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National
Moth
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Scheme

British and Irish moths: an illustrated guide to selected difficult species

(covering the use of genitalia characters and other features)

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PREFACE

It is twenty-five years since the publication of The Amateur Entomologists' Society Pamphlet No. 12 (Anon, 1985), which brought together information on the identification of difficult-to-separate species of the larger moths of Britain and Ireland. The original papers included in the 1985 pamphlet partly comprised Guides to the Critical Species by the late John Heath (and colleagues and collaborators), originally published between 1969 and 1972 as part of the Lepidoptera Distribution Maps Scheme (Heath, 1969, 1970, 1971, 1972; Heath and Cooke, 1969; Heath and Skelton, 1971; Reid, 1972). This scheme ran from 1967-1982 and proved a vital tool for lepidopterists and ecologists and provided an invaluable baseline for further recording work.

Complete guides to the genitalia of the larger moths of Britain and Ireland were last published in the early to mid 20th century (Pierce, 1909; 1914; 1942; Pierce and Beirne, 1938), and despite their age and inevitable limitations, these volumes remain the basis for their study. They have been reprinted and are also available in CD-ROM format. AES leaflet 34 (Anon, 1972) described the morphology of genitalia and dissection techniques, and Heath and Emmet (1976) included a section on techniques for the preparation of material for genitalia examination.

In more recent years, our knowledge of moths and moth distributions has advanced considerably and the number of active lepidopterists has increased enormously, as has the number of active local groups.

The burgeoning interest in moths has led to the publication of several affordable, high quality guides to the larger moths of Britain and Ireland (Skinner, 1984, 1998, 2009; Waring, Townsend and Lewington, 2003, 2009; Townsend, Waring and Lewington, 2007; Manley, 2008). There have also been English language editions of guides covering the fauna of Europe, or parts of it. These have further added to our knowledge, and helped British and Irish lepidopterists to see our fauna in a broader context, increasing awareness of the likelihood of continental species arriving or having been overlooked here.

However, the guides listed above do not provide key information on identifying every species. For some of the 'difficult' species, it is necessary to check for the differences in genitalia or other microscopic features, and these are not necessarily provided. The advent of a new National Moth Recording Scheme for the UK, Isle of Man and Channel Islands further raised the need for an up-to-date illustrated guide providing this information. This guide, which aims to do just that, has been written as part of the Moths Count project led by Butterfly Conservation to complement the National Moth Recording Scheme. It is hoped that it will be further developed as an internet resource, giving the opportunity to add to and amend the accounts, as new information is published.

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Slide preparations were made by Brian Goodey, with the exception of male Lydd Beauty (Michael Dale), female Cousin German, female Dark Dagger and female Crinan Ear (Michael Bailey), male Water Betony (Phil Sterling), male Uncertain and male Rustic (Rachel Terry), and male Powdered Rustic (Colin Plant). Specimens were photographed by Brian Goodey, with the exception of male Lydd Beauty (Michael Dale), Red Twin-spot Carpet male genitalia *in situ*, undersides of Treble-bar and Lesser Treble-bar, and antennae of Clouded Drab and Lead-coloured Drab (Martin Townsend).

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INTRODUCTION

Some of the larger (or 'macro') moth species found in Britain and Ireland are difficult to identify due to the similarity of their external features. This book provides up-to-date information not available in general field guides, on the accurate identification of such species using differences in the genitalia and other morphological features. It aims to inform novice recorders, thereby reducing erroneous records. We also hope that all lepidopterists will be able to use it to further develop their skills and learn new identification techniques, thereby improving the accuracy of recording.

In terms of identification, moth species can broadly be divided as follows (after Heath, 1969):

1. Those that will usually present little difficulty from external features, such as wing pattern (the vast majority).
2. Those needing special care in identification but which should all be readily named from general field guides.
3. Those which need careful expert examination, but which can usually be identified without dissection of genitalia or examination of other structural detail.
4. Those for which microscopic examination of structural (i.e. mainly genitalia) features is essential for conclusive identification.

These are broad and generalised categories, and we recognise that specimens of 'easy' species in poor condition inevitably present greater difficulty. This book mainly describes species in the last two categories. Exceptions occur where it was felt useful to collate and summarise present knowledge. These include Five-spot Burnet *Zygaena trifolii* and Narrow-bordered Five-spot Burnet *Z. lonicerae*, for which identification partly operates at the colony rather than individual level, such that diagnostic features include ecological considerations as well as physical characteristics.

People's perceptions of the detail and subtleties of the external markings and coloration of moths undoubtedly vary, and this book is not intended as a definitive collection of species that people might confuse. Indeed, one of the most difficult aspects was selecting species groups for inclusion. Ask several experienced lepidopterists to come up with a list of species which should go in a book of this nature for a given geographical area, and they will all come up with a different list, although some species will be common to most or all of those lists. A consultation exercise was carried out with exactly that result.

We expect very few readers to completely agree with the selection presented in this guide, but we hope that the majority will agree with most of it. We have particularly aimed at those groups that most often cause problems, those over which there is dispute in the existing literature, where the pre-existing literature does not give sufficient information, or where information is scattered, or inconsistent. 'Pug' moths (Geometridae: Eupitheciini) have recently been given detailed treatment by Riley and Prior (2003) and therefore are not included. As an additional resource, photographs of the genitalia of a range of species can currently be found at <http://dissectiongroup.co.uk>.

HOW TO USE THIS BOOK

The primary aim has been to provide the essential information in a user-friendly format, and this is reflected in the layout. For some species groups, certain external diagnostic features (such as differences in the antennae) have not been illustrated in previous guides (although they may have been described) and where appropriate have been included here. We have assumed that the reader has already attempted to identify the moth or moths in question using field guides, and have therefore tended to avoid reiteration of information provided therein. In some cases the reader is simply referred to the guide (or guides) under the relevant entry. However, in cases where more explanation was felt useful, descriptions of external differences as described in previous works have been expanded upon.

Moths are most often identified using patterns and features created by their covering of scales. However, as entomologists who study insects that lack a covering of scales have long been aware, these animals have evolved differences in the chitinous exoskeleton, which would be hidden if they possessed scales. In addition, their internal genitalia often possess diagnostic features. Why this should be the case has been the subject of debate among taxonomists and evolutionary biologists for many years, but such discussion is outside the scope of this book.

In the main text, under each species group, the scientific name of each species along with any subspecies with authority and year, vernacular name and conservation status (Waring, 1999) are given along with any UK Biodiversity Action Plan Priority status (Parsons and Davis, 2007). Nomenclature and English names follow Bradley (2000). Note that Karsholt and Razowski (1996) numbers refer to the species and may therefore not refer specifically to the sub-species described in this book. More detailed information on status and distribution has generally not been included except for that which is not easily obtainable elsewhere, where there have been recent discoveries, or where it is particularly relevant. For groups in which new species have only been reported relatively recently, a brief summary of the history of their discovery and status is provided, including references.

Simple dichotomous keys have been developed for the diagnostic morphological features. Keys of this nature, which use sequential pairs of alternatives known as couplets, are commonly used in entomology and in taxonomy generally. They are an essential aid to identification, guiding the reader to the distinguishing features and avoiding lengthy, repetitive descriptions when identification solely for recording purposes is the aim.

The keys in this book operate purely at species level. Naturally they assume that the specimen under consideration belongs to one of the species within that genus or group. If the specimen does not 'key out' (i.e. if the combination of features does not fit the sequence of features described) it is most likely another species and should be re-assessed. Where there are only two species in a group, the diagnostic features of each are simply stated as alternatives, there being no necessity for a sequence of couplets. Where more than one character is described under the halves of a couplet, the most important one is generally given first, following the usual convention.

In some cases, very closely-related (sibling) species may not show clear differences in the genitalia, and a positive identification may not be possible. In others only the males or the females can be distinguished. This is made clear in the text entries under the relevant species. Some may not have been distinct entities for long enough for clear morphological differences to have evolved. Nevertheless there may be good biological reasons to believe that they are distinct, such as their ecology, behaviour and use of chemical signals. Nature is often more subtle than we expect. It is likely that some sibling pairs, even those occupying the same geographical area (sympatric species), are still in the process of separation (speciation) into new species and, for that reason, do not fit neatly into any of the pigeon-holes we create for them. It would be surprising if this were not the case, since evolution is an ongoing process of which we are merely taking a 'snap-shot'.

Dissection of moth genitalia and the use of the dissected specimen as an aid to identification requires skill and patience, and adequate equipment, although in a few cases all that is needed is a good quality hand-lens. The methods, tools and chemicals required are described in the next section. As in all branches of biology, the use of morphological terms is necessary, and a full glossary and generalised figures, using composites of species illustrated in the guide, are provided. As described under Glossary of Terms, our research of the literature has revealed that a large number of terms have been used to describe the genitalia of moths. We have generally followed more recent publications, but even within these some terms are interchangeable, or have subtly different meanings when used by different authors. Therefore for clarity, pointers are used on the plates to indicate diagnostic features described in the accompanying text entries. Technical hints on preparing specimens for examination of genitalia are provided under some entries.

As described in the introduction, the *Zygaena* species covered are treated differently, due to the nature of the diagnostic features, which are tabulated and further discussed in the text. Authorities disagree on the status of Engrailed *Ectropis bistortata* and Small Engrailed *E. crepuscularia*. It is not possible to provide diagnostic genitalic or other morphological differences between them, since none are known. However, it was felt useful to provide a summary of current opinions, the evidence and some discussion, in order for readers to make an informed decision when recording and perhaps to stimulate further work. Research into sibling species is ongoing. For example, the possibility that other species in the genus *Euxoa* are present in Britain is currently being investigated. Also, studies by entomologists in continental Europe have suggested that what we know as Burnished Brass *Diachrysia chrysitis* may consist of more than one species (Plant, 2010).