This dataset consists of six files; a ReadMe.docx file to explain the metadata (including a list of references) and a series of five csv files containing traits information tables which are explained below.

This database must be cited with the following citation if used in publications.

Cook, P.M., Tordoff, G.M., Davis, A.M., Parsons, M.S., Dennis, E.B., Fox, R., Botham, M.S., Bourn, N.A.D., 2021. A traits database for the Butterflies and Macro-moths of Great Britain and Ireland. Butterfly Conservation & Centre for Hydrology and Ecology, United Kingdom.

**ecological\_traits.csv**

This file contains traits information for life cycle ecology and phenology, host plant specificity and characteristics, breeding habitat, and morphological characteristics. Broader categories, such as habitat, are split into sub-categories providing a choice of data resolution. The file also contains data on conservation status, distribution (occupancy) trend and abundance trend. For further information on how the data were derived please refer to the ReadMe.docx provided in the supplementary information.

**excluded\_species.csv**

This file contains a list of Lepidoptera species in Agassiz, Beavan & Heckford (2013) that were excluded from this database. These are mainly adventive or micro-moth species.

**excluded\_subspecies.csv**

This file contains a list of Lepidoptera subspecies and forms in Agassiz, Beavan & Heckford (2013) that were excluded from this database.

**hostplant\_list\_stacked.csv**

Raw data from Henwood, Sterling & Lewington (2020) on butterfly and macro-moth larvae host plant preferences. Each species has multiple rows depending on the number of hostplants used. Hostplants are listed in accordance with naming in Stace (2019).

**hostplant\_list\_unstacked.csv**

Table formatted data from Henwood, Sterling & Lewington (2020) on butterfly and macro-moth larvae host plant preferences. Each species has a single row with hostplant as listed in Stace (2019) providing the columns. If a cell is marked as 1 that species is known to use that hostplant.

**ReadMe.docx**

Detailed information on where and how each column in ecological\_traits.csv, excluded\_species.csv, excluded\_subspecies.csv, hostplant\_list\_stacked.csv and hostplant\_list\_unstacked.csv were derived. Any criteria used for numbering in the files are also explained in this document. A list of references used in the collation of the database are also provided.

Table 1. Files in the repository.

|  |  |  |
| --- | --- | --- |
| File Name | Format | Size |
| ecological\_traits | csv | 293 KB, 970 rows |
| excluded\_species | csv | 97 KB, 2022 rows |
| excluded\_subspecies | csv | 19 KB, 276 rows |
| hostplant\_list\_stacked | csv | 179 KB, 4955 rows |
| hostplant\_list\_unstacked | csv | 612 KB, 798 rows |
| ReadMe | docx | 286 KB |

* 1. Header information: Description of any header data or information attached to file

**Headers ecological\_traits.csv**

Table 2 contains notes on the values for each header and the source of the data. For some categories these headers have been merged to save space where appropriate. For instance, egg stage is described by a single row in Table 2 but is represented by 12 columns (one for each month of the year) in the data file. When observing the data file this should be self-explanatory, but to avoid confusion we have included the range of columns in brackets to the right of the header title when discussing merged examples.

Users should note that distribution and abundance data exists for varying political boundaries depending on the source. The metadata of each header clearly explains which political area each column of data covers The following political boundary definitions are used in the database.

Great Britain- Countries of England, Scotland and Wales.

United Kingdom- Countries of England, Scotland, Wales and Northern Ireland.

Ireland- this refers to the isle of Islands and include both Northern Ireland and the Republic of Ireland.

The Republic of Ireland, the Isle of Man and the Channel Islands are mentioned specifically in the metadata for trend data where relevant.

Table 2. Headers of ecological\_traits.csv.

|  |  |
| --- | --- |
| **Header** | **Explanation** |
| abh\_number | ABH number of the species as given in Agassiz, Beavan & Heckford (2013). |
| b&f\_number | Bradley and Fletcher number of the species as given in Agassiz, Beavan & Heckford (2013). |
| wiemers\_checklist\_number | Taxon identification number as given in Wiemers *et al*. (2018). |
| k&r\_number | Taxon identification number as given in Karsholt & Razowski (1996). |
| scientific\_name | Scientific name of the species as given in Agassiz, Beavan & Heckford (2013) for moths and Wiemers *et al*. (2018) for butterflies. |
| common\_name | English vernacular name of the species as given in Agassiz, Beavan & Heckford (2013). |
| family | Family of the species as given in Agassiz, Beavan & Heckford (2013) for moths and Wiemers *et al*. (2018) for butterflies. |
| recorded\_present (Columns H to L) | Recorded presence of each species in England, Wales, Scotland, Northern Ireland and the Republic of Ireland. Derived from data in the BNM (2021), NMRS (2021) and MothsIreland (2021) recording schemes. Additional sources included Thomson, 1980, Emmet & Heath (1991), Asher *et al*. (2001), Thompson and Nelson (2006), Nash, Boyd & Hardiman (2012), Agassiz, Beavan & Heckford (2013) and Eeles (2019). A 1 is placed in the column if the species has been recorded up to and including 2016 in that specific country. This includes species that have subsequently gone extinct since the initial recording. |
| reintroduced | A 1 is placed in the column if the species has been re-introduced in Great Britain (England, Scotland and Wales combined) and Ireland (Republic of Ireland and Northern Ireland combined) and a 2 for re-introduction within one country (eg just England, Wales, Scotland, Northern Ireland or the Republic of Ireland). This excludes regional introductions. |
| immigrant | If the species is known to migrate to the Great Britain (England, Scotland and Wales), Ireland (Republic of Ireland and Northern Ireland), the Channel Islands and the Isle of Man it is marked as a 1. A 2 represents a suspected, possible or probable immigrant. This is originally defined in Eeles (2019) and Randle *et al*. (2019). |
| resident | If the species is known to be resident in Great Britain (England, Scotland and Wales), Ireland (Republic of Ireland and Northern Ireland), the Channel Islands and the Isle of Man and can successfully overwinter it is marked as a 1. A 2 represents a species that have been temporarily resident either currently or in the past and a 3 represents a probable resident but yet to be confirmed. This is originally defined in Eeles (2019) and Randle *et al*. (2019). |
| extinct\_gb | Species of butterflies and macro-moth listed as extinct in Great Britain (England, Scotland and Wales) in Fox*,* Warren & Brereton (2010) or Fox, Parsons and Harrower (2019). |
| extinct\_i | Species of butterflies and macro-moth listed as extinct in Ireland (Republic of Ireland and Northern Ireland) in Regan *et al.* (2010) or Allen *et al*. (2016). |
| red\_list\_gb | Red List status of the species in Great Britain (England, Scotland and Wales) as stated in Fox*,* Warren & Brereton (2010) or Fox, Parsons and Harrower (2019). |
| red\_list\_ireland | Red List status of the species in Ireland (Republic of Ireland and Northern Ireland) as stated in Regan *et al.* (2010) or Allen *et al*. (2016). |
| gb\_10\_km\_squares\_(2000-2016) | Number of 10 km x 10 km grid squares with records of each macro-moth species in Great Britain (England, Scotland and Wales), the Channel Islands and the Isle of Man during the 2000-2016 period as given in Randle *et al*. (2019). |
| ireland\_10\_km\_squares\_(2000-2016) | Number of 10 km x 10 km grid squares with records of each macro-moth species in Ireland (Republic of Ireland and Northern Ireland) during the 2000-2016 period as given in Randle *et al*. (2019). |
| rarity\_gb | This is based on analysis of recorded 10 km squares in Fox *et al*. (2015) and Fox, Parsons and Harrower (2019). Nationally Rare = 15 or fewer 10 km squares with the species recorded as present, Nationally Scarce = 16-100 10km squares with the species recorded as present. For macro-moths this covers Great Britain (England, Scotland and Wales) only for the period 2000-2014 and for butterflies this covers the United Kingdom (England, Scotland, Wales and Northern Ireland) only for the period 2010-2014 |
| long\_term\_distribution\_trend\_gb | Long term distribution trend for Great Britain (England, Scotland and Wales) expressed as a percentage. This was calculated using occupancy modeling to account for recording effort over time. If no trend could be estimated the cell is blank. Trends are based on data from the BNM (2021) and NMRS (2021). For moths this was presented in Randle *et al*. (2019) and for butterflies in Fox *et al*. (2015). |
| sig\_long\_term\_distribution\_trend\_gb | If the trend expressed in field ‘long\_term\_distribution\_trend\_gb’ is statistically significant for a particular species a Y is placed in the cell, if the trend is not statistically significant a N and if no trend could be estimated the cell is blank. Sources are as for the ‘long\_term\_distribution\_trend\_gb’ |
| range\_long\_term\_distribution\_trend\_gb | The date range that the trend in the field ‘long\_term\_distribution\_trend\_gb’ is calculated over. Sources are as for the ‘long\_term\_distribution\_trend\_gb’ |
| short\_term\_distribution\_trend\_gb | Short term distribution trend for Great Britain (England, Scotland and Wales) expressed as a percentage. This was calculated using occupancy modeling to account for recording effort over time. If no trend could be estimated the cell is blank. Trends are based on data from the BNM (2021) and NMRS (2021). For moths this was presented in Randle *et al*. (2019) and for butterflies in Fox *et al*. (2015). |
| sig\_short\_term\_distribution\_trend\_gb | If the trend expressed in field ‘short\_term\_distribution\_trend\_gb’ is statistically significant for a particular species a Y is placed in the cell, if the trend is not statistically significant a N and if no trend could be estimated the cell is blank. Sources are as for the ‘short\_term\_distribution\_trend\_gb’ |
| range\_short\_term\_distribution\_trend\_gb | The date range that the trend in the field ‘short\_term\_distribution\_trend\_gb’ is calculated over. Sources are as for the ‘short\_term\_distribution\_trend\_gb’ |
| abundance\_trend\_gb | Abundance trend for Great Britain (England, Scotland and Wales) expressed as a percentage. If no trend could be estimated the cell is blank. Trends are based on data from Rothamsted Insect Survey (2021) and UKBMS (2021). For moths this was presented in Randle *et al*. (2019) and for butterflies Brereton *et al*. (2019). |
| sig\_abundance\_trend\_gb | If the trend expressed in field ‘abundance\_trend\_gb’ is statistically significant for a particular species a Y is placed in the cell, if the trend is not statistically significant a N and if no trend exists the cell is blank. |
| range\_abundance\_trend\_gb | The date range that the trend in the field ‘abundance\_trend\_gb’ is calculated over. |
| diurnal | Listed as a 1 if adults of at least one sex of the species are described as being active diurnally i.e. between sunrise and sunset. If a species is listed as flying at sunrise and sunset then diurnal and nocturnal (next header) are both listed as a 1. Sourced from Waring & Townsend (2017). |
| nocturnal | Listed as a 1 if adults of at least one sex of the species is described as being active nocturnally i.e. between dusk and dawn. If a species is listed as flying at sunrise and sunset then nocturnal and diurnal (previous header) are both listed as a 1. Sourced from Waring & Townsend (2017). |
| easily\_disturbed\_by\_day | Listed as a 1 if the adult form of the species is described as being easily flushed from cover by day in Waring & Townsend (2017). |
| communal\_or\_nest | Larvae that feed or bask communally or inhabit a communal nest. Species are listed as a 1 if this occurs for all instars except the final instar or 2 if this occurs only for early instars. Data derived from Emmet & Heath (1992), Porter (1997), Waring & Townsend (2017), Eeles (2019), Henwood, Sterling & Lewington (2020). |
| below\_ground | Species which form a pupa under the surface of the soil or in ants’ nests. 1 is confirmed, 2 is requires further confirmation. Based on data from Emmet & Heath (1992), Porter (1997), Waring & Townsend (2017), Eeles (2019) and Henwood, Sterling & Lewington (2020). |
| leaf\_litter\_moss\_on\_ground\_soil surface | Species which form a pupa on the ground/soil surface layer, amongst leaf litter or mosses. Does not include species whose pupa is formed on living vegetation. 1 is confirmed, 2 is requires further confirmation. Based on data from Emmet & Heath (1992), Porter (1997), Waring & Townsend (2017), Eeles (2019) and Henwood, Sterling & Lewington (2020). |
| hostplant\_external | Species which form a pupa externally on the hostplant. This includes species which pupate under bark or among mosses growing on the hostplant. 1 is confirmed, 2 is requires further confirmation. Based on data from Emmet & Heath (1992), Porter (1997), Waring & Townsend (2017), Eeles (2019) and Henwood, Sterling & Lewington (2020). |
| hostplant\_internal\_stem | Species which form a pupa within the stems of a plant. Does not include species pupating under bark which are either in hostplant\_external or other\_vegetation\_external. 1 is confirmed, 2 is requires further confirmation. Based on data from Emmet & Heath (1992), Porter (1997), Waring & Townsend (2017), Eeles (2019) and Henwood, Sterling & Lewington (2020). |
| hostplant\_internal\_root | Species which form a pupa within the walls of the root system of the hostplant. 1 is confirmed. Based on data from Emmet & Heath (1992), Porter (1997), Waring & Townsend (2017), Eeles (2019) and Henwood, Sterling & Lewington (2020). |
| other\_vegetation\_external | Species which form a pupa externally on vegetation other than the hostplant. This includes species which pupate under bark of non-hostplants. 1 is confirmed, 2 is requires further confirmation. Based on data from Emmet & Heath (1992), Porter (1997), Waring & Townsend (2017), Eeles (2019) and Henwood, Sterling & Lewington (2020). |
| stone\_inc\_walls | Species which pupate under rocks, in rock crevices or within stone walls. 1 is confirmed. Based on data from Emmet & Heath (1992), Porter (1997), Waring & Townsend (2017), Eeles (2019) and Henwood, Sterling & Lewington (2020). |
| dead\_rotten\_wood | Species forming a pupa within decaying and/or dead wood including fence posts. 1 is confirmed. Based on data from Emmet & Heath (1992), Porter (1997), Waring & Townsend (2017), Eeles (2019) and Henwood, Sterling & Lewington (2020). |
| wingless\_reduced\_wing\_female | Classed as a 1 where the adult females of the species are either wingless or have reduced wings not capable of flight, as described in Waring & Townsend (2017). |
| forewing\_minimum | Minimum length of the forewing (between forewing tip and to the location where it joins the thorax) in mm as described in Waring & Townsend (2017). |
| forewing\_maximum | Maximum length of the forewing (between forewing tip and to the location where it joins the thorax) in mm as described in Waring & Townsend (2017). |
| estimated\_dry\_mass | The data provided is an estimate of the dry mass of the adult of each species in mg. Note that these are not based on empirical measurements for each species, but derived from a model created by Kinsella *et al*. (2020). As such these measurements should be treated with caution. The model used provides a more reliable estimate of biomass for species with a forewing length greater than >12.5mm. The data is best used for cross family analyses rather than mass of individual species. |
| obligate\_univoltine | Species that have only one generation a year, even if only in part of their range in (England, Scotland and Wales) and Ireland (Republic of Ireland and Northern Ireland), are listed as 1. A species that is univoltine in some areas but multivoltine in tothers will be given a 1 in both the ‘obligate\_univoltine’ column and the ‘obligate\_multivoltine’ column (next header). Based on data in Waring & Townsend (2017), Eeles (2019) and Randle *et al*. (2019). |
| obligate\_multivoltine | Species that have two or more generations per year, even if only in part of their range in Great Britain (England, Scotland and Wales) and Ireland (Republic of Ireland and Northern Ireland), are listed as 1.. A species that is multivoltine in some areas but univoltine in others will be given a 1 as both ‘obligate\_multivoltine’ and ‘obligate\_univoltine’ (previous header). Based on data in Waring & Townsend (2017), Eeles (2019) and Randle *et al*. (2019). |
| partial\_generation | A species that has a partial second or third generation in particular years but not a full generation. A 1 is confirmed and 2 is requires further confirmation. Based on data in Waring & Townsend (2017), Eeles (2019) and Randle *et al*. (2019). |
| phenology\_shift | Shift in average flight period in days between the period 1970-1979 and 2000-2016 for univoltine species only. A minus number indicates an earlier flight period and a positive number a later flight period. Based on analysis presented in Randle *et al*. (2019). |
| sig\_phenology\_shift\_ | If the trend expressed in field ‘phenology\_shift’ is statistically significant for a particular species a Y is placed in the cell, if the trend is not statistically significant a N and if no trend exists the cell is blank. |
| egg\_stage (columns BA-BL) | Columns BA-BL represent the 12 months of the calendar year. A species is given a 1 if known to be in the egg stage during that month according to data in Emmet & Heath (1992). We did not account for latitudinal differences in phenology. |
| larval\_stage (columns BM-BY) | Columns BM-BX represent the 12 months of the calendar year. A species is given a 1 if known to be in the larval stage during that month according to data in Henwood, Sterling & Lewington (2020) or a ‘?’ if thought to occur in that month but there remains uncertainty. A 2 represents a month that a species is present in the larval stage but only when it overwinters more than once as a larva.  A 1 in column BY titled lar\_multiple refers to a species that obligatorily overwinters more than once as a larva, a 2 represents when a species sometimes overwinters more than once and a ‘?’ is given when there the status of the larval overwintering more than once is unsure. We did not account for latitudinal differences in phenology. |
| pupal\_stage (columns BZ-CL) | Columns BZ-CK represent the 12 months of the calendar year. A species is given a 1 if known to be in the pupal stage during that month according to data in Emmet & Heath (1992) or a ‘?’ if thought to occur in that month but there remains uncertainty. A 2 represents a month a species is present in the pupal stage but only when it overwinters more than once as a pupa. A 1 in column CL titled pup\_multiple refers to a species that obligatorily overwinters more than once as a pupa, a 2 represents when a species sometimes overwinters more than once and a ‘?' is when there the status of the pupa overwintering more than once is unsure. We did not account for latitudinal differences in phenology. |
| adult\_stage (columns CM-CX) | Columns CM-CX represent the 12 months of the calendar year. A species is given a 1 if known to be in the adult stage during that month or a ‘?’ if thought to occur in that month but there remains uncertainty. Moths are attributed with a 1 when the proportion of records in any given month is equal or greater than 1% of all records. Based on data from Eeles (2019), Randle *et al*. (2019), NMRS (2021). |
| overwintering\_stage (Columns CY-DB) | Winter is defined here as the calendar months December to February. 1c under larval means as a larva within a cocoon or cell.  Where a species has more than one overwintering strategy the main strategy is classified as a 1 and the lesser as 2 from Emmet & Heath (1992). A 1? in the column ‘pupa’ represents a species that is thought to overwinter as a pupa but has yet to be fully confirmed. Based on data from Emmet & Heath (1992), Waring & Townsend (2007) and Eeles (2019). |
| specificity | Monophagous species were defined as those being known to feed as larvae on a single hostplant e.g. Pedunculate Oak *Quercus robur*.  Oligophagous (Genus) species feed as larvae on plants within a single genus e.g. oaks *Quercus* spp.  Oligophagous (Family) are those that feed as larvae across two or more plant genera but within one family e.g. a species that feeds within the pea family (Fabaceae) on both *Trifolium* and *Medicago*.  Polyphagous species are those that feed on plants in two or more families.  Based on data in Henwood, Sterling & Lewington (2020). |
| number\_hostplants | Number of main and occasional hostplants the species is known to feed on as a larva according to Henwood, Sterling & Lewington (2020). Plants that a species is ‘also reported on’ in this source are excluded from the count in this column. |
| hostplant\_or\_hostplant\_category | Scientific and England vernacular name of specific hostplant or hostplant genus for species listed as Monophagous or Oligophagous (Genus) in the field ‘specificity’. Interpreted from Henwood, Sterling & Lewington (2020) and plant names based on Stace (2019). |
| hostplant\_or\_hostplant\_category\_scientific | Scientific name of specific hostplant or hostplant genus for species listed as Monophagous or Oligophagous (Genus) in the field ‘specificity’. Interpreted from Henwood, Sterling & Lewington (2020) and plant names based on Stace (2019). |
| hostplant\_native\_or\_non-native | 1- native or predominately native hostplant species, 2- mainly on non-native hostplants but also uses native species, 3 only on non-native hostplant species. Whether a species is classed as native (includes archaeophtyes but not neophytes) is based on data from Stace (2019), BSBI (2021). |
| light\_value | Ellenberg value for light from Hill *et al.* (1999) for the specific hostplant if monophagous or a mean Ellenberg value where there are several hostplants in a single genus e.g. *Salix* spp. Ellenberg values are indices that express the environmental preferences of plant species (Ellenberg, 1979). |
| moisture\_value | Ellenberg value for moisture from Hill *et al.* (1999) for the specific hostplant if monophagous or a mean Ellenberg value for species that feed on a single genus e.g. *Salix* spp. Ellenberg values are indices that express the environmental preferences of plant species (Ellenberg, 1979). |
| reaction | Ellenberg value for reaction from Hill *et al* (1999) for the specific hostplant if monophagous or a mean Ellenberg value for species that feed on a single genus e.g. *Salix* spp. Ellenberg values are indices that express the environmental preferences of plant species (Ellenberg, 1979). |
| nitrogen | Ellenberg value for nitrogen from Hill *et al* (1999) for the specific hostplant if monophagous or a mean Ellenberg value for species that feed on a single genus e.g. *Salix* spp. Ellenberg values are indices that express the environmental preferences of plant species (Ellenberg, 1979). |
| salt\_tolerance | Ellenberg value for salt tolerance from Hill *et al* (1999) for the specific hostplant if monophagous or a mean Ellenberg value for species that feed on a single genus e.g. *Salix* spp. Ellenberg values are indices that express the environmental preferences of plant species (Ellenberg, 1979). |
| broad\_host\_plant\_category (columns DM-EE) | Each species was attributed single or multiple broad host plant categories depending on hostplants listed in Henwood, Sterling & Lewington (2020). Columns include sedges, rushes, grasses, forbs, ferns, broadleaf trees, coniferous trees, shrubs/dwarf shrubs, mosses, lichens/algae, fungi, slime moulds, detritus (wool, fur, feathers etc), dead/withered leaves, live or dead invertebrates/meat, galls, stored goods and other. Willows counted as trees unless Creeping Willow *Salix repens*. Hawthorn *Crataegus monogyna* and Blackthorn *Prunus spinosa* are shrubs.  Four categories were used to attribute each species as follows. 1- Most common hostplants, 2- Occasionally reported hostplants, 3- Also reported on hostplants, 4- Record of hostplant use in continental Europe only where it is not known in Great Britain (England, Scotland and Wales) and Ireland (Republic of Ireland and Northern Ireland). Category 4 is not a complete list of hostplants used in continental Europe as defined by the literature. This category is included only for those species where no larval host plant data are available for Great Britain and Ireland as specified in Henwood, Sterling & Lewington (2020). |
| host\_plant\_section (Columns EF-EM) | Each species was attributed a section or sections of the hostplant where it feeds during the larval stage depending on hostplants listed in Henwood, Sterling & Lewington (2020). Columns EF to EL are roots, stem\_shoot, trunk\_bark, seeds\_berries, flowers\_flower buds\_catkins, leaves\_leaf buds\_fronds\_external, leaves\_internal\_mines, and other when a foodplant section preference doesn’t fit one of the previous categories. If not specified in Henwood, Sterling & Lewington (2020) then it was assumed leaves were used as the hostplant section. |
| common\_hostplants (Columns EN-FG) | Columns EN to FG list the 20 most commonly used hostplants or hostplant genera as stated in Henwood, Sterling & Lewington (2020) and adapted from the hostplant\_list\_unstacked.csv which contains species lists for all hostplants. If a species feeds on one or more of these hostplant species or genera then it is attributed a 1 if it is the main hostplant, a 2 if an occasional hostplant and a 3 if an ‘also reported’ on hostplant. |
| habitat (Columns FH-GB) | Each species was attributed one or more habitats in columns FH to GB on the basis of habitat types used for breeding. This was based upon expert opinion of multiple Butterfly Conservation staff and assisted by sources such as Waring & Townsend (2017), Eeles (2019) and Henwood, Sterling & Lewington (2020).  Breeding habitats are listed as both broad categories (such as 1\_woodland) and more specific subcategories (e.g. 1a\_broadleaved\_woodland). Species were attributed a 1 for each habitat used for breeding. Details and exceptions are listed below:  Column FK 1c\_scrub\_and\_hedgerows- includes species on woody shrubs (except dwarf shrubs and Bog Myrtle *Myrica gale*), young trees in open habitats, species on herbs characteristic of hedgerows, lichen feeders on shrubs. Excludes shrub feeders in woodland understorey, mature tree feeders including willows.  Column FL 1d\_wet\_woodland\_alder\_willow\_carr- includes species on trees and understorey shrubs in wet woodland. Excludes feeders on trees in damp or dry riparian banks.  Column FR. 4c\_acid\_grassland- habitats dominated by fine-leaved grasses with Heath Bedstraw *Galium saxatile* and Tormentil *Potentilla erecta* etc. Excludes species that feed on Purple Moor-grass *Molinia caerulea* in wet grassland habitats.  Column FS 5\_wetland- include permanent wet habitats whether wooded or not, but doesn't include species listed as breeding in damp habitats.  Column GA 7\_montane\_upland- upland defined as ≥300m above sea level for England, Wales, Northern Ireland and southern Scotland. Defined as ≥200m above sea level for Central Highlands of Scotland northwards. A 1 indicates species which are obligate upland species, 2 are species predominately associated with upland areas but will also use lowland areas and 3 are generalist species mainly found in the lowlands but that also extend into the uplands. |

**Headers excluded\_species.csv**

Some adventive species have not been included in this list.

Table 3. Headers of excluded\_species.csv.

|  |  |
| --- | --- |
| **Header** | **Explanation** |
| abh\_number | ABH number of the species as given in Agassiz, Beavan & Heckford (2013). |
| b&f\_number | Bradley and Fletcher number of the species as given in Agassiz, Beavan & Heckford (2013). |
| scientific\_name | Scientific name of the species as given in Agassiz, Beavan & Heckford (2013). |
| vernacular\_name | English common name of the species as given in Agassiz, Beavan & Heckford (2013). |
| family | Family of the species as given in Agassiz, Beavan & Heckford (2013). |

**Headers excluded\_subspecies.csv**

Table 4. Headers of excluded\_subspecies.csv.

|  |  |
| --- | --- |
| **Header** | **Explanation** |
| abh\_number | ABH number of the species as given in Agassiz, Beavan & Heckford (2013). |
| b&f\_number | Bradley and Fletcher number of the species as given in Agassiz, Beavan & Heckford (2013). |
| scientific\_name | Scientific name of the species as given in Agassiz, Beavan & Heckford (2013). |
| vernacular\_name | English common name of the species as given in Agassiz, Beavan & Heckford (2013). |
| family | Family of the species as given in Agassiz, Beavan & Heckford (2013). |

**Headers hostplant\_list\_stacked.csv**

Table 5. Headers of hostplant\_list\_stacked.csv.

|  |  |
| --- | --- |
| **Header** | **Explanation** |
| abh\_number | ABH number of the species as given in Agassiz, Beavan & Heckford (2013). |
| plant\_species | English vernacular and scientific names of the hostplant/s used by the butterfly or moth species, with species identified by abh\_number. Data originally from Henwood, Sterling and Lewington (2020) and plant names following Stace (2019). |
| hostplant\_category | Hostplant/s for the butterfly or moth species were assigned into two categories according to the description in Henwood, Sterling and Lewington (2020). 1= main or occasional hostplant, 2 = a hostplant the species is also reported to use but only rarely. |

**Headers hostplant\_list\_unstacked**

Table 6. Headers of hostplant\_list\_unstacked.csv.

|  |  |
| --- | --- |
| **Header** | **Explanation** |
| abh\_number | ABH number of the species as given in Agassiz, Beavan & Heckford (2013). |
| Columns B-ABO | English vernacular and scientific names of hostplants as given in Stace (2019). A 1 is attributed to the column if the species in that row is known to feed on that species of plant as its main or occasional hostplant as documented in Henwood, Sterling and Lewington (2020). |
| Total | Total number of hostplant species used by the butterfly or moth species found in that row. |

**Acknowledgments**.

We wish to thank all authors of existing datasets that were utilised to compile this database. In particular we wish to thank Barry Henwood, Phillip Sterling, Richard Lewington and Bloomsbury Publishing for providing us permission to incorporate raw data concerning larval hostplants, and Callum McGregor providing advice on the interpretation of estimated body mass data for macro-moths.

**References**

Agassiz, D.J.L., Beavan, S.D., Heckford, R.J., 2013. Checklist of the lepidoptera of the British Isles. Royal Entomological Society, London, UK.

Allen, D., O’Donnell, M., Nelson, B., Tyner, A., Bond, K.G.M., Bryant, T., Crory, A., Mellon, C., O’Boyle, J., O’Donnell, E., Rolston, T., Sheppard, R., Strickland, P., Fitzpatrick, U., Regan, E., 2016, *Ireland Red List No. 9: Macro-moths (Lepidoptera).* National Parks and Wildlife Service, Department of Arts, Heritage and the Gaeltacht, Dublin, Ireland.

Asher, J., Warren, M., Fox, R., Hardin, P., Jeffcoate, G., Jeffcoate, S., 2001. *The Millennium Atlas of Butterflies in Britain and Ireland*, Oxford University Press, Oxford, UK.

BNM., 2021, Butterflies for the New Millennium, Butterfly Conservation, viewed 22.2.2021, <https://butterfly-conservation.org/our-work/recording-and-monitoring/butterflies-for-the-new-millennium>.

Brereton, T.M., Botham, M.S., Middlebrook, I., Randle, Z., Noble D., Harris, S., Dennis, E.B., Robinson A., Peck. K., Roy, D.B., 2020. *United Kingdom Butterfly Monitoring Scheme report for 2019.* UK Centre for Ecology & Hydrology, Butterfly Conservation, British Trust for Ornithology and Joint Nature Conservation Committee.

BSBI., 2021, *Online atlas of the British and Irish flora*, BSBI, viewed 12.2.2021, <https://www.brc.ac.uk/plantatlas/>.

Eeles, P., 2019, *Life cycles of British and Irish butterflies*, Pisces Publications, Newbury, UK.

Fox, R., Brereton, T.M., Asher, J., August, T.A., Botham, M.S., Bourn, N.A.D., Cruickshanks, K.L., Bulman, C.R., Ellis, S., Harrower, C.A., Middlebrook, I., Noble, D.G., Powney, G.D., Randle, Z., Warren, M.S., Roy, D.B., 2015. *The State of the UK’s Butterflies 2015*. Butterfly Conservation and the Centre for Ecology & Hydrology, Wareham, UK.

Fox, R., Parsons, M.S., Harrower, C.A., 2019, *A review of the status of the macro-moths of Great Britain.* Butterfly Conservation report to Natural England. Butterfly Conservation, Wareham, UK.

Fox, R., Warren, M.S., and Brereton, T.M., 2010. *A new Red List of British Butterflies, Species Status* 12; 1-32. Joint Nature Conservation Committee, Peterborough, UK.

Emmet, M., Heath, J.H., 1991. *The moths and butterflies of Great Britain and Ireland volume 7(1)*, Apollo Books, Vester Skernige, Denmark.

Emmet, M., Heath, J.H., 1992, *The moths and butterflies of Great Britain and Ireland volume 7(2)*, Apollo Books, Vester Skernige, Denmark.

Henwood, B., Sterling, P., Lewington, R., 2020, *Field guide to the caterpillars of Great Britain and Ireland*, Bloomsbury Wildlife, London, UK.

Hill, M.O., Mountford, J.O., Roy, D.B., Bunce, R.G.H., 1999, *Ellenberg’s Indicator Values for British Plants*, Institute of Terrestrial Ecology, Huntingdon, UK.

Kinsella, R.S., Thomas, C.D., Crawford, T.J., Hill, J.K., Mayhew, P.J., Macgregor, C.J., 2020. Unlocking the potential of historical abundance datasets to study biomass change in flying insects. *Ecology and Evolution*, **10**(15), pp.8394-8404, DOI: 10.1002/ece3.6546.

Nash, D., Boyd, T., Hardiman, D., 2012. *Ireland’s butterflies a review*. Dublin Naturalists Field Club, Dublin, Ireland.

NMRS., 2021, National Moth Recording Scheme, Butterfly Conservation, viewed 22.2.2021, < https://butterfly-conservation.org/our-work/recording-and-monitoring/national-moth-recording-scheme>.

MothsIreland., 2021, MothsIreland Mapping Ireland’s Moths, MothsIreland, viewed 22.2.2021, <http://www.mothsireland.com/>

Porter, J., 1997, *Colour identification guide to the caterpillars of the British Isles*, Apollo Books, Vester Skernige, Denmark.

Randle, Z., Evans-Hill, L.J., Parsons, M.S., Tyner, A., Bourn, N.A.D., Davis, T., Dennis, E.B., O’Donnell, M., Prescott, T., Tordoff, G.M., Fox, R., *Atlas of Britain and Ireland’s larger moths*, Pisces Publications, Newbury , UK.

Regan, E.C., Nelson, B., Aldwell, B., Bertrand, C., Bond, K., Harding, J., Nash, D., Nixon, D., Wilson, C.J., 2010, *Ireland Red List No. 4 – Butterflies*. National Parks and Wildlife Service, Department of the Environment, Heritage and Local Government, Ireland.

Rothamsted Insect Survey., 2021, Insect Survey, Rothamsted Research, viewed 22.2.2021, <https://insectsurvey.com/moth-data>.

Stace, C., 2019, *New flora of the British Isles*, Fourth Edition, C&M Floristics.

Thompson, R. and Nelson, B 2006 *The Butterflies and Moths of Northern Ireland*. National Museums Northern Ireland, Belfast.

Thomson, G., 1980. *The Butterflies of Scotland*, Croom Helm, United Kingdom.

UKBMS., 2021. UK Butterfly Monitoring Scheme, UKBMS, viewed 22.2.2021, <https://ukbms.org/>.

Waring, P., Townsend, M., Lewington, R., 2017, *Field guide to the Moths of Great Britain and Ireland*, Third Edition, Bloomsbury Wildlife, London.