Bloomsbury Wildlife Guides

Field Guide to the Moths of Great Britain and Ireland

Third edition

Paul Waring
Martin Townsend
Illustrated by **Richard Lewington**

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Mark Tunmore (assistance with immigrant moth accounts)
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Authors: Paul Waring, moth conservation consultant; **Martin Townsend**, consultant ecologist and moth recorder for Oxfordshire
Illustrator: Richard Lewington, one of Europe's leading natural-history illustrators

Dedications
To my late parents, Doris and Clifford Waring, who encouraged my interest in moths in my formative years and who both died while this guide was in preparation; to my daughter, Kirsty Mae, who was born at the same time as the book, and to my wife, Rachel Thomas, for her support throughout. P.W.

To my late parents, Denis and Barbara Townsend, whose own love and knowledge of the natural world led to my interest in insects and other wildlife; to my wife Liz for her support during the revision for the third edition. M.T.

Bloomsbury Natural History
An imprint of Bloomsbury Publishing Plc

50 Bedford Square
London
WC1B 3DP
UK

1385 Broadway
New York
NY 10018
USA

www.bloomsbury.com

This electronic edition published in 2017 by Bloomsbury Publishing Plc

First edition published 2003
Reprinted (with corrections) 2004, 2006
Second edition published 2009
Reprinted 2011, 2013, 2015
Third edition published 2017

British Library Cataloguing-in-Publication Data
A catalogue record for this book is available from the British Library.

ISBN: HB: 978-1-4729-3029-3 ePDF: 978-1-4729-3031-6
PB: 978-1-4729-3030-9 ePub: 978-1-4729-3032-3

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Preface to the third edition

A great deal has happened with moths and moth recording since the second edition of the *Field guide to the moths of Great Britain and Ireland* was published in 2009, and this new edition sets out to reflect as much of that as possible. Recording of all larger moths in Britain and Ireland is now more popular and more sociable, and has better geographical coverage, and the coordination and speed of dissemination of records are better than ever before, to a large extent due to advances in technology, including the mobile variety. The National Moth Recording Scheme, run by Butterfly Conservation and launched in 2007, brought together the network of county moth recorders, leading to the publication of the *Provisional atlas of the UK's larger moths* in 2010 (Hill *et al.* 2010) based on the 11.3 million records accumulated to the end of 2010. A further, more complete, atlas is in the pipeline. Recording schemes, including online maps, flight period charts and other information, were subsequently set up for Scotland (through Butterfly Conservation) and for all of Ireland (Moths Ireland), which, along with the increase in recording, have resulted in huge improvements in our knowledge of moths in these areas.

Websites related to moth recording have proliferated, often dedicated to moths of particular counties or countries. These now cover most parts of the British Isles, and include county lists, distribution maps, flight season charts and records of immigrant species. Information is also accessible via the National Biodiversity Network (NBN) Gateway website, which holds records and maps of all fauna and flora. New discoveries continue to be published in the entomological journals and magazines, in particular *Entomologist's Record and Journal of Variation* (including detailed annual summaries of immigrant records) and *Atropos*, and books about the moths of individual counties also continue to be published.

Synthesising, verifying and summarising all the new knowledge has made abundantly clear how much more we now know about the increasingly profound effects that the results of human activities – in particular habitat change and loss, climate change and the accidental transportation of insects through international trade and travel – are having on our moth fauna. There have been gains and losses. The geographical range of many species has increased out of all recognition compared to 30–40 years ago. Examples are Orange Footman and Pale Pinion, and the strikingly marked day-flying Jersey Tiger. Others that were formerly widespread, such as Pale Shining Brown and Stout Dart, have declined drastically and may be struggling to cope with the altered climate, especially in southern inland areas, and there are signs that some northern and montane species are retreating to higher altitudes and further north. The trend for northward expansion of additional generations each year continues, and flight seasons in many cases are starting earlier. Exceptionally mild weather in autumn and early winter is causing premature emergence, and has also resulted in unprecedented immigrations, improving the chances of potential colonists and probably contributing to the northward drift of established residents. Colonisation is already increasing, as part of a trend for species to spread westwards to and within mainland Europe. In the second edition we noted that 2006 was an exceptional year for immigration of the very large and spectacular Clifden Nonpareil (or Blue Underwing), with at least 22 recorded, and it has since recolonised parts of southern England.

The similarly dynamic situation in terms of overall abundance has been highlighted in two recent *The state of Britain's larger moths* reports (Fox *et al*. 2006, 2013), using data gathered from over 40 years in the Rothamsted Insect Survey light-trap network. This work has concentrated on the more numerous, widespread species, for two-thirds of which declines (some over 90 per cent) have been recorded, many thought to be related to increased habitat loss and fragmentation, or climate change. Yet this has occurred at the same time as large increases (in a few cases spectacular, such as in the case of Least Carpet and Treble Brown Spot) and northerly spread of many species, along with huge increases in some of those feeding on lichens and conifers (such as Buff Footman and Spruce Carpet). We have made selective mention of these and would suggest that interested readers obtain copies of the reports and watch out for the new atlas, which will doubtless examine these trends in greater detail.

Observations on moths are being made on a daily basis, and the moth fauna of the British Isles is constantly changing, so no book will ever be a complete account. Parsons (2003) reports that, for the 20th century, in Britain the rate at which resident moth species are being added to the list is increasing, and the balance sheet of gains (successful colonists) to losses (extinctions) for all moths and butterflies is 66 lost to 89 gained. We tend to be gaining highly mobile species, predominantly of exotic foodplants or disturbed and degraded habitats and warmer climates, and losing species often closely associated

with some of our best-quality semi-natural habitats, such as the Essex Emerald of mature saltmarsh and the Viper's Bugloss, dependent on the rare native Spanish Catchfly in extensive Breckland.

On top of all of this, a completely new *Checklist of the Lepidoptera of the British Isles* was published by the Royal Entomological Society in 2013 (Agassiz *et al.* 2013), which, along with corrections and additions published in 2016, we have adopted (see Introduction for further details). This list brings us much more into line with the European checklist. There have been many changes to the scientific names of species and, in many cases, the order of the species within a genus, and also that of the genera and sub-families, has changed. The arrangement of the families is broadly similar, but some familiar ones have been demoted to sub-family status. The changes are perhaps most pronounced in the Noctuidae, with some groups moved to the Erebidae, a family never previously featured in British checklists. In the new checklist, species recorded doubtfully or only as accidental introductions are now listed separately, providing a clear demarcation between these species (most of which have only ever been recorded once or twice) and those that genuinely occur naturally. For the purposes of this field guide, we were therefore able to dispense with the appendix of species accounts from our previous editions (with a handful of species retained or mentioned in the species accounts). To help the reader navigate through the new taxonomic sequence, the book has been indexed by the specific names as well as by the generic names.

The existence and accessibility of all this new and varied information meant that, in order to make the third edition as up to date and useful as possible, it was necessary to undertake a thorough review of the text, as well as providing 55 additional illustrations covering 19 species, of which ten have occurred in the British Isles for the first time since the second edition. Numerous recent observations, including our own, personally communicated or published elsewhere, on various aspects of the identification and biology of individual species have also been added, and we have engaged in a considerable amount of correspondence with recorders. However, time constraints meant that it was not possible to contact everyone, and information often has had to be summarised, but we continue to welcome any additional observations or comments.

The third big change in this third edition is the inclusion of maps showing post-2000 moth records. The maps have been produced by Chris Manley and are derived from those in his own *British moths* (second edition, 2015), which were based on the 2010 *Provisional atlas*. Amendments were made by Martin Townsend, as part of the process of updating the text. Further detail on the maps can be found in the Introduction. We hope readers welcome all the changes and improvements made, and find the book helpful and stimulating.

Paul Waring, Martin Townsend and Richard Lewington
September 2016

Acknowledgements

As for the first and second editions, information included in this third edition has come from a great many sources. Many people – too numerous to list fully – have offered new information and constructive comment, have published papers and articles that have increased our knowledge, or have produced websites with distribution maps and flight period charts. We are extremely grateful to them all.

A number of individuals deserve special mention for help with this and/or previous editions, including: Andrew and Anne Branson, Mark Parsons, Richard Fox and Les Hill (Butterfly Conservation); Sean Clancy (immigrant moth recorder); Deborah Procter (Joint Nature Conservation Committee); Martin Honey, John Chainey and Geoff Martin (Natural History Museum, London); Dave Allen, Angus Tyner and Andrew Crory (Ireland); Roy Leverton and Mark Cubitt (Scotland); and Chris Manley (provision of, and alterations to, distribution maps). Thanks must also go to David Agassiz, Martin Albertini, Martin Anthony, Rich Austin, Jon Baker, Melissa and Andrew Banthorpe, David Brown, Dave Budworth, Martin Cade, Julian Clarke, Graham Collins, Martin Corley, Graham Crittenden, Barry Dickerson, Ian Ferguson, Charles Fletcher, Andrew George, Brian Goodey, Martin Gray, Colin Hart, Martin Harvey, Paul Harvey, Bob Heckford, Gary Hedges, Barry Henwood, Tony James, Mark Lawlor, Roger Long, Brenda Marney, the late Michael Marney, Andrew Masterman, Neil Money, Steve Nash, Steve Palmer, Sarah Patton, Colin Plant, Colin Pratt, Chris Raper, Alison Robertson, Ian Scott, David Slade, Michael Taylor, Robin Taylor, George Tordoff, Gerry Tremewan, Leon Truscott, Mike Wall, David Wedd and Sheila Wright. We also thank Katy Roper (Bloomsbury) for her invaluable help, input and guidance at the writing stage, Susi Bailey for her excellent copy-editing, Michael Jones for proof-reading, and similarly David and Namrita Price-Goodfellow at D & N Publishing for the production and design of the third edition. With apologies to anyone inadvertently omitted.

Introduction

This field guide is written for everyone interested in moths, from the beginner to the long-term enthusiast, and from the amateur naturalist with a passing interest to professional lepidopterists, biological surveyors and conservation land managers. In order to make the guide more user-friendly, technical terms have been avoided wherever possible.

One of the major reasons for embarking on this field guide is the difficulty many people have, frequently expressed among the many new moth enthusiasts, in identifying a live moth, with wings folded at rest, from a photograph or painting of a set specimen with its wings spread out. The moths in this field guide are generally shown in their normal resting positions because the emphasis is on identifying live moths, unless the salient features are not visible when the moth is at rest.

Moths are often dismissed as drab, night-flying relatives of butterflies. A thumb through the illustrations in this guide shows quite the opposite. In terms of colour, many moths are as brightly patterned and as attractive as butterflies. In terms of wing shape, body form and size, moths are much more varied than butterflies, and there are so many more species in which to take an interest. One of the largest resident moths in Britain is the Privet Hawk-moth, which is as big as a mouse, as is the immigrant Death's-head Hawk-moth, which even squeaks like one! This field guide aims to help the reader navigate through this amazing variety of adult moths.

The text covers the latest details on their life cycle, foodplants, habitat, status and distribution. All the naturally occurring larger or so-called 'macro-moths' that have been reported 'in the field' in Britain, Ireland and the Channel Islands are covered, from the abundant species you are likely to see in any garden to the rarest of immigrants that have flown to Britain from other parts of the world.

How to use this field guide

To identify a moth

Some moths have strikingly distinctive wing patterns or other features that enable identification simply by looking through the illustrations to find an exact match. The plates are grouped taxonomically, i.e. into families of moths, which often share a similar wing shape, posture and body form. With practice, you will be able to recognise the families, and therefore know where to search. In other cases, you will find that several species provide a fairly good match and you will now need to scrutinise certain details. Turn to the text for the species and use the 'Field characters' sections to examine the diagnostic features, which in most cases should enable you to finalise your identification. Also take into account variation, habitat, location and time of year, but bear in mind that moths sometimes appear in the 'wrong' place and at the 'wrong' time, or species are discovered in parts of Britain where they have never been seen before, so do not dismiss your identification purely on that basis. Knowledge of geographical distributions is continually being updated, so you might find that you have made an important new discovery, for example, a new country or county record. The 'Similar species' section of the description draws attention to other species to check. Take a photograph of the moth if at all possible. This will provide a long-term record of the species, which can be checked by other people at any time in the future, although bear in mind that in some cases it will not be conclusive, and it may be necessary to show the actual moth (rather than a two-dimensional image) to an expert to obtain confirmation and acceptance of the record. Many people seek guidance with identifications from more experienced recorders, particularly when they are just starting to familiarise themselves with moths, by posting photographs on social media (notably on blogs). However, it is important to be aware that photographs of moths posted on the Internet are sometimes incorrectly identified, so be careful where you look. By far the best way to become proficient at recognising moths is to

try to make your own identification first, by potting the moth and studying it at length, rather than taking a long series of photographs and trying to identify it later (which, although it may be more convenient, often proves more difficult).

A small minority of species cannot be distinguished reliably by their immediate external appearance. In some cases, only small details on the underside of the abdomen or elsewhere enable certain identification, and diagrams of these features are shown in the guide or references to other publications are provided. For a very few species, it is necessary to look at diagnostic differences in the genitalia, situated at the tip of the abdomen. Moth genitalia are quite complex. The male has a pair of claspers with which he grasps the female, in addition to a penis-like structure (the aedeagus) and other associated structures for opening the female aperture (known as the ostium). The male genitalia are sculptured and have patterns of bristles, all of which fit together with the female genitalia of the same species, rather like a lock and key. In many cases, mating with another species is physically impossible. Consequently, the genitalia of a species vary very little, and so are extremely useful in identifying moths and in confirming tentative identifications made using other more variable characters. Where features of the genitalia can be viewed without dissecting the moth, illustrations are given. Where dissection is needed, the reader is referred to more specialist resources for methods and diagrams (including Townsend *et al.* 2010).

Illustrations

Each of the species illustrated is represented by at least one example of the adult, usually a male. Where the female differs substantially in appearance, this is also illustrated. Additional illustrations are provided where a species varies greatly or more than one subspecies occurs. Sometimes additional diagnostic features are shown, including the hindwing. Photographs of a number of larvae have also been included. These have been selected to show the great diversity of form between, and even within, family groupings. The selection includes widespread species, and others that are more localised or rare but are of particular interest.

Format of the species accounts

Nomenclature, taxonomic changes and the 'new' checklist English names, scientific names and taxonomic order are as given in the most recent checklist and corrigenda, addenda and amendments (Agassiz *et al.* 2013, 2016a,b). The English names have the advantage that they have remained largely stable for the last 200 years (compare the English and scientific names in this guide with those in 19th- and early 20th-century works).

Anyone with long-term experience of any branch of natural history will know that scientific names and taxonomic relationships are far from being set in stone. In entomology in particular, rather like the organisms they describe, the system is itself subject to an 'evolutionary' process, as understanding of status and phylogeny changes (and hopefully becomes more accurate). We all, to some extent, find the resultant changes frustrating, but it is unavoidable given the vast numbers of species involved (including the many as yet undescribed) and the still relatively superficial nature of our knowledge in some areas.

The previous revision of the British Isles checklist was Bradley (2000), as used in earlier editions of this field guide. Considerable advances in taxonomic techniques and analysis have occurred since then, including traditional studies of external features and genitalia, but also the wider use of DNA. In fact, the 2000 list did not take into account all of the thinking elsewhere in Europe, including elements of the European checklist (Karsholt & Razowski 1996, now superseded by the Fauna Europaea project; see 'Websites' on page 438). Therefore, it was inevitable that the next British checklist was going to result in something of an upheaval. The ordering of families, genera and species within (or between) genera is now considerably different, sometimes along with all or part of the scientific name. In previous editions of the guide, we adhered very closely to the recognised checklist and we continue to do so. Agassiz *et al.* (2013) has a main section comprising species occurring naturally (unlike Bradley, who placed everything in one list), and those recorded doubtfully or only as accidental introductions (adventives) are listed separately, in appendices.

This time, we do not include an appendix with additional species accounts and simply cover all the species in the main section of Agassiz *et al.*, plus an additional three, namely African, Eastern Bollworm and Spiny Bollworm, which we feel may well have been genuine immigrants, at least in some instances. Adventive or doubtfully recorded species are generally not mentioned, except in a few cases where confusion with other, accepted, species is known to be likely.

A new numbering system has been adopted in the current checklist and we have provided that, along with the Bradley (2000) numbers (in parentheses), for cross-referencing on databases, collections and older works. The new code numbers are of the form X.XXX or XX.XXX. The digits before the decimal point are those of the family to which the species belongs, while the three after the decimal point indicate the species, so that each has a unique code. In the checklist appendices, doubtful or adventive species are numbered according to their taxonomic position, with an additional sixth digit, so that if they subsequently need to be moved to the main list, they can be slotted in easily. Newly recorded, naturally occurring species are treated in the same way, and this has already begun to happen, with four having already been added since 2013 (Agassiz *et al.* 2016b).

Field characters and similar species This begins with the forewing length, i.e. the distance from the forewing tip to the point where it joins the thorax (see Fig. 1), to indicate the size of the moth. If necessary, this measurement can be taken by holding a pair of dividers close to the moth without touching it, provided it is docile. Forewing length is given rather than wingspan because the latter can be measured only when the wings are spread. The diagnostic features of the moth are then given, together with a description of its variation. When describing features of the wings, the standard convention is to describe the wing in the singular. When the description states that there are two or more spots, cross-lines or other markings, this is the number on each wing. For species with two or more distinct subspecies or forms, these are also named and described. Also, species that can easily be confused are listed and diagnostic features are given to separate them. Often, to avoid repetition, these features will be found under one of the confusion species.

Flight season The number of generations per year is specified and, if this varies in different parts of the British Isles, this is stated. The approximate period when each generation is on the wing is given, i.e. when you can usually expect to find the adult moth. Moths generally emerge earlier in the south than in the north, until late summer, when the onset of autumn and emergence of its associated moths is earlier in the north. Also, flight seasons for many species vary from year to year, and since the early 1990s many have been earlier than the long-term average by as much as two weeks. This correlates with higher-than-average temperatures, and has led to much interest in the use of moths to monitor the effects of climate change. Every year, occasional individuals are reported well outside the usual dates, for reasons that are not always clear.

Other aspects of adult behaviour are also reported in this section. The moths are nocturnal, unless otherwise stated. We use the term 'comes to light' to cover all sources of light normally used for attracting moths. The extent to which they come to light and baits (see pages 20–21 for more information on these) is given, and this applies to both sexes unless otherwise stated. The term 'comes to sugar' is used as a short-hand term for sugaring mixture, wine-roping and other sweet baits.

Life cycle The overwintering stage is given first, because much practical habitat-management work is done during the winter period, with the intention of minimising the impact on wildlife. It is crucially important to site managers that they know how and where particular moth species spend the winter. Many are dormant below ground as larvae or pupae, but others spend the winter as eggs, larvae or pupae on or inside the twigs of both living and dead trees, shrubs and herbaceous plants, or as adults in caves, cold buildings, among dense vegetation or under loose bark, and are likely, for example, to be removed by scrub clearance or felling. Relatively little is known about pupation sites of some moths, but many species pupate in the earth, unless it is

too hard to burrow into, while others remain on the ground surface among plant debris, such as fallen leaves.

Larval foodplants Although this guide is intended for the identification of adult moths, their early stages are also fascinating, and some understanding of the larval requirements is necessary to select appropriate places to search for particular moths and to interpret the results obtained from light-trapping and other monitoring of the adults. The English plant names used in the guide follow Stace (2010). An effort has been made to specify the exact species wherever possible, and these begin with capital letters. The scientific foodplant names are listed on pages 439–443. In previous works, there has been a tendency to list some foodplants generically, but this can be misleading. For instance, many larvae found on Pedunculate Oak are likely to refuse Holm (Evergreen) Oak. Unless stated otherwise, the larva eats the leaves. The most frequently used foodplants are listed first. If a wide range is involved, closely related plants generally appear together. Some moth species have clear preferences for either mature or scrubby growth in the case of trees, or for plants growing in the open or the shade, and where it is known this is indicated. There is much work to be done on this subject and it is hoped that this guide will stimulate readers to fill such gaps in our knowledge. Larvae have often been reared in captivity on common and readily available plants such as Dandelion and chickweeds. These are not listed in the accounts, except for the minority where the foodplants in the wild are unknown.

Habitat The descriptions used are largely self-explanatory. They are intended to indicate the major habitat types occupied, and whether the species prefers calcareous (e.g. limestone, chalk), acidic (heathland, moorland, bogs), wet or dry (e.g. marshes, sand-dunes), open or sheltered, upland or lowland, and inland or coastal locations. Where certain habitats are preferred, these are presented first, but many species occur equally in a wide range of habitats. Where a species is likely to be found in most gardens within its geographic distribution, this habitat tends to be given near the front of the list, because this is the most accessible habitat for the majority of people. If gardens appear late in the list, you have a fair chance of recording the species in gardens, but the moth is much better represented in other habitats.

Status and distribution Most species are described as 'Resident' or 'Immigrant', or sometimes as both. 'Resident' means breeding and surviving the winter, such that the populations are not dependent on annual migration from elsewhere for their survival. The term 'Immigrant' is used where the species has flown to the British Isles under favourable conditions from origins outside, sometimes as far away as North Africa and eastern Europe. They are most frequently recorded on the coast and some have been seen flying across the English Channel or arriving from the North Sea. Others are likely immigrants but are not proven to be so, and are listed as 'Suspected immigrant'. The total numbers given are partly based on information published and posted on the Internet (see Further Reading, page 436) by the national recorder for immigrant moths, Sean Clancy, as well as other recent publications, Internet postings and personal communications.

Other moths have clearly been accidentally or deliberately imported (often with goods or produce), or released from captivity. A few have been captured in the field, but many have origins so far away from Europe that their arrival by natural means is extremely unlikely. In our previous editions we labelled these as 'Accidental introduction', 'Import' or 'Suspected import'. In this edition we have adopted the generally accepted collective term 'Adventive'.

Every species occurring naturally in Britain is assigned a national conservation status by the Joint Nature Conservation Committee (JNCC), and these are provided. They are now out of date for some species, because of changes in the distribution of the species and/or our knowledge of it, so that in some cases there is a considerable discrepancy between the grading and our current knowledge. However, updating on the scale required can be done only under a formal review, which Butterfly Conservation, as lead organisation, is currently undertaking for the government agencies. It is a complex process and may involve changes in the criteria used in assigning designations. The basis for the various categories will change to take into account new criteria

from the International Union for the Conservation of Nature (IUCN) for defining Red Data Book gradings, along with new delineations for national rarity. Unfortunately, the results are not yet available. So, for this third edition, the statuses are unchanged from the second edition.

The status categories used are as follows:

- Red Data Book species (RDB) – species included in the *British Red Data Books 2. Insects* (Shirt 1987) or meeting Red Data Book criteria subsequently. All resident species known from 15 or fewer 10km squares in Britain. More recently introduced criteria give greater emphasis to rates of decline, and declining species with recent records (the last 25 years) from more than 15 10km squares can be admitted to this category.
- pRDB species – proposed here as Red Data Book species in the next review because information indicated the species met then current criteria. Note that this is different from Provisional RDB (also commonly abbreviated to pRDB), which refers to lists published by JNCC prior to review.
- Nationally Scarce A (Na) – recorded from 16–30 10km squares in Britain since 1 January 1980.
- Nationally Scarce B (Nb) – recorded from 31–100 10km squares in Britain since 1 January 1980.
- Local – recorded from 101–300 10km squares in Britain since 1 January 1960.
- Common – recorded from over 300 10km squares in Britain since 1 January 1960.
- Uncommon on introduced foodplant (alien host) – recorded from less than 100 10km squares in Britain since 1980 but all known larval foodplants are non-native.
- Naturalised – species artificially introduced and now breeding successfully in the wild.
- Immigrant – flown or transported by wind from sources outside the British Isles. Note that resident populations may be supplemented by immigrants.
- Adventive – originating outside the British Isles and usually found with imported goods or in their vicinity, such as in docks and warehouses. Referred to as 'Import' or 'Accidental introduction' in the second edition.

Waring (1994) annotated every species of macro-moth on the British list according to this system. The list was reviewed by Waring (1999b) and then again for the first (2003) and second (2009) editions of this field guide when new proposals were drawn up, in consultation with JNCC, for a small number of species, in order to take account of additional data. These listings have been widely adopted by moth recorders, in county lists and biological recording packages. This third edition follows Waring (1999b), with the following few proposals (as per the second edition): False Mocha, Nb (was Local); Slender-striped Rufous, Na (was Na, then RDB); Pretty Pinion, Local (was Nb); Marsh Pug, Nb (was Local); Four-spotted Footman, Na as well as Immigrant; Cousin German, Na (was Na, then RDB); Stout Dart, pRDB (was Local, as in the first edition of this book); Pale Shining Brown, pRDB (was Nb); Bordered Gothic, pRDB (was Na, now probably extinct in Britain); White-spotted Pinion, pRDB (was Na); and Brighton Wainscot, pRDB (was Na, now probably extinct in Britain).

There are three main components to the accounts of distribution, i.e. the parts of the British Isles in which the species occurs, the density, uniformity or pattern of distribution within these areas, and the frequency with which the species is normally encountered in the field. For species present over large areas of Britain, terms such as northern and western, upland and lowland are used, sometimes in combination. Note that south-east England is used here to mean Surrey, Kent and Sussex mainly, and is not intended to include parts of Essex, which is generally treated as part of East Anglia. Very localised species are described in terms of the counties they occupy. Moth recording has been based on the Watsonian vice-county system since the 19th century (see https://en.wikipedia.org/wiki/Vice-county) and this continues to be the case, since unlike modern political boundaries they are not subject to change. Generally, this guide uses vice-counties or amalgamations of them (e.g. East and West Sussex into Sussex, Yorkshire to mean its five constituent vice-counties). A noteworthy exception is use of the term Cumbria, which is a readily understood amalgamation of the cumbersomely named vice-county of Westmorland with North Lancashire with the vice-county of Cumberland.

In many cases, the vice-county boundaries are clearly demarcated on the ground by rivers and other landscape features. In Scotland, many moth distributions follow the valleys of the major

rivers and associated lowlands, so it sometimes makes more sense to refer to Speyside and Deeside, for instance, than to list the vice-counties. In most cases in England, the text would read the same whether using names of amalgamated vice-counties or modern county names. Exceptions include the large part of vice-county Berkshire in modern Oxfordshire. Where it is helpful or prevents confusion, the modern county is added. Within Britain, we have usually distinguished the individual countries in the text, partly because there are often major differences in the patterns between them, due to geographical features (such as hills and mountains), habitat and climate. However, we have treated Ireland as a single geographical entity, partly because ecological differences between Northern Ireland and the Republic of Ireland are less clear, and partly for brevity. We have used Britain as short-hand for Great Britain. The abbreviation 'Man' is used for the Isle of Man and 'Scilly' for the Isles of Scilly. Since the range of many species has changed, the new distribution sections are designed to emphasise this, while at the same time retaining the essential historical information. The assessment of the pattern and density of distribution is largely based on that of the 10km squares from which the species has been recorded. The following terms are used, although the criteria are necessarily somewhat loose:

- Very well distributed – records from almost every 10km square.
- Well distributed – records from a majority of 10km squares.
- Quite well distributed – areas without records not overwhelming.
- Local – localised or patchy distribution of records.

The distribution of species with relatively few records is described in greater detail. An indication of the usual frequency with which the moth is encountered is also given. Most often this is based on impressions from use of mercury vapour light-traps, but sometimes species are found to be more numerous using other techniques; if so, this is stated.

The number of moths recorded on a site visit depends partly on the trapping or searching effort. As a very rough guide to what is intended by the following terms, they are based on, and explained in terms of, the experience of a lone trapper with one to three mercury vapour light-traps. The categories are:

- Abundant – often 100 or more individuals per light-trap in a single night at peak season (e.g. Large Yellow Underwing).
- Frequent – often more than ten individuals in a visit to an occupied site, or seen on most visits during its flight season.
- Fairly frequent – seen on most visits to occupied sites, but seldom as many as ten individuals at one time.
- Occasional – unlikely to be seen on most site visits during its flight season and seldom as more than one or two individuals, but likely to be encountered every year. Species insufficiently numerous to be 'Occasional' are described more specifically, and for species with few records, these may be listed individually.

Use of these terms for moths on Man, Ireland and in the Channel Islands is according to information supplied by the respective local recorders and not necessarily as above.

Distribution maps As mentioned in the Preface, records from 2000 onwards were used to draw up the distribution maps, which were originally based on the 10km square dot maps in *Provisional Atlas of the UK's Larger Moths* (Hill *et al.* 2010) and the Moths Ireland maps. It is an acknowledged fact that substantial geographical gaps exist in the provisional atlas maps. It was therefore necessary to update both text and maps, to interrogate these and other resources (as described in the Preface), and to consult with recorders, in order to verify data. Much pre-existing text relates to records made before 2000, but remains important and informative, and where significant changes have occurred, the text is designed to complement the new maps. In particular, where a species has been recorded from a particular area but only pre-2000, this is stated although the date may not be given.

When interpreting the maps, it is important to remember that they have not been created by a sophisticated digital system, and are intended only to give an overall impression of the range of a species, which may be restricted to certain habitats or altitudes within that range, so that records may in reality be thinly scattered. Similarly, in the case of outlying groups of islands, distinction is not made on the maps between the islands in that group (presence or absence of a species is indicated for the Channel Islands as a whole, for example). The accompanying status and distribution text complements the maps by providing extra detail where readily available (often including something on the history of the moth), especially for the rarest species. For species that are both resident and immigrant, it is often very difficult to assign records to one or the other, so we have not attempted to do so. We are very aware that published or mapped records can later turn out to be spurious. In spite of strenuous efforts to establish the veracity of records (especially outlying ones), we cannot claim 100 per cent accuracy. Maps can also be biased by recording effort (i.e. simply the distribution of recorders), and this was also taken into account as much as possible. Also, overall recording effort is now much greater than in the past, although the vast majority of major geographical changes are undoubtedly real.

For one species, the New Forest Burnet, which survives in the British Isles at a single site only, no map is included. This is intentional and has been done so as not to increase the risk of undesirable (and illegal) interference with that one remaining population. Maps are not provided for suspected immigrant species that have been recorded only very few times. In these instances, details of their capture are set out in the text.

Moths in more detail

Moth anatomy

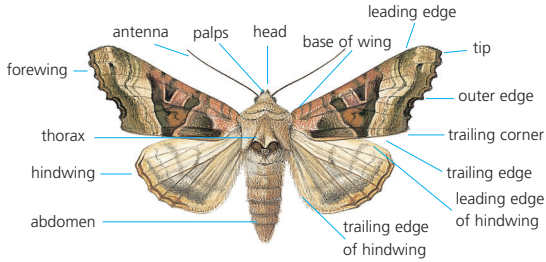
The illustration opposite (Fig. 1) shows the Angle Shades moth at rest and with wings spread, as in a set specimen. This shows how some diagnostic features such as resting posture (in this case with furled wings) are lost, while conversely, features of the hindwings are revealed. The difficulty many people have in mentally translating the resting moth into the set specimen is one of the main reasons for producing this guide. Illustrations of Lesser Yellow Underwing and Common Emerald are used to show the main anatomical terms used in the guide.

The life cycle of the moth

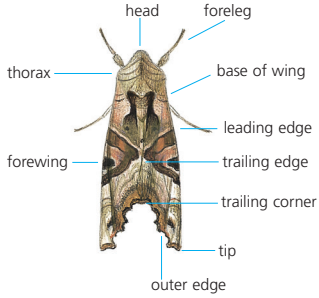
Larvae, larval foodplants and pupation Moths reproduce by laying eggs, which hatch into caterpillars, commonly known among moth enthusiasts as larvae (plural) or larva (singular). The larvae are 'feeding machines', which do all the eating and weight-gain necessary to produce an adult moth from a tiny egg. Most moth larvae feed on plant material, usually eating the leaves. Others eat the flowers, fruits or roots, or bore into the stems or rootstocks. Most are specialists in particular plants or groups of plants, and in many cases will starve rather than feed on anything else. A small number feed on lichens and fungi, and a few are partly carnivorous.

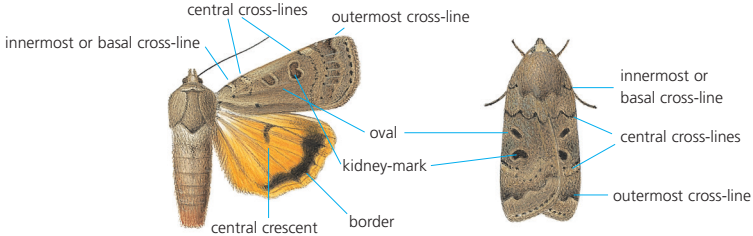
As the larva grows in size, it sheds its skin in order for expansion to occur, revealing a new skin that has formed underneath (a process called ecdysis). This typically happens four times before the larva moults to produce what outwardly looks like a resting stage, the chrysalis, or pupa. For moths, it is generally called the pupa (singular) or pupae (plural), and the act of forming the pupa is known as pupation. The larvae of many species of moths leave the larval foodplant and burrow into the ground before forming the pupa, or pupate among leaf litter. Others attach themselves to the foodplant in various ways, frequently spinning a cocoon of silk, often spun between leaves or in grooves or cracks in loose bark, or soft, rotten wood. Some are even spun inside the plant near exit holes made by the larva.

Figure 1

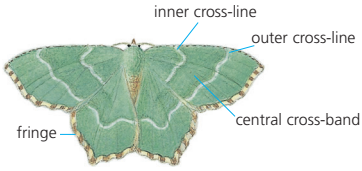


Angle Shades
Phlogophora meticulosa





Lesser Yellow Underwing
Noctua comes

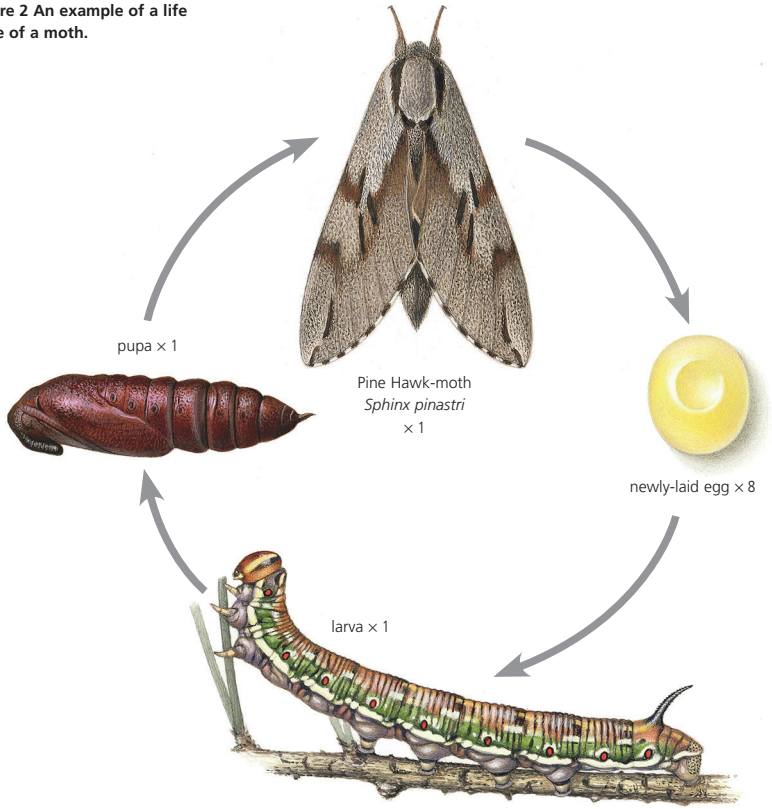


Common Emerald
Hemithea aestivaria

From pupa to adult moth to egg-laying and dispersal Inside the pupa, the body of the insect is rebuilt to form the adult moth, which breaks out of the pupa and expands its initially soft wings by pumping fluids into them and allowing them to dry. It is then ready to take flight. For male moths, the main activity is to find females and mate with them. They do this by following scents released by unmated females. Sometimes mating takes place before the female has dried her wings, and there are even species in which the male locates the cocoons of females and simply waits for them to emerge. Others emerge with the gonads immature and must feed and/or undergo a period of dormancy before mating can occur. The main activities of the female moth are to attract a mate, and to survive long enough to lay as many eggs as she can, which may be over 100, or even 1,000.

Often the females do not move far from the larval foodplants, particularly in the early phase of egg-laying. They may spend much time gluing eggs to particular parts of the foodplant, either singly or in large batches, although others lay them loose and the larvae have to locate

Figure 2 An example of a life cycle of a moth.



the appropriate foodplants. Once some eggs are laid, the females weigh less and may show a greater tendency to wander and seek out new supplies of foodplant.

In many species, the males, or both sexes, feed like butterflies, with a tube-like tongue, known as the proboscis. They feed for energy at sugary substances, such as the nectar produced by flowers, honeydew excreted by aphids (which often accumulates on leaves) or the sap that oozes from wounds on tree trunks. Others have no requirement to feed and have reduced, non-functional mouthparts, existing instead on the energy provided by fats and carbohydrates accumulated when they were larvae.

For most moths, the adult stage is also the main means of dispersal and colonisation of a new habitat. Some individuals fly great distances, leaving breeding grounds in the south of Europe and flying north to reach the British Isles as immigrants. Certain species display a strong tendency to migrate and arrive in numbers annually from mainland Europe, while others move no more than a few hundred metres during their adult lifespan, which typically varies from a few days to two or three weeks, although those that overwinter as adults can in some cases live for up to about ten months.

For a few species, the larva is the most mobile stage. Tiny caterpillars of tussock moths and some loopers have been found drifting in the upper atmosphere. Eggs and pupae can move hundreds of miles attached to plant material floating on water, or on objects transported by man.

Determining the sex of a moth and examining the genitalia

This is particularly important if you wish to try to breed a species, which is the best start to learning the young stages and finding them more successfully in the wild. Generally, when a

wild female moth is found, she has already been mated and has received from the male a supply of sperm that will enable her to lay fertile eggs, usually over the next few days. In some species, the size or wing patterns are very different in males and females. Otherwise, the sexes are most easily recognised by examining the antennae and the abdomen.

Antennae In many species, the antennae of the male are much broader than those of the female. Often they are feathery on one or both sides, while those of the female are much less feathery or single-stranded and thin. The most notable exceptions are those of the burnet moths, which have pointed club ends in both sexes.

Abdomen shape Features of the abdomen are the best means of sexing some moths. Generally, females have a wider abdomen that does not curve upwards. In geometrids and some hawk-moths, the tip of the male abdomen often curves upwards in an extreme fashion. The abdomen of the female is often fat with eggs, usually tapering to a rather blunt tip, but if all the eggs have been laid it will be slimmer. The rather pointed ovipositor, from which the eggs are laid, is often noticeable, especially after egg-laying has started, when some scales are lost from the end of the abdomen. In male moths of the majority of species, the two claspers at the tip of the abdomen are an obvious distinguishing feature and sometimes serve to distinguish closely related species. They often make the tip of the male's abdomen appear rather squared, sometimes even slightly bulbous, as in the burnet moths.

Genitalia examination If confirmation of difficult species such as the Marbled Minor group (page 356) or the Grey and Dark daggers (page 308) is required, it is possible to see the diagnostic differences in the genitalia of the males, without dissection. First either place the moth in a deep-freeze for a minimum of one hour to kill it and wait a few minutes for it to defrost, or anaesthetise it in a killing jar (leaving it in only until it is still; it will soon rouse once back in fresh air). Lay it on its back and gently apply pressure to the central portion of the abdomen with forceps or a setting needle, working towards the genitalia, which will extrude and can then be examined with a hand-lens or low-power binocular microscope. With the larger species, some lepidopterists extrude genitalia on live, active moths. This requires experience and a delicate touch but can be done without apparent injury on, for example, Grey and Dark daggers. For males of pugs and the November moth group, the diagnostic genital plate can be examined without extrusion. Further details on dissection techniques can be found in Townsend *et al.* (2010), Sterling *et al.* (2012), at the website mothdissection.co.uk and elsewhere.

How to distinguish moths from butterflies and other insects

Butterflies and moths are very closely related. Together they comprise the order Lepidoptera within the class Insecta in the kingdom Animalia. Taxonomically, butterflies are placed in a discrete group of families toward the middle of the moths, implying that they evolved later as a branch of the Lepidoptera 'family tree' rather than early in the history of the group, so the division is somewhat artificial. There are about 165,000 described species of Lepidoptera in the world, and perhaps as many more awaiting discovery and description. Some 2,535 species of moth have been recorded as naturally occurring in the British Isles (as listed by Agassiz *et al.* 2013, 2016b), including 869 macros. These numbers are constantly changing as new species colonise Britain, others are discovered and some become extinct.

The British butterflies can be distinguished from nearly all British moths by their clubbed antennae. The moths have many types of antennae (see above) and only those of the burnets are clubbed. This group of moths is easily recognised by their slender wings, held close to the body at rest, in marked contrast to all the butterflies.

Caddisflies (order Trichoptera) are the only other group of insects that are frequently confused with moths, and they often occur in large numbers in light-traps, but they lack the powdery, detachable, overlapping wing scales after which the moths and butterflies are named (Lepidoptera literally means 'scale-winged', from the Greek). Caddisflies can also be recognised

by their long antennae (usually longer than the whole body), which point forward and are held together at rest. They never lay them back along the body or wings, like many moths do. Even moths with very long antennae, such as the members of the families Adelidae and Incurvariidae, do not generally align the antennae together. Caddisflies are usually brown and the wings look coarse and leathery, with few cross-veins.

The division of moths into macro-moths and micro-moths

Like the division of Lepidoptera into butterflies and moths, the division of moths into macro- and micro-moths is one of convenience rather than science. This field guide covers the macro-moths. Our companion guide *Field guide to the micro-moths of Great Britain and Ireland* (Sterling *et al.* 2012) covers the microlepidoptera, or 'micros', which are generally smaller in size, with a forewing length of 10mm or less, although there is actually some overlap in size with the 'macros' (see box below). Macro-moths, being generally larger, are more easily handled and identified, and therefore were more widely studied in the early days of entomology, with many people ignoring families of the very small moths. The micros are considered to be more primitive (indeed, the most primitive have not developed a proboscis for feeding, and instead use mandibles) and therefore are placed at or toward the front of the classification. However, a

Common micro-moths that may easily be confused with macro-moths

The reader will find a few common moths that, on the basis of size, could reasonably be expected to be in this book, but that are covered by the companion *Field guide to the micro-moths of Great Britain and Ireland* (Sterling *et al.* 2012). The following is intended to help beginners recognise what is not a macro-moth and to guide them to sources of information on the larger micro-moths, most of which belong to the family Pyralidae. Some large and frequent pyralids you will encounter include: **Mother of Pearl** *Pleuroptya ruralis* (Scop.), often disturbed from rest by day around Common Nettle, the larval foodplant; **Small Magpie** *Anania hortulata* (L.), also widespread and frequent on Common Nettle; **grass-veneers** or **grass-moths** (sub-family Crambinae), frequent among uncut grass, on which the larvae feed; the various purple and gold *Pyrausta* species, which are day-flying, often seen visiting flowers for nectar, and feed as larvae on the flowers of labiate plants such as mints, marjorams and thymes, sometimes in herb gardens.

When at rest, most pyralid moths fold the antennae backwards over the wings so that they lie alongside the body. Notable exceptions are the **Bee Moth** *Aphomia sociella* (L.) and the **Wax Moth** *Galleria mellonella* (L.), both of which are frequently captured in light-traps. For further information on pyralid moths, see Goater (1986).

More distinctive than pyralids are the **plume moths** (family Pterophoridae), so named because the wings when spread look like feathers or plumes. The **White Plume** *Pterophorus pentadactyla* (L.) is a widespread and frequent species dependent on bindweeds. Other plumes are generally brown and roll their wings up at rest, in a 'T' shape, e.g. the **Common Plume** *Emmelina monodactyla* (L.). An exception is the **Twenty-plume Moth** *Alucita hexadactyla* L. (family Alucitidae). It is often encountered hibernating in gardens near the larval foodplant, Honeysuckle. For further information on plume moths see Hart (2011).

Tortricoid moths (super-family Tortricoidea) are widespread, often colourful moths, so named because the larvae twist up leaves so that they are protected within them while feeding. They are medium-sized, often bell-shaped moths. The **Green Oak Roller** or **Green Oak Tortrix** *Tortrix viridana* L. is abundant in woodland, the larvae feeding on oak. This species is sometimes confused with the rarer Cream-bordered Green Pea (a macro-moth of the family Nolidae; page 430). Also illustrated in Fig. 3 is a typical bell-shaped tortricoid, the **Large Fruit-tree Tortrix** *Archips podana* (Scop.).

The **small ermines**, *Yponomeuta* species (family Yponomeutidae), are often confused with macro-moths, both as adult moths and as larvae. The adults are similar in shape to footman moths (macro-moths in the family Erebidae; page 187), but with pinprick-sized black dots, and have been confused with the very rare Speckled Footman. The larvae of some of the small ermines defoliate shrubs, which they cover in silk webbing, such as the **Orchard Ermine** *Y. padella* (L.) on hawthorns, Blackthorn and Cherry Plum, and the **Spindle Ermine** *Y. cagnagella* (Hb.) on Spindle. The naked black-spotted greyish larvae are easy to see in the thin webbing. Touch one on the head or disturb it and it will wriggle backwards. This 'reverse wriggling test' is a good means of distinguishing larvae of micro-moths from larvae that will produce the macro-moths covered in this book, because the latter will generally not do this, although some, like the larvae of the Buttoned Snout, wriggle vigorously from side to side.

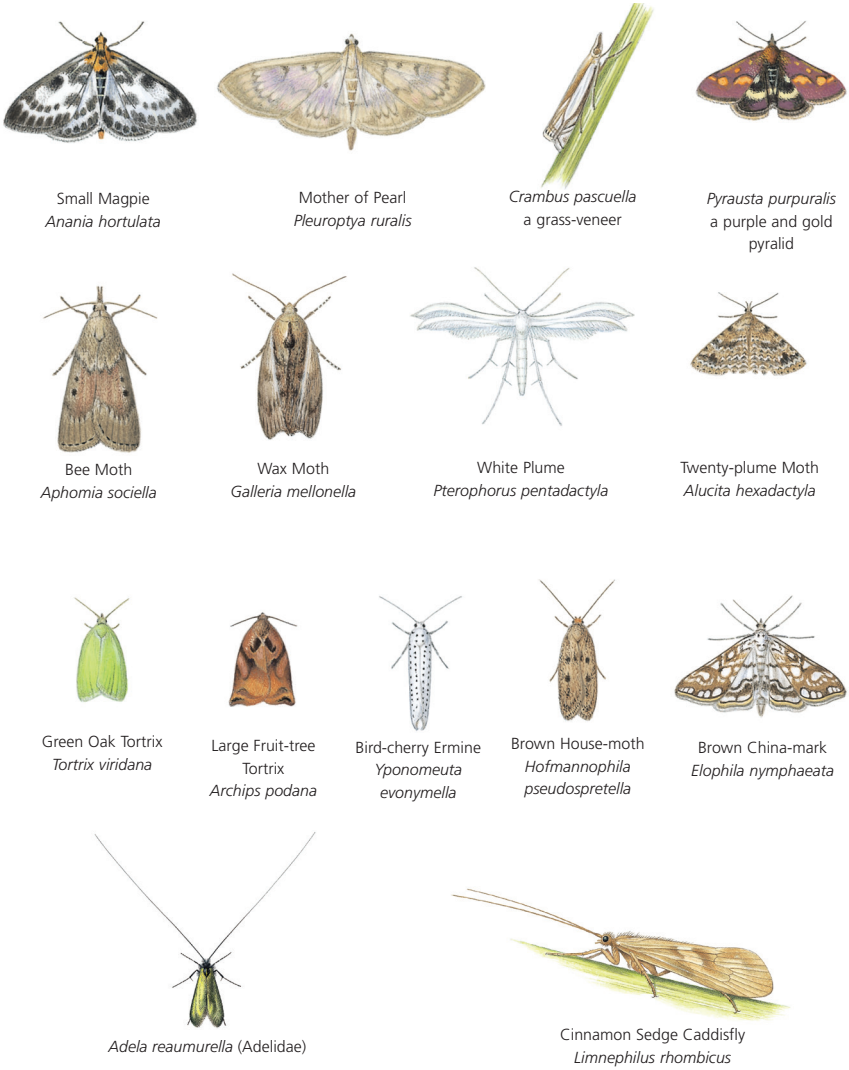


Figure 3 Some micro-moths that may easily be confused with macro-moths, and a caddisfly.

small number of primitive groups have developed quite large species, such as the swifts, goats and clearwings, and these have become 'honorary' macros. The treatment of the Pyralidae as micros is also puzzling, since they are a diverse group, and even in the British Isles many species are comparatively large.

Scientific names

Like all forms of life known to science, from bacteria to bracket fungi to birds, each described species of moth has been given a binomial ('double-barrelled') name in Latin (often mixed with Greek), a system introduced by Carl von Linné (Linnaeus) in 1758, by convention written in italics. Latin was the internationally understood language of science in the 18th and early 19th century, when most European moths were first formally named in print.

Scientific names are used throughout the world. So, while the very descriptive English name of the Figure of Eight moth means something only to a person who speaks English, its scientific name, *Diloba caeruleocephala* (Linnaeus, 1758), is universal. The first name given is the generic name, i.e. the genus or grouping into which the moth and its close relatives have been placed, and this always begins with a capital letter. The second word is the specific or species name and should always be written in lower case. The full scientific name of a species also includes that of the natural scientist (known as the authority) who named it, along with the year in which it was published. This system thereby recognises the discoverer of the new species and distinguishes the name from another similar one, for example if it is discovered that another authority later named the same species, in which case the earliest name takes precedence. Where the species has subsequently been classified in another genus (as in most cases), the original authority and year are retained but placed in parentheses (and in formal lists the authority for the genus is also given). Elsewhere, as in this guide, the authority may be abbreviated (using officially accepted abbreviations, see page 435) and the year omitted. Colour forms of many species have also been given scientific names, again followed by the authority who named them. There are many rules and permutations of changes to scientific names that can occur, and the International Commission on Zoological Nomenclature (ICZN) governs the allocation (and reallocation) of these.

It is unfortunate that the majority of people interested in natural history today do not have the benefit of having learned Latin and Greek in school. As a consequence, the scientific names are often perceived as no more than code words that are hard to remember and difficult to pronounce and spell. In fact, they are often as descriptive as the English names. In the case of the Figure of Eight moth, the species name *caeruleocephala* means 'blue-headed one', and comes from the Latin *caeruleus*, meaning 'sky blue', and the Greek *kephale*, meaning 'head'. This refers to the larva, unlike the English name, which refers to the adult moth. Bear in mind that in the days before electric light-traps, many moths were much more easily found as larvae and then reared to adult. The generic name *Diloba* means 'two lobes' in Greek and refers to the same figure of eight marking on the forewing of the moth that inspired the English name.

Subspecies and forms

Generally, the term subspecies (also synonymous with race) has been applied to populations of a species in which the individuals are consistently different in form and often in ecology, and occur in a different geographical area from other populations, such that they do not generally interbreed, although they are capable of doing so if they encounter one another. If they were unable to interbreed (i.e. produce fertile offspring) when meeting, they would qualify as separate species. In addition, any population may consist of several recognisable colour forms. Names have been given both to subspecies and some forms. Forms are sometimes referred to as aberrations, which automatically implies rarity, but the frequency of a particular form can vary greatly from one population to another, being rare in some and predominating in others, and can change in frequency over time! An 'aberrant' form has very atypical features that include structural differences, for example in size or wing shape.

In scrutinising and comparing set specimens from many locations while preparing this guide, we noted much subtle variation. It is clear that intergrading regional differences occur in many species. In practice, this means that species can look somewhat different when you move out of regions you know well into other areas, even though the moths are not recognised as different subspecies or forms. All this variation has been a source of fascination since the earliest days of the study of moths, and is part of the foundation for evolution by natural selection.

Recording moths

The number of people in the British Isles involved in observing and recording moths now runs to many thousands and is increasing year by year. The majority have some contact with the county moth recorders who compile county databases on moths, usually with the aim of producing and updating annotated county lists and atlases, now collated by the National Moth Recording Scheme. Some of the resultant data can be found on the websites of county moth groups and

Moths Count (see page 438). The county recorders are essential in quality control, i.e. verifying records. Some have support from natural history societies, wildlife trusts and biological records centres, and have formal or informal groups of recorders, supplying data in electronic format, from field notebooks via spreadsheets or directly into databases such as MapMate, Recorder and iRecord. More recently, online data-entry systems have been set up.

The ready availability of the Global Positioning System (GPS) in hand-held units or incorporated into smart phones now enables quick and accurate location recording, and saves poring over maps later on. These and other mobile devices enable information to be shared instantaneously from the field, of great use particularly to beginners (and their existence makes venturing out at night with light-traps a safer pursuit). Use of dictaphones and video camcorders as the first means of capturing the data is less common, but sometimes employed as a temporary or additional record. Note that, as with digital photographs, there are concerns about long-term storage of digital information. In the shorter term, back-ups (such as external hard drives and cloud storage) are essential, but moth information remains of use indefinitely and future changes are not necessarily easy to predict. Some may wish to make good-quality prints of the more noteworthy records, but this is an expensive option. Moth recorders are still strongly advised to retain hand-written records as county recorders may query unusual records, and also for posterity, and additionally to publish noteworthy findings in the entomological journals listed later in this guide (page 438). Many moth recorders have made careful arrangements for their materials and specimens to be transferred to appropriate museums and libraries after their passing.

Recorders are venturing out with ever more light-traps, and disseminating their results the following morning with digital photographs, via smart phones and the Internet. Moth recording has also become much more of a social activity. Many still prefer to operate alone or with one or two others, but the numbers of moth groups and field meetings, or morning 'moth breakfasts' after inspecting the catches of light-traps, have increased. Moth Night, organised jointly by *Atropos* magazine and Butterfly Conservation, has provided encouragement to organise social mothing events throughout the British Isles. There has also been considerable investment in facilities on many nature reserves, and this has increased the options for operating traps from mains electricity and running public events.

National recording schemes

National distribution maps were originally produced by the Biological Records Centre (BRC), Monks Wood, Huntingdonshire, based on returns from all the county recorders and many other individuals. A national recording scheme covering all the macro-moths in the British Isles and the Channel Islands was operated from BRC, coordinated by the late John Heath, from the 1960s until his retirement in 1982, when the scheme was formally closed down. In the following years, national distribution maps were produced on an ad hoc basis, usually by updating existing maps of particular species, for publications such as *The moths and butterflies of Great Britain and Ireland* (see Further Reading, page 436). Between 1991 and 1996, Paul Waring set up and coordinated the National Scarce Moth Recording Scheme for the 300 rarest species of larger moths, for the Nature Conservancy Council and, later, the JNCC. This provided the information and distribution maps for a national review (Waring 1997) and for the UK Biodiversity Action Plan (1999), in which the most recent date class was 1980 onwards. As mentioned in the Preface, Butterfly Conservation launched the National Moth Recording Scheme in 2007 to cover all macro-moths in the UK, Isle of Man and the Channel Islands, founded on the voluntary efforts of county moth recorders. The organisation set about collating newly submitted data, existing data-sets and historical sources, and promoting interest in moths via citizen science projects (including Moth Night) and targeting under-recorded areas. As at January 2016, the National Moth Recording Scheme held 20.3 million records of macro-moths. Distribution maps and other resources for Scotland have been available online since 2011, the product of a scheme coordinated by Roy Leverton. Moth enthusiasts in Northern Ireland and the Republic of Ireland have collaborated in a scheme now known as Moths Ireland, co-ordinated by Angus Tyner and Dave Allen. It has been online since 2015 and includes distribution maps for the whole of Ireland. For websites, see page 438.

Field techniques for finding moths

Searching for adult moths

Day-flying moths can be sought as for butterflies, by walking around likely places, inspecting flowers and tapping vegetation to dislodge resting individuals. Some flowers are particularly attractive to moths, such as sallow catkins, ragworts, Hemp-agrimony, buddleias, heathers, Ivy and the flower-heads of some grasses and sedges, the latter often as a result of infections of ergot fungus, which result in sticky, sweet secretions. Success is greater on warm, dry and calm days and a few species require sunshine. Others have dawn or pre-dusk flights. Many species roost on tree trunks, fence posts, rocks or man-made structures by day and, for some species, these objects are well worth searching, especially early in the morning, as warmth and direct sunlight will often cause the moths to move out of sight later. Places with all-night lighting are worth searching by day, such as hallways, porches, shop windows, street lights, and especially rural telephone boxes and toilet blocks on campsites. As dusk falls, more moths take to the wing, when hedgerows along footpaths and rides in woodland are good places. The more species of woody plants in the hedge and the more varied the herbs and grasses in the verge, the greater the variety of moths you can expect. Open woodlands of native trees are the most productive places, but herb-rich, permanent unimproved grassland is also very good. Fens, carr woodland, heathland and moorland all have characteristic species unlikely to be found elsewhere, and for some moths you will need to climb to the very tops of mountains. After dark, you can carry on searching with a torch. You will smell the scent of flowers you never noticed by day and will find moths feeding by searching these, as well as sap runs, overripe and fallen fruit, and even damp bare ground, animal corpses and dung. Under the cover of darkness you will see many larvae starting to feed more openly, safe from the birds, and you will not be able to resist collecting a few to rear on the same foodplant to find out what they are. Then you will have really become a moth hunter!

Baiting techniques

Having seen how moths are attracted to fermenting fruit or sap runs, you can provide some attractants of your own. For centuries, moth collectors have mixed or gently boiled up potions based on black treacle, with various additives, and painted the mixture in vertical strips measuring about 30cm by 2–3cm on tree trunks, fence posts or even rocks, to attract moths. This is known as 'sugaring'. The black treacle gives the mixture body and adhesion, but for an effective potion you need to add something to attract the moths from a distance – a dash of rum is traditional and very effective, amyl acetate is also frequently used, but you need only a drop or two as any more can be repellent. A little beer adds a fermenting smell and can intoxicate the moths and make them easier to catch. Sour chutney and overripe bananas are also effective attractants and add substance to the mix. The majority of moths arrive quickly once the 'sugar' has been applied at dusk.

Wine-roping is a technique in which approximately 1m lengths of thin rope are soaked in a saturated solution of white sugar in red wine, and then draped across low branches, bushes and other vegetation at dusk. Note that the rope needs to be of an absorbent natural fibre and must not have been treated with any chemicals that render it distasteful, such as the fungicides and herbicides used to prevent

Light Crimson Underwing at a wine rope.

moulds and algae from growing on washing-line cord. Like sugaring, wine-roping can be a very successful means of attracting moths to feed.

Light-trapping

A BENHS meeting gathered around a light and sheet.

Light-trapping exploits the commonly observed tendency of many moths to approach and become disoriented around bright lights. The types of electric light that emit part of their output as ultraviolet light have been found to be the most effective, and two are particular favourites among moth trappers: mercury vapour discharge bulbs and actinic fluorescent tubes. Traps are designed around these, operating on the lobster-pot principle. The moths rest on egg-trays in the trap unharmed and can be released again after recording. There are a number of commercially produced designs, chief of which are the Robinson, Skinner and Heath traps, although a number of newer variants are now available, including some that utilise other types of light source. For a guide to moth-traps and their use, see Fry & Waring (2001). Light-trapping is the single most effective technique for general recording, site assessment and compiling a site inventory, and for targeted trapping of particular species, both in terms of economy of effort and the wide spectrum of species found.

Assembling and pheromone lures

These are techniques that will specifically attract the males of a particular species to the pheromone of the female (or a synthetic equivalent) and provide a wonderful display of how male moths locate females for mating in the wild. Assembling involves rearing a batch of females but keeping them unmated. This can be done by keeping all the pupae in separate containers and determining the sex of the adults when they emerge. For species that are difficult to sex as adults, there are methods of sexing the pupae in order to segregate them. In many species, female pupae are recognisably larger or fatter than those that will produce males. Generally, if the underside of the pupa is examined, there are four unmarked abdominal segments beyond the tip of the wing cases and a pair of small bumps on the fourth in the male, while the female has only three unmarked segments before grooves and other markings intervene (see also May 2014). You may need a hand-lens to see this clearly. When rearing for assembling, the larvae and pupae must not be kept too warm, or they will emerge early and fail to coincide with the wild males.

When the virgin females emerge, one or more of them is placed in a netting bag, cage or trap, preferably on the day of emergence or within a day or two thereafter. At some point during the day or night, depending on the species, she will be observed to adopt a hanging position, with the wings slightly parted to expose the hind end of the abdomen (this is known as 'calling'). A small scent gland, which is usually white or yellowish and may glisten, is extruded from the tip of the abdomen. From this a scent known as a pheromone evaporates into the air, to be carried off on the breeze. The males detect this scent using their antennae. The very feathery antennae of the males of some species provide a greater surface area with which to 'comb' the air for the faintest traces of pheromone. Even single molecules touching the antennae

A Red-belted Clearwing attracted to a pheromone lure.

have been shown to cause a nervous discharge and recognition behaviour. The males fly upwind towards increasing concentrations of the scent, which brings them to the female. In some species, such as the Emperor Moth, Oak Eggar and the clearwings, the females attract the males during the day. The males can be seen flying upwind from distances of up to several hundred metres, often adopting a wide zigzagging behaviour to relocate the scent plume. Assembling is particularly useful for the many moths that 'call' during the night, as a trap can be made, based on the lobster-pot principle, and then left unattended, like a light-trap.

For some species, generally those of economic importance as pests, the pheromone (a complex molecule or precise combination of several molecules) has been made synthetically in the laboratory and impregnated onto a small rubber bung. These can be contained within a small netting bag and hung from a branch from a length of string, or placed on low vegetation. Alternatively, small plastic lobster-pot type traps can be purchased, originally designed for pest monitoring, in which the pheromone bung is suspended in a small cage over a funnel. For pests, these normally contain a liquid, such as brine, to kill and preserve the moths for later analysis, but can be used dry, with a few small pieces of egg-tray for perching. Other types of trap use a very sticky surface, from which it is not possible to remove the moths, so are only suitable for pests. Some pheromone lures can last for up to ten years or more if stored in a deep freeze. See May (2014) and elsewhere for further details.

Searching for eggs, larvae and pupae

Searching for the eggs, larvae or pupae of moths and rearing them to adult to confirm the identification will increase your chances of encountering the full range of species and can provide a great deal of enjoyment, satisfaction and knowledge. This guide includes enough information to enable you to find the larvae and pupae of many species, and in some cases the eggs. Larvae that feed on trees and shrubs can be knocked into an upturned umbrella or sheet, or a purpose-built beating tray, by jarring the branches with a stick. Those among grasses and herbs can be swept into a heavy-duty net. Both of these methods are most productive at night. See May (2014), Porter (1997) and Tutt (1994) for additional advice.

Conservation of moths

Many moth species are likely to thrive in the British Isles as long as their foodplants and habitat are well represented. For others, the required habitat has been severely reduced in extent or quality, often as a direct result of human activities, or the micro-climate has altered, often due to plant succession. Conservation of such species depends largely on preventing further habitat loss and reversing declines by restoration and creation of additional breeding grounds. A small minority of moth species are so restricted and at risk that removal of any individuals from the wild is considered likely to jeopardise the remaining populations. These receive full legal protection under Schedule 5 of the Wildlife and Countryside Act 1981 and subsequent amendments, and are labelled as such in the text accounts: New Forest Burnet, Fiery Clearwing, Sussex Emerald, Barberry Carpet, Black-veined Moth, Fisher's Estuarine Moth (a species also protected under European legislation) and Reddish Buff. In summary, it is an offence to kill, injure, possess or sell any life stage of these moths, or to damage or destroy their habitat. Two species, Viper's Bugloss and Essex Emerald, have been removed from Schedule 5, as they are thought to be extinct. Also, two species, Slender Scotch Burnet and Talisker Burnet (= ssp. *jocelynae* of the Narrow-bordered Five-spot Burnet), were added as protected from sale only in the Fifth Quinquennial Review of the Act. For further information, see Parsons *et al.* (2001).

For other species, it is most unlikely that removal of a single specimen, particularly a male, will have any impact on a population, except in the unlikely event of large numbers of people doing so where a population is small and isolated. The population has to be able to withstand much

higher losses to predators, parasitoids and inclement weather, or it would not survive. There is a genuine need to collect a voucher specimen of certain species to substantiate the record. For many species, however, provided the moth has not lost too many scales, one or several good-quality photographs, taken from a variety of angles, will enable a specialist to confirm the record. The importance of substantiating and vetting records cannot be emphasised too highly. These days, the latest generations of mobile phones are able to take good-quality close-up digital photographs.

In terms of the overall picture, the JNCC conservation statuses (see under 'Status and distribution' above) form a well-established system, but a separate initiative, the UK Biodiversity Action Plan (UKBAP), has provided a huge impetus, and substantial funding for practical conservation measures for moths has been released since it was published by the UK Biodiversity Group (1999). The UKBAP was a response to the United Nations Conference on Environment and Development (popularly known as the Earth Summit or Rio Conference), held in Rio de Janeiro on 3–14 June 1992.

As part of the UKBAP process, a list of priority species in greatest need of special conservation measures was drawn up by the statutory agencies and non-government organisations, and biodiversity action plans for each were produced and implemented. This has resulted in surveys, habitat protection and management, and monitoring and reporting of the results. For UK moths, Butterfly Conservation is the lead agency for this work. When the list was last reviewed, in 2007, 56 macro-moths (and 25 species of micros) were included as priority species. Priorities for action have changed at various times, following surveys that have revealed that species are more widespread than previously available data had suggested, or when their status has improved as a result of conservation measures.

In July 2012, the UKBAP was succeeded by the UK Post-2010 Biodiversity Framework and the focus has moved from UK to country level, so for England, Scotland, Wales and Northern Ireland, there are lists of species considered of principal importance to the conservation of biodiversity. These are covered by Acts of Parliament, including the Natural Environment and Rural Communities Act 2006 (England and Wales), the Wildlife and Natural Environment (Scotland) Act 2011 and the Wildlife and Natural Environment (Northern Ireland) Act 2011. The legislation has many aspects, but essentially relates to compliance with biodiversity obligations by the relevant government bodies, including local authorities deciding on planning applications. The original reviews for the UKBAP identified much longer lists of species for conservation action (e.g. see Waring 1994: 24–30, with 94 species of macro-moths), and in many cases action for these species is taking place at a country, regional or local level.

A group of moth-trappers at sunset on the coast of Northern Ireland.

In Ireland, the National Parks and Wildlife Service and the Northern Ireland Environment Agency have joined forces to produce Red Lists (based on IUCN criteria) of fauna and flora for all of Ireland. A moths Red List is currently in preparation and Moths Ireland has been one of the key players in the data analysis.

As mentioned in the Preface, *The state of Britain's larger moths* reports (Fox *et al.* 2006, 2013) have identified a number of trends in abundance over a 40-year period from 1968 using data from the Rothamsted Insect Survey light-trap network of approximately 80 traps. Over that period, roughly twice as many species have declined as have increased, and in the latest list, 27 have declined by 90 per cent or more and 61 species have declined by 75 per cent or more. This has major consequences not only for the moth species but also for predators, pollination and other aspects of the ecosystem. Further research into the causes of these declines, and development of plans to halt or reverse them, is urgently needed.

Societies and local recording groups

Amateur Entomologists' Society
Ideal for beginners, but retains many members for life. Publishes the *AES Bulletin*, *Entomologist's Record and Journal of Variation* and many helpful books and leaflets, and holds a large annual exhibition and trade fair. Contact: AES, PO Box 8774, London SW7 5ZG (www.amentsoc.org).

British Entomological and Natural History Society
The national society for the field entomologist. Covers all insect groups but comprises a large proportion of moth enthusiasts. Publishes *British Journal of Entomology and Natural History*, holds an annual exhibition, has lecture space, a library and reference collections, and holds indoor lectures and field meetings. Contact: BENHS Secretary, c/o Dinton Pastures Country Park, Davis Street, Hurst, Reading, Berkshire RG10 0TH (www.benhs.org.uk).

Butterfly Conservation
Despite its name, this is the UK's lead non-governmental organisation involved in the conservation of moths as well as butterflies. Has a paid staff, involved in a wide range of activities promoting the conservation of butterflies and moths, undertakes moth conservation contract services and advises government agencies. Lead partner on moths for the UK Biodiversity Action Plan and the Post-2010 Biodiversity Framework. Runs the National Moth Recording Scheme (Moths Count), and holds an annual moth recorders meeting. Publishes a members' magazine three times a year, *Butterfly*, holds an annual members' day and symposia, and has many active local branches with meetings and regular newsletters. Contact: Butterfly Conservation, Manor Yard, Shaggs, East Lulworth, Wareham, Dorset BH20 5QP (www.butterfly-conservation.org).

Royal Entomological Society
For professional entomologists and others with special interests in entomology. Publishes a range of scientific journals on entomology and a members' magazine three times a year, *Antenna*. Has extensive library facilities and holds international symposia. Contact: The Mansion House, Chiswell Green Lane, St Albans, Hertfordshire AL2 3NS (www.royensoc.co.uk).

Many **moth recording groups** now have their own websites. The Moths Count website (www.mothscount.org) lists the county-based moth groups and the contact details for the county moth recorders.

Hepialidae Swift moths

The Hepialidae are primitive moths, with five of the 500 or so species occurring in the British Isles. All five have elongated wings that are held almost vertically against the body when at rest. The main flight is from early dusk until full darkness. They come to light-traps, sometimes laying large numbers of eggs that collect in the base. Adults have no functional proboscis, so are incapable of feeding, and have very short antennae. The eggs are normally laid in a low flight over the foodplant. The larvae live underground, feeding internally or externally on plant roots, among which they pupate. The life cycle commonly takes two years to complete, with the larvae overwintering twice.

Ghost Moth

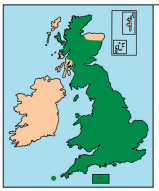
Common Swift

Orange Swift

plate 1

Triodia sylvina (L.)

Common 3.001 (15)



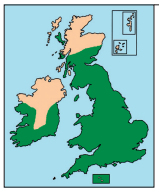
Field characters and similar species FW M 12–18mm F 15–26mm. Male has distinctive bright orange-brown forewing, with two quite narrow, fairly straight, continuous, dark-edged, whitish diagonal lines forming an open V. Duller female is somewhat similar to plainer forms of Map-winged Swift, which has a white marking at base and in centre of forewing, and chequered fringes. Both sexes vary greatly in size, but female is generally larger. See also Common Swift. **Flight season** One generation. Late Jun–early Sep. Flies from early dusk. Comes to light, sometimes in numbers, and is often attracted to house lights. **Life cycle** Overwinters twice as a larva. Larva Sep–May or Jun. Pupates underground. **Larval foodplant** The roots of many herbaceous plants, including Broad-leaved Dock, Dandelion, Bracken and probably grasses. **Habitat** Frequent in gardens, on roadside verges, downland, moorland, woodland rides and other rough grassy places. Rarely in upland areas. **Status and distribution** Resident. Common. Mainland Britain (more local in the north), Channel Islands, Scilly and Man.

Common Swift

plate 1

Korscheltellus lupulina (L.)

Common 3.002 (17)



Field characters FW M 11–16mm F 15–20mm. Probably the most frequently encountered of the swifts. Forewing markings of male vary greatly in amount and intensity, ranging from whitish to pale brown to grey; entirely plain examples occur. Female is slightly larger, with forewing generally much less strongly marked, often plain grey. **Similar species** In northern Britain especially, can resemble worn or plain Map-winged Swifts, but that species has broader forewing and fringes (if still present) chequered. Orange Swift is usually found later in the year; forewing is broader, bright orange in male and with narrower, usually smoother, divergent white bands. Female has smoother, often more continuous and more extensive grey or greyish-white markings than female Common Swift. See also Gold Swift. **Flight season** One generation. May–Jul. Flies mainly at dusk, and is sometimes attracted to house lights. Usually caught in light-traps in the first hour of darkness. Male flies swiftly, low over the ground. Mating pairs may be found after dark, with the male hanging head downwards and immobile. **Life cycle** Overwinters as a larva. Larva Jun or Jul–Apr. Pupates underground. **Larval foodplant** The roots of grasses and many other wild and cultivated herbaceous plants. Sometimes a pest of agriculture and horticulture. **Habitat** Open grassland, gardens and roadside verges, including in urban areas, moorland, heathland, fens and grassy woodland rides. **Status and distribution** Resident. Common.

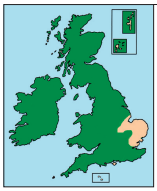
Most parts of mainland Britain, Channel Islands and Man. Sometimes abundant in the south, less so further north. In eastern Scotland, locally frequent and found north to Kincardineshire and East Perthshire. Much scarcer in the west, where it is mainly in the south-west but reliably recorded on Skye. Local in Ireland, predominantly in coastal counties north to Cos. Sligo and Louth.

Map-winged Swift

plate 1

Korscheltellus fusconebulosa (DeG.)

Local 3.003 (18)



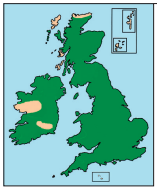
Field characters FW 14–26mm. Named after the distinctive, map-like variegated markings on forewing. In f. *gallicus* Led., which occurs throughout the range, forewing is more uniformly yellowish brown and the whitish markings are limited to two small marks, one in centre of wing (often elongated) and one at base. Both forms have chequered fringes, unlike the other swifts. On the sand-dunes of Orkney the moths are small and pale. In Shetland some have particularly bright patterns and have been named f. *shetlandicus* Viette. **Similar species** See Orange Swift and Common Swift. **Flight season** One generation. Late May–early Jul or early Aug (in the north). Flies at dusk, earlier in Shetland. Comes to light, sometimes in large numbers. **Life cycle** Overwinters twice as a larva. Larva Jul–May. Pupates underground. **Larval foodplants** Widely associated with Bracken roots, among which it can be numerous. Also on the roots of Red Fescue in the absence of Bracken, and may feed on roots of broadleaved herbs. **Habitat** Moorland, rough pasture, heathland and open woodland, less often on downland and sand-dunes. **Status and distribution** Resident. Local. Mainland Britain, Man, Western Isles of Scotland, Orkney, Shetland. Most frequent in the north, and absent from large areas of the south and east of England. Widespread in Ireland.

Gold Swift

plate 1

Phymatopus hecta (L.)

Local 3.004 (16)



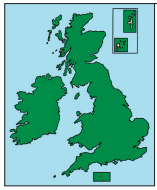
Field characters FW M 12–15mm F 13–16mm. Golden markings on forewing of male are diagnostic. In particular, the inner and outer bands run roughly parallel to one another, unlike those of other swift moths. Male has very swollen tibia on the hind legs, used in the release of pheromones. Duller female has broad purplish-grey bands on forewing, which may appear brown when wings are spread out. **Similar species** More slender than Common Swift, banded examples of which have divergent, whitish markings, with those near base angled to almost meet outer markings near trailing edge. In addition (as in all other British swifts), tibia is not swollen on hind legs of male. **Flight season** One generation. Mid-Jun–mid-Jul. Males fly at dusk around the larval foodplants. They attract females with a pineapple-like scent, hanging from the vegetation by the forelegs as they do so. Dawn and late-afternoon flights are also reported. Both sexes come to light in small numbers. **Life cycle** Overwinters twice as a larva. Larva Jun–late May. Pupates underground. **Larval foodplants** Bracken is a major foodplant and larvae have been found in the roots of young Bracken shoots in Apr. Occurs on sites without Bracken and must also feed on roots of herbs or grasses. **Habitat** Mainly open woodland, also scrubby areas and Bracken-covered slopes on heathland and on rough grassland. Rarely in uplands. **Status and distribution** Resident. Local. Mainland Britain, Man, Scotland including the Hebrides, Ireland.

Ghost Moth

plate 1

Hepialus humuli (L.)

Common 3.005 (14)



Field characters FW M 21–29mm F 21–35mm. The largest of our swift moths, and unmistakable. Male usually has plain, chalky white forewing and hindwing (dark grey underneath). Female has yellowish forewing, marked with orange-brown. The Shetland population conforms to f. *thulensis* (Newm.) (formerly regarded as a distinct subspecies). Here, the moths are smaller. Male has creamy-white or yellowish forewing, variably marked with brown, while that of female is less yellow than in the typical form. This form is occasionally recorded elsewhere in northern Britain. **Flight season** One generation. Jun–early Aug. Both sexes fly at dusk and after dark, and come to light. Males have a characteristic display or 'lekking' flight at dusk, which can involve up to several dozen moths, each swaying to and fro over one spot as if attached to a pendulum, and releasing a goat-like scent from eversible brushes on the hind legs. Mating pairs are conspicuous on low vegetation by torchlight. **Life cycle** Overwinters as a larva, probably twice. Larva Jul–May. Pupates underground among roots. **Larval foodplants** The roots of grasses and many other wild and cultivated herbaceous plants, including Common Nettle, docks, burdocks and Wild Strawberry. **Habitat** Grassy or rank, weedy places, both on open ground and in woodland rides and clearings, often where the soil surface has been disturbed. **Status and distribution** Resident. Common. Throughout Great Britain and Ireland, but usually at low altitude in the north of Britain. Two females on Alderney in 2006, the first Channel Islands records since the 19th century.

Cossidae Leopard and goat moths

This family consists of about 700 species, of which three are found in the British Isles. The wings are elongated and held at a steep angle close to the body when at rest. The antennae are variable and the abdomen is extremely long in some species. The adults are nocturnal, and are incapable of feeding. The females attach the eggs to stems of the host plant. The larvae feed in the living wood and stem tissue of trees and other plants, often taking two or more years to complete their growth. Most pupate within the foodplant.

Leopard Moth

Goat Moth

Cossinae

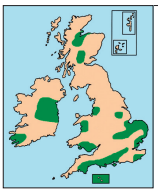
Goat Moth

plate 1

Cossus cossus (L.)

Nb

50.001 (162)



Field characters FW 32–42mm. A large, very thickset moth with a distinctive upright resting posture. Forewing silvery grey-brown with many fine, dark, irregular and often branched cross-lines, which resemble cracks in bark. **Flight season** One generation. Jun–Jul. Comes to light occasionally, but otherwise seldom seen. Female sometimes attracted to sugar bait painted on trees, but since it cannot feed it may in fact mistake the sweet smell for that of oozing sap caused by previous larval damage, i.e. as an egg-laying site. **Life cycle** Overwinters three or four times as a larva, the final time in a cocoon in which it pupates in the spring. Some larvae leave the tree in the autumn to spin a cocoon in rotten wood or soft earth. Eggs are laid in batches in a bark crevice, often near old larval burrows or other damage. **Larval foodplants** Under the bark and in the heartwood of a variety of broadleaved trees, including sallows, willows and poplars, Ash, birches, English Elm, oaks, Alder, Apple and other fruit trees. Trees in low-lying or damp situations that are prone to winter flooding are particularly favoured. **Habitat** Riverbanks, fens, marshes, parkland, hedgerows and woodland edges. **Status and distribution** Resident. Nationally Scarce B. In Britain, previously locally widespread, mainly in the southern half, but now found locally in widely scattered areas, mainly in East Anglia, southern and south-west England (especially along the south coast), the south and east Midlands (including Nottinghamshire) and south Wales. In Scotland, in the Great Glen, Inverness-shire, the Morayshire coast and Perthshire, and in the Channel Islands. In Ireland, in central, eastern and south-western parts.

Zeuzerinae

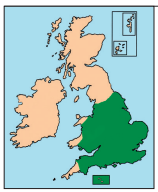
Leopard Moth

plate 1

Zeuzera pyrina (L.)

Common

50.002 (161)



Field characters FW 22–35mm. Six large black spots on big, furry thorax and heavy spotting on whitish wings, along with comb-like antennae of male, are diagnostic. In the rare f. *confluens* Cock., central spots of forewing are joined to form stripes. **Similar species** See Puss Moth. **Flight season** One generation. Late Jun–early Aug. Comes to light and is occasionally found at rest on tree trunks by day. **Life cycle** Overwinters two or three times as a larva, feeding in the stems and branches of trees and shrubs, sometimes in slender young stems and generally in those less than 10cm in diameter. Pupates under the bark. Larva Aug–May. The eggs are attached singly or in small batches to the bark. **Larval foodplants** Many woody plants, including willows, Blackthorn, plums, cherries, Hawthorn, Apple, Pear, privets, Ash, elms, oaks,

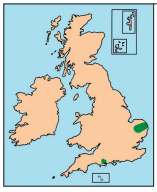
Beech, Wayfaringtree, Honeysuckle, Lilac and Black Currant; occasionally causes economic damage to fruit trees. **Habitat** Most frequent in open woodland and scrub, but also found in gardens, orchards and parkland. **Status and distribution** Resident. Common. Found widely and frequently in the south of England, north to Yorkshire, Lancashire, in Wales (mainly in the south and east), and recorded (rarely) in the Channel Islands. A single accepted record for Ireland, one in Co. Mayo on 12 Jul 1978.

Reed Leopard

plate 1

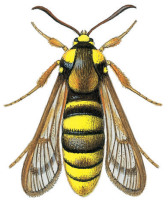
Phragmataecia castaneae (Hb.)

RDB 50.003 (160)



Field characters FW 15–23mm. The fine blackish spotting and rounded tip of the slightly transparent straw-white forewing, comb-like antennae of male and very long abdomen, especially of female, extending well beyond wing tips when at rest, are diagnostic. **Similar species** Several wainscot moths similar in colour occur in the same habitat, but none has the combination of features listed above. **Flight season** One generation. Jun–Jul, sometimes late May or early Aug. Male comes readily to light soon after dark; female rarely does so but can be found at rest on reed stems at night. She starts laying eggs immediately after mating, in batches between the leaf-sheath and stalk. **Life cycle** Overwinters twice as a part-grown larva, low down in a reed stem, usually 20cm or more below the water level. Larva Jul–May of the third year, feeding in stems, moving from one to another and pupating near a prepared exit window through which the pupa breaks to release the adult. Occupied stems tend not to flower. **Larval foodplants** The roots and lower stems of Common Reed. **Habitat** Fens, marshes and the margins of ponds, where there is year-round standing water (reed swamp) or seasonal flooding or waterlogging (reed-bed). **Status and distribution** Resident. Red Data Book species. Extremely local. Resident only at Chippenham Fen and Wicken Fen, Cambridgeshire, the Norfolk Broads and a single locality, known for over 70 years, near Wareham, Dorset.

Sesiidae Clearwing moths



Hornet Moth

Yellow-legged Clearwing

Clearwing moths are fairly closely related to the more familiar burnet moths. There are about 1,000 species worldwide, of which 14 are resident in the British Isles, and one is of uncertain status. They mimic wasps, which is thought to confer protection from vertebrate predators, but they can in most cases be distinguished from wasps by the dark bar or blotch across the forewings, from which numerous veins radiate. Also, the head and eyes are much smaller. They have very narrow forewings and quite narrow hindwings, both with large transparent areas, and black bodies banded with yellow or red. Species in the genera *Sesia*, *Bembecia* and *Pyropteron* hold their wings quite close to the body when settled. *Synanthedon* species settle with their wings extending at a greater angle from the body.

The adults are active by day, particularly in sunny weather, but they are very elusive, in some species probably due to their inconspicuous, wasp-like appearance, especially when in flight. Until recently, those of many species were rarely encountered in the wild. Some may be found when freshly emerged by searching the trunks of the larval foodplants from early to mid-morning, but soon disperse when warmed by the sun. Some visit flowers and are occasionally caught when sweep-nets or malaise-traps are used for general invertebrate sampling. The males fly around the larval foodplants,

seeking out unmated females. Recently, the use of lures containing synthetic sex pheromones came into use as a recording technique, particularly for this group. This has greatly improved the speed and efficiency of detection, and some species are proving to be more widespread and frequent than previous records indicated.

Locating the actual breeding sites requires patience, persistence and specialised, yet simple, techniques. Eggs are usually laid singly, often on freshly cut tree-stumps and on callouses and other damaged bark, or on the leaves of herbaceous foodplants. The larvae feed in the live stems, trunks or roots, boring out tunnels that usually bear traces of silk, distinguishing them from those of other plant-boring insects. Some betray their presence by issuing brown sawdust-like droppings (frass) from holes in the plant, or by causing a swelling (gall).

The life cycle may take up to three years for some species. The pupa is formed in a fibrous cocoon just under the outer layer of the occupied trunk or root, behind a lidded exit hole prepared by the larva, which can be found by careful searching or scraping, and the section containing the insect carefully cut, chiselled or dug out for rearing to adult. In species feeding below ground, a silken tube may be formed leading to the surface of the earth. Breeding sites are best located by searching for empty pupal cases, which are left protruding from exit holes in stems and trunks at the start of the flight season and may remain in place for weeks.

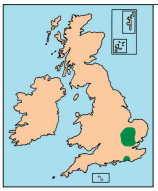
Tinthiinae

Raspberry Clearwing

plate 2

Pennisetia hylaeiformis (Lasp.)

Recent colonist/Adventive 52.001 (369a)



Field characters and similar species FW 11–13mm. Forewing extensively marked with reddish scales. Abdomen with tuft of black scales on fourth segment, and seven (in male) or six (in female) prominent yellow bands, four between tuft and tail in male and three in female. A further yellow band, behind and obscured by scale tuft, may be apparent if moth is worn. Tail fan black and yellow in varying proportions. Antennae distinctly feathered in male. Rests with wings held close to body. **Similar species** See Six-belted Clearwing (male with six yellow bands on abdomen) and Yellow-legged Clearwing (three or four yellow bands on abdomen), both without black tuft on abdomen and with only very fine, short hair-like projections on antennae in male. **Flight season** Jul–Aug. Male is attracted to pheromone lures. **Life cycle** Overwinters twice as a larva, in the rootstock of the foodplant. In the second summer it feeds in the roots, sometimes causing a rounded walnut-sized gall at the base of the plant. It then mines a short way up a fruiting stem and returns to the roots to overwinter. The following spring it mines a little further up the stem and makes an exit hole, leaving the outer skin as a 'window'. Pupates by early Jun, just below the exit hole, without a cocoon. **Larval foodplants** In Britain, so far recorded only on cultivated Raspberry. Abroad also found on Raspberry growing in the wild, and recorded on Bramble. **Habitat** Gardens and fruit farms. **Status and distribution** Probably accidentally introduced, most likely with Raspberry plants, now established locally. Found breeding locally in Hertfordshire, Cambridgeshire, Essex and Bedfordshire (in 2009 and 2010), and found very locally in Sussex in 2009 and 2010. First discovered in early Oct 2007, a larva in a garden at Meldreth, Cambridgeshire. Subsequently, vacated mines were found at local commercial raspberry growers, and males came to pheromone lures in several places in the Lee Valley, also Kimpton, Bishop's Stortford and on a farm near Cambridge. The origin of these populations remains uncertain. Long-term residency, recent immigration and accidental importation with plant stock are all possibilities. Widespread in mainland Europe.

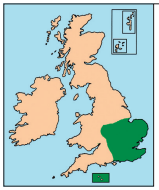
Sesiinae

Hornet Moth

plate 2

Sesia apiformis (Cl.)

Nb 52.002 (370)



Field characters and similar species FW 17–21mm. As large and bulky as a true Hornet *Vespa crabro*, and even has jerky, wasp-like movements when disturbed. However, it is yellower, and lacks the wasp-waist. Distinguished from Lunar Hornet Moth by bright yellow head and shoulder patches, and black collar. **Flight season** One generation. Mid-Jun–Jul, sometimes to early Aug. Can be found, including mating pairs, at rest on poplar trunks after emergence, usually from 7–11am, but seldom seen when active. Male is attracted to pheromone lures, usually in the morning. **Life cycle** Overwinters as a larva, at least twice, fully grown in a cocoon during the second or third winter. Larva Sep–May of the third or fourth year. Female glues the eggs to the base of the trunk. Larva feeds mainly just beneath the bark, near ground level or just below it. Look for adult exit holes near the base of the tree. During the flight season, these may have pupal cases protruding from them or lying on the ground nearby. **Larval foodplants** The live wood of Black-poplar, Aspen, Lombardy-poplar and other poplars. Occasionally found on willows. **Habitat** Includes parks, hedgerows, golf courses, quarries, fens, plantations and amenity plantings. Favours trees in open habitats, often those planted as wind-breaks, with little vegetation around the base so that the sun warms the trunks. Some trees may be tenanted year after year, and may eventually be killed. **Status and distribution** Resident. Nationally Scarce B. Locally fairly frequent in the Midlands and southern England, from Oxfordshire, Berkshire and Northamptonshire eastwards and through East Anglia. More local in Hampshire, Sussex and Kent. Older records from south-west England, Cheshire, Lancashire, Co. Durham and north and south Wales (Denbighshire, Flintshire and Glamorgan). A single record from Ireland, in Co. Dublin in 1946. Local in the Channel Islands.

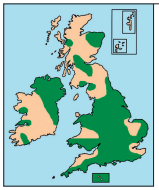
Pupa and cocoon of Hornet Moth.

Lunar Hornet Moth

plate 2

Sesia bembeciformis (Hb.)

Common 52.003 (371)



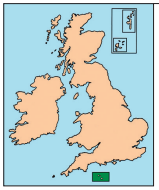
Field characters and similar species FW 15–19mm. Similar to Hornet Moth, but smaller, and with black head and shoulders, and bright yellow collar. **Flight season** One generation. Jul–early Aug. Very rarely seen, but can be found freshly emerged on willow trunks in the morning. No specific pheromone lure is available. **Life cycle** Overwinters, normally twice, as a larva. Larva Aug–spring. Feeds under the bark and close to the ground in the first year, making piles of fine brown frass. In the second, it burrows deeper in and tunnels upwards vertically up to 50cm from the ground. Look for small piles of fine brown frass at the base of the tree, old exit holes, and rough gashes in the trunks made by woodpeckers trying to reach the larvae. The larval workings are a frequent sight in felled willows. **Larval foodplants** The lower trunk and upper roots of sallows and willows, including Goat Willow, Grey Willow and Crack-willow, and also poplars. Mature trees in damp ground seem to be preferred. **Habitat** Most situations in which the foodplants occur, particularly fens and carr, open woodland, heaths, moors, hedgerows, old quarries and other scrubby areas. **Status and distribution** Resident. Common. The most widespread clearwing in Britain and Ireland, with records from most counties of England and Wales. Widespread but more local in Scotland, mainly recorded in the south, Central Belt and north-east. In Ireland, quite widespread in the north, but a few, scattered records from the south and east of the Irish Republic, south to Co. Cork. Local in the Channel Islands.

Dusky Clearwing

plate 2

Paranthrene tabaniformis (Rott.)

Presumed extinct; former resident 52.004 (372)



Field characters FW 13–14mm. Distinguished from all other clearwing moths in Britain and Ireland by dark clouding over most of forewing. **Flight season** One generation. Late May–mid-Jul (or Aug). Apparently very elusive, and rarely seen in Britain. In mainland Europe, males respond well to pheromone lures. **Life cycle** Not known in Britain, but probably similar to that abroad, where it overwinters twice as a larva. Eggs are laid on a twig of the foodplant or in a bark crevice near the base of the trunk. In the first instance, the small larva overwinters inside the twig gall of the longhorn beetle *Saperda populnea* (L.). It then tunnels along the twig and creates its own gall, more elongated and tapering than that of the beetle, in which it overwinters and

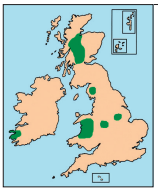
pupates in May. Alternatively, the larva feeds under the bark or in the roots and pupates just beneath the surface of the bark. **Larval foodplants** In England recorded on Aspen, but possibly also associated with other poplars. In France recorded from poplars, sallows and Sea-buckthorn. **Habitat** Generally associated with broadleaved woodland in England, but also found in coastal habitats abroad. **Status and distribution** Former resident in Britain, but given the obscure habits of the adults its rediscovery using pheromone lures is still a possibility. In the 19th or early 20th centuries, very small numbers were found in the London area, Middlesex (Colney Hatch, Ealing Gardens), Kent (Bexley, Ashford), Essex (Epping Forest), Sussex (Brighton), Surrey (Warlingham), Hampshire (near Portsmouth), Devon (Totnes) and Cornwall (Bodmin). The most recent records are of an adult found in Tubney Wood, Berkshire (modern Oxfordshire), in 1924 and one beaten from the foliage of Black-poplar at Birtley, Co. Durham, in 1931. First recorded in the Channel Islands on 28 Jun 2012, one at a pheromone lure at Grouville Common, Jersey, another on 6 Jul 2013.

Welsh Clearwing

plate 2

Synanthedon scoliaeformis (Borkh.)

RDB 52.005 (376)



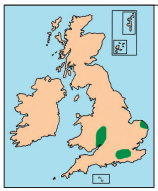
Field characters FW 12–15mm. Large, broad and roughly heart-shaped central black mark on forewing, pointing towards base of wing, is diagnostic. Antennae whitish towards tip in female, darker in male, and two narrow yellow bands on abdomen. Tail fan orange in female, brownish orange in male. **Similar species** Orange-tailed Clearwing also has two yellow bands on abdomen, but is much smaller with narrower, squarer central forewing mark, and black antennae. See also White-barred Clearwing. **Flight season** One generation. Jun–early Jul. Occasionally found at rest on birch trunks in the morning or seen laying eggs in the afternoon. Male is attracted to pheromone lures, usually before 1pm. **Life cycle** Overwinters twice as a larva. Larva Aug–May, feeding on the inner bark of old trees. Look for emergence holes 1–2m above ground and for the 15–18mm-long extruded yellowish-brown pupa. **Larval foodplants** Downy Birch. **Habitat** Open birch woodland, on wet, acidic pasture and moorland. It may be important that the base of the tree is not shaded or smothered with vegetation, thus providing a warmer micro-climate for the larvae within. **Status and distribution** Resident. Red Data Book species. First discovered in Britain in 1854, near Llangollen, Denbighshire. Still found very locally in Wales, in Merionethshire (foothills of Snowdonia) and Montgomeryshire (several sites). In England, in Staffordshire (Cannock Chase, where it was found in the 19th century, rediscovered in 2005, and in 2006 proved to be well established). A strong colony at Sherwood Forest, Nottinghamshire, was discovered in 2008, and another in Borrowdale, Cumbria, in 2014. In Scotland, in Perthshire (Rannoch and the Trossachs) and East Inverness-shire (Glen Affric and Glen Moriston), and old larval workings have been reported from Sutherland. In the Irish Republic, found in the area between Killarney and Kenmare, Co. Kerry. In the 19th and early 20th centuries, also found in Glamorgan and Cheshire (Delamere Forest), with unconfirmed records from Herefordshire. There could be other overlooked populations elsewhere.

White-barred Clearwing

plate 2

Synanthedon spheciformis ([D. and S.])

Nb 52.006 (375)



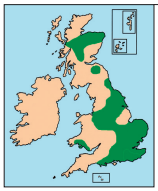
Field characters FW 12–14mm. A relatively large, quite dark species. Diagnostic features are the presence of only one yellowish-white band on abdomen, near the front, yellowish-white spot or short dash to rear of thorax, and whitish band near tips of antennae. **Similar species** Welsh Clearwing has two pale bands on abdomen and a partly or wholly orange tail fan, and central band on forewing is broader and more rounded. **Flight season** One generation. Mid-May–early Jul, with peak numbers in early Jun. Once recorded visiting flowers of Guelder-rose. Male is attracted to pheromone lures. **Life cycle** Overwinters as a larva, at least twice. Larva Aug–May, feeding near the base of the trunk or in the roots. Look for a small pile of frass on the ground beneath the 5mm round exit hole. **Larval foodplants** Alder and birches. **Habitat** Heathland, raised mosses, Alder groves, stream-sides, woodland edges, glades and way-leaves in damp woods. **Status and distribution** Resident. Nationally Scarce B. Recent records come from the heaths of north Hampshire, Surrey and Berkshire, and from Norfolk and the west Midlands. Formerly recorded more widely in south-east and southern England (from Hampshire eastwards), East Anglia, Wales, the north-west Midlands and north-west England.

Large Red-belted Clearwing

plate 2

Synanthedon culiciformis (L.)

Nb 52.007 (381)



Field characters FW 12–14mm. Combination of single broad red band on abdomen and a scatter of reddish scales at base of forewing is diagnostic. **Similar species** See Red-belted Clearwing and Red-tipped Clearwing. **Flight season** One generation. Mid-May–late Jun, earlier than most clearwings, but emergence can be delayed by prolonged cool, wet weather. On hot, sunny days,

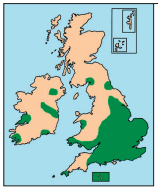
females can be seen (sometimes in numbers) laying eggs on freshly cut birch stumps and tree trunks. Recorded visiting flowers, including Wood Spurge, hawthorns and Rhododendron. Male is attracted to pheromone lures. **Life cycle** Overwinters as a larva in a cocoon. Larva Jul–May. Tunnels and pupates under the bark. Look for small holes and frass at the edges of cut stumps, between the bark and the heartwood. **Larval foodplants** Downy Birch and Silver Birch, occasionally Alder. **Habitat** Birches in light woodland, particularly areas of recent coppicing or felling, and birch and Alder scrub on heathland and other open sunny places, on both light soils and clays. **Status and distribution** Resident. Nationally Scarce B. Recorded locally from most counties in England. Recent records are more thinly distributed, in southern coastal counties from Dorset to Kent, Berkshire, East Anglia, the east Midlands and north to Durham. Also Shropshire, Cheshire, Lancashire and south Wales. In Scotland, Berwickshire, West Perthshire, Inverness-shire and the north-east. Recorded on Jersey, but not recently.

Red-tipped Clearwing

plate 2

Synanthedon formicaeformis (Esp.)

Nb 52.008 (380)



Field characters FW 9–11mm. Combination of dense patch of red scales at forewing tip and a single broad red band on abdomen is diagnostic. On emergence, has two bands of powdery yellow scales on abdomen, which are lost during early flights. **Similar species** See Red-belted Clearwing and Large Red-belted Clearwing. **Flight season** One generation. Late May–early Aug, with peak emergence in mid-Jun, later in cool summers. Has been found at rest on tree trunks in early morning and beaten from willow foliage in dull weather, and is sometimes seen visiting flowers. Male is attracted to pheromone lures in the afternoon. **Life cycle** Overwinters as a part-grown larva. Larva Aug–May, living in the trunks, branches and thin stems of the foodplants. Sometimes frass is found where the tree has been damaged in some way.

Empty pupal case of Red-tipped Clearwing.

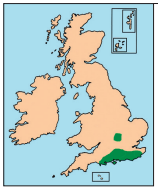
Larval foodplants Osiers and other willows, including Goat Willow, Grey Willow and Creeping Willow. **Habitat** Sallow carr and swamp, osier or withy beds, riverbanks, flooded gravel pits and pond edges, and other places where willows grow, usually in damp or marshy ground. **Status and distribution** Resident. Nationally Scarce B. Widespread but local and absent from some areas. In England, found north to Northumberland and Cumbria. Also in south and north-west Wales. In Scotland, recorded very locally from the south-west, but not since 1942. In Ireland, widely distributed but very local. In the Channel Islands, recently recorded from Alderney.

Sallow Clearwing

plate 2

Synanthedon flaviventris (Stdgr.)

Nb 52.009 (377)



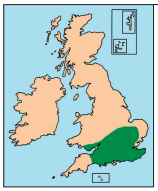
Field characters FW 8–9mm. A small clearwing with a dark thorax and three thin yellow bands on otherwise black abdomen, the central one slightly broader. Occasionally a very faint fourth abdominal band. **Similar species** Currant Clearwing is similar in size, but with yellow collar and two yellow lines on thorax. Yellow-legged Clearwing has largely yellow legs and four distinct yellow bands on abdomen. See also Thrift Clearwing. **Flight season** One generation. Mid-Jun–mid-Jul. Seldom seen except when attracted to pheromone lures, mainly in the afternoon. **Life cycle** Overwinters twice as a larva, in the stem of the foodplant. Larva Aug–Jun. The eggs are laid on slender stems and the larva burrows within, causing a pear-shaped gall 25mm in length to form in the second year, in a stem about 10–15mm in diameter. These can be found mainly in winters from odd to even years, usually on the top-most twigs of old bushes or the young straight stems of those cut back a year or two previously. The larva of the longhorn beetle *Saperda populnea* (L.) makes a similar gall in slender willow stems. **Larval foodplants** Sallows, particularly Goat Willow and Grey Willow. **Habitat** Damp, open woodland and damp heathland. **Status and distribution** Resident. Nationally Scarce B. Very local from Dorset to Kent and north to Oxfordshire and Buckinghamshire. Old records from Devon (1927) and the Isle of Wight.

Orange-tailed Clearwing

plate 2

Synanthedon andrenaeformis (Lasp.)

Nb 52.010 (378)



Field characters and similar species FW 9–11mm. Distinctive wide orange and black tail fan on slender abdomen of male is visible even in flight, but see Welsh Clearwing and Yellow-legged Clearwing. Female with less orange on tail fan.

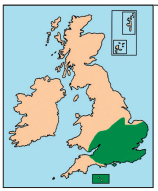
Abdomen in both sexes with two yellowish bands, and sometimes further very fine bands. **Flight season** One generation. Mid-May–mid-Jul. Male comes readily to pheromone lures. Otherwise, adults are very seldom recorded, but have been seen in flight around lime blossom. Some populations are reported to produce adults only in alternate years. **Life cycle** Overwinters twice as a larva in the stem of the foodplant. Larva Jul–May, in stems or branches 8–25mm or more in diameter, most frequently on bushes growing in sheltered, sunny locations. Look for exit holes up to 6m from the ground. The holes are about 3mm in diameter, covered with a disc of bark about 7mm across, making them quite hard to find. However, the discs are often slightly concave and sometimes fall off, in which case the hole may be plugged with frass. **Larval foodplants** Wayfaringtree and, less often, Guelder-rose. **Habitat** Chalk downland, limestone grassland and woodland edges. **Status and distribution** Resident. Nationally Scarce B. Found locally from Dorset and Somerset eastwards to Kent, northwards to south-east Wales, Worcestershire and Herefordshire, and east to Northamptonshire, Cambridgeshire and West Norfolk. Also reported from Ilfracombe, Devon (in 1935), and in Wales from Monmouthshire and Glamorgan.

Red-belted Clearwing

plate 2

Synanthedon myopaeformis (Borkh.)

Nb 52.011 (379)



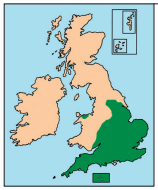
Field characters FW 9–11mm. Combination of a single broad red (very rarely white) band on abdomen with uniformly black forewing markings is diagnostic. **Similar species** See Large Red-belted Clearwing and Red-tipped Clearwing. **Flight season** One generation. Mid-Jun–early Aug. Male can often be seen flying around the top-most branches of Apple trees and comes readily to pheromone lures, sometimes in numbers, from mid-morning to late afternoon. **Life cycle** Overwinters as a larva. Eggs are laid in the afternoon, singly on the bark, especially where main trunk divides to form the largest branches in mature trees. Larva Aug–May, feeding underneath the bark. Wounded trees are especially favoured, and a tree may be infested for many years. Look for exit holes, empty, protruding pupal cases and frass in bark crevices. **Larval foodplants** Usually Apple, including native Crab Apple. Also recorded from Hawthorn, Pear, Almond and Rowan. **Habitat** Well-established orchards and gardens, hedgerows, open woodland and mature scrub. **Status and distribution** Resident. Nationally Scarce B, but probably under-recorded. Recorded locally in most counties in England south of the Wash, but few or no recent records from south-west England. A very few historical records from the north Midlands and northern England. Rare on Jersey but seen regularly on Alderney.

Yellow-legged Clearwing

plate 2

Synanthedon vespiformis (L.)

Nb 52.012 (374)



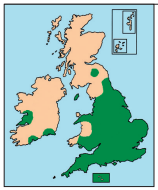
Field characters FW 10–12mm. Central cross-bar on forewing is reddish and easily visible parts of legs are largely yellow. In female, second, fourth and sixth abdominal segments with yellow band (also one on fifth, but usually more faint). In male, extra yellow band on seventh segment. Tail fan yellow above on female (conspicuous in flight), while that of male is black above, with some yellow underneath. Sometimes leading and trailing edges of forewing are bordered with red (f. *rufomarginata* Spul.). **Similar species** Reddish central bar on forewing and yellow legs distinguish this moth from Orange-tailed, Sallow, Currant and Welsh clearwings. See also Six-belted Clearwing, with five or six distinct yellow bands on abdomen, tail fan black and yellow above, and wings held closer to the body at rest. See also Raspberry Clearwing. **Flight season** One generation. Late May–mid-Aug. Recorded visiting Bramble flowers. Females have been seen laying eggs on sunny afternoons. Male comes readily to pheromone lures, usually between noon and 6pm. **Life cycle** Overwinters as a part-grown larva, probably only once. Eggs are laid on one- or two-year-old stumps, or in wounds and calluses on the trunk. Larva Aug–May, feeding on the inner bark. **Larval foodplants** Usually Pedunculate Oak but also Sweet Chestnut; and recorded on Sessile Oak, Evergreen Oak, Wych Elm, birches, cherries and, recently, on a broadleaved willow. **Habitat** Open woodland, parkland and hedgerows, especially where felling has taken place in the last three years. One report from a shaded avenue of Wych Elms, in London. **Status and distribution** Resident. Nationally Scarce B, but probably under-recorded. Found locally in most counties of England north to Yorkshire, very locally in Wales and recorded from Jersey.

Currant Clearwing

plate 2

Synanthedon tipuliformis (Cl.)

Nb 52.013 (373)



Field characters FW 8–10mm. A small clearwing with a yellow collar. Usually two fine yellow lines running along thorax. Three (female) or four (male) thin yellow cross-bands on abdomen, which is black-tipped. **Similar species** Sallow Clearwing has no yellow lines on thorax. See also Thrift Clearwing. **Flight season** One generation. Jun–Jul, usually peaking in late Jun. Flies around the larval foodplants in sunny weather, and is more inclined to settle on leaves than some other clearwings. Male comes quickly and in numbers (sometimes dozens) to

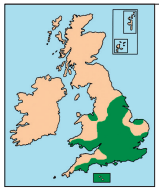
pheromone lures, most often in the afternoon, which is also the main egg-laying time. Recorded visiting the flowers of Ground-elder. **Life cycle** Overwinters, usually once, as a larva in the main stem or a side stem of the foodplant. Larva Aug–Apr or May. In the spring, brownish frass is sometimes found issuing from cut ends of affected shoots, or from cracks in the bark. **Larval foodplants** Cultivated and sometimes wild Black Currant and Red Currant, and less frequently on Gooseberry. **Habitat** Fruit fields, gardens and allotments, in both rural and urban locations. Neglected Black Currant bushes in sheltered, sunny positions seem to be favoured. Occasionally reported on wild currants in sunny places on the banks of streams in damp woods and the margins of fens. **Status and distribution** Resident. Nationally Scarce B, but widespread and under-recorded. Recorded from every county in England, and locally in Wales, Man and the Channel Islands. Very local in Scotland. Recorded north to Aberdeenshire, but recently only from Roxburghshire in the south. Few, very scattered records from the southern half of Ireland, but thought to be under-recorded.

Six-belted Clearwing

plate 2

Bembecia ichneumoniformis ([D. and S.])

Nb 52.014 (382)



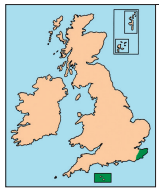
Field characters and similar species FW 9–12mm. The six (in male) or five (in female) yellowish bands on abdomen, in combination with a frosting of orange scales on tip and on central bar of forewing, and largely yellow legs, distinguish this from most other clearwings. Tail fan black with yellow on sides and thin central yellow streaks. Male with fine, short projections on antennae. Yellow-legged Clearwing has three or four strong yellow bands on abdomen. Female Raspberry Clearwing (with six strong yellow bands on abdomen) has black tuft on fourth abdominal segment. Thrift Clearwing is smaller, with fewer, less obvious bands and lacks orange scales on forewing. **Flight season** One generation. Late Jun–mid-Aug. Can be caught using sweep nets. Male sometimes seen perching on the flowers of Salad Burnet and other vantage points in the afternoon and comes readily to pheromone lures, sometimes in large numbers, from 8am to 7pm. Female is sometimes seen laying eggs on the leaves and other parts of the foodplant. **Life cycle** Overwinters as a larva. Larva Jul–May or early Jun. Can be found only by digging up the foodplant, when frass may be seen along the main root. Look on stressed, rather isolated plants in somewhat disturbed ground, particularly at the edges of paths and tracks, rather than in lush growth. **Larval foodplants** Common Bird's-foot-trefoil and Kidney Vetch, and recorded laying eggs on Horseshoe Vetch. **Habitat** Grassy swards, mainly in areas of chalk or limestone, on downland, coastal grassland and rough upland fields, embankments, quarries, brick-pits and cliffs. Does not thrive under heavy grazing. **Status and distribution** Resident. Nationally Scarce B. Most counties in England north to Shropshire and Yorkshire, south and north-west Wales, and the Channel Islands. Much overlooked until recently, but may be expanding its range northwards.

Fiery Clearwing

plate 2

Pyropteron chrysidiformis (Esp.)

RDB (protected species) 52.015 (384)



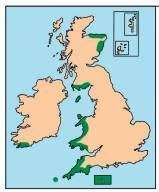
Field characters FW 9–12mm. The fiery orange-red scales over most of forewing are diagnostic. There are two (in female) or three (in male) narrow whitish bands on abdomen. Tail fan orange centrally, black at the sides. These features are very apparent when the moth is at rest. **Flight season** One generation. Mid-Jun–early Jul. Has been seen flying about the foodplants, egg-laying and visiting flowers such as Common Mallow. **Life cycle** Overwinters usually once or sometimes twice as a larva. Larva Aug–May. Tunnels into the tap roots of larger, often isolated plants. Those affected may appear unhealthy. **Larval foodplants** Curled Dock, Common Sorrel and probably other species of dock. **Habitat** Well-drained sites with a warm micro-climate. Shingle at the top of beaches or similarly bare man-made features, including railway ballast, rough herb-rich grassy sward, broken chalk under-cliff, cliff-tops and nearby roadside verges. **Status and distribution** Resident. Red Data Book species. Protected by law from collection or disturbance. Found very locally along the coast and a short distance inland in Kent, between Folkestone and Dover, including Folkestone Warren, where it was first discovered in 1836. Recently rediscovered on the north Kent coast, where it was first reported in 1944. Records from the 19th century from Hampshire (Hayling Island, Gosport and Southsea), Sussex (Eastbourne) and Essex (between Leigh and Southend-on-Sea). In the Channel Islands, a single male on Alderney at a pheromone lure on 2 Jul 2007.

Thrift Clearwing

plate 2

Pyropteron muscaeformis (Esp.)

Nb 52.016 (383)



Field characters FW 6–8mm. Our smallest clearwing, with three longitudinal yellowish stripes on thorax, three (sometimes four) narrow yellowish-white bands on abdomen and no orange scales on forewing. When freshly emerged, the wings have a light covering of yellowish-white scales, which are lost on the first

flight. **Similar species** See Six-belted Clearwing. On Currant Clearwing the dark outer band on forewing is streaked with orange. Sallow Clearwing has a dark thorax. Both are slightly larger, and unlikely to occur in the same habitat as Thrift Clearwing. **Flight season** One generation. Early Jun–late Jul. Flies rapidly, from late morning until late afternoon, sometimes visiting the flowers of Thrift and Wild Thyme. Male comes readily to pheromone lures. **Life cycle** Overwinters as a part-grown larva. Larva Aug–May, feeding in the roots and stems. Most frequent in plants growing in rock crevices, often in the splash zone. In occupied plants, the cushion of foliage often dies around the feeding larva and turns brown, or there are small piles of reddish-brown frass on the surface. Larvae of the tortricoid micro-moth *Lobesia littoralis* (Humph. and Westw.) also cause Thrift dieback and browning, and are much more frequent. Like clearwing larvae, they are whitish and unmarked, with a brownish head, but much smaller (<10mm) in Apr–May. **Larval foodplants** Thrift. **Habitat** Rocky coastlines and sunken lanes close to the sea. **Status and distribution** Resident. Nationally Scarce B. Quite well distributed along the coasts of south-west England (including Scilly), west Wales (including Anglesey) and Man, with older records from Cumbria. In Scotland, very local in the south-west (Kirkcudbrightshire and Wigtownshire) and the north-east (Banffshire, Moray and Kincardineshire, with older records from Aberdeenshire and Angus). In Ireland, recorded widely but very locally in the southern half, and recently only from Co. Clare. Locally frequent in the Channel Islands.

Limacodidae

This family of about 1,000 species is mainly tropical, but has representatives all over the world. There are only two species found in the British Isles, both quite small moths but with the deep, rather rounded forewings and tent-like resting posture characteristic of the group. The proboscis is rudimentary and the adult moths do not feed. The family name derives from *Limax*, the Latin for slug, on account of the distinctive slug-like larvae.

Festoon

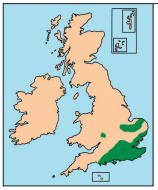
Triangle

Festoon

plate 2

Apoda limacodes (Hufn.)

Nb 53.001 (173)



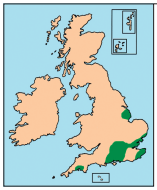
Field characters FW M 10–12mm F 11–13mm. The cross-lines, strongly diverging from leading edge of broad orange-brown forewing, and resting posture, with forewings held at a steep angle and creased so that tips are flattened out (with abdomen upturned in male), are diagnostic. Female is paler than male. Sometimes the area between cross-lines is darker and occasionally male is as pale as female (f. *ochracea* Seitz). Rare melanic forms of male have forewing lightly or heavy marked with blackish brown (f. *suffusa* Seitz and f. *assella* Esp.). **Flight season** One generation. Jun–Jul. Flies mainly at night and comes to light. Occasionally seen flying in sunshine, high in the oak canopy. From a higher vantage point, this might prove to be frequent behaviour. **Life cycle** Overwinters as a larva in a cocoon formed on a leaf, which falls to the ground in autumn. Larva late Jul–early May. **Larval foodplants** Usually Pedunculate Oak, but also other oaks and Beech. **Habitat** Principally mature lowland broadleaved woodland, but also hedgerows with mature oaks, and wooded heathland. **Status and distribution** Resident. Nationally Scarce B. Found locally in the southern half of England, mainly in Dorset, Hampshire, Isle of Wight, Wiltshire, Berkshire, Surrey, Sussex, Kent, East Anglia and the south-east Midlands. Also very locally in Oxfordshire and at a single site in Worcestershire (Trench Wood). One record from Wales, at Usk, Monmouthshire, in 1967.

Larva of Festoon.

Triangle plate 2

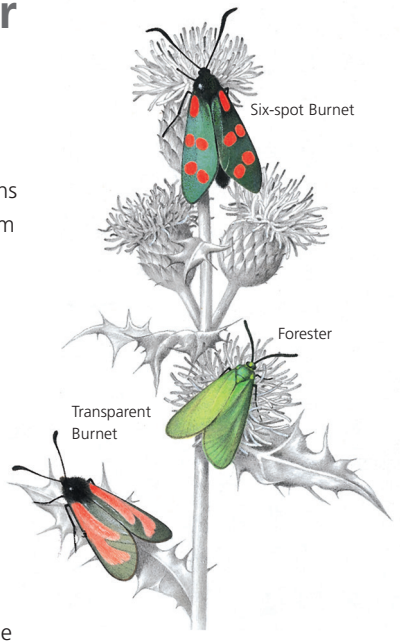
Heterogenea asella ([D. and S.])

RDB 53.002 (174)



Field characters FW M 5–7mm F 9–11mm. Could be confused with some microlepidoptera (e.g. Tortricidae). Recognised by the combination of very plain, rather triangular brown forewing with a very curved leading edge, and the tent-like resting posture. Occasionally male is very dark (f. *nigra* Tutt) and female is pale yellow (f. *flavescens* Tutt). **Flight season** One generation. Mid-Jun–late Jul. Flies mainly at night, coming to light in small numbers, usually on warm nights. There are a few reports of flights in the tree canopy on sunny afternoons; it is possible that this occurs more frequently but usually goes undetected. **Life cycle** Overwinters as a fully grown larva, in a gall-like cocoon on a leaf or twig. Larva Aug–May or Jun, feeding until Oct. **Larval foodplants** Oaks and Beech. Recorded once on a poplar. **Habitat** Oak and Beech woodland. **Status and distribution** Resident. Red Data Book species. Very localised and scarce in the most southern parts of England. Most records are from the large and ancient oak woodlands of Hampshire, Wiltshire, Sussex and south-east Kent. Two males at Great Torrington Wood in 1999 were the first in Devon for nearly 100 years, with more subsequently. Also found very locally in south Devon, Essex, Berkshire, in Lincolnshire in Bardney Forest and near Woodhall Spa, in Buckinghamshire and near Looe, Cornwall, in 1960 and 1969. Two larvae were found on poplar at Seaford, Sussex, in about 1930.

Zygaenidae Forester and burnet moths



This family comprises about 800 species worldwide. There are ten species recorded in Great Britain and Ireland. Typically, these moths live in colonies, sometimes rather isolated from one another for many generations, and as a consequence a number of differences have evolved between populations, some of which are recognised as races or subspecies.

The adults are almost exclusively seen by day and their flight is generally rather direct. All have round-tipped, rather narrow forewings that are held at a steep angle quite close to the body when at rest, and stout antennae that are always forward-pointed and in some cases clubbed, rather like those of butterflies. Both adults and larvae are toxic to non-insect predators, releasing poisons such as hydrogen cyanide when attacked. Forester moths are not, in fact, particularly associated with woodland and the name is most probably derived from Lincoln green, the colour supposedly worn by medieval foresters in Sherwood Forest.

Adults regularly visit flowers in open habitats, particularly rough grassland. The larvae feed mainly on herbaceous plants, often members of the pea family. The tapering whitish papery cocoons are usually formed low down in the vegetation, but those of some burnet moths are spun high along grass stems, and are rather conspicuous.

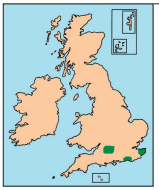
Procridinae

Scarce Forester

plate 3

Jordanita globulariae (Hb.)

Na 54.001 (165)



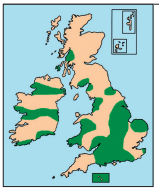
Field characters and similar species FW M 12–15mm F 10–12mm. Forewing of both sexes is generally broader and more rounded at tip than in same sex of Forester, and both sexes are larger than those of Cistus Forester. Male antennae are tapering and pointed at tip, and lack distinct feather-blade extensions only on the last three segments. Those of male Forester and Cistus Forester are thickened at tip, with nine to eleven and eight to ten segments, respectively, lacking feather-like extensions. Antennae of female Scarce Forester are of almost uniform thickness from tip to base, whereas in the other two species they gradually thicken towards tip. These differences are best seen under a hand-lens or binocular microscope. **Flight season** One generation. Jun–early Jul. Male flies in sunshine but sits on flowers and vegetation in dull weather. Female spends more time perching or resting. Both sexes visit flowers, notably Salad Burnet and knapweeds. **Life cycle** Overwinters as a larva, low down among vegetation. Larva Jul–May, feeding until Sep and then again in spring. Pupates in May in a brownish-grey cocoon concealed on or just below the ground. **Larval foodplants** Common Knapweed and Greater Knapweed, mining the leaves. **Habitat** Dry, unimproved calcareous grassland. The moth and foodplant require quite a rough sward to thrive. **Status and distribution** Resident. Nationally Scarce A. Very restricted, in southern England. Found on Salisbury Plain, Wiltshire; Porton Down and Shipton Bellinger on the Wiltshire–Hampshire border; between Findon and Eastbourne in Sussex; and near Dover, Kent. Old records from Gloucestershire.

Forester

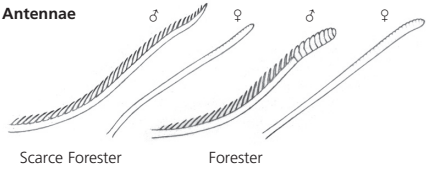
plate 3

Adscita statices (L.)

Local 54.002 (163)



Field characters and similar species FW M 12–15mm F 11–13mm. The three British forester moths are superficially almost identical, but can be separated by careful comparison of individuals of the same sex. Males have feathery, slightly larger, broader antennae than females. When comparing the same sex, Forester and Scarce Forester are about the same size, but Cistus Forester is smaller. See also under Scarce Forester. **Flight season** One generation. Mid-May–Jul, occasionally into Aug. Flies in sunshine and spends much time feeding at flowers such as Ragged-Robin, Field and Devil's-bit Scabious, clovers and Viper's-bugloss, even in cloudy weather. Mating pairs are seen in the afternoon. Male sometimes flies again an hour or so before sunset on warm evenings, and very occasionally comes to light, sometimes away from suitable habitat. One fertile female recorded visiting garden flowers 35km from the nearest known colony. **Life cycle** Overwinters as a part-grown larva, low down among the sward. Larva Jul–early May, pupating in a cocoon concealed near the ground. **Larval foodplants** Common Sorrel and Sheep's Sorrel. Will feed on Broad-leaved Dock in captivity. **Habitat** Open habitats ranging from damp, neutral grassland to limestone grassland, chalk downland, acid and sandy heathland, mature coastal sand-dunes, and woodland rides and clearings. **Status and distribution** Resident. Local. Well distributed but local in some parts of England and Wales, where many colonies have been lost as a result of agricultural intensification. Very local in western Scotland in Kirkcudbrightshire, Argyllshire and on Jura, Lismore and Mull. Widespread but very local in Ireland. Local in the Channel Islands but frequent and increasing on Alderney since 2003.

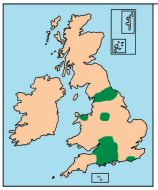


Cistus Forester

plate 3

Adscita geryon (Hb.)

Nb 54.003 (164)



Field characters and similar species FW M 10–12mm F 9–10mm. Both sexes are distinctly smaller than the same sex of Forester and Scarce Forester. See Scarce Forester for differences in antennae. **Flight season** One generation. Late May–Jul or early Aug. Visits flowers, including those of Kidney Vetch, Wild Thyme and Common Bird's-foot-trefoil. Male flies in sunshine but female spends much of the time perching on stems. **Life cycle** Overwinters as a larva, low down among the sward. Larva Jul–May. Pupates in a cocoon formed close to the ground and concealed. **Larval foodplants** Common Rock-rose. **Habitat** Open grassland on chalk and limestone hills, favouring warm, flower-rich, south-facing slopes. Egg-laying has been observed on rather small plants in short and fairly sparse sward (up to 5cm tall). **Status and distribution** Resident. Nationally Scarce B. Sometimes numerous on breeding sites, but these

are highly localised. Extends from Dorset east to Sussex, with old records from Kent, and north through Wiltshire and Gloucestershire, following calcareous strata north-east to Oxfordshire and formerly to Buckinghamshire and Bedfordshire. Very local in the north Midlands and northern England, including Staffordshire, the Derbyshire Dales, Yorkshire, Co. Durham and Arnside, Cumbria. In Wales, recorded from Denbighshire and Caernarvonshire, notably on the Great Orme.

Zygaeninae

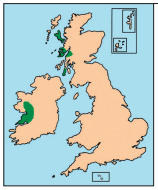
Transparent Burnet

plate 3

Zygaena purpuralis (Brünn.) 54.004 (172)
ssp. *segontii* Trem.
RDB; presumed extinct

ssp. *caledonensis* Reiss
Na

ssp. *sabulosa* Trem.
Ireland

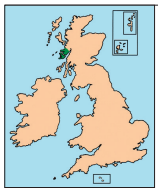


Field characters and similar species FW 14–16mm. Distinguished by thinly scaled forewing, and uniquely among burnets in Britain or Ireland, with three blunt red streaks, the outermost of which is hatchet-shaped. The red is sometimes inclined to purplish, and in the rare f. *obscura* Tutt is replaced by blackish. On Skye, and rarely elsewhere, forms occur with red markings replaced by orange or yellow. Scotch Burnet and Slender Scotch Burnet also have thinly scaled forewings, but are smaller and thinner, with distinct spots rather than streaks. **Flight season** One generation. Early Jun–Jul. Both sexes fly in warm weather, preferring sunshine, and visit flowers such as Wild Thyme. During dull or wet weather they sit about, often fully exposed, on flower-heads or other vegetation, sometimes for days. **Life cycle** Overwinters as a larva, sometimes twice. Larva Jul–May. Pupates in a cocoon spun and concealed near the ground. **Larval foodplants** Wild Thyme. **Habitat** Steep south- and south-west-facing heathy and grassy slopes and undercliffs on or near the coast, and inland on limestone. Large fluctuations in population density have been recorded, sometimes in response to changing grazing levels. **Status and distribution** Resident. The Nationally Scarce A ssp. *caledonensis* occurs on the Hebridean islands of Mull, Ulva, Lismore, Kerrera, Eigg, Rum, Canna and the west coast of Skye. Also on the mainland coast of Argyll at Ardnamurchan and Oban, in a limestone area 7km inland of Oban, and on the Mull of Kintyre. Ssp. *segontii* occurred in small colonies along the cliffs near Abersoch on the Lleyn Peninsula, Caernarvonshire. Not seen since 1962, in spite of searches, and could be extinct. Ssp. *sabulosa* occurs in western Ireland, mainly in the Burren district of Cos. Clare and Galway, very locally in Limerick and West Mayo, and on Inishmore in the Aran Islands.

Slender Scotch Burnet

plate 3

Zygaena loti ([D. and S.]) 54.005 (167)
ssp. *scotica* (Rowl.-Br.)
RDB (protected from sale)

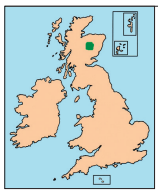


Field characters FW 14–16mm. Outermost red forewing spots merged, forming a large, kidney-shaped blotch. The other four spots are distinct and hindwing has a very narrow black border. Thorax black with greyish-white hairs, especially in female. Legs in male outwardly black, in female largely yellowish brown. **Similar species** Six-spot Burnet may have merged outer spots, but is usually larger, with forewing more thickly scaled and body less hairy. See also Scotch Burnet and Transparent Burnet. **Flight season** One generation. Early Jun–early Jul. Male searches out the female, which spends much of the time perching and nectaring, particularly at the flowers of the larval foodplant. Male often visits other flowers, particularly milkworts and Wild Thyme. **Life cycle** Overwinters as a larva, sometimes twice. The eggs are laid in batches on the foodplant. Larva late Jul–late May or early Jun. Pupates in an oval-shaped, dull white cocoon, spun on or near the ground. **Larval foodplants** Common Bird's-foot-trefoil. Most larvae are found on the shorter plants, generally less than 6cm tall, and often in poor condition. **Habitat** On south- or south-west-facing slopes by the sea, where the underlying rock is basaltic. Foodplant and moth are most numerous in areas where slippage, disturbance or moderate grazing occur (but colonies are vulnerable to overgrazing). Less numerous where other plants have colonised and where the height of the vegetation is greater than 6cm. **Status and distribution** Resident. Red Data Book species. Ssp. *scotica* is endemic to Scotland, where it is restricted to five or six sites on the Hebridean island of Mull, and on the small nearby island of Ulva. Formerly found (pre-1945) near Lochaline and Drimnin on the Morvern peninsula, West Inverness-shire.

Scotch Burnet (Mountain Burnet)

plate 3

Zygaena exulans (Hohen.) 54.006 (166)
ssp. *subochracea* White
RDB



Field characters FW 10–16mm. The thinly scaled forewing, with five distinct but sometimes very small red spots, broad black border of hindwing and yellow shoulder patches of female distinguish this burnet. **Similar species** See Slender Scotch

Burnet, New Forest Burnet and Transparent Burnet. **Flight season** One generation. Mid-Jun–late Jul. Flies strongly in sunshine but hides low down among vegetation in bad weather. Both sexes visit flowers, particularly Common Bird's-foot-trefoil, but also Mountain Everlasting and others. **Life cycle** Overwinters once or more as a larva. Larva Jul or Aug–late May or Jun. Spins a cocoon low in the vegetation. **Larval foodplants** Mainly Crowberry, eating the terminal shoots and unripe berries. Also Cowberry, Bilberry and heather. **Habitat** The higher slopes and summits of mountains, where the vegetation consists mainly of prostrate Crowberry and heathers, lichens and scattered Bilberry, Mountain Everlasting and Trailing Azalea. **Status and distribution** Resident. Red Data Book species. Known only from the eastern Cairngorms near Braemar, Aberdeenshire, at 700–850m, where it can be numerous very locally. One (probably wind-blown) individual was recorded in 1984 near Loch Builg, to the north. There is also an old unconfirmed record from Lochnagar, to the south-west.

Cocoon of New Forest Burnet on underside of leaf.

New Forest Burnet

plate 3

Zygaena viciae ([D. and S.]) 54.007 (168)

ssp. *ytenensis* Briggs
Extinct

ssp. *argyllensis* Trem.
RDB (protected species)

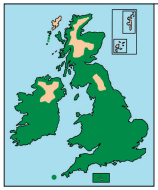
Field characters FW 12–14mm. A small burnet moth, with very round-tipped forewing and five clearly defined red spots, and a broad, dark area beyond. Antennae slender and weakly clubbed. **Similar species** See Scotch Burnet. Five-spot Burnet is larger and stouter, with more pointed wings. **Flight season** One generation. Jul. Adults are rather sedentary, especially female. They nectar on Wild Thyme and occasionally other flowers. Male flies only if the weather is warm and calm. **Life cycle** Overwinters as a larva, sometimes more than once. Eggs are laid in batches in late Jul. Larva Jul–early Jun. Pupates in a papery cocoon concealed on the underside of leaves and on grass stems low down in the vegetation. **Larval foodplants** Meadow Vetchling and Common Bird's-foot-trefoil. **Habitat** In Scotland, ssp. *argyllensis* is restricted to a steep, south-facing, herb-rich grassy slope with ledges above, flushed by water from calcareous rocks. During the late 1980s the slope was heavily grazed, and by 1990 breeding was confined to ledges inaccessible to the sheep, with a total adult population estimated at about 15 individuals. Sheep are now excluded, and as a result the sward is taller, herb-rich and, crucially, is allowed to flower. **Status and distribution** Resident. Red Data Book species; highly vulnerable and protected by law from collection or disturbance. Ssp. *argyllensis* known from one site on the coast of western Argyllshire, where it was discovered in 1963. Following the reduction in grazing, the population has increased greatly and in 2005 it colonised a small adjacent area to the west. Ssp. *ytenensis* formerly occurred in the New Forest, Hampshire, in woodland rides and clearings, but was last seen there in 1927.

Six-spot Burnet

plate 3

Zygaena filipendulae (L.) 54.008 (169)

ssp. *stephensi* Dupont
Common



Field characters FW 15–19mm. The only British burnet with six separate red spots on forewing (red patch at base is divided by a vein and counts as two spots). In some forms, outermost spots are merged, also sometimes the middle pair. Very rarely, red colour is replaced by yellow throughout (f. *flava* Robson). **Similar species** See Slender Scotch Burnet. **Flight season** One generation. Late Jun–Aug. Visits flowers such as thistles and knapweeds. Male patrols, searching for unmated females. **Life cycle** Overwinters as a larva, sometimes twice. Larva Aug–Jun. Pupates in a cocoon formed in an exposed position along a grass or other plant stem. **Larval foodplants** Mainly Common Bird's-foot-trefoil, but also Greater Bird's-foot-trefoil. **Habitat** Flowery grassland, usually on light soils, including downland, permanent pasture, woodland rides, sand-dunes and other grassy coastal habitats. **Status and distribution** Resident. Common. Well distributed in England, Wales and Man. Formerly, largely coastal in Scotland, reaching the northernmost parts of the mainland and the Outer Hebrides, but has recently spread inland, especially in the south and north-east. Widespread in Ireland, more so around the coast. Very local in the Channel Islands.

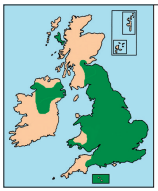
Narrow-bordered Five-spot Burnet

plate 3

Zygaena lonicerae (Schev.) 54.009 (171)
ssp. *latomarginata* (Tutt)
Common

Talisker Burnet ssp. *jocelynae* Trem.
RDB (protected from sale)

ssp. *insularis* Trem.
Ireland



Field characters and similar species FW 15–19mm. The differences between the adults of this species and Five-spot Burnet (especially ssp. *decreta*) are comparative and slight, but become apparent when a number of specimens are compared. In Narrow-bordered, forewing is generally longer and more pointed, tip of hindwing is more pointed and black border of hindwing is narrower. Examples with the middle pair of spots merged are frequent in Five-spot Burnet, but rare in Narrow-bordered. Additionally, in Five-spot (all subspecies), eggs are laid in several layers, forming an irregular heap, whereas in Narrow-bordered they are laid in a single layer. Eggs are readily laid in captivity. Larva of Narrow-bordered has much longer hairs than that of Five-Spot, and the cocoon is translucent in Narrow-bordered, but opaque in Five-spot.

Talisker Burnet (ssp. *jocelynae*) is larger than ssp. *latomarginata*, with longer, black hair on head, thorax and abdomen, and larger, sometimes suffused and merged forewing spots. Ssp. *insularis* has larger spots than ssp. *latomarginata*, with a tendency for middle pair to merge. **Flight season** One generation. Late Jun–Jul. Nectars at many flowers, sometimes in numbers, and can be seen at rest, often beside the cocoon. **Life cycle** Overwinters as a larva. Larva Jul–Jun. Often sits exposed on the foodplant, especially when fully grown. Pupates in a white papery cocoon spun high on a plant stem. **Larval foodplants** Mainly Meadow Vetchling, Red Clover, Sainfoin and Greater Bird's-foot-trefoil. Occasionally Common Bird's-foot-trefoil, White Clover and Bitter-vetch. **Habitat** Rough grassland, on well-drained calcareous ground, and on damper clays, uncut roadside verges and embankments, woodland rides and the margins of wetlands. Ssp. *jocelynae* occurs mainly on steep, grassy coastal slopes. **Status and distribution** Resident. Common. Ssp. *latomarginata* is well distributed over most of England to Cumbria and Northumberland, and in north and south Wales. In south-west England, formerly extending only to Somerset, but colonies have been found in Devon since 2010. In Scotland, formerly restricted to the far south, but has recently become widespread in the south-east, north to the Edinburgh area. Widespread in the Channel Islands. Ssp. *jocelynae* is a Red Data Book taxon. Confined to Skye, Inner Hebrides. Ssp. *insularis* is local in Ireland, mostly in the northern half, and in decline.

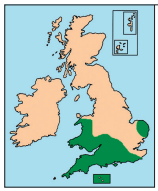
Five-spot Burnet

plate 3

Zygaena trifolii (Esp.) 54.010 (170)
ssp. *decreta* Ver.
Local

ssp. *palustrella* Ver.
Local

ssp. *subsyracusia* Ver.
Channel Islands



Field characters and similar species FW 14–19mm. Can be difficult to distinguish from Narrow-bordered Five-spot Burnet ssp. *latomarginata* (see under that species), even using features of genitalia. Habitat, time of year and geographical location provide additional clues. Flight periods overlap, but that of Narrow-bordered is earlier than that of ssp. *decreta*. Absence of bird's-foot-trefoils usually precludes the presence of a Five-spot colony. Rarely, the red is replaced by yellow. Ssp. *palustrella* has thinner scaling and is usually smaller than ssp. *decreta*. Yellow forms are more frequent than in ssp. *decreta*, but are still uncommon. Ssp. *subsyracusia* is slightly smaller and more brilliantly red. **Flight season** One generation. Ssp. *decreta* Jul–early Aug. Ssp. *palustrella* late May–Jun. **Life cycle** Overwinters as a larva, sometimes twice. Ssp. *decreta* larva Aug–early Jun. Pupates in a cocoon formed in an exposed position on the stem of a tall plant. Ssp. *palustrella* larva late Jun–early May. Pupates in a cocoon formed low down and concealed in the vegetation. **Larval foodplants** Ssp. *decreta* favours Greater Bird's-foot-trefoil and (occasionally) Common Bird's-foot-trefoil. Ssp. *palustrella* feeds on Common Bird's-foot-trefoil. **Habitat** Ssp. *decreta* usually occurs in damp grassland, heathland and wetlands. Since 2003, colonies have been discovered on dry grassland, sand-dunes and dry dune-slacks in Cornwall, with the larvae feeding on Common Bird's-foot-trefoil. These are thought to have recently colonised from wetland colonies in the local area. A colony found in 2007 in Buckinghamshire, in a scrubby field on clay, also on Common Bird's-foot-trefoil, is also regarded as belonging to this subspecies, although its flight period is in early Jun. Ssp. *palustrella* favours dry calcareous grassland on chalk and limestone. **Status and distribution** Resident. Local. Ssp. *decreta* occurs in southern and south-west England, and parts of Wales, usually near the coast. Also very locally in Berkshire and Buckinghamshire. Its detailed distribution is imperfectly known because of confusion with Narrow-bordered Five-spot Burnet. Ssp. *palustrella* is distributed along the North and South Downs from Hampshire to Kent, Wiltshire (including Salisbury Plain), and locally in Gloucestershire (Cotswolds), Berkshire and Buckinghamshire. Ssp. *subsyracusia* habits are as for ssp. *palustrella*. Widespread in the Channel Islands.

Drepanidae Hook-tips and lutestrings

Oak Hook-tip

Buff Arches

The Drepanidae are divided into two sub-families. Of the 400 or so species of Drepaninae worldwide, only eight occur in Europe. They have broad wings and slender bodies, like the geometrid moths. Six are resident in the British Isles and a seventh is an occasional immigrant. On all but one of these, the tips of the forewings are strongly hooked. Some rest with their wings in a rather tent-like position, while others hold them flat to the surface. Some fly by day or are sometimes disturbed from among the foliage of the larval foodplants, or netted on the wing at dusk. However, they are most frequently encountered in light-traps, to which they come quite regularly, but usually in small numbers. Some adults are able to feed, but have a rather short tongue and do not visit flowers; they are only occasionally attracted to baits, aphid honeydew and oozing sap. The larvae of all the British species feed on the foliage of trees and shrubs. The females attach the eggs to the leaves, either singly or in rows. The hind pair of claspers of the larvae are pointed and the tail end is held in a characteristic raised position. Pupation takes place in a slight cocoon, spun between leaves of the foodplant. The cocoon drops with the leaves to the ground in the overwintering generation. See also the unrelated Beautiful Hook-tip *Laspeyria flexula* (page 213).

The Thyatirinae (previously regarded as a separate family is a small group of about 200 species worldwide, with ten in Europe, nine of which are resident in the British Isles. Superficially, they resemble the noctuid moths, although they are slightly slimmer in build and all hold their wings close to the body when fully at rest. Most have prominent scale-tufts or ridges on the thorax. The larvae of Peach Blossom and Buff Arches feed exposed, whereas the remainder of the group conceal themselves between spun leaves. Pupation occurs either on or under the ground, or between leaves of the foodplant, which then fall to the ground. Most overwinter in this stage.

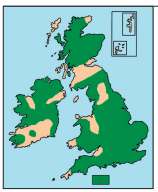
Drepaninae

Scalloped Hook-tip

plate 4

Falcaria lacertinaria (L.)

Common 65.001 (1645)



Field characters FW 14–18mm. Distinctive. Forewing has irregularly scalloped and toothed outer edge with chequered fringes, two dark parallel cross-lines and a single small dark central dot. Rests with wings raised, tent-like. There is little variation in markings, but second-generation moths are smaller and paler brown. First-generation moths often have stronger brown lattice-like or flecked markings and are more silvery grey, especially in northern Britain. **Similar species** Beautiful Hook-tip has smooth outer edge to forewing, with only two projections and fringes unchequered, and two dark central dots; rests with wings flat. **Flight season** Two generations. Late Apr–late Jun and mid-Jul–Aug, except in Scotland, where there is one generation from late May–Jun. Nocturnal. Comes to light, sometimes in numbers, and can be disturbed by day from the foodplant. **Life cycle** Overwinters as a pupa, in a cocoon in a folded leaf. Larva Jun–Jul and Aug–Sep; Jul–Aug in Scotland. Can be frequent

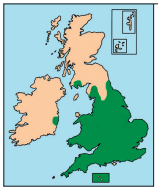
on birch regrowth only 2m tall, and is more numerous in warm, sunny situations. **Larval foodplants** Downy Birch and Silver Birch. **Habitat** Usually in woodland, scrub, heathland and bogs; also hedgerows and gardens. **Status and distribution** Resident. Common. Widely distributed in most of England, Wales, mainland Scotland, the Inner Hebrides and Ireland. In the Channel Islands, possibly immigrant only. Singletons on Jersey in 1999, and Guernsey and Alderney in 2011.

Oak Hook-tip

plate 4

Watsonalla binaria (Hufn.)

Common 65.002 (1646)



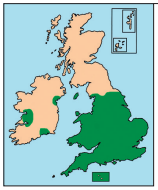
Field characters FW 13–18mm. Quite a distinctive orange-brown moth, with two well-defined pale cross-lines on forewing, and a lilac tinge when freshly emerged. Has two prominent blackish spots in centre of forewing, and two small dots on hindwing. Male is often darker, and female is generally larger with orange hindwing. Varies little, but first-generation moths are larger and more richly coloured. Rests with wings spread flat. **Similar species** See Barred Hook-tip. **Flight season** Two generations. May–Jun and late Jul–mid-Sep. Male flies high around oaks by day and both sexes may be disturbed from lower branches. Flies from dusk and comes to light. **Life cycle** Overwinters as a pupa, in a tough brown cocoon spun in a tightly folded oak leaf. Larva Jun–Jul and late Aug–Sep. **Larval foodplants** Pedunculate and Sessile oaks, and almost certainly Turkey Oak. Reported occasionally on Silver Birch. **Habitat** Most numerous in oak woodland, but also occurs in hedgerows, parkland and gardens. **Status and distribution** Resident. Common. Well distributed in southern Britain, north to Cumbria and Co. Durham, and in the Channel Islands. Recently recorded very locally from south-west Scotland. One record from Ireland, one at light near Glenealy, Co. Wicklow, in 2008.

Barred Hook-tip

plate 4

Watsonalla cultraria (Fabr.)

Local 65.003 (1647)



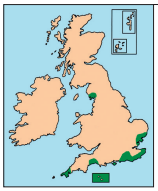
Field characters and similar species FW 12–17mm. Not dissimilar to Oak Hook-tip, but orange-brown forewing lacks lilac tinge and has a broad, darker central cross-band. Has a single dark, rather small central forewing spot (rarely two), and no central spots on hindwing. Little variation in markings, and only slight variation in colour. Rests with wings flat. **Flight season** Two generations. May–Jun and mid-Jul–early Sep. Male sometimes flies by day, rather high around the foodplant. Both sexes fly at night and come to light. **Life cycle** Overwinters as a pupa, in a white cocoon within a curled Beech leaf or between two leaves spun together. Larva Jun–Jul and Sep. **Larval foodplants** Beech. Accepts oak in captivity. **Habitat** Beech woods, especially on calcareous soils and other places with mature Beech. Has colonised many areas where Beech is an introduction. **Status and distribution** Resident. Local. Well distributed in southern Britain, although more local in the Midlands, Wales and northern England. Has recently spread in Yorkshire and Lancashire. First recorded on Man in 2008. In Ireland, probably a recent colonist, first recorded in 1999, in Co. Down, and first recorded in the Irish Republic in 2007, very locally in Cos. Clare, Limerick and Waterford, and subsequently in Cos. Galway and Louth. First recorded on Guernsey in 2013, but considered to be an overlooked resident.

Dusky Hook-tip

plate 4

Drepana curvatula (Borkh.)

Immigrant 65.004 (1649)



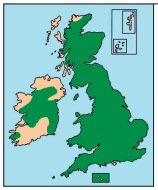
Field characters and similar species FW 16–21mm. Varies in colour from orange-brown with a slight lilac tinge, to dark brown with lilac-grey banding. Less variegated examples are not dissimilar to Pebble Hook-tip (and, like that species, rests with wings spread flat), but central spots on forewing are small, and hindwing has a strong, dark cross-line beyond middle. See also Scarce Hook-tip. **Flight season** Two generations in mainland Europe. May–Jun and late Jul–Aug. Nocturnal and comes to light. **Life cycle** Overwinters as a pupa. Larva Jun–Jul and Sep in mainland Europe. **Larval foodplants** Birch, Alder and oak in mainland Europe. **Status and distribution** Immigrant and possible future colonist. First recorded on 13 Aug 1960, a female at Dover, Kent. Over 90 more since, all but three since 1990 and mainly on or near the coast of southern and eastern England, from Cornwall to Lincolnshire. One in Westmorland in 2006 and several in the Channel Islands. Most have been in Aug, with some in May and Jul.

Pebble Hook-tip

plate 4

Drepana falcataria (L.)

Common 65.005 (1648)



Field characters FW 17–21mm. Central, rather pebble-like spot on forewing and distinct purplish-brown blotch along outer edge, near wing tip, are the main diagnostic features. Hindwing is generally paler, especially in leading half. Rests with wings spread flat. In the northern half of Scotland, ground colour of wings is straw white and outer markings darker (f. *scotica* Bytinski-Salz); formerly regarded as a distinct subspecies. Form

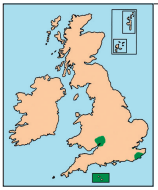
pallida Stephan is very pale, approaching ssp. *scotica*, but less strongly marked. **Similar species** See Dusky Hook-tip and Scarce Hook-tip. **Flight season** Two generations: in most places, late Apr–Jun and mid-Jul–early Sep, with occasional individuals of a possible third generation in Oct. In Scotland, one generation: mid-May–late Jul. Occasionally found at rest by day near foodplant. Comes to light, usually in small numbers. **Life cycle** Overwinters as a pupa, in a cocoon between leaves. Larva late Jun–late Jul and Sep in southern Britain, Jul–Aug in the north. **Larval foodplants** Downy Birch, Silver Birch and sometimes Alder. **Habitat** Woodland, heathland and other habitats with birch, including town gardens. Also Alder carr. **Status and distribution** Resident. Common. Found in suitable habitat throughout mainland Britain, except on high ground, and on Man, the Inner Hebrides and the Channel Islands. Widespread but local in Ireland.

Scarce Hook-tip

plate 4

Sabra harpagula (Esp.)

RDB; suspected immigrant 65.006 (1650)



Field characters FW 17–20mm. Distinctive. Forewing more strongly hooked than in related species, with a second distinct projection roughly midway along outer edge. The brown and gold blotch in centre of forewing and lilac and black outer markings are also diagnostic. Second-generation moths from mainland Europe are noticeably smaller. **Similar species** Pebble and Dusky hook-tips are superficially similar but lack the features mentioned above. **Flight season** One generation. Early Jun–mid-Jul. Can produce a partial second generation in captivity. Seldom seen, except in light-traps, to which it comes quite readily, more especially males. **Life cycle** Overwinters as a pupa, in a tough, thin cocoon spun in a curled leaf, which later falls to the ground. Larva late Jul–late Sep, sometimes mid-Oct. Apparently lives high in the canopy, since it is rarely beaten from the lower branches, but has been found on the trunk shoots (epicormic growth) of tall trees.

Fully grown larva of Scarce Hook-tip.

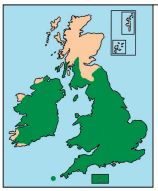
Larval foodplants Small-leaved Lime. **Habitat** Woodland with abundant Small-leaved Lime. **Status and distribution** Resident and occasional suspected immigrant. Red Data Book species. Currently appears to be resident only in the Wye Valley, on the border between Monmouthshire and Gloucestershire, where it was discovered in 1961. Here, the population seems to be stable. Formerly found at Leigh Woods, near Bristol, but not since 1938, despite searches. Single suspected immigrants on 26 Aug 2000 at Rye Harbour Nature Reserve, East Sussex, on Guernsey in 1996, and on Jersey in 2005–08.

Chinese Character

plate 4

Cilix glaucata (Scop.)

Common 65.007 (1651)



Field characters FW 10–13mm. Unmistakable. When at rest, with wings held steeply over the body, it closely resembles a bird dropping. There is little variation, but first generation tends to be more intensely marked than second. **Flight season** Two generations. Late Apr–early Jun and Jul–early Sep, tending to overlap in the north. Sometimes found at rest on vegetation by day. Nocturnal and comes regularly to light, usually in small numbers. Often seems to escape predation by birds on the outside of moth traps in the morning. **Life cycle** Overwinters as a pupa, in a cocoon attached to leaves, debris or bark. Larva mid-Jun–mid-Jul and late Aug–Sep. **Larval foodplants** Mainly Blackthorn, Hawthorn and Crab Apple. Bramble, Rowan and Pear are also recorded. **Habitat** Hedgerows, scrub and open woodland, on many soil types and in both damp and dry situations; also in gardens. **Status and distribution** Resident. Throughout England and Wales except on the highest ground, and in the Channel Islands and Man. In Scotland, only in parts of the south. Widespread in Ireland, but less so in the west.

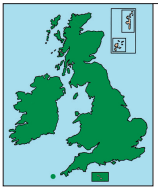
Thyatirinae

Peach Blossom

plate 4

Thyatira batis (L.)

Common 65.008 (1652)



Field characters FW 16–19mm. Unmistakable, with pink and brown petal-like markings on forewing. Shows little variation. **Flight season** One generation. Late May–late Jul. Occasionally a partial second generation from late Aug–Sep in southern Britain. Hides in ground cover by day, becoming active from dusk, when it is attracted to sugar and wine ropes. Regular at light, usually in small numbers. Often fails

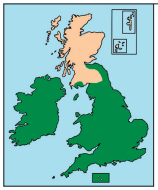
to enter the trap, instead fluttering around in short, hopping flights. **Life cycle** Overwinters as a pupa, in a cocoon on the soil surface or just below it. Larva early Jul–mid-Sep. Remains on the foodplant when small, but when larger hides in leaf litter by day, feeding mainly at night. **Larval foodplants** Bramble. **Habitat** Most numerous in light woodland and scrub, but also breeds at lower density in many other places where Bramble grows, including urban areas. **Status and distribution** Resident. Common. In suitable habitat throughout England, Wales, mainland Scotland and the Hebrides, Man, Ireland and the Channel Islands.

Buff Arches

plate 4

Habrosyne pyritoides (Hufn.)

Common 65.009 (1653)



Field characters FW 17–20mm. Forewing markings have a flint-like quality and are unmistakable, etched with white and orange-brown 'arches', as seen when at rest. Shows little variation. **Flight season** One generation. Late Jun–early Aug, with occasional individuals in the autumn. Active from dusk and often attracted to sugar and wine ropes. Comes frequently to light, and is sometimes numerous. **Life cycle** Overwinters as a pupa in a loose cocoon underground. Larva late Jul–mid-Oct. Reportedly more frequent on Bramble beneath trees than in the open; feeds mainly at night. **Larval foodplants** Bramble and Dewberry. Possibly also Raspberry, which it will accept in captivity. **Habitat** Most numerous in open woodland, particularly coppiced areas and young plantations; also scrubby grassland and many other places where Bramble grows, including gardens. **Status and distribution** Resident. Common. Throughout England and Wales, north to Cumbria, Northumberland and Man. Scarce in southern Scotland. Widespread and frequent in Ireland. Abundant in the Channel Islands.

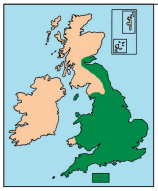
Figure of Eighty

plate 4

Tethea ocularis (L.) 65.010 (1654)

ssp. *octogesimea* (Hb.)

Common



Field characters FW 16–20mm. White and rather finely etched figure '80' in centre of forewing is diagnostic. Cross-lines generally rather fine, and that beyond '80' mark curves more or less around it before reaching leading edge. Forewing light to dark brown, often with a purplish sheen. The dark f. *fusca* Cock. was first recorded in south and south-east England in the 1940s, and has since spread; it is suspected to have arrived by immigration. **Similar species** See Poplar Lutestring and Figure of Eight. **Flight season** One generation. Late May–Jul. Nocturnal. Comes to light, wine ropes and sugar. **Life cycle** Overwinters as a pupa, in a frail cocoon formed between leaves of the foodplant, which fall to the ground in autumn. Larva mid-Jul–Sep. Rests by day between two leaves spun flatly together; feeds at night. **Larval foodplants** Aspen and other poplars. **Habitat** A wide variety, including broadleaved woodland, carr, river valleys, plantations, parkland, hedgerows and gardens. **Status and distribution** Resident and possibly immigrant. Common. Throughout most of England and Wales, north to Cumbria and Northumberland. First recorded on Man in 1998. Has recently been recorded over a wide area of eastern Scotland, north to West Lothian and Fife. Widespread in the Channel Islands.

Poplar Lutestring

plate 4

Tethea or or ([D. and S.]) 65.011 (1655)

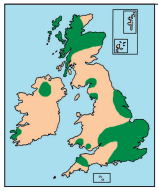
Local

ssp. *scotica* (Tutt)

Local

ssp. *hibernica* (Turn.)

Ireland



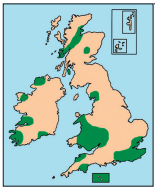
Field characters and similar species FW 16–19mm. Ssp. *or* is not unlike Figure of Eighty. The dark cross-lines and bands or 'lute-strings' on forewing are wavier, generally thicker and more numerous, usually numbering three or four in basal half. Central whitish mark is not clearly numerical and cross-line beyond it turns toward wing tip before reaching leading edge. Central markings may be faint or occasionally replaced by a dark mark. See also Yellow Horned and Figure of Eight. In ssp. *scotica* the dark markings are usually more sharply defined and ground colour paler grey, sometimes with a purplish tinge when freshly emerged, although indistinctly marked brownish forms also occur. Ssp. *hibernica* is midway between ssp. *or* and ssp. *scotica* in terms of colour, but with weaker markings. **Flight season** One generation. Late May–early Aug in England and Wales, Jun–early Jul in Scotland and Ireland. Nocturnal. Comes to light, sugar and wine ropes. **Life cycle** Overwinters as a pupa, in a cocoon formed between leaves of the foodplant, which fall to the ground in autumn. Larva mid-Jul–Sep. Lives by day between two leaves spun flat together; feeds openly at night. **Larval foodplants** Aspen, and sometimes other poplars. **Habitat** Broadleaved woodland and other habitats with well-established Aspen, including low regrowth. **Status and distribution** Resident. Local. Ssp. *or* is widespread south of a line from the Severn to the Humber (although rare in the south-west) and local in Wales. Very local further north, but records extend to the Scottish border. Ssp. *scotica* is widespread in the Scottish Highlands and found in the Hebrides. Ssp. *hibernica* is very local in Ireland, mainly in the north.

Satin Lutestring

plate 4

Tetheella fluctuosa (Hb.)

Local 65.012 (1656)



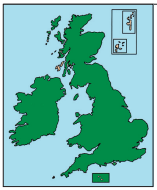
Field characters and similar species FW 17–21mm. Similar to Common Lutestring, but generally larger. Diagnostic features are the small dark crescent or dash in centre of forewing and small dark dash arising on leading edge just inside pale outermost cross-line. Most examples in the south have outer part of forewing broadly pale. F. *albilinea* Lempke, which is darker with narrow whitish bands, predominates in Scotland and has occurred elsewhere. In the west of Ireland, ground colour is paler. F. *unicolor* Lempke, with more uniformly dark greyish-brown forewing, has occurred regularly at Hamstreet, Kent, since 1955, and also in Surrey, Sussex and Staffordshire. **Flight season** One generation. Jun–early Aug. Sometimes disturbed by day from tree foliage. Nocturnal. Comes to light, often in quite large numbers, especially in the west of its range, and occasionally to sugar or wine ropes. **Life cycle** Overwinters as a pupa, in a cocoon formed between leaves of the foodplant, falling to the ground in autumn. Larva late Jul–mid-Sep. Rests in spun leaves by day and feeds at night. **Larval foodplants** Birches. Also recorded on Alder. **Habitat** Mainly long-established, mature broadleaved woodland; wooded heathland in south-east England. **Status and distribution** Resident. Local. Locally widespread and frequent in south-east England, especially the Weald of Kent, Sussex and Surrey. Also found locally in east Hampshire, south-west England, Forest of Dean, west Midlands, south and north-west Wales and the Lake District. In Scotland, quite widespread around the Great Glen, Inverness-shire, and recorded locally in East Ross, Sutherland, Perthshire, Mull and Arran. In Ireland, widespread but very local, mainly in the west. Local and rare in the Channel Islands.

Common Lutestring

plate 4

Ochropacha duplaris (L.)

Common 65.013 (1657)



Field characters and similar species FW 14–18mm. Rather like Satin Lutestring, but usually smaller. Diagnostic features are the pair of small dark dots in centre of forewing (occasionally almost merged) and diagonal black dash arising from forewing tip. These characters are visible in all forms. Considerable variation occurs in strength of cross-lines and bands. The more or less uniform grey-brown f. *obscura* Tutt predominates in many parts of England, and blackish-brown melanic forms are found in the London area, the Midlands and Scotland. Strongly banded forms are more frequent in the north and west, including Ireland, where outer area of forewing is often whitish. **Flight season** One generation. Mid-Jun–mid-Aug. Nocturnal. Comes to light and sugar, sometimes in fair numbers, but at many sites only occasionally. **Life cycle** Overwinters as a pupa, in a cocoon formed between leaves of the foodplant, which fall to the ground in autumn. Larva late Jul–early Oct. Rests in spun leaves by day and feeds at night. **Larval foodplants** Birches. Also reported from Alder, Hazel and oaks. **Habitat** Light woodland and scrub where birches are frequent, often in river valleys in northern Britain, but more generally in woodland and heathland further south. In south-east England, not unusual in suburban gardens. **Status and distribution** Resident. Common. Throughout most of Britain and the Channel Islands, Man and Ireland, but scarcer on calcareous soils, for instance in the Chilterns and Cotswolds. In Scotland, extends to Caithness and the Outer Hebrides (old records from Hoy, Orkney).

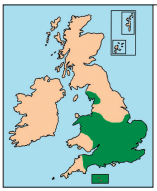
Oak Lutestring

plate 4

Cymatophorina diluta ([D. and S.])

ssp. *hartwiegi* (Reisser)

Local 65.014 (1658)



Field characters and similar species FW 15–17mm. Usually easy to recognise, with two strong, black-edged brown cross-bands on pale grey forewing. There are several darker forms. In f. *nubilata* Robson, forewing is largely brown, but darker cross-lines remain. This form is frequent and widely distributed. Rare forms have grey-brown forewing, with broad, dark grey-brown or black central cross-band. Other lutestring moths either lack the brown bands or have a predominantly brown forewing. **Flight season** One generation. Late Aug–Sep, sometimes early Oct. Flies from early dusk, coming to sugar and wine ropes, and later to light, sometimes in fair numbers. **Life cycle** Overwinters as an egg, attached to a twig of the foodplant. Larva Apr or early May–early Jul. Hatches after bud-burst; emerges from spun leaves to feed at night. Pupates in a cocoon, formed among foliage on the tree. **Larval foodplants** Pedunculate Oak and Sessile Oak. **Habitat** Long-established broadleaved woodland containing mature oak trees. **Status and distribution** Resident. Local. Well distributed in southern England, from Dorset to Kent, and quite widespread northwards to the clay vale between Oxford and Peterborough, the Midlands, Wye Valley, and north and west Wales. More thinly scattered and local in the rest of England and Wales south of the Humber. In the west, extends well into Cumbria, but rare in Yorkshire and only very old records from Northumberland and the Scottish borders. Recorded once in the Channel Islands in 2006, on Guernsey.