla europaea</i>	Hymenoptera
<i>Odynerus melanocephalus</i>	Hymenoptera
<i>Odynerus simillimus</i>	Hymenoptera
<i>Oxybelus uniglumis</i>	Hymenoptera
<i>Pompilus cinereus</i>	Hymenoptera
<i>Priocnemis schioedtei</i>	Hymenoptera
<i>Pseudepipona herrichii</i>	Hymenoptera
<i>Pseudomalus auratus</i>	Hymenoptera
<i>Symmorphus bifasciatus</i>	Hymenoptera
<i>Tachysphex pompiliformis</i>	Hymenoptera
<i>Attactagenus plumbeus</i>	Coleoptera
<i>Pelenomus canaliculatus</i>	Coleoptera
<i>Poophagus sisymbrii</i>	Coleoptera
<i>Thryogenes nereis</i>	Coleoptera
<i>Turnotaris bimaculatus</i>	Coleoptera
<i>Asilus crabroniformis</i>	Diptera
<i>Beris morrisii</i>	Diptera
<i>Bombylius minor</i>	Diptera
<i>Dysmachus trigonus</i>	Diptera
<i>Leptarthrus brevirostris</i>	Diptera
<i>Oxycera pygmaea</i>	Diptera
<i>Pamponerus germanicus</i>	Diptera
<i>Thyridanthrax fenestratus</i>	Diptera
<i>Alydus calcaratus</i>	Hemiptera
<i>Brachyptera putata</i>	Plecoptera
<i>Leptophyes punctatissima</i>	Orthoptera
<i>Metrioptera brachyptera</i>	Orthoptera
<i>Stethophyma grossum</i>	Orthoptera
<i>Anaptychia ciliaris</i> subsp. <i>ciliaris</i>	Lichens
<i>Anisomeridium viridescens</i>	Lichens
<i>Arthonia anombrophila</i>	Lichens
<i>Arthonia ilicina</i>	Lichens
<i>Arthopyrenia carneobrunneola</i>	Lichens
<i>Bacidia incompta</i>	Lichens
<i>Bactrospora homalotropa</i>	Lichens
<i>Caloplaca dichroa</i>	Lichens
<i>Caloplaca ochracea</i>	Lichens
<i>Collema fasciculare</i>	Lichens
<i>Cresponea premnea</i>	Lichens
<i>Eopyrenula grandicula</i>	Fungi

<i>Flavoparmelia soledians</i>	Lichens
<i>Fuscopannaria sampaiana</i>	Lichens
<i>Graphina ruiziana</i>	Lichens
<i>Gyalideopsis muscicola</i>	Lichens
<i>Hypotrachyna sinuosa</i>	Lichens
<i>Hypotrachyna taylorensis</i>	Lichens
<i>Lecanactis subabietina</i>	Lichens
<i>Lecania cyrtella</i>	Lichens
<i>Lecanographa lyncea</i>	Lichens
<i>Lecanora albella</i>	Lichens
<i>Lecanora horiza</i>	Lichens
<i>Lecanora populicola</i>	Lichens
<i>Leptogium brebissonii</i>	Lichens
<i>Leptogium burgessii</i>	Lichens
<i>Leptogium cyanescens</i>	Lichens
<i>Lobaria amplissima</i>	Lichens
<i>Lobaria pulmonaria</i>	Lichens
<i>Lobaria scrobiculata</i>	Lichens
<i>Lobaria virens</i>	Lichens
<i>Menegazzia terebrata</i>	Lichens
<i>Micarea alabastrites</i>	Lichens
<i>Micarea stipitata</i>	Lichens
<i>Nephroma laevigatum</i>	Lichens
<i>Pannaria conoplea</i>	Lichens
<i>Pannaria rubiginosa</i>	Lichens
<i>Parmeliella parvula</i>	Lichens
<i>Parmeliella testacea</i>	Lichens
<i>Parmeliella triptophylla</i>	Lichens
<i>Peltigera britannica</i>	Lichens
<i>Peltigera collina</i>	Lichens
<i>Pertusaria ophthalmiza</i>	Lichens
<i>Phaeographis dendritica</i>	Lichens
<i>Phyllopsora rosei</i>	Lichens
<i>Porina coralloidea</i>	Lichens
<i>Pseudocyphellaria crocata</i>	Lichens
<i>Pseudocyphellaria intricata</i>	Lichens
<i>Pseudocyphellaria norvegica</i>	Lichens
<i>Punctelia borneri</i>	Lichens
<i>Pyrenula laevigata</i>	Lichens
<i>Pyrenula occidentalis</i>	Lichens
<i>Ramalina fraxinea</i>	Lichens

<i>Rinodina roboris</i> var. <i>roboris</i>	Lichens
<i>Schismatomma cretaceum</i>	Lichens
<i>Schismatomma graphidioides</i>	Lichens
<i>Schismatomma niveum</i>	Lichens
<i>Schismatomma quercicola</i>	Lichens
<i>Sclerophora pallida</i>	Lichens
<i>Stenocybe septata</i>	Fungi
<i>Sticta fuliginosa</i>	Lichens
<i>Sticta limbata</i>	Lichens
<i>Sticta sylvatica</i>	Lichens
<i>Strigula taylorii</i>	Lichens
<i>Thelotrema macrosporum</i>	Lichens
<i>Thelotrema petractoides</i>	Lichens
<i>Toninia sedifolia</i>	Lichens
<i>Usnea articulata</i>	Lichens
<i>Usnea ceratina</i>	Lichens
<i>Usnea florida</i>	Lichens
<i>Varicellaria hemisphaerica</i>	Lichens
<i>Wadeana dendrographa</i>	Lichens
<i>Acosmetia caliginosa</i>	Moths
<i>Acronicta psi</i>	Moths
<i>Acronicta rumicis</i>	Moths
<i>Adscita statices</i>	Moths
<i>Agrochola helvola</i>	Moths
<i>Agrochola litura</i>	Moths
<i>Agrochola lychnidis</i>	Moths
<i>Aleucis distinctata</i>	Moths
<i>Allophyes oxyacanthae</i>	Moths
<i>Amphipoea oculea</i>	Moths
<i>Amphipyra tragopoginis</i>	Moths
<i>Apamea anceps</i>	Moths
<i>Apamea remissa</i>	Moths
<i>Aplasta ononaria</i>	Moths
<i>Aporophyla lutulenta</i>	Moths
<i>Archanara neurica</i>	Moths
<i>Arctia caja</i>	Moths
<i>Asteroscopus sphinx</i>	Moths
<i>Atethmia centrigo</i>	Moths
<i>Brachylomia viminalis</i>	Moths
<i>Caradrina morpheus</i>	Moths
<i>Catocala promissa</i>	Moths

## 4b Status of UK priority species: distribution

<i>Catocala sponsa</i>	Moths
<i>Celaena haworthii</i>	Moths
<i>Ceramica pisi</i>	Moths
<i>Chesias legatella</i>	Moths
<i>Chesias rufata</i>	Moths
<i>Chiasmia clathrata</i>	Moths
<i>Cosmia diffinis</i>	Moths
<i>Cossus cossus</i>	Moths
<i>Cucullia lychnitis</i>	Moths
<i>Cyclophora pendularia</i>	Moths
<i>Cyclophora porata</i>	Moths
<i>Cymatophorima diluta</i>	Moths
<i>Dasypolia templi</i>	Moths
<i>Diarsia rubi</i>	Moths
<i>Dicycla oo</i>	Moths
<i>Diloba caeruleocephala</i>	Moths
<i>Ecliptopera silaceata</i>	Moths
<i>Endromis versicolora</i>	Moths
<i>Ennomos erosaria</i>	Moths
<i>Ennomos fuscantaria</i>	Moths
<i>Ennomos quercinaria</i>	Moths
<i>Entephria caesiata</i>	Moths
<i>Entephria flavicinctata</i>	Moths
<i>Epione vespertaria</i>	Moths
<i>Epirrhoe galiata</i>	Moths
<i>Eriogaster lanestris</i>	Moths
<i>Eriopygodes imbecilla</i>	Moths
<i>Eugnorisma glareosa</i>	Moths
<i>Eulithis mellinata</i>	Moths
<i>Eustroma reticulata</i>	Moths
<i>Euxoa nigricans</i>	Moths
<i>Euxoa tritici</i>	Moths
<i>Graphiphora augur</i>	Moths
<i>Hadena albimacula</i>	Moths
<i>Hadena caesia</i>	Moths
<i>Heliothis maritima</i>	Moths
<i>Hemaris tityus</i>	Moths
<i>Hemistola chrysoprasaria</i>	Moths
<i>Hepialus humuli</i>	Moths
<i>Hoplodrina blanda</i>	Moths
<i>Hydraecia micacea</i>	Moths

4b Status of UK priority species: distribution

<i>Hydraecia osseola</i>	Moths
<i>Leucania comma</i>	Moths
<i>Lithostege griseata</i>	Moths
<i>Lycia hirtaria</i>	Moths
<i>Macaria carbonaria</i>	Moths
<i>Macaria wauaria</i>	Moths
<i>Malacosoma neustria</i>	Moths
<i>Melanchra persicariae</i>	Moths
<i>Melanthia procellata</i>	Moths
<i>Minoa murinata</i>	Moths
<i>Mniotype adusta</i>	Moths
<i>Noctua orbona</i>	Moths
<i>Orthonama vittata</i>	Moths
<i>Orthosia gracilis</i>	Moths
<i>Paracolax tristalis</i>	Moths
<i>Parasemia plantaginis</i>	Moths
<i>Pareulype berberata</i>	Moths
<i>Pechipogo strigilata</i>	Moths
<i>Pelurga comitata</i>	Moths
<i>Perizoma albulata</i>	Moths
<i>Perizoma blandiata</i>	Moths
<i>Photedes extrema</i>	Moths
<i>Polia bombycina</i>	Moths
<i>Protolampra sobrina</i>	Moths
<i>Rheumaptera hastata</i>	Moths
<i>Rhizedra lutosa</i>	Moths
<i>Sabra harpagula</i>	Moths
<i>Scopula marginepunctata</i>	Moths
<i>Scotopteryx bipunctaria</i>	Moths
<i>Scotopteryx chenopodiata</i>	Moths
<i>Sideridis reticulata</i>	Moths
<i>Siona lineata</i>	Moths
<i>Spilosoma lubricipeda</i>	Moths
<i>Spilosoma lutea</i>	Moths
<i>Stilbia anomala</i>	Moths
<i>Synanthedon scoliaeformis</i>	Moths
<i>Thalera fimbrialis</i>	Moths
<i>Tholera cespitis</i>	Moths
<i>Tholera decimalis</i>	Moths
<i>Thumatha senex</i>	Moths
<i>Timandra comae</i>	Moths

4b Status of UK priority species: distribution

<i>Trichiura crataegi</i>	Moths
<i>Trichopteryx polycommata</i>	Moths
<i>Trisateles emortualis</i>	Moths
<i>Tyria jacobaeae</i>	Moths
<i>Tyta luctuosa</i>	Moths
<i>Watsonalla binaria</i>	Moths
<i>Xanthorhoe decoloraria</i>	Moths
<i>Xanthorhoe ferrugata</i>	Moths
<i>Xestia agathina</i>	Moths
<i>Xestia alpicola</i>	Moths
<i>Xestia ashworthii</i>	Moths
<i>Xestia castanea</i>	Moths
<i>Xylena exsoleta</i>	Moths
<i>Arctosa fulvolineata</i>	Araneae
<i>Dictyna pusilla</i>	Araneae
<i>Dipoena inornata</i>	Araneae
<i>Dolomedes plantarius</i>	Araneae
<i>Haplodrassus dalmatensis</i>	Araneae
<i>Haplodrassus soerenseni</i>	Araneae
<i>Mecopisthes peusi</i>	Araneae
<i>Meioneta mollis</i>	Araneae
<i>Monocephalus castaneipes</i>	Araneae
<i>Notioscopus sarcinatus</i>	Araneae
<i>Ozyptila nigrita</i>	Araneae
<i>Philodromus margaritatus</i>	Araneae
<i>Saaristoa firma</i>	Araneae
<i>Semljicola caliginosus</i>	Araneae
<i>Sitticus caricis</i>	Araneae