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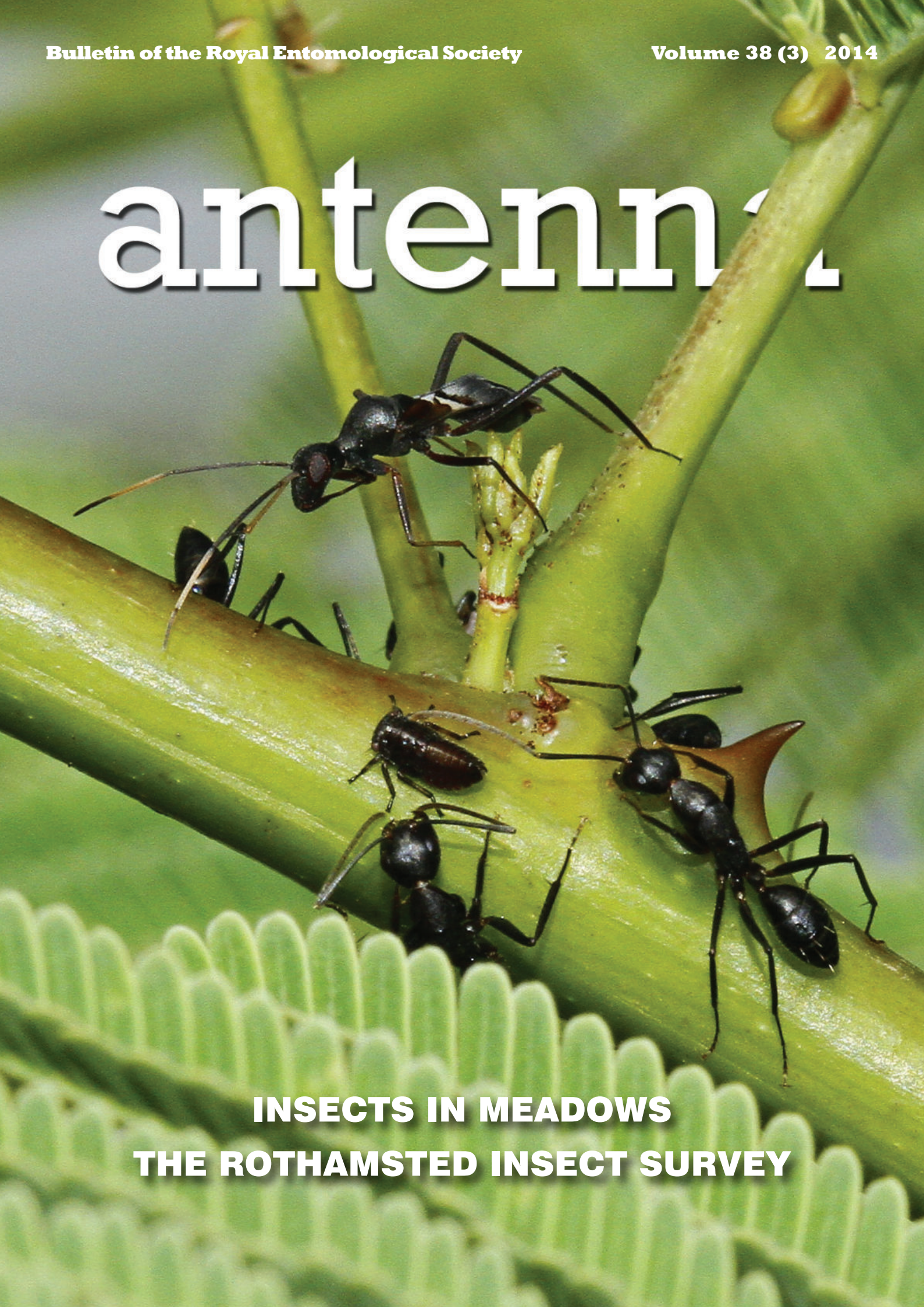

INSECTS IN MEADOWS

THE ROTHAMSTED INSECT SURVEY

meetings of the society

for more information on meetings and contact details see meetings page on www.royensoc.co.uk

2014

Sep 3
Aphid Special Interest Group
Venue: Harper Adams University
Convenor: Simon Leather

Oct 14
Behaviour Special Interest Group
Venue: Rothamsted Research, Harpenden
Convenor: Jason Chapman and James Bell

Nov 5
Orthopterists' Special Interest Group
Venue: Natural History Museum
Convenor: Björn Beckmann

Nov 11
South-East Regional Meeting
Forest Entomology
Venue: Alice Holt Lodge, Surrey
Convenor: John Badmin

Nov 21
SW Regional Meeting
And now for something completely different... Exploring the fringes of entomology
Venue: Plymouth University
Convenor: Peter Smithers

2015

Mar 4
Verrall lecture by Prof. Sue Hartley, University of York
Venue: The Flett lecture theatre, NHM
Convenor: Archie K. Murchie

June 3
RES AGM
Venue: The Mansion House, St Albans

Sept 2-4
Ento' 15 Annual Science Meeting and International Symposium
Insect Ecosystem Services
Venue: Trinity College Dublin
Convenors: Jane Stout
Olaf Schmidt
Archie Murchie
Eugenie Regan
Stephen Jess
Brian Nelson

2016

Sep 5-8
Ento'16
Venue: Harper Adams University College, Shropshire
Convenor: Simon Leather

Special Interest Group meetings occupy either a whole day or an afternoon (check www.royensoc.co.uk for details).

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COVER PICTURE

Camponotus ants attending a leafhopper nymph *Macropsis* sp. (Cicadellidae: Macropsinae) on *Acacia* in Hessaraghatta, nr Bangalore, India. Accompanied by hemipteran interloper *Sohenus uvarovi* Ballard (Hemiptera, Miridae) which feeds on the eggs of the leafhopper.

Photograph courtesy of Yeshwanth Murthy

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Bulletin of the Royal Entomological Society

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EDITORIAL

Welcome to this edition of *Antenna*.

In this issue we offer a range of articles that reflect the season. As a a child growing up in the Surrey countryside I remember summers as a time of running and crawling through what Dylan Thomas describes as hay fields high as the house. Dens and adventure abounded but always accompanied by hordes of insects. Meadows like those of my childhood are still vital reservoirs of insect diversity as the article by Richard Jefferson and Keith Porter reveal.

Richard Harrington reports on the 50th birthday celebrations of the Rothamsted Insect Survey and reviews its role in the development of modern entomology, providing a fascinating history of what has become an entomological institution.

As summer is often an occasion to visit your local zoo we bring you news of a new Insect House at Paignton Zoo in Devon. Investigate offers a very modern perspective, using biomimetics as its theme while retaining the thrill of live insects in abundance.

We also have an insiders perspective of Butterfly World, an insect house on a grand scale. Louise Hawkins offers an account of the daily challenges facing her as the entomologist on the project.

Val McAtear offers a tantalising glimpse of some of the rare books that she is the custodian of in our library at Mansion House and we review a clutch of new field guides to encourage you to go out into the field and explore those hay meadows and conduct your own insect survey. While our review of *Drawing and Painting Insects* may inspire you to add a few sketches to your field note-book.

In my previous editorial I discussed the possible role of insects in our diets, so it was encouraging to see this topic being considered by the wider scientific community. *New Scientist* fielded an article on insect farms earlier this year, and it was also good to hear Sarah Beynon announce, at the launch of National Insect Week, her intention to open a restaurant on her farm in Pembrokeshire that would offer some insect based meals as part of its sustainable dinning experience. It appears that insects will be on the menu far earlier than I anticipated.

We would also like to offer a warm welcome to our new president Professor John Pickett and following the very humorous introduction to his plenary lecture at the recent ECE in York, we look forward to a series of interesting contributions to *Antenna* over the next two years.

After much discussion the editorial team have decided to alter the way in which we receive details of entomological events. In future please send details of these events to the *Antenna* email address (antenna@royensoc.co.uk), labelling them as RES or non RES events. As a result of this change Duncan Allen who has been collating the non RES events for the diary is stepping down from this post. Duncan has put in many long hours to ensure that the diary arrived on time so on behalf of the editorial team and the society we would like to offer an enormous vote of thanks to Duncan. We wish him well in his future career.

Peter Smithers

Guidelines for submitting photographs

To maintain a high quality we suggest that submissions for *Antenna* be presented via e-mail or on CD. Files must be in a PC-compatible format preferably in MS Word.

Electronic images can be embedded in the Word document but we will also require separate electronic images. These images should be at least 300dpi at an image size that is either equal to, or greater than the expected final published size.

Please do not submit images that have been printed from a computer on a domestic inkjet or laser printer. Even if the camera is a good one and photo quality paper is used, the graininess is very hard to deal with. If plain paper is used, the prints are virtually unusable.

Photos taken on film should ideally be submitted as slides or as reasonable sized prints for us to scan or alternatively they can be scanned in by authors provided the scanner is capable of scanning at up to 1200dpi.

If an image is intended for the front cover then the photograph should be in portrait format (i.e. the shape of the final image) and will need to be quite a large file size (at least 5,000kb) or a good quality slide or print.

To give an idea as to what happens when the image is not of sufficient size, take a look at these two photographs. One is 300dpi and the other is 72dpi.

300dpi

72dpi

From the President

John presenting the commemoration award when Professor Thomas gave the Southwood Lecture at Rothamsted Research on Monday 10th March 2014 entitled "The Ecology and Conservation of Insect Parasites of Ants".

John Pickett

President, Royal Entomological Society

Rothamsted Research, West Common, Harpenden, Herts, AL5 2JQ

On 4 June 2014 I was privileged to take over, from Professor Jeremy Thomas, the Presidency of the Royal Entomological Society for the next two years.

Besides the immense honour of occupying the Presidency, I also take over at a point of unprecedented success by the Society thanks to not only the elected officers and the secretariat but also the fellowship and membership, to whom I also extend my thanks. Jeremy represents a long line of distinguished Presidents and I compliment him on demonstrating not only world-leading entomological scholarship but also conspicuous evidence of that currently much sought after impact. In Jeremy's case, the exploitation of rigorous entomological studies in the re-establishment of a butterfly species, the large blue *Maculinea arion*, once lost from British fauna. I also thank Jeremy for his leadership of a group comprising, in addition to himself, previous council members Professor Jenny Mordue, Aberdeen University, Dr Gordon Port, Newcastle University, Dr Bob Clements, RES Council member, Dr Archie Murchie, RES Secretary and Agri-Food & Biosciences Institute, Belfast and Mr Bill Blakemore, Registrar and Chief Executive, who have taken on the arduous task of revising the by-laws, now completed but still requiring legal ratification. It is also good to know that our finances are currently sound due to income from our publications and wise investment of the Society's assets by the Registrar and Chief Executive, for which I also express thanks.

My own background is in chemistry but my interest in entomology started during early interactions with insects and particularly the metamorphosis of Lepidoptera. I was reminded of this at the wonderful opening of National Insect Week at the Natural History

Museum, where we were welcomed by Sir Mike Dixon, Director of the Museum. I then had the privilege, as my first public task as President, of introducing our Vice Patron, Lord Selborne GBE FRS DL FRES FIBiol, who gave us his lively views on the importance of insects. This was followed by a questions and answers session, some via the internet, Chaired by the television personality Jonathan Ross and a panel of entomology experts who, together with Jonathan, responded to the questions both with wit and great expert insight. Indeed I see events such as National Insect Week and the membership of the Society itself, being a strong and important feature of engagement with the public at all levels. I hope to offer my own support further in this and in publicising our routes to these engagements.

I also strongly support the wider engagement with the scientific community. Besides the excitement that insects offer and their public engagement potential, we also have in this class of arthropods, both beneficial insects (offering eco-system services) and pests that compete with the sustainable provision of our own sustenance. Many of the insects with these roles now have either completely sequenced genomes or other genomic resources which, with continually rapid development will offer great insights into securing more eco-system services and less pest damage. We must continue to draw into our Society, those practising the best entomological science as well as those from areas that could benefit from the study of insects as model organisms and those that work towards more sustainable pest control. In doing this I hope that we can expand our international impact and membership and demonstrate our ability to seek positive solutions to problems, rather than to attempt, sometimes with insufficient evidence, to pass blame. Of course there are contentious issues within the sphere of entomology, but I commend the example contributed recently by distinguished UK members of the Royal Entomological Society under the leadership of Charles Godfray FRS, Oxford University and including a recent President, Professor Lin Field, Rothamsted Research, in reviewing the current knowledge of the much debated issue of neonicotinoids and bees (see Godfray *et al.* 2014, "A restatement of the natural science evidence base concerning neonicotinoid insecticides and insect pollinators". *Proceedings of the Royal Society B* **281**: 20140558). In this particular context, and in line with their findings, it is gratifying that we appear to be moving towards a bumper year for the honey bee *Apis mellifera* ahead of the EU imposed restriction of the use of neonicotinoid insecticides.

Although the debate is still believed to be open by many, I personally support the notion that the way forward for securing sustainable food production is with a 'land sparing' rather than a 'land sharing' option (see Phalan *et al.* 2011 "Reconciling food production and biodiversity conservation: land sharing and land sparing compared". *Science* 333:1289-1291). However, if we are to justify sparing land for eco-system services, then we must endeavour to maximise such services (see Hulme *et al.* 2013 "Conserving the birds of Uganda's banana-coffee arc: land sparing and land sharing compared". *PLoS ONE* 8:e54597), at the same time as ensuring optimised production from the agricultural land. It is my view that this will be achieved by new, rigorously researched science-based interventions, which will require further testing of the value of genetically modified organisms (GMOs) in the context of insect-plant interactions, as well as other advances in crop protection. In a purely entomological context, development of GMOs may seem even more provocative, but we must at least do the experiments in order to assess their potential value.

Amblyptilia acanthadactyla.

Insects and meadow flowers

Richard Jefferson & Keith Porter,
Natural England

Introduction

Flower-rich or species-rich hay meadows are highly valued semi-natural habitats which are rare and threatened habitats in Great Britain (Bullock *et al.* 2011, Natural England 2008, Blackstock *et al.* 1999). As a consequence, lowland and upland meadows are listed as habitats of principal importance under section 41 of the Natural Environment and Rural Communities (NERC) Act 2006 (Priority Habitats), and two types are listed on Annex 1 of the EC Habitats and Species Directive, and are of European nature conservation significance (Rodwell *et al.* 2007). Two sub-types of the Meadows Priority Habitats are exclusively managed as hay meadows (MG3 *Anthoxanthum odoratum-Geranium sylvaticum*, MG4 *Alopecurus pratensis-Sanguisorba officinalis*), and two (MG5 *Centaurea nigra – Cynosurus cristatus* grassland and MG8 *Cynosurus cristatus-Caltha palustris*) may be managed as either meadow or as permanent pasture (Crofts & Jefferson 1999, Rodwell 1992). For hay meadows, the sward is normally cut for hay in the summer (early to mid-July), and then the 'aftermath' growth is grazed by livestock in late summer and autumn, although upland types may also be grazed in spring prior to shut up for hay (Jefferson 2005).

Whilst the unique botanical assemblage and cultural significance of hay meadows is well recognised (Hopkins 1990, Peterken 2013), much less is known about their insect fauna and overall entomological interest, with the possible exception of their value for species foraging for nectar and pollen and their role in supporting insect pollinator populations, which are in global decline (Potts *et al.* 2010). In the UK, loss and fragmentation of flower-

Calocoris rosemaculatus.

rich semi-natural grasslands is considered to be one of several key factors in the decline of bumblebees, for example (Carvell *et al.* 2006).

Some commentators have indicated that hay meadows have a rather limited insect fauna due to the drastic nature of the management regime (Kirby 2001) but Waring (1990) provides some insight into which species may be present.

This article aims to describe the potential composition of the insect 'guild' associated with the flowers and seeds of herbaceous vascular plants in meadows. This is a pertinent topic as there have been suggestions that for those grasslands managed as hay meadows, changing their management to maximise or enhance their entomological interest (including supporting pollinator populations), could be beneficial. While their value for insects could, in principle, be enhanced by a change in meadow management, this would require departure from the so-called traditional management that originally helped to shape their current botanical value (Kirby 1992).

Methods

Meadow plant species

A list of herbaceous vascular plant species that regularly occur in meadows (see introduction for definition) was compiled using the grasslands volume of the National Vegetation Classification (Rodwell 1992) and using the first author's knowledge of British meadow grasslands. It should be stressed that a precise definition of meadows has been used here and there are other types of grassland or related vegetation that may occasionally be managed as meadow (see Peterken 2013).

This synthesis of published and professional experience produced a list of 104 species (Annex 1) which amounts to around 29% of the total number of native herbaceous vascular plants (excluding grasses, sedges, rushes and ferns/horsetails) considered by Walker (2008) to be primarily 'grassland' species (356). Very few of the species in Annex 1 are meadow specialists *per se* and most can persist in grasslands managed as pasture although they may be much less frequent (e.g. great burnet *Sanguisorba officinalis*).

Flower-feeding insects definition and literature search

The definition of 'flower-feeding insect' is generally taken here to mean that the flowers and seeds of host plants are able to support the development of the insect larva from first to final instar exclusively or predominantly or are the main food source for adults. The definition excludes species (usually adults) that feed very widely on the nectar and/or pollen of the flowers of herbaceous species. These so-called 'tourist' species (Porter 1994) include bumblebees and sawflies (Hymenoptera), hoverflies (Diptera) and various beetles (Coleoptera). For these species, hay meadows provide a significant seasonal resource of nectar or pollen within a wider landscape context.

A full search of the entomological literature and the Biological Records Centre's Database of insects and their food plants was undertaken and insects associated with the pre-defined list of meadow flowers were tabulated. Species which fed on the flowers but also on other plant parts were included where there appeared to be a regular

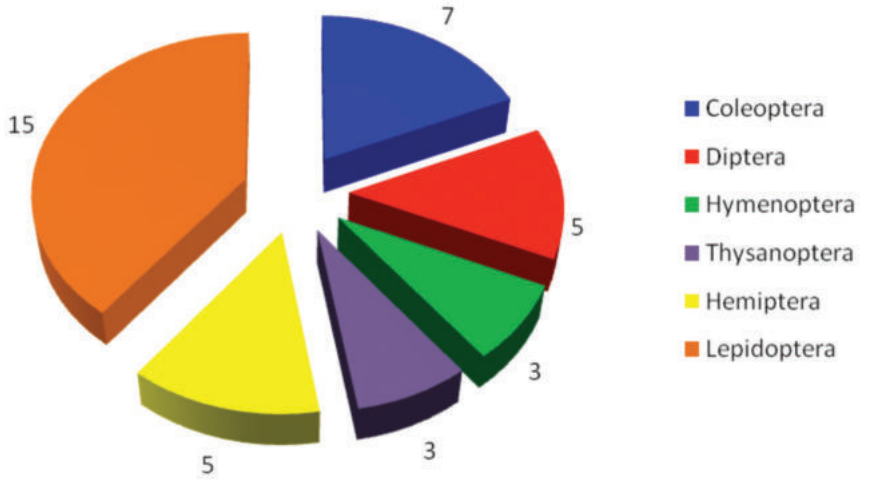


Figure 1: Insect orders and number of families of the specialist flower-feeding guild.

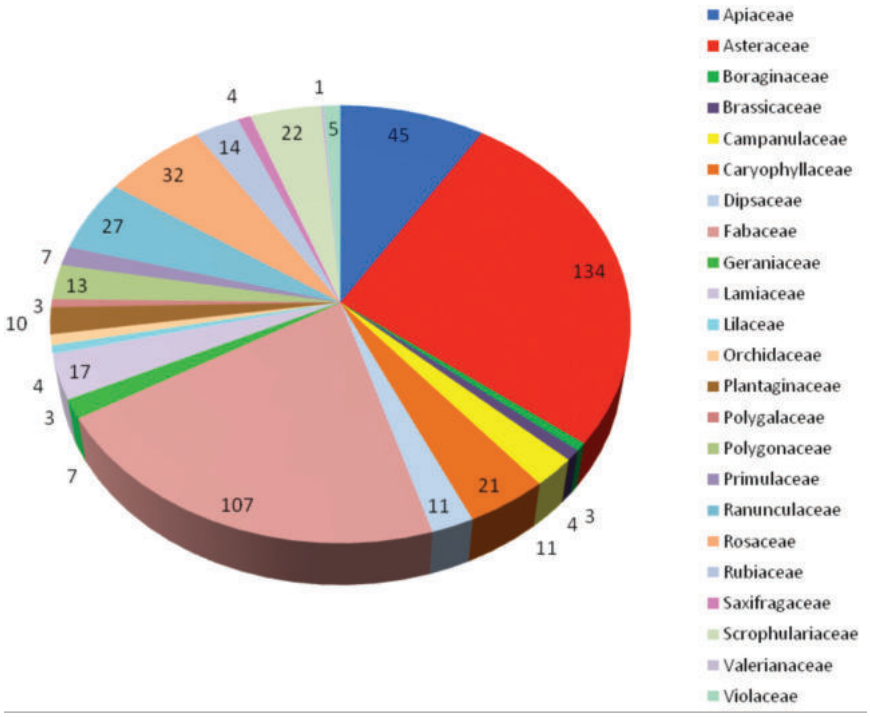


Figure 2: Number of flower-feeding insects by plant families.

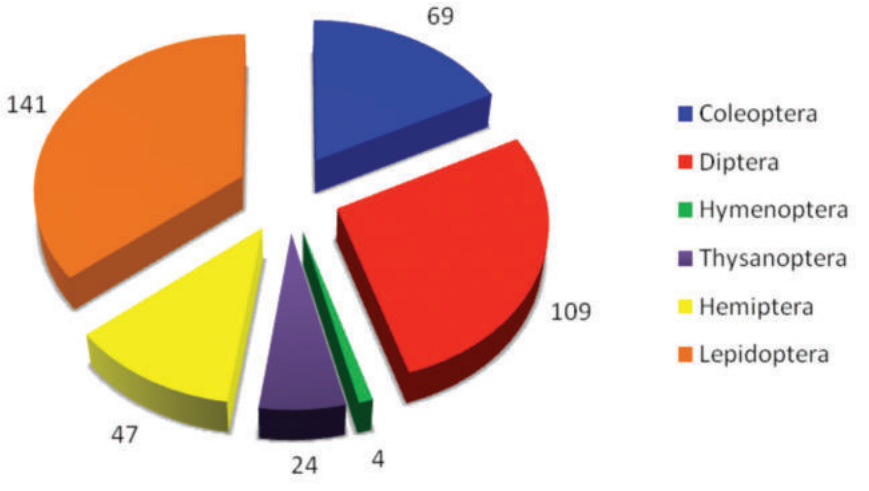


Figure 3: Number of flower-feeding insects by Order.

association of flower feeding. No attempt was made to filter the resulting list by habitat as such information is very patchy and inconsistently recorded in the literature. Thus, undoubtedly there will be insect species in the inventory that may not actually occur on the host plant when it occurs in a meadow or other type of grassland. Also, some species, although associated with the plant, may not actually be able to survive certain meadow management regimes due to cutting time, microclimate etc. Thus, the list of flower-associated insects needs to be seen as a potential list as demonstrated, see box: Hay-meadow management and its influence on insect species composition (pg 153). This shows the degree to which different families within insect orders have adapted to flower feeding.

Summary of species, host plants and insect families

A full excel spreadsheet is available from the first author on request.

Three hundred and ninety three species of insect fit the definition of being a flower-feeding insect. These were represented by six orders (Coleoptera, Diptera, Hemiptera, Hymenoptera, Lepidoptera and Thysanoptera) and 38 insect families (see Figure 1).

These feed on plants in 23 different families. Figure 2 shows the relative distribution of plant families by number of insect feeding records.

Two plant families account for over 50% of the insect species, the Asteraceae (daisy family) and Fabaceae (pea family). Both of these two plant families were ranked in the first seven families by Ward & Spalding (1993) in an analysis of the numbers of all British plant-feeding insects and mites associated with the British flora. They also found that these families have low proportions of polyphagous insect species. However, if a correction factor is applied to take account of the number of species within the families in relation to the number of plants in the British flora, this elevates the importance of families such as the Dipsacaceae (teasel family) and Scrophulariaceae (figwort family) and 'downgrades' the Rosaceae (rose family) and Caryophyllaceae (pink family). That is, the former families have a disproportionate number of flower-feeding insect associates in relation to their contribution to the total British flora.

Bruchus rufimanus

Lepidoptera (largely smaller moths) make up 141 species in 15 families followed by Diptera (109 species in five families and Coleoptera (69 species in seven families) (Figure 3). In broad terms, of the insect orders that feed on plants, only the Collembola and Orthoptera are not represented.

In terms of feeding habits, the majority have larval stages that feed in various ways on a variety of parts of a flower including the seeds. Thirty-eight species spin flowers together forming webs (larval Lepidoptera) and around 78 species form galls in the flowers (principally the Dipteran families, Tephritidae (picture-winged flies) and Cecidomyiidae (gall flies)).

The majority of flower-feeding insects have a narrow host plant spectrum. For example, of the 394 species, 85% are confined to feeding within a single plant family. The Thripidae are an exception but it was postulated by Ward (1993) that greater polyphagy in this family may be due to depending on a microhabitat (pollen) that is very ephemeral.

Host plant breadth	Number of insect species
One genus (Monophagous)	254 (64%)
One family (Oligophagous)	84 (21%)
Two or more families (Polyphagous)	56 (14%) (Aphids and thrips only)

An example of a specialist insect/plant flower/seed-feeding association

Globeflower (*Trollius europaeus*) is a boreal-montane perennial herb associated with a variety of habitats such as open woodland, rock ledges, marshy grassland but including damp meadows, especially in upland areas. In Great Britain, the plant supports five species of *Chiastocheta* (small flies of the Dipteran family Anthomyiidae)[1]. The adults are the sole pollinators of the plant and the larvae feed on the seeds of the plant.

There are records for three of the five species from northern England, north Wales and Scotland and for the other two species, from England and Scotland. All species are apparently scarce but may be under-recorded.

This is an obligate mutualism with both 'costs' (loss of seeds) and benefits (pollination and outcrossing) to the plant of which very few examples have been documented. It is presumed that species of *Chiastocheta* minimise competition by partitioning the seed resource spatially and temporally.

[1] *Chiastocheta dentifera , C. inermella C. rotundiventris, C. setifera C. trollii*

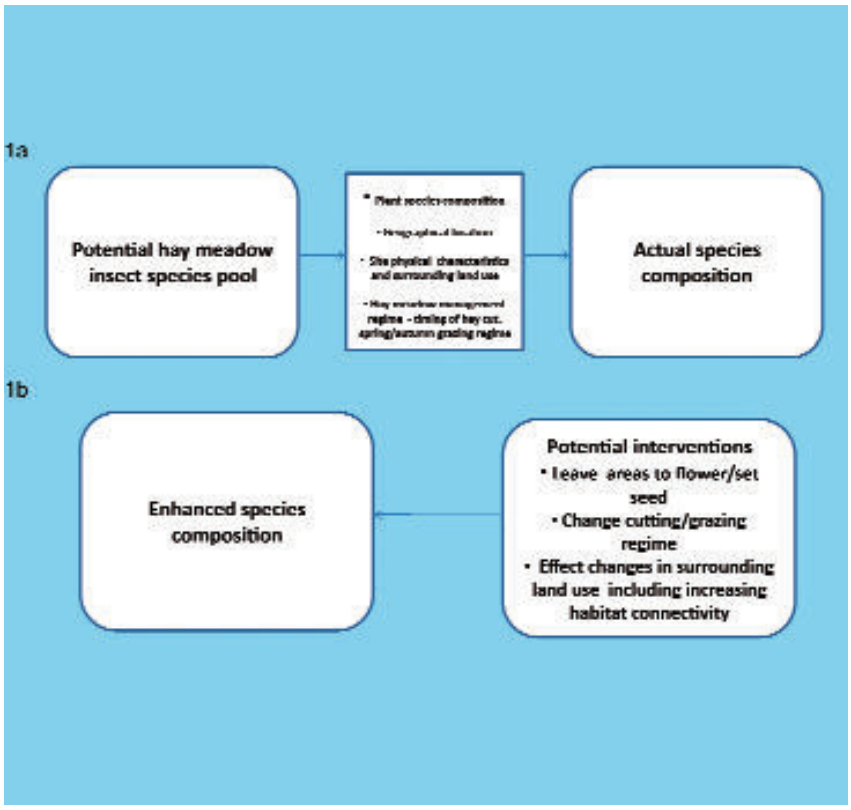
This degree of monophagy is perhaps unsurprising given a food resource that is generally small in size, has a short period of availability during the year and a variable distribution at different spatial scales. The form and phenology of flowers and seeds will require a high degree of specialisation on behalf of the insect in order to successfully exploit this food source. There are some parallels with fleshy-fruit feeding species (Jefferson 2004), particularly the degree of monophagy and the short duration of food availability. A summary of the biology/ecology of insect families can be found in Barnard (2011).

It would be interesting to know whether the patterns described above would hold true if the study were extended to include flower feeding on plant species associated with all types of semi-natural grassland, the majority of which are managed as pasture.

Factors influencing hay meadow invertebrate composition

The 'true' insect composition of the specialist flower/seed feeding 'guild' of long-established hay meadows is likely to be made up of species that are adapted to a 'traditional' annual hay cutting and aftermath and/or spring grazing regime (see for example Crofts & Jefferson 1999). These will be insect species that can i) complete the flower/seed feeding part of their life cycle before the hay is cut and the flower/seed heads of plants are removed and other aspects of life cycle fit in with meadow management or occur elsewhere – examples might include orange tip butterfly (*Anthocaris cardamines*) and *Ceutorynchus cochleariae*, a weevil, both with larvae associated with the flower and seeds of cuckoo flower and *Phytomyza varipes*, an Agromyzid fly whose larva feeds on the seeds of yellow rattle; and ii) species that are able to exploit the flowers of plants that are able to flower after the hay cut in the 'aftermath' such as devil's-bit scabious (*Succisa pratensis*), red clover (*Trifolium pratense*) and yarrow (*Achillea millefolium*) – an example might be *Griselda stagnana*, a micromoth, whose larva feeds on the flowers and seeds of devil's bit-scabious.

Cryptocephalus aureolus.



Hay-meadow management and its influence on insect species composition.

Many meadows have regular uncut margins that will support insect species that cannot survive the infield management regime. These margins can also provide a refuge for in-field species when hay is being cut. However, in many meadows, the vegetation of permanent margins, particularly when bounded by hedgerows, is somewhat different to the floristic composition of the rest of the meadow due to altered microclimate and deposition of leaf litter (Crofts & Jefferson 1999). Such margins are often less species-rich and tall competive species, such as cow parsley (*Anthriscus sylvestris*), are more abundant. Irregularly cut margins are also believed to help perpetuate some meadow plants through allowing seeding and may similarly help to maintain the persistence of some flower- feeding insect species (Smith & Jones 1991).

The suite of generalist flower-visiting species not considered here (see definition above) will also exploit meadow flower species. Whilst, these foraging species will probably rely on other nearby habitats to complete their

Exapion genistae

life cycles, meadows will still form an important resource particularly in landscapes where other flowery habitats may be scarce. This may be important to retaining the diversity of pollinators within cropped landscapes and thus supporting the pollination service needed by some crop types (Potts *et al.* 2010).

Hay-meadow management and invertebrates

Prior to the onset of settled agriculture at the start of the Neolithic period, grasslands would have existed in woodland glades and steep unstable slopes, and would have been grazed by native herbivores. However, it would seem likely that there was no equivalent natural process that mimics the hay-meadow regime, although occasional wildfires may be a candidate. Under these natural scenarios the flower-feeding insects described in this paper would probably have been far scarcer than today.

It is likely that changes to the way that hay meadows are managed would benefit both generalist flower-visiting insect species and possibly also specialist flower-feeding species. These changes might include specifying later hay cutting dates to allow for certain plant species to flower and set seed, leaving margins uncut but subsequently grazing them as part of the late summer aftermath grazing regime and, making changes to the grazing regimes (see Figure 1b on page 153). Alternatively, meadow and low-intensity pasture management might be rotated but this would need to be done at a landscape scale to ensure a mixture of the management types occurred in any one year.

Given that the high-value plant communities of hay meadows are maintained by the management described above, however, any changes to this management have the potential to cause adverse changes to the botanical composition. Any proposed changes would need to be carefully assessed. There is, for example, increasing evidence that consistent late cutting (for example, late July/early August in the lowlands) leads to a decline in floristic richness and increase in competitive species (Humbert *et al.* 2012) and a build up of soil nutrients over time (http://www.floodplainmeadows.org.uk/files/floodplain/Cutting%20Article.pdf). Also, certain species that thrive under a meadow management regime may decline under pasture management and there are also risks of an increase in undesirable plant species with conversion as detailed in an experiment conducted on unimproved neutral grassland in Somerset (Tallowin & Griffiths 2013).

The aim should be to substantially expand the area of such habitat increasing connectivity and reducing fragmentation as prescribed in the *Making Space for Nature* report (Lawton *et al.* 2010). This should increase the overall diversity of insects if it provided continuous availability of nectar and pollen throughout the key life stages of generalist flower feeders including the life cycle of colonies of social Hymenoptera.

It is also possible that insects capable of exploiting any new management regime may never colonise due to the highly fragmented nature of the existing resource; this may especially be true of the specialist species.

The management changes with the least likelihood for having a detrimental botanical impact would probably involve cutting all or parts of fields, such as the margins later (but see above), or leaving partial uncut margins or fields which would also then be subject to aftermath grazing later in the year. Both options would allow a later supply of nectar and pollen and, in the case of the former, greater structural diversity. With the latter, there may be scope for rotating the areas such that the same margins or areas would not be left each year. Another option would be to occasionally substitute a hay cut with the introduction of grazing animals at around the time hay would normally be cut as this would involve a much more gradual removal of the biomass at least prolonging the flowering of certain species.

Alternatively, and the approach favoured by the authors, it may be better to not risk such adverse botanical changes and concentrate on creating additional flower-rich grassland or similar habitat in the surrounding countryside for both generalist flower-visiting species and, where possible, specialist flower feeders.

Seed harvesting

Many existing meadows are increasingly being used for seed harvesting for the restoration and creation of new species-rich meadows to meet existing biodiversity initiatives (Defra 2011). This in itself will have an impact on insects and other invertebrates. There is already established guidance to minimise these impacts (e.g. Crofts & Jefferson 1999, Waring 1990).

Final thoughts

A better understanding of the insect species composition of hay meadows and their value and role in conserving insects at a landscape scale would appear desirable to inform future land management strategies. With increasing interest in pollinators as an

Orsodacne cerasi.

ecosystem service, any such improvement in knowledge would contribute to improved targeting and delivery of sustainable agricultural landscapes.

It is hoped that this study will also help to highlight the value of all semi-natural grasslands for the specialist flower-feeding guild of insects.

Acknowledgements

We are grateful to Jon Webb, John P. Martin (Natural England), Paul Evans (Buglife) and Roger Key for useful discussions, comments on the text and information supply. All photographs are courtesy of Roger Key

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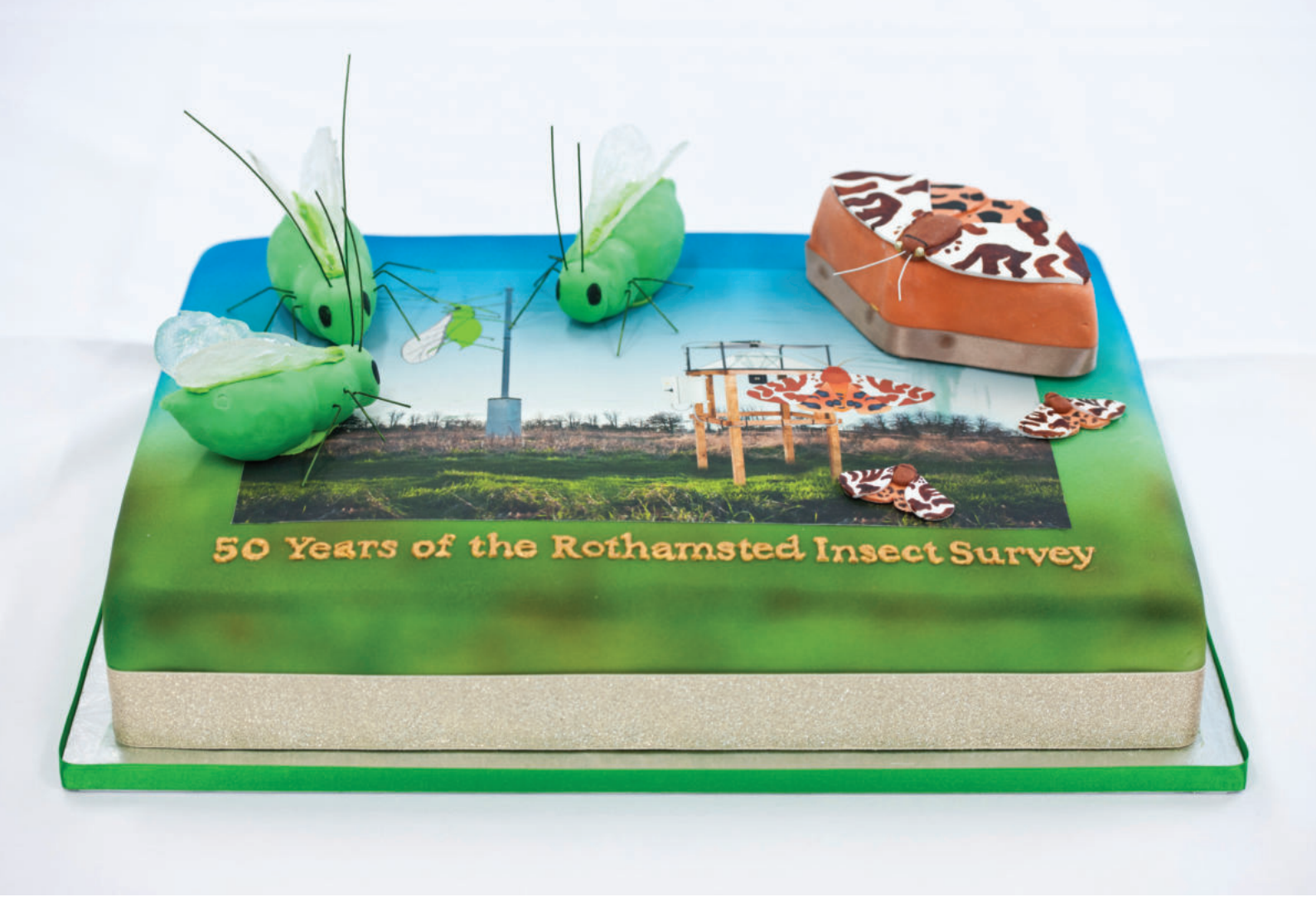
Annex 1. Vascular plants (forbs only) associated with grasslands managed as hay meadows.

Achillea millefolium
Achillea ptarmica
Agrimonia eupatoria
Ajuga reptans
Alchemilla spp.
Allium vineale
Anacamptis morio
Anemone nemorosa
Angelica sylvestris
Bellis perennis
Caltha palustris
Campanula rotundifolia
Cardamine pratensis
Centaurea nigra
Cerastium fontanum
Cirsium dissectum
Cirsium heterophyllum
Cirsium palustre
Coeloglossum viride
Colchicum autumnale
Conopodium majus
Crepis capillaris
Crepis paludosa
Dactylorhiza spp.
Euphrasia spp.
Filipendula ulmaria
Filipendula vulgaris
Fritillaria meleagris
Galium palustre
Galium verum
Genista tintoria
Geranium sylvaticum
Geum rivale
Gymnadenia spp.
Heracleum sphondylium
Hyacinthoides non-scripta
Hypochaeris radicata
Knautia arvensis
Lathyrus linifolius
Lathyrus pratensis
Leontodon autumnalis
Leontodon hispidus
Leucanthemum vulgare
Linum catharticum
Listera ovata
Lotus corniculatus
Lotus pedunculatus
Lychnis flos-cuculi
Lysimachia nummularium
Medicago lupulina
Mentha aquatica
Meum athamanticum
Myosotis discolor
Myosotis laxa
Myosotis scorpioides
Narcissus pseudonarcissus
Oenanthe pimpinelloides
Oenanthe silaifolia
Orchis mascula
Persicaria amphibia
Persicaria bistorta
Pimpinella major
Pimpinella saxifraga
Plantago lanceolata
Plantago media
Platanthera chlorantha
Polygala vulgaris
Potentilla anserina
Potentilla erecta
Potentilla reptans
Primula veris
Prunella vulgaris
Ranunculus acris
Ranunculus auricomus
Ranunculus bulbosus
Ranunculus ficaria
Ranunculus flammula
Ranunculus repens
Rhinanthus minor
Rumex acetosa
Sanguisorba minor
Sanguisorba officinalis
Saxifraga granulata
Senecio aquaticus
Serratula tinctoria
Silaum silaus
Stachys officinalis
Stellaria graminea
Succisa pratensis
Taraxacum spp.
Thalictrum flavum
Tragopogon pratensis
Trifolium dubium
Trifolium medium
Trifolium pratense
Trifolium repens
Trollius europaeus
Valeriana dioica
Veronica chamaedrys
Vicia cracca
Vicia orobus
Vicia sativa
Vicia sepium
Viola riviniana


Celebrating 50 years
of the Rothamsted
Insect Survey
A network of suction-traps and
light-traps founded in 1964 by
L.R. (Roy) Taylor to investigate
the migration and population
dynamics of aphids and moths
across the United Kingdom.



The Rothamsted Insect Survey Strikes Gold

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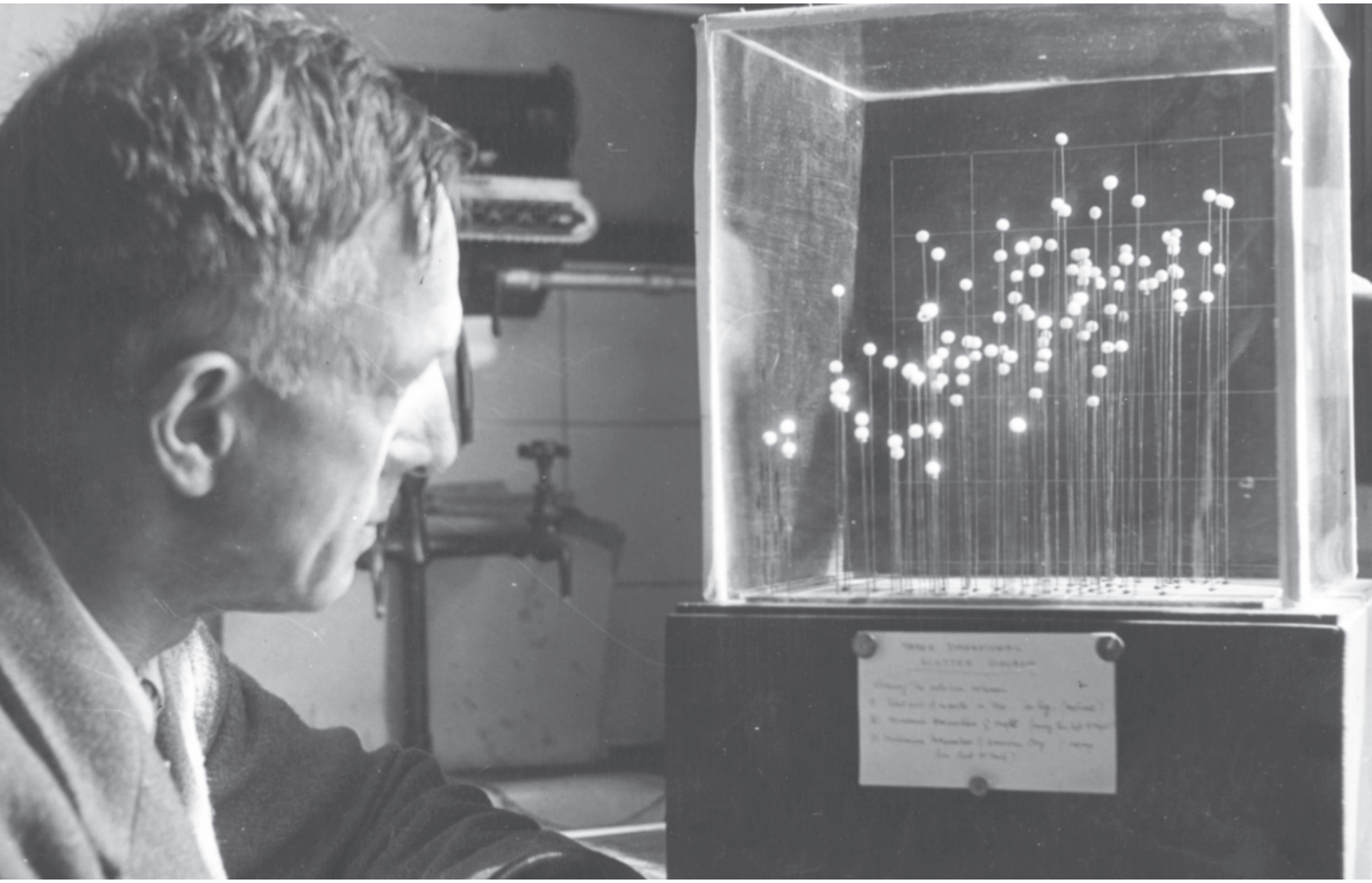
Party time

On 29th April, the Rothamsted Insect Survey (RIS) celebrated its 50th birthday. Current and past staff, volunteers, funders and dignitaries participated in a day of reminiscing and looking forward. Ian Woiwod, former Head of the RIS provided an introduction entitled "The mythology of the Rothamsted Insect Survey", tracing its origins back to the Egyptian pyramids. Richard Harrington outlined the uses to which the suction-trap network is put today and Mark Stevens, Lead Scientist of the British Beet Research Organisation, highlighted the importance of the RIS to the agricultural industry. There were plenty of posters and artefacts to view at lunch time, although renewing acquaintances and making new ones took priority. The truly amazing birthday cake was the talk of the twittersphere. It was cut by Ian Tillotson, our longest serving volunteer, who has clocked up 46 years of light-trap operation and around 200 trap-years of identification. Volunteers are the cornerstone of the RIS and each of those present received a certificate of thanks, as did all others who had ever emptied a light-trap or suction-trap. Tim Benton, University of Leeds and UK Government Adviser on food security, opened the afternoon session by describing how the RIS contributes to knowledge aiding ecosystem service provision and how much more information is still locked up in the samples waiting to get out. Chris Shortall, RIS Chief Ecologist, gave an update on the uses of the light-trap network and Martin Warren, Chief Executive of Butterfly Conservation (BC), outlined collaborations between BC and RIS which have led to an improved understanding of changes in moth abundance and pointed to mitigation options. A commemorative

Early days- Johnny (standing) and Roy working on a suction-trap (left); Health and safety regulations were less stringent (right).



CB Williams and a 3D model that would be produced by a computer in seconds these days.

plaque was unveiled by Robin Taylor (Texas A&M), son of RIS founder Roy, helped by Harpenden Town Mayor, Councillor Rosemary Farmer. The Rothamsted bar provided refuge for further conviviality prior to a well-attended public open meeting in the evening.

History

The birth date is a moot point. 29th April was chosen because on that day in 1964 the first RIS 12.2m suction-trap began continuous operation at Rothamsted, but much was already happening and years of work had gone in to reaching this landmark. The Entomology Department (as it was called then) at Rothamsted had a long history of studies on insect migration, ecology and population dynamics, notably through the pioneering quantitative work of C.B. Williams FRS ("CB"), President of our Society 1947-48, and C.G. ("Johnny") Johnson. In 1948 CB and Johnny recruited L.R. (Roy) Taylor to help investigations on the population biology of insects of importance to agriculture. Roy realised that insect migration is crucial to their population dynamics. He needed good data from around the Country to develop the mathematics of spatial ecology. He and Johnny had designed suction-traps to help understand population dynamics, particularly of the black bean aphid, *Aphis fabae*. Then the publication of Rachel Carson's "Silent Spring" in 1962 led to huge concerns over the environmental impact of pesticides. The government made funds available through the Agricultural Research Council (ARC) for research into what is now termed integrated pest management. Realising the potential of a thorough understanding of population dynamics in relation to rationalising the use of pesticides, Roy proposed a network of 12.2m high suction-traps as an early warning system and predictive tool, and the ARC enthusiastically embraced this idea. In the meantime Roy had resumed studies on moths at Rothamsted using the light-trap design of CB. The trap at Barnfield (on the Rothamsted Estate) was operated by CB from 1933 to 1937 and again from 1946 to 1950 (during the war, the use bright lights was somewhat frowned upon!). Roy brought it back into operation in 1960 and it has run continuously ever since. In 1965 and 1966 two further traps were installed at Rothamsted. By 1968, 60 traps were in place, well distributed across the United Kingdom.

The power of long-term datasets and the range of applications to which they can be put increases with time. Fifty years is short compared to some of Rothamsted's classical field experiments, but the aphid and moth sampling provide the most extensive standardised data for any terrestrial invertebrate groups anywhere in the World. Many of the uses to which the data have been put could not have been foreseen at the inception. "Climate change", for example, hadn't been invented! This versatility is what has enabled the RIS to survive the funding attrition that has pervaded science since the 1980s. The ARC became the AFRC and then, twenty years ago, the BBSRC. From 2012 the RIS has been funded as a BBSRC National Capability, with much needed support from the agricultural industry, especially the British Beet Research Organisation and the Home Grown Cereals Authority, and from Rothamsted's Lawes Agricultural Trust. The data have also formed the basis of a wide range of specific research projects funded by BBSRC, NERC, Defra (Natural England), the EU and others.

Roy retired in 1984, leaving the suction-traps in the very capable hands of Mark Tatchell and the light-traps in those of Ian Woiwod. Mark left in 1993, handing on the baton to myself, and Ian left in 2008. The light-trap network is now managed by Chris Shortall. Many other wonderful people have, of course, been essential to the success of the group.

International dimension

Suction-traps of the Rothamsted design were soon deployed by aphidologists in other countries, first France under the direction of Yvon Robert (INRA Le Rheu). Funding was mostly provided by the governments and industry bodies within individual countries, leading to collaboration only being possible on a rather *ad hoc* basis. Roy and Yvon recognised the value of standardising the procedures used in the aerial sampling of aphids. In 1980, travel funds provided by the Commission of the European Communities (CEC) enabled them to organise a meeting of interested parties at Rothamsted, which led to the informal EC Experts' Group known as EURAPHID, and to the publication of a handbook aimed at the rapid identification of winged aphids (Taylor, 1981). EURAPHID meetings were subsequently held at Brussels-Gembloux, Belgium (1982) (Bernard, 1982); Montpellier, France (1985) (Cavalloro, 1987) and Catania, Italy (1988) (Cavalloro, 1990).

After that, there was no funded co-ordination until the establishment in 2000 of the EU Thematic Network, EXAMINE (EXploitation of Aphid Monitoring IN Europe). The seeds of EXAMINE were sown at the Fifth International Symposium on Aphids held in 1997 in León, Spain. At this meeting a workshop on suction-trapping was convened (Harrington, 1998). The meeting led to a reinvigoration of international collaboration which resulted in a successful application to the EU Framework Programme 5. The main purposes of the project were to establish a common database for deposition and retrieval of data from the suction-trap network and to use these data to examine the impacts of climate, land-use and pollution on the dynamics of aphids. Many publications resulted (e.g. Cocu *et al.*, 2005a,b,c; Harrington *et al.*, 2007). Further details on the EXAMINE project can be found at www.rothamsted.ac.uk/examine.

The EXAMINE database is still functioning but, once funding for EXAMINE ceased in 2003, few new data were added other than by the UK and Czech Republic. At a Europe-wide scale the database is now incomplete, and out of date technologically. At Rothamsted, a new, more versatile database is being developed by Paul Verrier. In the past two years this work has not been funded and has relied on voluntary effort by Paul.

Last November a meeting was organised at Bäckaskog, Kristianstad, Sweden by myself and Roland Sigvald, long-term friend and colleague from the Swedish Agricultural University, Uppsala, to attempt again to reinvigorate international collaboration. Delegates from 12 countries including China, South Africa and New Zealand attended (in spite of the best efforts of the St Jude's Day storm), provided an update on the status of suction-trapping in their countries and presented their work to a meeting of the Nordic Association of Agricultural Scientists (NJF, 2013).

The new database (known as "Paul") was presented at the Bäckaskog

meeting and all delegates recommended its adoption as a databank and as a means to facilitate collaborative analyses. As with EXAMINE, the database uses Microsoft SQL Server. All Rothamsted aphid and moth data from the suction-trap and light-trap networks have been uploaded to the new database. The EXAMINE data have also been uploaded. The database contains a complete nomenclature for all included taxa, host-plant information and metadata on the traps. A menu of predetermined retrieval options is currently under development and will allow tabular or graphical output. Once the retrieval system is completed, a JAVA application will be developed to make the data available via the internet in a password-protected environment with appropriate access agreements.

Greatest hits

Data from the RIS have been put to a wide range of uses. Here we provide a simple statement on what we consider ten of the most important fundamental or strategic discoveries, and references to further details.

Taylor's Power Law (Taylor, 1961; Taylor and Taylor, 1977; Taylor and Woiwod, 1980; 1982; Taylor *et al.*, 1978; 1980; 1983)

The discovery of the power law relationship between variance and mean is essential to sequential sampling programmes. Although the discovery was made prior to the inception of the RIS, one of the key early uses of the RIS data was to investigate the relationship further and seek an underlying mechanism.

Diversity statistics (Taylor *et al.*, 1976; Taylor 1978)

Taylor used the temporal replication in data from the light-trap network to compare a range of methodologies for describing diversity and concluded that the log series diversity index, α , was the most powerful discriminator being less affected by sample size and dominant species than other widely used statistics.

Density dependence (Woiwod and Hanski, 1992)

The RIS data enabled the incidence of density dependence in 5715 time series of annual abundance of 447 species of moth and aphid to be examined. This analysis showed, for the first time, the critical importance of long time series in the ability to detect this important cornerstone of population dynamic theory. Density dependence was detected in 79% of the moth and 88% of the aphid time series longer than 20 years.

Neutral Theory (Mutshinda *et al.*, 2008)

Hubbell (2001) developed a controversial theory to explain the dynamics of biodiversity. This "unified neutral theory of biodiversity and biogeography" was based on the assumption that trait differences between trophically similar species had no impact on their relative abundance or speciation rates. Data from the light-trap network were used to test a version of Hubbell's neutral model. The model did not fit the data well because ecological communities fluctuate more than expected under neutrality.

Trait ecology of aphids (Bell *et al.*, 2012)

The annual populations of 170 aphid species were characterised in terms of abundance and distribution in time and space. Functional traits such as life-cycle type and host-plant geographic range sizes explained macro-ecological patterns better than did taxonomic relatedness.

Winter mortality of aphids (Bale *et al.*, 1988)

Various authors had shown aphids to supercool and to freeze at temperatures below -20°C. It was assumed that they could survive such low temperatures, but data from the suction-trap network suggested that temperatures much higher than this were causing significant mortality to the mobile forms. Laboratory investigations showed that aphids die at temperatures much higher than those at which they freeze (pre-freeze mortality), probably as a result of membrane disruption. This is a good example of how patterns in long-term data can lead to testable hypotheses to establish causality.

Climate Change (Woiwod, 1997; Conrad *et al.*, 2002; Harrington *et al.*, 2007)

The data have been used to detect effects of climate and other environmental changes on the phenology and abundance of aphids and moths. Aphid phenology is advancing throughout Europe but more in the case of species overwintering in the mobile stages compared to eggs. Moth phenology is also advancing, and climate change is implicated in some recent moth declines.

Trophic mismatch (Thackeray *et al.*, 2010)

Holders of long-term datasets often join forces to search for generalities. Data from the light-trap and suction-trap networks were used in a major study of changes in phenology of 726 UK terrestrial, freshwater and marine taxa. Most phenological events advanced with time but those for primary producers and primary consumers advanced more than those for secondary consumers, suggesting that changes pose a threat to ecosystem function because of potential trophic mismatch.

Changes in biodiversity (Conrad *et al.*, 2006; Shortall *et al.*, 2009)

Declines of many widespread and common moth species have been detected using RIS data collected since 1968, with many more moth species declining in abundance than are increasing in southern Britain but not in the north. Total biomass of insects caught in suction-traps declined over a 30-year period in the RIS Hereford suction-trap but not at three other sites (Starcross, Rothamsted, Wye). This is probably related to changes in agricultural practice, which were greater over the period in question at Hereford compared to the other locations. The taxa involved in the decline at Hereford are recorded.

Evolution of plant defences (Züst *et al.*, 2012)

Europe-wide suction-trap data, combined with laboratory selection experiments, showed that defence chemotypes of *Arabidopsis thaliana* are selected according to the relative abundance of two specialist aphid species.

The suction-trap network today

The traps

We operate 15 suction-traps in the UK, each 12.2 metres tall. The traps are emptied daily in spring, summer and autumn, weekly in winter. Aphids are identified at Rothamsted and SASA (Edinburgh), counted, and recorded on our long-term database.

Barnfield light trap

Forecasts and pest control

We have found strong relationships between winter temperature and the time that aphids are first found in our traps, and their abundance. We use these relationships to forecast when movement into crops is likely to start, and to predict the impacts of climate change on pest problems. Compared to 50 years ago, many aphids are flying a month or more earlier.

Insecticide resistance

We test individual aphids, in particular the major pests *Myzus persicae* (Peach–potato aphid) and *Sitobion avenae* (English grain aphid), for their resistance to a range of insecticides. Molecular tools are used to detect the mutations conferring resistance.

Plant viruses

Aphids are important vectors of crop viruses. We detect the presence of certain viruses in aphids and hence their potential as vectors. The traps in Scotland provide data in support of the Scottish Seed Potato Classification Scheme.

Informing pest control

We present all of this information in web and email bulletins which are issued every Friday and used by practitioners to guide aphid control programmes.

Not just aphids

We keep all samples. They are an invaluable resource for studies of, for example, the natural enemies of aphids such as ladybirds and lacewings, wasps, the mosquito vectors of West Nile virus, and the midge vectors of Bluetongue virus of sheep and cattle.

Fundamental science

The data are used in many projects, often aimed at understanding the processes affecting insect population dynamics and community structure.

The light-trap network today

The traps

We currently have 84 light-traps in a wide range of habitats. Each trap uses a 200 Watt tungsten bulb. Most traps are emptied daily throughout the year. The moths are identified by volunteers and by a contractor, counted and recorded on our long-term database. Samples are not stored.

Moth abundance and distribution

We have shown that two-thirds of our common larger moth species have declined significantly over the past 50 years, especially in southern Britain. This is worrying as moths are good indicators of the health of the environment and are important components of the food chain. However, one third of species have become more abundant. The reasons for the changes are being investigated and will inform conservation strategy.

Not just moths

Other insects have been studied by volunteers on an *ad hoc* basis, resulting in numerous publications, several first records of insect species in the UK and at least two species new to science.

Wider applications

The data are used in a wide range of projects, most of them aimed at understanding population dynamics and community structure in the face of environmental changes, and developing conservation strategies.

The Survey Team (above) and at work (below)

The future

The RIS datasets will continue to be used to answer key fundamental questions in ecology and to support solutions to practical problems in conservation and pest control.

The data suggest that, in general, pest insects are increasing whereas insects of conservation concern are decreasing. We plan to test the hypothesis that features of insects predisposing them to being pests, such as high mobility and potential for rapid rates of population increase, also make them adaptable to change.

The advance in molecular tools, combined with our wealth of samples, will allow us to understand and predict the interactions between environmental changes and species genetic variability, and their impact on insect population dynamics. Molecular tools may even make it possible to identify and count insects automatically in due course.

Acknowledgements

The RIS has always depended on collaboration between employees and volunteers. We are indebted to all those who have run traps, identified insects, analysed data and contributed to projects over the past 50 years, to those who continue to do so, and to a wide range of funding bodies, especially the BBSRC and its predecessors, who have supported the work. Together we have achieved much and will achieve much more.

Facts and figures (UK)

Total number of aphids to the end of 2013	18,720,533
Largest number of aphids in a year	1,082,509 (1979)
Largest number of aphids in a single trap in a day	51,136 (Broom's Barn, 26th July 1979)
Largest number of a single aphid species at a single trap in a day	44,736 (rose–grain aphid *Metopolophium dirhodum,* Broom's Barn, 26thJuly 1979)
Number of distinct aphid species identified from suction-traps	478
Largest number of distinct aphid species from a single trap	345 (Rothamsted and Silwood)
Largest number of distinct aphid species from a single trap in a day	86 (Silwood, 4th June 1974)
Total number of moths to the end of 2013	12,243,842
Largest number of moths in a year	629,868 (1977)
Largest number of moths in a single trap in a night	4,681 (Yarner Wood, 28th June 1976)
Largest number of a single moth species in a single trap in a night	3,612 (Heart and dart, *Agrotis exclamationis*, Yarner Wood, 28th June 1976)
Number of distinct moth species identified from light-traps	1,535
Largest number of distinct moth species from a single trap	711 (Rhandirmwyn)
Largest number of distinct moth species from a single trap in a night	103 (Yarner Wood, 29th July 1978)
Peak number of suction-traps	24 (1979)
Peak number of light traps	155 (1976)

Further information

www.rothamsted.ac.uk/insect-survey

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What have invertebrates ever done for us?

2014 is the Year of the Invertebrate at Paignton Zoo in Devon. Investigate is a striking new invertebrate exhibit, which opened in June this year.

Philip Knowling, Mike Bungard & Michelle Bales

Paignton Zoo Environmental Park
Totnes Road, Paignton,
Devon, TQ4 7EU

Invertebrates have never been particularly well represented at Paignton Zoo, so this new display has been a wonderful opportunity to highlight a group that is often overshadowed by the much larger mammals, birds and plants on display.

The idea for Investigate came from Paignton Zoo's curator of lower vertebrates and invertebrates, Mike Bungard, and Michelle Bales, a member of the Zoo's education team who is also an invertebrate specialist (Michelle has recently left the zoo to work for Sustrans). Their concept has been brought to life by Zoo technician Don Nielsen who has built the exhibits and Sue Misselbrook, the Zoo's artist, who designed the exhibits, presentation and interpretation.

Also involved were Plymouth University's robotics department who designed and created the interactive robot display, while Pete Smithers, Associate Research Fellow at Plymouth University and also an invertebrate expert, worked closely with the Investigate team throughout.

The team did not want to replicate exhibits on offer elsewhere. We were keen that Paignton would offer a new approach to the invertebrate world - but how could we approach such an exhibit from a fresh perspective? Most collections take the traditional approach, talking about the animal's role in their ecosystem, conservation issues and generally set the exhibit in the framework of the natural world. But making an exhibit educationally

important is about making it relevant. We decided to show invertebrates in a different light and relate them to the visitor's everyday life; in this way we felt we would stand a better chance of engaging and inspiring our visitors.

Investigate focuses on the science of bio-mimicry, which is the concept of looking to nature for the solutions to human problems. The term comes from the Greek bios, meaning life, and mimesis, meaning to imitate. Over millions of years nature has evolved solutions to many of today's technological problems. Bio-mimicry is about being inspired by the world around us and invertebrates are truly inspirational.

The initial ideas came from the dramatic imagery associated with B movies and computer games and from there it quickly evolved into a science-orientated exhibit which asks '*how has research into invertebrates changed our world*?' or, to paraphrase John Cleese, "What have invertebrates ever done for us?"

The answer to that is – plenty. You begin to realise just how many things in our everyday lives – from Facebook to mobile 'phones – have some roots in the study of invertebrates. Algorithms developed from the decision-making process of social insects are responsible for many data mining and internet-based applications. Desert irrigation techniques have been inspired by how the bodies of desert dwelling beetles collect dew droplets from the early morning mist. Faster computers are being developed, based upon the light reflectance of beetles' exoskeletons.

Airless tyres are being modelled from the hexagonal forms found in bee and wasp nests. Incredibly, robotics also draws on invertebrate studies; the behaviour and locomotion of search and rescue robots is being based on spider locomotion, allowing them to search for survivors in previously inaccessible spaces in collapsed buildings, while the designers of micro surveillance drones are looking to flying insects for inspiration. As for medical advancement, the list (involving spiders, scorpions and other venomous beasties) is endless – invertebrates hold the promise of cures for some of the major diseases of our time.

The exhibit itself is fun and interactive with a strong education emphasis. There are five live exhibits, each representing one of the major inspirational groups. They are leaf cutter ants (demonstrating algorithms), beetles (dewdrop collection), giant spiders (their silk is being used in nano-scale medical applications and appears to exhibit some antibiotic properties), scorpions (their fluorescence under UV light is being studied, while their venom can help make a range of beneficial medicines) and the resistance of stick insects to pathogens which may offer resistance to pathogens and help develop new antibiotics.

In this suitably futuristic room you'll find stories about principles and discoveries for which we have invertebrates to thank. The mix of science and live invertebrates is designed to engage audiences of all ages. The leaf-cutter ant exhibit, which extends the entire length of the room, consists of transparent tubes which link coloured acrylic spheres which represent a giant sugar molecule, one of the building blocks of life. There is also a working robotics display using technology developed from the study of invertebrate movements.

Investigate is a fitting tribute to Dr David Stradling, the late Chairman of the Whitley Wildlife Conservation Trust, the charity that runs Paignton Zoo. He was an entomologist and ecologist who specialised in the study of leaf-cutter ants and tarantulas and was also an enthusiastic and passionate communicator.

To accompany the opening of the exhibit the Zoo organised a series of invertebrate-inspired events, which included the Invertebrate Festival during May half term, a butterfly release in the Zoo's Crocodile Swamp at Easter and a native species BioBlitz in September. We hope that everybody who visits Investigate will learn something new about invertebrates and be inspired to look at this misunderstood group in a new light.

The RES Library's Collection of Rare Entomological Books

Figure 1. Merian Plate 23.

Val McAtear

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As the librarian of the Royal Entomological Library, I have in my care a wonderful collection of early entomological publications. It includes almost a thousand volumes published before 1850, with many exquisite illustrations. I love to find an excuse to take these books off the shelf and display their contents, and frequently do so at Mansion House events. In the following pages I want to give you a taste of this fascinating collection.

One of the main objectives of the Society from its very beginnings was to form a library; Fellows were encouraged to donate books. The early "Transactions of the Entomological Society of London", as well as containing some very fine insect illustrations themselves, detail lists of donations to the Library. In addition the Society was exceptionally fortunate in receiving many books as bequests. In 1898 the widow of H.T. Stainton offered "Such books as the Society might choose" from her late husband's library, which also incorporated the collection of J.F. Stephens. The Society chose around 600 volumes and 31 periodicals. The books included in this bequest can all be recognized by a distinctive bookplate. A large number of books contain a small plate acknowledging them as a donation from a Miss Broomfield, the sister of W.A. Broomfield who, incidentally, was not a Fellow of the Society. More recently the library acquired Professor Philip Corbet's books on dragonflies. Others have given monetary donations for the specific purpose of buying books and of course, the Society purchases many volumes each year as advised by the Library Committee.

One of the finest books in the library is by the German-born Maria Sibylla Merian. *"Metamorphosis insectorum Surinamensium"*, published in 1726 and donated by Miss Broomfield. Merian (1647-1717) was one of the greatest artist-naturalists of her time, and beyond. From childhood she had been fascinated by the life cycles of

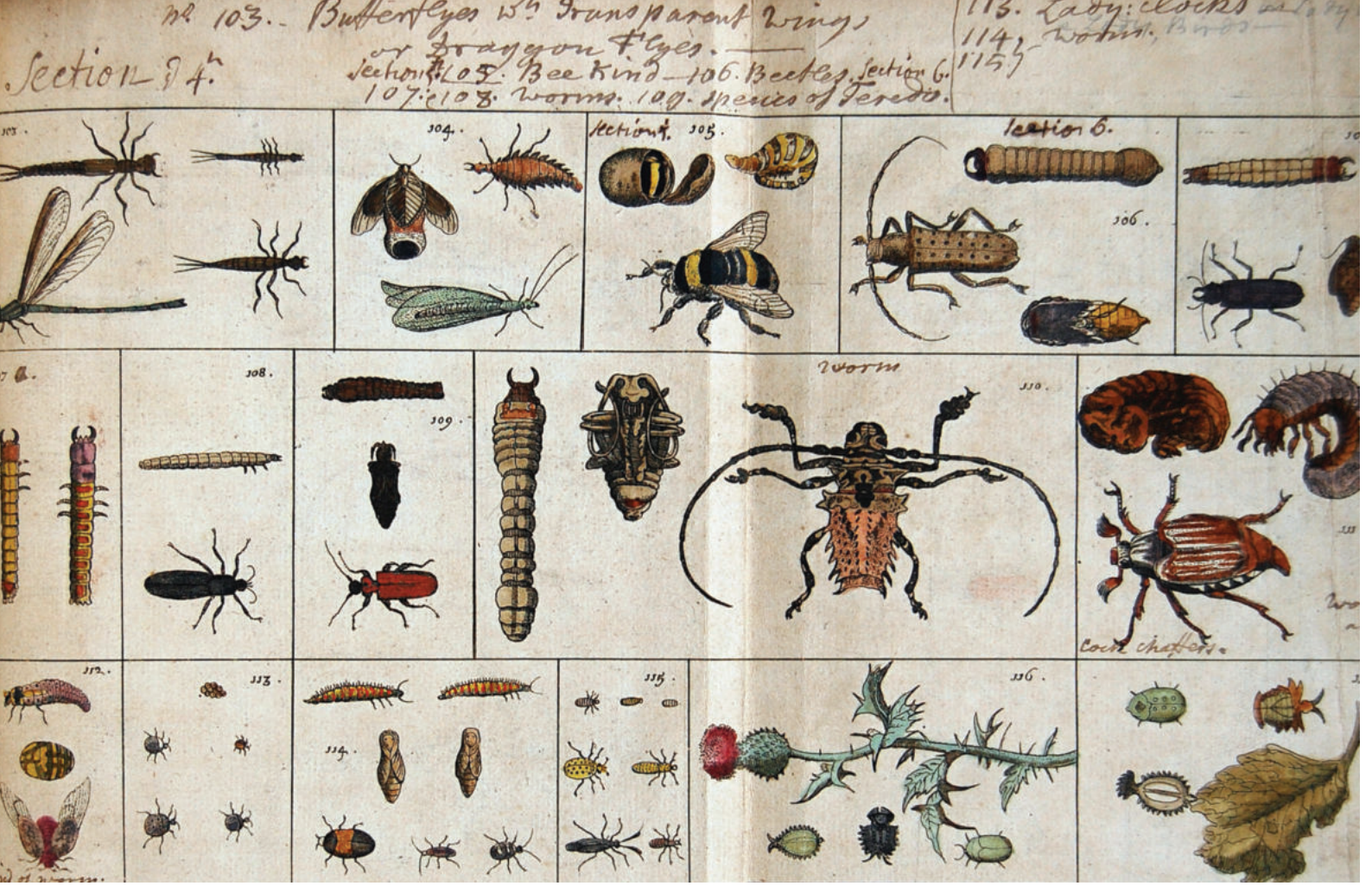

Figure 2. Johannes Godartius of Insects. Illustrations to section 4.

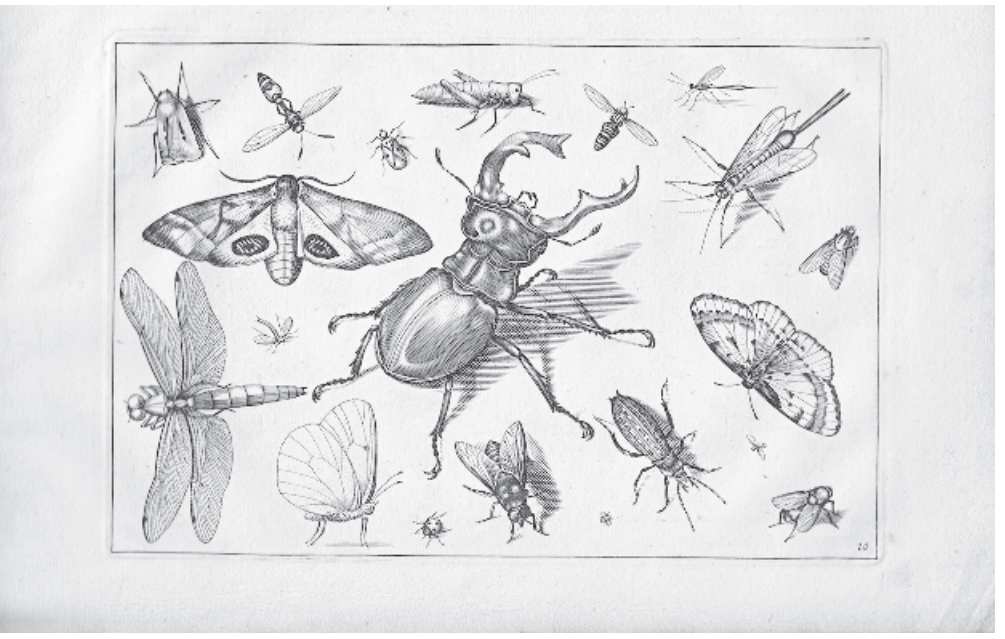

Figure 3. Hoefnagel Plate 10.

butterflies and she made a close study of their transformations. In later life she travelled to South America with her daughter where she collected and reared butterflies which, along with other aspects of the Surinam Natural World, she painted, engraved and coloured for this stunning volume (Figure 1).

One of the earlier books in the collection is *"Johannes Godartius Of Insects; Done Into English, and Methodized with the Addition of Notes by D. Martin Lister; the Figures Etched Upon Copper, by Mr. F. Pl*". The original book was written in Dutch and published in 1662. We, as the title explains, have the later English version translated and added to by Martin Lister (1638-1712) published in 1682. Johannes Goedaerdt (1620-68) was a Dutch painter and natural historian, his interest was also in the metamorphosis of insects (Figure 2).

An earlier book is Jacob Hoefnagel's (1575-1630) collection of engravings "*Diversae Insectarum volatilium icones ad vivum accuratissmè depictæ per celeberrimum pictorem"* published in 1630. This is a collection of just 16 plates but it contains the unnamed images of some 302 invertebrates (Figure 3).

From a similar period comes Thomas Mouffet's (1553-1604) "*Insectorum sive minimorum animalium theatrum"* which was produced from woodcuts. Even so, many of the butterflies can still be recognized. Although it is commonly known as Mouffet's work, it is in fact based on a manuscript begun in the 16th century by Sir Edward Wooten and Conrad Gesner. Thomas Penny continued the work until his death when it was purchased and added to by Thomas Mouffet who also died before its publication (Figure 4).

Much finer detail is possible with copper plate engraving as used by Eleazar Albin (1713-59) in "*A Natural History of English Insects*" produced in 1720. Albin was an excellent artist who produced books on insects, spiders and birds. The library holds his volumes on insects and spiders as well as a collection of 118 original drawings (Figure 5).

Many engravers employed colouring artists who worked from the coloured


minimorum animalium & beatrum. 99

2. Præter magnitudinem parum differt à prima, oculos habet nihilominus nigerrimos atque porre ctiores antennas: ubi album colorem vides, ibi melinum sufficito, exceptis illis quasi oculis majoribus juxta finem alarum interiorum positis, quorum pupillam flammeam, semicirculum vero xerampelinum reddere oportet.

3. Non multùm colore abludit, nisi quod internarum alarum exphyses, totaque ipsarum extima lacinia glastiva sit; uti & tres illi spintheres, quos sub concava illarū parte vides depictos.

4. Omnium Regina dici potest; nam extremis alis, veluti adamantes quatuor in pala Hyacinthina radiantes, miras opulentias ostendunt, imò fere adamanti & Hyacintho oculum effodiunt. Lucent enim pulcherrimè (ut Stellæ) Scintillásque iricolores circumfundunt: his notis ita dignoscitur, ut reliquum corpus describere (licet variis pictum coloribus) supervacaneum esset.

K 2 5. Caput

Figure 4. Mouffet page 99.

Figure 5. Albin Original Drawings No.74.

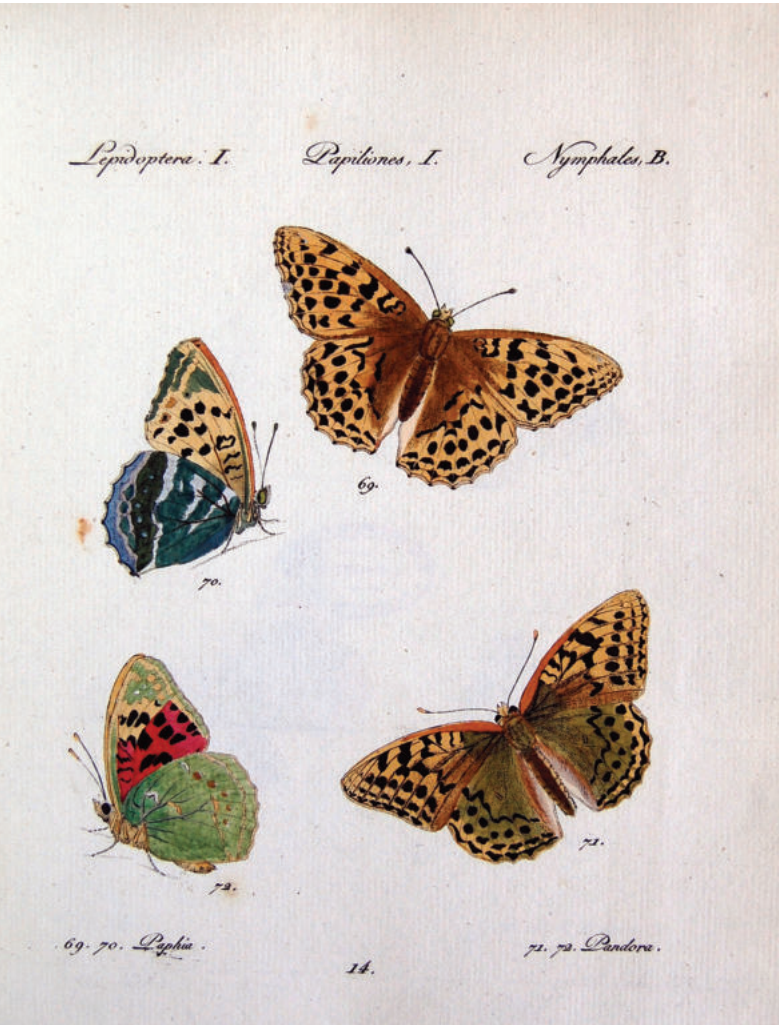

Figure 6. Hubner Volume 1 Plate 24.

Figure 7. Harris Plate 26.

Figure 8. Drury Volume 1 Plate 31.

plates produced by the artist. The library houses a collection of books and manuscripts by Jacob Hubner (1761-1826). Some of these volumes are, according to the book spine, "original drawings", but they may be the pattern plates produced for the colourists. The illustration shown is from "*Sammlung Europaischer Schmetterlinge"* published between 1796 and 1805 (Figure 6).

Moses Harris's (1731-88) publication "*The Aurelian; or Natural History of English Insects; namely Moths and Butterflies. Together with Plants on Which they Feed"* was published in several editions and is probably one of the best known of the early entomological books. Harris was a superb artist as well as a careful observer. We have several editions of this book as well as copies of his other publications. Figure 7 is from the 1766 edition of the Aurelian.

Dru Drury's (1725-1804) *"Illustrations of Natural History*" was published in three volumes between 1770 and 1772. It included only those specimens that had not previously been drawn and was later described by W.F. Kirby as 'Opus entomologicus splendissimus' (Figure 8).

Another interesting volume is Thomas Martyn's (1760-1816) "*The English Entomologist, exhibiting all the Coleopterous Insects found in England: arranged and named according to the Linnean system"* published in 1792. He was born in Coventry and moved to London where he ran "a private painting establishment for instructing youth". These youths also coloured his plates. His works were printed and engraved to a high standard (Figure 9).

"Les Genres des Insectes de Linne" by James Barbut was published in 1781. I have not been able to discover any information about Barbut but the book contains some fine illustrations including Figure 10.

The naturalist Edward Donovan (1768-1837) did not just confine himself to the entomological world but amongst his works are three beautifully illustrated works "*On the Insects of China*" (1798), "*India*" (1804) and "*Asia*" (1805) as well as part-work published between 1792 and 1813 on "*The Natural History of British Insects"*. These are all in the library and we have featured several of his illustrations on the Society's greetings cards (Figure 11).

Georg Wolfgang Franz Panzer, (1755-1829) published the "*Faunae Insectorum Germanicae Initia oder Deutschlands Insecten*" in 110 parts containing 2640 figures drawn and etched by Jacob Sturm (1771-1848) with brief descriptions by Panzer. It is a beautiful collection of miniature drawings published from 1796 to 1813 (Figure 12).

Another beautiful book donated by Miss Broomfield is "*The English Moths and Butterflies*" by Benjamin Wilkes (d.1749). The first edition was published in 1749 but the book was so popular and successful that further editions were published in 1773 and 1824. The illustrations depict the butterflies or moths with their caterpillars and their food plants as well as other flowers and fruits. Wilkes preferred not to repeat the same plants in his illustrations (Figure 13).

A later volume and a favourite of our Director of Science is George Bowdler Buckton's (1818-1905) *"Monograph of British Aphides"* published in four volumes between 1876 and 1883. George Buckton, as well as being a Fellow of the Royal Entomological Society and the Linnean Society, was elected as a Fellow of the Royal Society for his original work in Physics and Chemistry (Figure 14).

Finally, John Obadiah Westwood (1805-1893) was not only an original Member of the Society and a great supporter but also one of only two Honorary Life Presidents. He was a prolific writer and a highly skilled illustrator responsible for the frontispiece of our "Obligation book or Entomological Society signature book". We have several of his publications and Figure 15 comes from *"Arcana Entomologica, or illustrations of new, rare, and interesting Insects"*.

This is only a snapshot of the collection but if you would like to examine the books themselves do please contact me to arrange a visit. The books are of course not available for loan! You can however obtain copies of a few of the illustrations by buying a pack of greeting cards.

Figure 9. Martyn Plate 1.

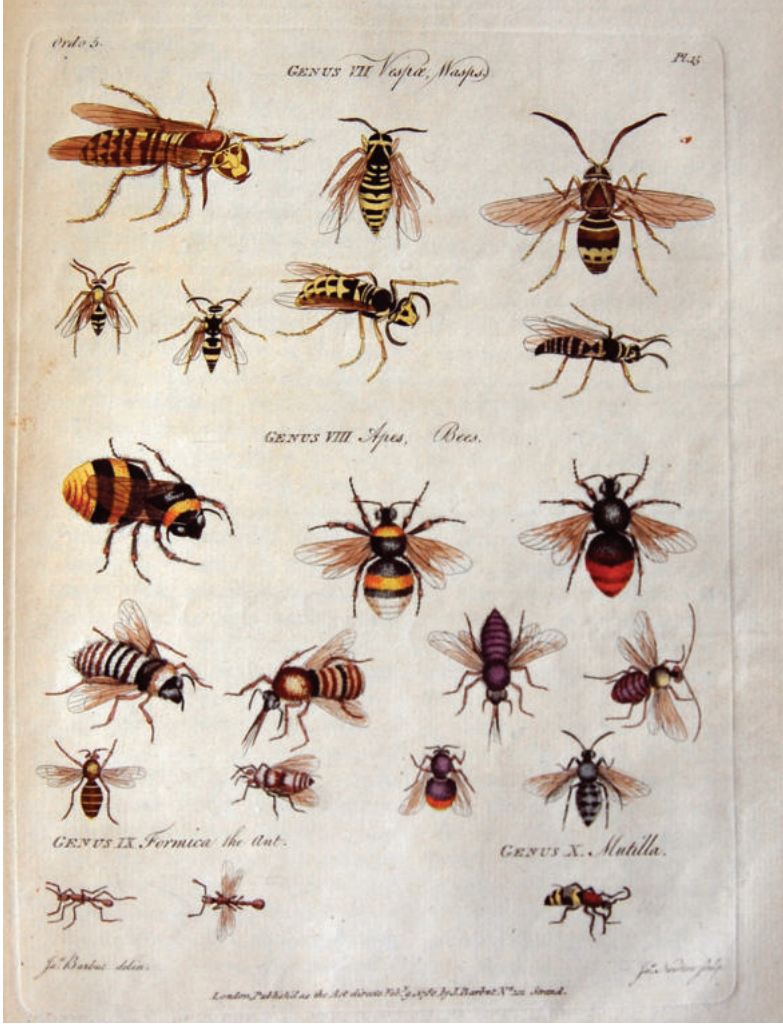

Figure 10. Barbut Plate 15.

Figure 11. Donovan On the Insects of China Plate 15.

Figure 12. Panzer Volume 33 Plate 3.

Figure 13. Wilkes Plate 46.

Figure 14. Buckton Volume 1 Plate 38.

Figure 15. Westwood Plate 70.

A Day in the Life at Butterfly World

Louise Hawkins

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It's a cold, dark afternoon just two days before Christmas. Butterfly World has been shut since November for its annual closure over the winter period, and there are only a handful of us on site. As the much loved tropical butterfly house is empty over the winter months, for the past weeks I'd been focussing on the remaining invertebrates in the Animal Study Centre and Ant World. Ensuring the temperatures remain constant in the tanks of African land snails and the hissing cockroaches have enough food to last until the New Year. Suddenly, the power to Ant World shuts off and the whole building falls into a silent darkness.

Despite quickly restoring power to Ant World, it was not immediately apparent what had happened. Indeed, it was not for another three months that I discovered just how serious the incident had been.

As the resident lepidopterist and ecologist, I am one of a very small team of permanent staff at Butterfly World. I'm involved with everything from releasing freshly-emerged butterflies into the butterfly house, explaining metamorphosis to small children for the first time or trying to stop the leaf cutter ants from escaping without getting bitten to pieces.

Ever since I was small, I have been fascinated by insects. I used to keep jars of insects in my bedroom and school bag when my friends were filling theirs with lip gloss. Once I got to Anglia Ruskin University in Cambridge, I specialised all my projects in butterflies and was able to spend some time in Namibia surveying insects as part of my Ecology and Conservation degree. My research for my dissertation involved helping my local reserve warden manage a site for the rare Duke of Burgundy butterfly, but it was eighteen months until I saw my first one!

Since joining Butterfly World in 2011, my main responsibility is for the livestock on site, particularly the

butterflies in the butterfly house, tropical invertebrates and leafcutter ants. In fact the two colonies of leaf cutter ants, one of which being the largest in the UK, are some of Butterfly World's most popular attractions and cause me the biggest headaches. They regularly escape, are very fussy about their favourite foods and, literally, bite the hands that feed them but I can't help but be really fond of them. Which is why I became more and more concerned about them throughout the Spring as numbers in the largest colony started to decline, activity slowed to a halt and finally no more ants were seen outside of the nest. Eventually, I had to very reluctantly declare the colony dead and began to excavate the soil to make way for a new colony that we would have to source and install. It was then that I discovered the frayed electrical cable to the water tank – the ants had chewed through the main power cable that had caused the power outage three months previously. In all the time we have been looking after ants, and liaising with our colleagues around the country, we have never heard of this happening before. Whether this had any role in the demise of the colony, we do not know.

Although the leafcutter ants are the most adventurous, I do find myself in other odd situations thanks to the insects that I look after. It is not unusual for me to be smearing rotten banana on a cheek or a bald head to encourage tropical butterflies to take part in a photo shoot. And I will never forget the time I had discreetly removed a dead cockroach from its tank and kept it in my pocket for safekeeping, only for it to come back to life in the middle of the supermarket on my way home from work!

Although I do really enjoy looking after the insects that we have on display to the visitors, I find the conservation side of my role most rewarding, and it is central to the mission of Butterfly World. When Butterfly World first opened in 2009 it was a bare patch of earth with no resident butterflies. Less than five years later, 28 different British species have been recorded here, making it one of the best butterfly sites in the district.

To develop the conservation side of things, I work very closely with the gardeners to manage the 27 acres across the site, particularly focussing on all the different habitats from wildflower meadows to highly landscaped designer gardens. Indeed all the gardens have been designed to be favourable to butterflies, particularly extending the reach of butterflies known to be in the area. There are south facing slopes, sheltered areas, areas planted with vegetation suitable for both caterpillars and nectar rich plants for the adult butterflies.

Last year we welcomed over half of all the UK's native species, including some particularly endangered ones. The Small Blue was once considered extinct in Hertfordshire and Middlesex and it is a Priority Species in the UK Biodiversity Action Plan as national populations are becoming increasingly isolated as a result of habitat loss and fragmentation. However, the Small Blue was first sighted at Butterfly World in 2011 and the vast increase in 2013 numbers confirms that Butterfly World now has an established breeding colony. I had been very excited to finally see this endangered butterfly, but I must admit I was a little underwhelmed by its appearance when I finally saw it as it was even smaller and greyer than I had been expecting. I'd rather watch the Emperor dragonflies even if they were not so hard to spot.

Nevertheless, I have started to put in place an annual procedure for recording the Small Blue. I record the distribution of the food plant, the egg laying sites and roosting areas in the antenna walks. In addition, working in partnership with Butterfly Conservation, I do a weekly butterfly transect throughout the butterfly flight season.

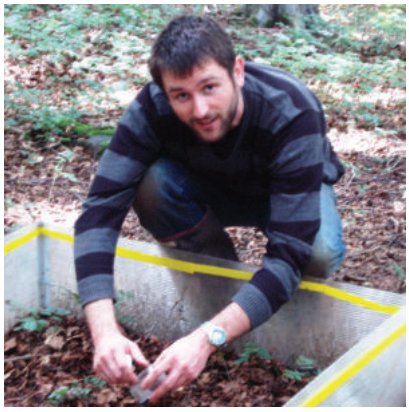
Although conservation on the site is still only a few years old, I do have more ambitious plans for the future. I am starting to put together a full invertebrate species list for the site and this is where we have a unique role to play with our local community. Being a visitor attraction we can inspire our visitors to get involved with observing and monitoring their local environment, something that we kicked off this summer with our Bug Hunt Bonanza as part of National Insect Week. It is fantastic to be located right next to the Royal Entomological Society – we can bring some of the best experts in the country together with hundreds of families, school groups and older visitors who are keen to know what wildlife is in their immediate area, and how to conserve it.

Indeed, one of the other parts of my job that I love is being involved in the public education programme. Through managing the insect study centre, I'm able to explain to visitors how they can play their part in reversing the decline in butterfly numbers by creating nature reserves in their own gardens. Although working with children has its own unique challenges, I had not expected to be asked whether I preferred dolphins or fairies as part of my Ant World talk!

Being part of such a small team, I'm involved with almost everything at Butterfly World and so much more than I could have imagined during my years studying the insects. On a single day I could be talking to a clothes designer about accurate butterfly motifs, identifying species via Twitter or making caterpillars out of egg boxes and pipe cleaners. And there are always the leafcutter ants to keep me on my toes....

Society News

Marsh/RES Award for an Early Career Entomologist – Dr Don A'Bear –



My research is focussed on the role of soil invertebrates in decomposition, in particular their effect on the growth and activity of woodland soil fungi. This subject first grabbed my attention as a Final-Year Cardiff University undergraduate, conducting my Dissertation Research Project on the effects of oribatid mites on the growth patterns of fungal mycelium. The project revealed a potential anti-fungal effect of chemical secretions from the mites – an unexpected result (I was looking for grazing effects!). This work provided my first opportunity for international collaboration. I contacted Dr Günther Raspotnig, a chemical acarologist (Karl-Franzens-Universität, Graz, Austria), who analysed the secretions from the opisthonotal (paired sac) glands of the mites. This experience ignited my enthusiasm for scientific research and resulted in my first paper, published in *Ecological Entomology*.

Keen to continue in this field of research, I undertook a NERC-funded Ph.D. supervised by Dr Hefin Jones and Prof. Lynne Boddy, at Cardiff University. My project investigated the role of grazing by soil invertebrates in moderating effects of climate change on the growth and activity of woodland decomposer fungi. In laboratory microcosm studies, I used Collembola (honorary insects!) as 'model' fungal feeders and demonstrated that they could prevent warming-induced increases in fungal growth. Grazer and fungus species-specific feeding preferences were evident – different Collembola exerted stronger effects on different fungi. In more realistic soil communities (intact 'mesocosms' cut from the woodland floor), the bottom-up effect of grazing preferences for different fungi determined the composition, and response to warming and altered soil moisture, of a multi-species Collembola community. It was exciting to find that publishing these findings in *Global Change Biology* and *Oecologia* resulted in considerable interest among the soil ecology community; the latter paper was endorsed by the Faculty of 1000 (*F1000 Prime*) as being of major significance in its field.

Larger soil invertebrates, particularly woodlice, exert stronger effects than Collembola in reducing fungal biomass. Laboratory experiments show that they can graze away entire mycelial colonies of some species. The functional importance of woodlice, coupled with predictions for altered abundance in temperate regions due to climate change, led me to my next line of enquiry, this time, in the field. I set up an ambitious year-long experiment in Wytham Woods – manipulating woodlouse population density in field plots dominated by different decomposer fungi. This study provided an opportunity for further international collaboration. I was awarded a Travel Scholarship by the German Academic Exchange Service, enabling me to spend several months working in two World-leading research groups. With Prof. Liliane Ruess (Humboldt Universität, Berlin), I used recently developed techniques for analysing animal dietary lipids to demonstrate that decomposer fungi were a significant component of the generalist diet of woodlice recovered from our field study. I then explored the effects of this fungal feeding on the production of soil enzymes by microbial communities that were dominated by different fungi, with Prof. Ellen Kandeler (Universität Hohenheim, Stuttgart).

Although my research to date has focussed on interactions in the soil decomposer system, my ecological interests are broad. I have enjoyed attending and presenting at a range of international conferences, including the International Congress of Entomology (Daegu, 2012). This was made possible by a much appreciated Travel Grant from the RES. Following this meeting,

Biological Control to contribute a Special Issue paper on the influences of aboveground–belowground interactions (often involving insect herbivores and their natural enemies) on ecosystem functioning. I really enjoy writing, and relished the opportunity to publish on a totally different subject, in collaboration with Dr Scott Johnson (University of Western Sydney) and my supervisor, Dr Hefin Jones.

I have found both the entomological and ecological communities to be friendly and encouraging, and I have been very fortunate to work, and discuss my research, with international leaders in the various areas of specialism that my studies have linked with. I find it particularly encouraging when I receive the occasional email from an international peer, letting me know that their group has enjoyed a recent paper of mine. The success and productivity I have enjoyed during the early stages of my career is due, in no small part, to the guidance and encouragement I have received from my supervisors, collaborators and peers. To be the recipient of an award so prestigious as this is a great honour, and will act as a catalyst for me to continue my research on the effects of invertebrate fauna on ecosystem processes.

Council Matters December 2013

The RES Director of Science, Prof. Jim Hardie, presented an overview of his activities to Council. These are very diverse and included: interfacing with statutory bodies in respect of Government policy, insect identification, insect re-homing, media interactions and many (occasionally bizarre) public queries. Council were fascinated to hear of some of the specific examples dealt with by the Director of Science and expressed thanks to Prof. Hardie for presenting such a credible scientific 'face' of the Society.

Details of forthcoming meetings were discussed by Council. Plans for National Insect Week, the European Congress of Entomology, Ento'15 and Ento'16 were aired. Council were generally pleased to see that most matters were in hand.

Following requests from the Membership Committee, Council agreed that email details of the Membership be made available to other Members / Fellows via a PIN. This is in lieu of a Fellows and Members address booklet, which is becoming increasingly difficult to produce due to Data Protection concerns. Some 70 Fellows and Members had asked that their email address not be made available.

After much debate Council agreed to endorse a proposal by the Membership committee that the suffix 'Mem. R.E.S.' be permitted for subscribing Members of the Society.

Council Matters March 2014

Council considered Society Awards including the Marsh awards for Early Career Entomologist and for Insect Conservation, the journal awards, the student essay awards, the Wallace award for PhD thesis and the Westwood Award. Various logistical matters were discussed and, in some cases, the winners were confirmed (these have been announced elsewhere).

The Honorary Treasurer, Prof. Loxdale, gave an overview of the Society's finances, following from the recent meeting of the Finance Committee. Our investment portfolio is giving good returns but the impact of 'Open Access' publishing remains a potential threat to our journal income. Prof. Pickett, President-Elect, considered discussing this matter with other learned Societies in a similar situation. Council endorsed the recommendation of the Finance Committee that there be no change to the Society's subscription rates.

Council Matters May 2014

Council reviewed the annual reports from the Library, Publications and Meetings sub-committees. The Library Committee considered that shelf space would be an issue in the future and the Registrar outlined briefly the option to utilise the porch area at the rear of the building, should it be required. Dr Clements, as Chair of the Library committee, stated that overall, the library is in good hands, much appreciated by the Membership and the librarian excellent.

Professor Field presented the draft Publications Committee report. The journals are doing well and Wiley's have been able to achieve a 3.5% increased net return to the Society, despite the concerns over 'Open Access'. Every journal has now adopted the Scholar One manuscript handling programme and copy flow is good. Two Handbooks were published during the year and three are in various stages of preparation.

Dr Murchie gave an overview of the Meetings Committee report. He emphasised the Public Benefit aspects of the Society's meetings and drew particular attention to the 2013 Insect Festival, which had approximately 1000 visitors. He commended all the Society's meeting convenors who had contributed to SIGs, regional meetings, the Postgraduate Forum and Ento'13.

Council considered updates of the sub-committees Terms of Reference (ToR). These are required to be revisited every five years. Council appreciated the efforts to standardise the ToRs and approved those received (Library, Publications and Finance). The Registrar was asked to formally inform the sub-committees of this outcome and to emphasise the need to follow their own guidelines, in terms of membership and length of service.

Council unanimously approved the appointment of Prof. Jeremy Thomas as Chair of the Conservation Committee. Many thanks were expressed to Dr Alan Stewart who had chaired the Committee for the past 12 years.

Final arrangements were discussed for both National Insect Week (NIW) and the European Congress of Entomology (ECE). Dr Tilley (as NIW coordinator) gave a verbal update on the anticipated events. Prof. Reynolds provided an overview of the ECE programme. The President and Council expressed much appreciation to Dr Tilley and Prof. Reynolds for their tremendous efforts in organising NIW and the ECE, respectively.

The Registrar circulated and ran-through the draft accounts. He drew attention to the surplus of income over expenditure and the increase in investment values. The Honorary Treasurer proposed that the draft accounts be accepted, which they were unanimously. The Honorary treasurer and President thanked the Registrar for his careful and diligent stewardship of the Society's finances.

The president circulated an update of the Society's Bye-Laws for consideration at the June Council Meeting.

SCHEDULE OF NEW FELLOWS AND MEMBERS

as at 4th June 2014

New Honorary Fellows
None

New Fellows (1st Announcement)
Dr József Vuts
Professor Göran Arnqvist
Dr Himender Bharti

Upgrade to Fellowship (1st Announcement)
None

New Fellows (2nd Announcement and Election)
Dr Neil Ravenscroft
Dr Giles Elliott Budge
Dr Ed Harris
Mr Timothy Andrew Lavery
Mr Ian Peter Whelan (as at 7.5.14)

Upgrade to Fellowship (2nd Announcement and Election)
Dr Jennifer Alessia Banfield-Zanin

New Members Admitted
Dr Manu Elinor Saunders (as at 7.5.14)
Ms Anna Maria Platoni
Dr Briony Alisha Norton

New Student Members Admitted
Ms Kirsten Miller (as at 7.5.14)
Mr Rodrigo Pracana
Miss Megan Mckerchar

Re-Instatements to Fellowship
None

Re-Instatements to Membership
Dr Jennifer Sarah Garbutt

Re-Instatements to Student Membership
None

Deaths
None

OBITUARY

Mark Anthony Jervis

1951-2014

Dr. Mark Jervis, who has died suddenly at the age of 62, was an entomologist and ecologist of the highest calibre. A true pioneer in developing our understanding of host-feeding and resource allocation in parasitoids, he was also an inspiring and guiding force to many others working in the field. He published over 100 peer-reviewed papers and numerous general articles on insects. Many of his papers are now considered classic works and widely cited. The book on 'Insect Natural Enemies' (1996), which I first co-edited with him but which he later took to greater heights, was very much Mark's own inspiration and is now considered the essential text for many undergraduate courses.

Mark was born in the city of Leicester and early on showed an interest in and aptitude for things biological. It was during his time as an undergraduate at Royal Holloway College, University of London, that he first developed his academic interest in insects, becoming particularly enthralled by the work of Dick Askew on parasitoid wasps. After graduating with a first class degree in Zoology in 1973, he joined Mike Claridge's group at the then Zoology Department at Cardiff University, to work as a demonstrator and study for his PhD. He was to remain in Cardiff for the rest of his life, working in what had become the School of Biological Sciences.

Mark's initial research was carried out on the parasitoids of leafhopper communities living on naturally occurring broadleaved plants in South Wales. The project had a strong taxonomic bias, leading to the description of a number of new species of pipunculid flies and dryinid wasps. While his taxonomic work was always meticulously and expertly carried out, Mark was never content to remain labelled solely as a taxonomist. His fascination with parasitoids and insects generally extended just as much to their habits, ecology and evolution. Our first collaborative works on host feeding in parasitoids (Biological Reviews, 1986; Researches on Population Ecology, 1989) were conceived entirely by Mark himself, with me acting solely as a jobbing modeller. It was Mark, with his deep knowledge of parasitoid diversity and life-cycles, who could pin-point the important gaps in our knowledge and where the research had to be focussed. Over the years, he applied the same approach to many other research problems relating to insect life-history and reproductive strategies, these involving collaborations with many other colleagues around the world.

Besides his more scholastic interest in insects, Mark was equally at home applying his knowledge to the management of insect pests. His involvement in this area started early on in his career when he worked with Mike Claridge to set up the first Diploma in Applied Insect Taxonomy course at Cardiff. The aim of this course was to improve the taxonomic and insect identification skills of pest management workers in the field and it quickly attracted students of widely varying backgrounds from all over the world. Such was the success of the course that many of the students stayed on afterwards to study for Masters and PhD degrees and Mark soon became immersed in supervising a wide range of pest management projects. From this beginning, Mark applied his growing knowledge and expertise over the years to numerous insect pest problems, most notably those attacking olives and various glasshouse crops.

In everything he did, Mark always set standards that were challenging to himself and others. He was an excellent teacher and at Cardiff University was

held in high esteem by both colleagues and students alike. His courses on entomology, evolution, ecology, animal diversity and integrated pest management were prepared with characteristic scholarship and meticulous attention to detail – but with a heavy sprinkling of wit and humour. They were a popular choice with students and he was always in demand as a guest lecturer at other institutions.

Mark's attention to detail in both his teaching and research was legendary among his colleagues. He was, for example, a perfectionist in his writing. His need to be continually revising manuscripts would inevitably slow up their preparation, but always they would be the better for it. The truth was that Mark loved writing and the written word. This, of course, made him an excellent editor of other people's work and students, colleagues and collaborators would seek him out to help improve their writing. Typically, Mark would give generously of his time and energy in this way and it was only a matter of time before he became sought after as a journal editor. Since its inception in 1993, Mark was editor of The International Journal of Pest Management. He also served on other editorial boards, but IJPM was his main focus of interest for over 20 years, during which time he built up the journal to become one of the most respected journals in its field.

Away from work, Mark was above all a family man who adored his wife, Julia, and two sons, Will and George. He would speak of happy family holidays and travel, enjoying their busy life together. Nothing gave him greater pleasure in recent years than to talk proudly of his sons and their activities and achievements at school, and later university. Those of us who had the privilege to count him as a friend knew him as an ebullient, funny, warm and generous person, always ready to listen or cast a comment with his ready wit. A lover of music in all its forms, he could converse equally about Mahler's symphonies or the blues music of B.B. King - indeed, he was no mean blues guitarist himself. Football was also a major passion, an interest he enjoyed sharing with his two sons. He was also deeply interested in history, especially the history of science and in recent years had become fascinated by the work of Robert Hooke and Henry Power. He was due to give a public lecture at the Royal Society on Robert Hooke's Micrographia, during the week he died. His insights on Hooke and on the Micrographia were published only recently in an article in Antenna, 2014 37 (4).

In a long and distinguished academic career, Mark's life and influence must have touched many thousands of undergraduates, graduate students, researchers and collaborators across the globe. It is a measure of the respect and affection in which he was held that warm messages of condolence with many happy memories of Mark came in from all over the world when news of his death began to circulate. Many said how critical his influence had been in their own scientific interests and career development. He will be deeply missed by all who were fortunate enough to have known him.

Neil Kidd

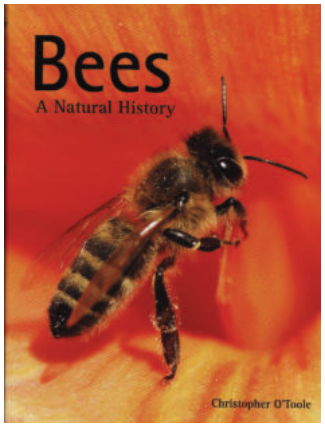
Book Reviews

Bees: A Natural History

Christopher O'Toole

Firefly Books

ISBN 978-177085-208-2 - £30.00



'Bees' is a large format hardback that looks like a coffee table book, but don't be deceived. Its bright and vibrant cover is more than decorative and offers a tantalising glimpse of what's in store for the potential reader. The book is a fascinating introduction to a group of insects that are now so often in the news. It offers an informed overview that reveals the extraordinary diversity that exists within a group that many naturalists may assume they are at least familiar with. So be prepared to be surprised; for instance, I had no idea that some bees nest in abandoned snail shells.

The book comprises an introduction that outlines the ecological role of bees and their taxonomy.

The next section examines the natural history and biology of the various bee families. It then looks at the complex relationship that exists between bees and plants, examining the mechanisms involved in bee-mediated pollination.

The final chapters look at issues that relate bees to humans such as conservation, folklore, their role in traditional and modern medicine and a brief history of apiculture.

The book is richly illustrated and the large format provides the publisher with the opportunity to display the many excellent photographs at a size that enhances their impact, revealing the delicate beauty of these insects in greater detail.

The accompanying text is lively, informative and peppered with the author's observations and anecdotes, which add a more informal style to the book. These detailed accounts are informally referenced and a bibliography of these is appended at the rear of the book.

My only criticism is that some of the photographs have been enlarged beyond their maximum resolution and have become slightly fuzzy, which detracts from the book's otherwise high standard of presentation.

Overall, 'Bees' is an excellent introduction to the wider world of bee biology and should be of great interest to natural historians, beekeepers and any one who would like to know more about this fascinating group.

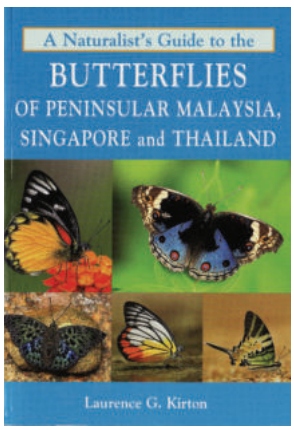
Peter Smithers

A Naturalists Guide to the Butterflies of Peninsular Malaysia, Singapore and Thailand

Laurence G Kirton

John Beaufoy Publishing for the Forest Research Institute, Malaysia.

ISBN 9781906780906 - Price £11.99



This is the book that entomologists, ecologists and natural historians who visit or work in SE Asia have been waiting for. Laurence Kirton's pocket sized but comprehensive guide fills a long-awaited niche in the entomological literature. The guide covers 470 of the 1,400 species in the region and includes photographs of the 280 common species that occur across the region. The excellent photographs show a side view with wings closed of most species and an additional wings open view of a fair number. Males and females are shown where there is a significant difference.

The text provides a description of the species illustrated plus the distinguishing features of any similar species. The distribution is described and notes on any subspecies, behaviours and typical habitat are also included.

The guide opens with a brief overview of the regions climate, vegetation, butterfly habitats, behaviours and defences. Life history, seasonality, morphology and classification are also covered.

The book concludes with a taxonomic list of the species covered in the guide, a bibliography, index and map of the region.

The guide may be small but it brims with high quality images and information. Its compact size makes it eminently portable while the contents make it indispensable. Laurence Kirton is to be congratulated on producing a valuable, convenient and very attractive field guide. I am sure it is destined to become an entomological best seller in SE Asia.

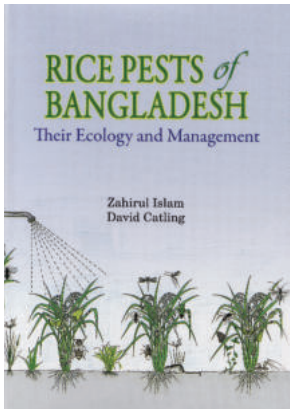
Peter Smithers

Rice Pests of Bangladesh: their Ecology and Management

by Zahirul Islam and David Catling

Print ISBN: 9789845060486

Hardcover 422 pages, 2012, University Press Ltd., Dhaka



Insect pest management in rice has transitioned through the eras of pre-insecticide traditional practices, the outset of the green revolution with the introduction of extensive chemical inputs, early IPM with its emphasis on action thresholds for chemical control, and, beginning in the 1980s, the recognition of the overwhelming importance of naturally-occurring biological control. Over the past 20 years, the foundation of rice pest management has been further strengthened by new studies of yield loss assessment, plant compensation, biodiversity beyond the rice field, and farmer decision making. Among the many challenges that remain is the communication of this knowledge to new generations of rice researchers and extension personnel.

In light of this history, *Rice Pests of Bangladesh* is a much needed contribution to the field. The authors forcefully argue for change in pest management practices and provide an excellent presentation of the scientific basis and application of an ecologically-based approach. With their vast experience in rice research and extension, particularly in Bangladesh, Drs. Islam and Catling are among the most authoritative scientists able to address this subject matter.

Planthopper outbreaks have driven much of the evolution in rice pest management since the green revolution, and continue to demonstrate the need for further progress. Historically a sporadic pest, outbreaks of planthoppers swept across Asia shortly after the widespread introduction of insecticides in the early 1970s. It was soon recognized that disruption of biological control was the primary cause of the outbreaks. Following a reduction in insecticide use, among other factors, the outbreaks abated during the late 1980s and 1990s. In fact, during my eight years as a rice entomologist in Asia (1994-2002) I never saw a planthopper outbreak in a farmer's field.

In the mid-2000s, however, large planthopper outbreaks began anew in China and Southeast Asia. Insecticide overuse remains the most important cause, and it is painfully apparent that advances by researchers in understanding rice ecosystems are not being transferred to or accepted by many farmers. Instead, chemical practices are primarily influenced by aggressive marketing by pesticide companies, and the problem continues to spread. Although it is among those countries in which rice farmers have previously not been heavy users of pesticides, the authors note that "Insecticide use is increasing explosively in Bangladesh."

Improved understanding of yield loss and plant compensation are fundamental to the argument that insecticides are generally not needed in tropical rice production. For many years the remarkable ability of rice plants to compensate for pest damage inflicted at the vegetative stage was underappreciated. At the same time, rigourous studies of yield losses were lacking, and losses caused by insects, diseases, weeds and other pests were overestimated. Thus the chapter on yield loss and the appendix with exercises on yield loss assessment are particularly valuable components of *Rice Pests of Bangladesh*. The coverage of yield loss assessment is complemented by material on understanding and changing farmers' pest management decision making, highlighting approaches pioneered by K.L. Heong (e.g. Heong *et al.*, 1998).

The book is broad in scope, and inevitably there is a trade-off between depth and breadth. The ecology and management of all classes of pests of rice plants and stored rice are covered: insects and other invertebrates, diseases, weeds, and vertebrates. There is an emphasis on entomology, while plant pathology and weed science are covered in considerably less detail. Coverage of rodent pests is more extensive than in many pest management texts, reflecting the importance of these pests in Bangladesh and the experience of the authors. Of course, for more detail on the biology or management of any particular pest, readers will need to consult other sources to supplement the information in *Rice Pests of Bangladesh*. The bibliography contains an adequate selection of general references and an extensive list of references from Bangladesh.

Many of the line drawings in *Rice Pests of Bangladesh* will appear familiar to experienced rice workers, as they are drawn from classic texts including Grist and Lever (1969) and several well-known publications from the International Rice Research Institute, notably Reissig et al. (1986). The quality of reproduction of line drawings is generally good, but the resolution of some of the black and white photographs is of lower quality. There is a small number of well-chosen colour photographs to illustrate plant diseases.

Rice Pests of Bangladesh will serve as an excellent university textbook and reference for researchers and extension agents. Much of the book is useful for all tropical rice-growing areas. However, rice cultivation in Bangladesh and neighbouring areas of Eastern India has several distinct characteristics, such as the names and timing of the growing seasons, and the authors correctly note that their book is meant primarily for use in this geographic region. Nonetheless, *Rice Pests of Bangladesh* serves as a model for updated rice pest management texts for other regions of Asia, and I strongly recommend that it be consulted by prospective authors.

References

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Heong, K.L., Escalada, M.M., Huan, N.H. and Mai, V. 1998. Use of communication media in changing rice farmers' pest management in the Mekong Delta, Vietnam. *Crop Protection* 17:413-425.

Reissig, W.H., Heinrichs, E.A., Litsinger, J.A., Moody, K., Fiedler, L., Mew, T.W. and Barrion, A.T. 1986. *Illustrated Guide to Integrated Pest Management in Rice in Tropical Asia*. International Rice Research Institute, Manila, Philippines. 411 pp.

Michael Cohen, Edmonton, Canada

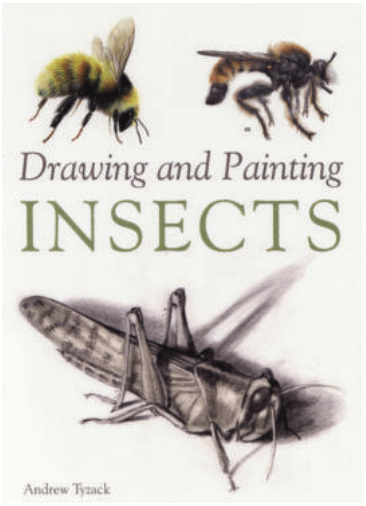
Drawing and Painting Insects

Andrew Tyzack

The Crowood Press

ISBN 9781847974891

Price £19.99



This is not the book that I had anticipated arriving in the post. The title hints at a practical manual offering tutorials on techniques and approaches to the depiction of insects, but the book is much more than this. It is an introduction to entomology for artists, followed by an outline of the various approaches that UK artists use to depict their entomological muses.

The first two chapters will offer nothing new to the entomologist, as they outline some basic insect natural history aimed at artists who are new to the field. They include where and how to look for insects, introducing standard collecting techniques, observing insects in insect houses, zoos and museums or just walking into the countryside and looking. Insect anatomy is then explained for non-entomologists and the use of photography is discussed as a means of analysing movement.

In chapter three a number of drawing techniques are explored using the work of three UK artists. Subsequent chapters examine drawing and painting insects from life in the field, a review of the range of media used in painting insects, followed by print making and etching. While the previous chapters have viewed insect imaging from a natural history or scientific perspective the final chapter that looks at insects images in art using the work of thirteen artists to illustrate the variety of aesthetic possibilities.

For the artists, it is an uncomplicated non-technical introduction to insect morphology with examples of the various approaches to insect illustration, emphasising the need for careful observation and accuracy. For entomologists, it is a gallery of images that range from the technical to the emotive, images that capture the finest details of form to those that offer the observed nuances of an individual's behaviour. The wide variety of techniques on display provides a kaleidoscope of perspectives making this book a joy to browse, from Robin Gillmor's "New Naturalist" book jackets to Val Littlewood's intense watercolours set in plain line-drawn backgrounds. The dynamic field notebooks of Tim Freed and David Measures to the author's own dark and slightly sinister view of the insect world. While it will inspire artists to look at insects in more depth it may also inspire entomologists to grasp their pencils and start drawing the objects of their studies. The section on drawing without fear is especially pertinent to scientists, who naturally shy away from enterprises that are bound to be an initial failure. Mastering some basic drawing skills can enhance field notes and offer new observational insights. The book is also a directory of insect artists providing any one who wants to see more with a list of names to type in to their search engine.

There are a couple of negative points, a few of the images in the early chapters appear to be enlarged beyond their resolution rendering them fuzzy, the dragonfly on page 143 seems to be needlessly replicated and the image of a bumble bee on page 90 appears to be larger than the frame offering only part of the image to the viewer.

These small points aside, 'Drawing and Painting Insects' is a wonderfully diverse collection of images and techniques that will encourage both artists and entomologists to observe and record the equally diverse insect life that can be found all around us.

Peter Smithers

Britain's Dragonflies
A field guide to the damselflies and dragonflies of Britain and Ireland
3rd edition

Dave Smallshire & Andy Swash

Wild Guide published by Princetown University Press

ISBN 978-0-691-16123-5

£17.95

Wild Guides have excelled themselves with this update, which is a superbly complete field guide to the British Odonata. This guide contains all of the features that make this series so useful plus a raft of new features that provide a holistic armoury of information, which will enable even inexperienced dragon hunters to make confident identifications.

It opens with chapters dealing with the biology and ecology of the group, photographs of the major habitats and an introduction to odonatan morphology.

There is a photographic guide to genera showing an example of each at rest, which allows rapid recognition of the various groups.

This is followed by a visual guide to species, which is the powerhouse of the book and illustrates all of the important features of each species. For the dragonflies, they include detailed images of the abdomen, side views of the thorax, wing spots and many notes on head colours for both male and females. For the darters, there are images of the faces of each species.

The damselfly section also has images of the whole abdomen, but also includes detailed images of segments 1 and 2 plus the pronotum, side views of the thorax and details of any wing markings. This detailed visual guide enables extremely rapid and accurate identification of any British Odonata.

Each species is illustrated with photographs of males and females plus any variants that may be encountered. These are accompanied by fully descriptive text plus notes on behaviour, breeding habitat, distribution and conservation status. There is also a map displaying distribution. Flight periods, body and hind wing length appear as summary boxes, while drawings of abdominal and thoracic patterns are provided for both sexes.

The book also includes a detailed visual guide to the immature stages and a table of the species of conservation interest with comprehensive definitions of the various categories.

This new edition enables a rapid identification to species that can then be double-checked against the detailed information in the species descriptions. Its ease of use and attractive format must inevitably attract a new generation of natural historians to study these impressive insects.

'Britain's Dragonflies' is Wild Guides most comprehensive and impressive field guide to date and has set the bar for field guides in the future.

Peter Smithers

Britain's Day Flying Moths
A field guide to the day-flying moths of Britain and Ireland

David Newland, Robert Still and Andy Swash.

A Wild Guide. published by Princetown University Press

ISBN 978-0-691-15832-7

£17.95

There are many excellent moth books available, but if you encounter a moth in the daytime you would normally have to search through all of the moths, diurnal and nocturnal, to locate it. This book shortcuts that process and is the first book to deal with only day-flying moths.

Each species has a page devoted to it, which includes at least one photograph, a detailed description of the wing patterns, followed by an outline of its natural history. A concise table gives the flight period, habitat and food plants, forewing length and distributional status, along with a map that shows both distribution and population centres. At the rear of the book is a concise summary table that replicates this information to facilitate easy comparisons.

There is a photographic guide to the key features of the various families covered in the book showing a member of each group at rest. There is also an introduction to moth biology, habitats, a glossary, notes on conservation status and an index.

This is the field guide that many naturalists who are not lepidopterists have been waiting for. This concise, extremely colourful and attractively produced field guide to day-flying moths is full of useful information, presented in a clear and concise fashion. While hardened light trappers may find it superfluous, anyone else with an interest in moths will find it extremely useful as it facilitates simple and rapid identification of this group. 'Day-Flying Moths' is highly recommended and Wild Guides are to be congratulated on another excellent field guide.

Peter Smithers

Handbooks for the Identification of British Insects
Vol. 4 Part 5b
Keys to the adults of the water beetles of Britain and Ireland (Part 2)

G.N. Foster, D.T. Bilton and L.E. Friday
ISBN 978 0 901546 97 5
Royal Entomological Society 2014

This volume covers the Hydrophiloidea and includes the terrestrial as well as aquatic species. A general introduction is followed by an excellent illustrated key to the genera. I found it very useful. A further key giving guidance on water beetles for non-specialists is included as an appendix. These combined with the colour plates, which include all species covered in the handbook, should enable beginners and non-specialists such as myself to be confident at this stage of the identification process. The illustrations of surface structures and genitalia have been produced using photographs manipulated using Adobe Photoshop. These show the features described clearly and maintain the frequently minute size differences and proportions that are virtually impossible to describe in words. As the authors state, 'The human eye is often better than the ruler!'

The keys to genera are illustrated in the same level of detail with the addition of extra information for some of the more difficult groups such as a plate of all the *Helophorus* male genitalia together with a table of dimensions. The keys are followed by an account for each species giving further information on habitat and distribution. Useful notes are given here of further splits which may occur, e.g. the need to obtain voucher specimens of the ubiquitous *Hydrobius fuscipes*. Amendments to this and Part 1 will be made available in the journal Latissimus and online at www.latissimus.org.

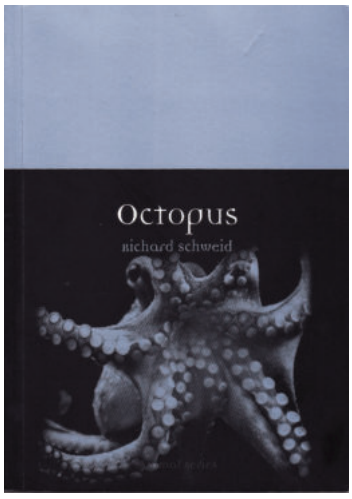
The authors are amongst the foremost authorities on the British water beetles and have made a superb job of communicating their knowledge of these fascinating and ecologically important insects. I look forward to seeing the third and final part of this series.

John Walters

Octopus

Richard Schweid

Reaktion Books
isbn 9781780231778 – £9.99



I can already see the avalanche of letters arriving in the Antenna inbox: "what is a review of a book on Octopi doing in Antenna, we are entomologists!" It is a fair comment, but I felt that any entomologist worth his salt would have a broad interest in the natural world and invertebrates in general, and, as you will discover if you read this book, the octopus is a particularly fascinating invertebrate.

'Octopus' begins with an introduction to the biology of the group exploring the body and brain, then going on to explore the evidence for sentience in the group. These chapters are much more than this, in that they weave the history of octopus research into the narrative resulting in a fascinating account of our evolving understanding of these molluscs.

The next chapter is an account of the octopus fisheries around the world and it presents a depressing account of over fishing and exploitation of octopus populations.

There is then a discussion of the culinary properties of the octopus examining its history as an item on our menus and a guide to where it is commonly eaten.

The next chapter explores the way various societies have perceived and used the images of the octopus, which bizarrely range from the erotic in Japan to the more traditional image that we are familiar with in the west of the octopus as a monster of the deep.

The final chapter gives an overview of the problems involved in keeping octopi in captivity and includes a discussion of octopi venom.

The book is another of Reaktions fascinating accounts of the biology and cultural interactions of this group of animals. While it is profusely illustrated, many of the images do not seem relevant to the text they are adjacent to, but that is a minor point. 'Octopus' is an informative and enjoyable reading experience. The next time I am on the Mediterranean coast and I order a grilled cephalopod, I will consume it with greater respect.

Peter Smithers

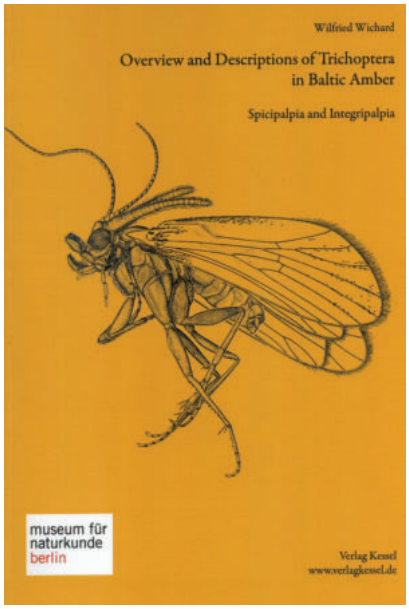
Overview and Descriptions of Trichoptera in Baltic Amber, Spicipalpia and Integripalpia

Wilfried Wichard

2013.

Dr. Kessel, Germany. ISBN 978-3-941300-84-2

Price €32 (from Amazon.de, or approx. £35 from UK booksellers)



This is the first major work on the Trichoptera (caddisflies) in Baltic amber since Ulmer (1912), written by the foremost expert on Trichoptera in amber. This paperback book is written in English on good quality paper with detailed line drawings and good quality colour photographs.

The book commences with an introductory chapter summarising previous work on this subject. Wichard explains that unfortunately most of Ulmer's type and figured specimens were lost or destroyed during the Second World War. Since Ulmer's publication, Trichoptera in Baltic amber received little attention with only 10 new species described. For the past 40 years Wichard has studied 15,000 specimens. 90% belong to the Suborder Annulipalpia, of which the Polycentropodidae are the most abundant. There are 26 families present in Baltic amber, of which only 7 belong to the Annulipalpia. This work concentrates on the rarest 10% of the fauna, belonging to the suborders Spicipalpia and Integripalpia; one family, eight genera and 32 species are described as new. Neotypes are designated for previously described species where the types are lost.

Three tables are included: Table 1 is a list of repositories of specimens; Table 2 is a list of all the extant families of Trichoptera, indicating those that are found in Baltic amber, plus the new extinct family Ogmomyiidae (spelt with one i in the list); Table 3 is a useful simple tabular key to the genera of Spicipalpia and Integripalpia, identified using a combination of tibial spur formulae, presence or absence of ocelli and number of segments of the maxillary palps in the males.

Chapter 2 covers the Suborder Spicipalpia (cocoon-making caddisflies), commencing with a key to families. A systematic description of the taxa then follows, starting with the family, its type genus, diagnosis and remarks on its fossil record. There is a key to the Baltic amber species for the family. The generic name is followed by its type species, diagnosis and remarks on its fossil record. The species name is followed by information on the type specimen (although it only mentions the repository, not the specimen number), followed by a diagnosis and description. The species descriptions are accompanied by detailed line drawings of the wings and male genitalia, and colour photos of complete specimens and close-ups of male genitalia. Chapter 3 covers the Suborder Integripalpia (case-making caddisflies) using the same format as the previous chapter. Unfortunately there are no discussions on the probable palaeoecology of the species.

Within the book there are interesting specimens and taxa, such as a well-preserved phryganeaid larva, which begs the question how did it get trapped in the amber? Surprisingly there is only one species of Limnephilidae (a new genus and species) which is the most diverse family in Europe today. Also, some specimens have interesting and distinctive structures and characters, such as the basal antennal segment of *Maniconeurodes ruedigerwagneri*, which is very long and very hairy. Specimens of *Helicopsyche damseni* (on the front cover), *H. cona* and *Palaeohelicopsyche serricornis* have incredible androconial organs projecting from the tops of their heads, which the males would have used to release pheromones to attract females. There is an interesting teratological specimen of *Aulacomyia infuscata* with head and genital deformities. There is also a very rare specimen of a pair of mating caddisflies, which are named as the new species *Stenoptilomyia incopula*.

This book is a very welcome addition to the literature on the Baltic amber fauna and will be of interest and use to palaeoentomologists, trichopterists and dedicated amber collectors. We very much hope that there will be a second volume to cover the Annulipalpia, which are the most abundant caddisflies in Baltic amber.

Ulmer, G. 1912. *Die Trichopteren des Baltischens Bernsteins. Beiträge zur Naturkunde Preussens*, 10, 380pp.

Andrew and Emma Ross

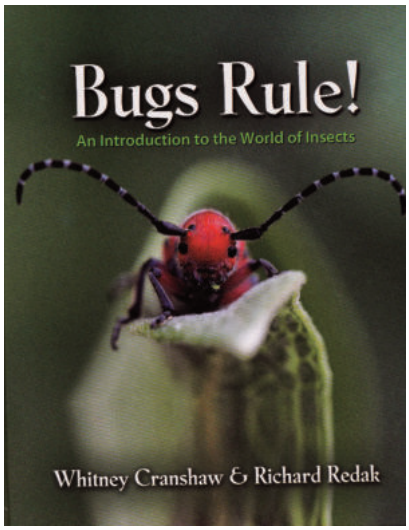
Bugs Rule. An introduction to the world of insects

Whitney Cranshaw & Richard Redak

Princeton University Press

ISBN 978-0-691-12495-7

£37.95



In their preface the authors state that this book is intended as an introduction to entomology for non science majors and they hope it will open a lifetime of learning for these students re the insect world. The book is a natural history and an introduction to the vast cast of characters that appear on the entomological stage.

'Bugs Rule' deals with the arthropods in their entirety covering all of the groups from the myriopods and crustaceans through the arachnids to the insects. It opens with an introduction to the arthropoda, then examines external morphology, moves on to look at internal organization, and finally discusses development and metamorphosis. The remaining thirteen chapters examine the various arthropod orders, using less formal headings than other entomological texts. These include, 'Life on a Fluid Diet' (the Hemiptera), 'City Builders that Rule' (the hymenoptera) and 'Marvels of the Air' (the Diptera). The book is richly illustrated with an excellent series of colour photographs and black-and-white drawings. The text is peppered with boxes that tell many peripheral entomological stories, from bioluminescence to the Rocky Mountain locust and insects as living jewellery.

Written to appeal to non-science students, this book offers a light, informal approach with an easy to read style. It brims with fascinating facts and eye-catching images. It should do exactly what the authors intended, making entomology easily accessible to a wide range of students outside of mainstream science courses.

Peter Smithers

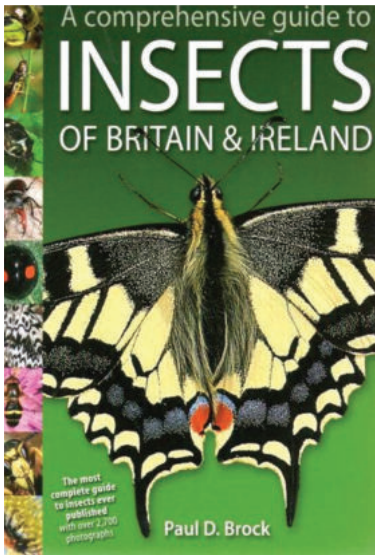
A Comprehensive Guide to Insects of Britain and Ireland

Paul D Brock

Pisces Publications

ISBN 978-1-874357-58-2

£28.95



This field guide claims to be the most complete guide ever published and I think it probably is. Paul Brock is to be congratulated on a superb new guide to the UK's insect fauna. It is a no nonsense guide with only the briefest of introductions that explain and define the terminology used. The front inner covers offer a photographic guide to the main orders while the rear covers provide a glossary. There is an appendix of references and another of national status categories plus an index. The remaining 505 pages are devoted to double page spreads of insect the orders with photographs on one page and text on the other. There is a one page introduction to each of the orders and each of the species illustrated has a brief description, with notes on habitat, season and distribution. Thumbnail maps of the UK distribution are also provided. Additional photographs of larvae are often squeezed in amongst the text. This field guide is densely populated with information, it is compact but diverse enough to make the commonly encountered elements of our insect fauna easily identified. It could be considered a Tardis among field guides.

This comprehensive guide is of course not comprehensive, just as other guides claim to be complete or concise this is neither of those either but it does offer coverage of most if not all of the common insects that can be encountered in the UK. Over this summer I have used it at a number of bioblitzs and insect safaris and found that any insect that the public find can be easily located in this field guide.

Paul Brock's book is a superb addition to the range of UK insect guides available and stands out as a leader in the field. It will certainly be the field guide that I will be recommending to aspiring Entomologist and seasoned field biologists alike.

Peter Smithers

International Bee Research Association

The world's longest established apicultural research publishers

INTERNATIONAL BEE RESEARCH ASSOCIATION

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Main Avenue, Treforest,
Rhondda Cynon Taf,
CF37 5YR, UK.

TEL: +44 (0)29 2037 2409
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PRESS RELEASE

[embargoed until 00:01 GMT on 4/4/14]

Forage for pollinators in an agricultural landscape

Today the International Bee Research Association launches an important book about food for pollinators at the British Beekeepers Association Spring Convention at Harper Adams University College.

Bees and other insect pollinators have intrinsic cultural value and play an essential role in the diversity and resilience of our plant and animal life, through the pollination of agricultural crops and wild plants. Changes in land use which have led to a reduction in the food available for pollinating insects are thought to be a major contributor to their recent well documented declines in abundance and diversity. Defra's National Pollinator Strategy, subject of a current consultation, aims to ensure that all of the approximately 1,500 insect pollinator species in England thrive and provide essential pollination services for agriculture and the wider environment. It is therefore timely that IBRA is now republishing this volume, first published twenty years ago. The book's six chapters cover the changes in land use that occurred during the twentieth century and their effects on the availability of forage plants, important nectar sources for honey bees, and farmland as a habitat for bumble bees and for solitary bees. The remaining two chapters cover the use of forage mixtures for pollinators and what can be done in practice to encourage pollinator forage.

IBRA Science Director Norman Carreck says: *"This little book, which has sadly been unavailable for some time, provides sound information about the changes in land use which have reduced food availability for pollinators, their effects on insect populations, and possible strategies for reversing these changes".*

[Ends]

International Bee Research Association

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PRESS RELEASE

[embargoed until 00:01 GMT on 4/7/14]

New study on pesticide residues in honey

Much attention in recent years has focussed on agricultural pesticides and their possible role in the decline of bee populations. Several studies have shown, however, that the majority of pesticides found in bee hives result from chemicals used by the beekeepers themselves, especially those used to control the parasitic mite varroa. A new study published today in the *Journal of Apicultural Research* looks at pesticide residues in honey samples from the USA by comparing the pesticide levels for honey collected in the supers (which would be used for human consumption) with honey contained in the brood nest which would be consumed by the bees themselves.

The study, by Dr Nancy Ostiguy of Penn State University, and Dr Brian Eitzer of the Connecticut Experiment Station examined paired samples of honey collected by amateur beekeepers from five US states. Eight different pesticides were identified of which four are used by US beekeepers, and four are widely used in agriculture. They identified the organophosphate coumaphos; the synthetic pyrethroid fluvalinate; and the essential oil thymol, which are used by US beekeepers to control varroa. The fourth compound, dichlorobenzene, is used to fumigate empty honey comb to protect it from wax moth attack. The other agricultural compounds identified were dimethoate, an organophosphate insecticide, a fungicide and two herbicides; they are not used in beekeeping. All of the honey samples taken from the honey supers contained coumaphos and fluvalinate at levels below the tolerance limits set by the US Environmental Protection Agency, but several samples collected directly from the brood chambers had higher levels.

IBRA Science Director Norman Carreck says: *"In general, the levels of residues found in honey from the brood combs in this study were significantly higher than in the honey supers. Even though the amounts of pesticide found were well below the LD_{50} levels known to directly kill bees, because the brood nest honey is fed to developing bee larvae bees there is a concern that these sub lethal doses of pesticide may harm bees. This study's results support current concerns relating to the possible effects of sub-lethal doses of pesticides on bees and clearly demonstrates that further studies of this nature are needed".*

[Ends]

Diary

Contributions please! Your support is needed to make this diary effective so please send any relevant items to the diary's compiler. E-mail: antenna@royensoc.co.uk. No charge is made for entries. To ensure that adequate notice of meetings, etc. is given, please allow at least 6 months' advance notice.

Details of the Meetings programme can be viewed on the RES website (www.royensoc.co.uk/meetings) and include a registration form, which usually must be completed in advance so that refreshments can be organised. Day meetings usually begin with registration and refreshments at 10 am for a 10.30 am start and finish by 5 pm. Every meeting can differ though, so please refer to the details below and also check the website, which is updated regularly.

Offers to convene meetings on an entomological topic are very welcome and can be discussed with the Honorary Secretary.

MEETINGS OF THE ROYAL ENTOMOLOGICAL SOCIETY 2014

Sep 3 **Aphid Special Interest Group**
Venue: Harper Adams University
Convenor: Prof Simon Leather (simonleather@harper-adams.ac.uk)

Tony Dixon - *Role of thermo-biology in the distribution of aphids in space and time*
Ailsa McLean - *Endosymbionts in aphids: variation in effects on defence against parasitoids.*
Julia Ferrari - *Interactions between multiple symbionts in the pea aphid*
Richard Harrington - *The Rothamsted Insect Survey: golden years of aphid monitoring*
Helmut van Emden - *White black bean aphids and other "Tales of the Unexpected"*
Sally Luker - *Investigating the potential for a non-native monophagous aphid species to switch hosts to one or more related (congeneric) host species*
Jennifer Banfield-Zanin - *Drought stress and populations of green spruce aphid on Sitka spruce: an effect of stress frequency and intensity*
Henriett Elek – *Role of hydroxamic acid in wheat resistance to aphids*
Nicole Goodey- *The effects of glucosinolate variation on aphid colony dynamics in a wild cabbage population*

Oct 14 **Behaviour Special Interest Group**
Venue: Rothamsted Research, Harpenden
Convenor: Dr Jason Chapman (jason.chapman@rothamsted.ac.uk) and Dr James Bell (james.bell@rothamsted.ac.uk)

We shall be holding an Insect Behaviour SIG with the theme of "sensory biology" at Rothamsted, and we welcome submission of oral or poster presentations for this meeting. We have some agreed speakers already (tentative titles are below), but there are still plenty of slots for interested speakers. To submit an oral or poster presentation for this one-day meeting, please email the convenors.

Prof Gabriella Gibson, Natural Resources Institute, University of Greenwich "Auditory communication in mosquitoes"
Prof Daniel Robert, School of Biological Sciences, University of Bristol "Hearing and the electro-reception senses in insects"
Prof Gareth Jones, School of Biological Sciences, University of Bristol "Sky wars: moths v bats"

Nov 5 **Orthopterists' Special Interest Group**
Venue: Natural History Museum, from 1.30 – 8.00 pm
Convenor: Dr Björn Beckmann (orthoptera@ceh.ac.uk)

Everyone is very welcome to attend the annual Orthopterists' meetings, whether to present research or just to listen and meet others. Talks, posters and other contributions are welcomed on grasshoppers, crickets and related groups (cockroaches, earwigs, stick insects, mantids). Both initial observations and ideas, as well as completed research can be presented.

A draft programme will be posted online and circulated in the autumn. To date we are expecting a talk by Mike Edwards on the conservation and current status of the Field Cricket (*Gryllus campestris*) in Britain. Suggestions for further speakers are welcome, e.g. students working on Orthoptera.

Cost
Either a full price of £14.00 to include a cold buffet with wine at about 6:00 pm, and tea and biscuits during the afternoon
Or a reduced price of £4.00 to include tea and biscuits only, if you are not staying for the buffet.

Registration
Please register by sending an email to orthoptera@ceh.ac.uk, or by post to Björn Beckmann, Centre for Ecology & Hydrology, Wallingford OX10 8BB, providing the following details:
Your first name, surname, and institution if applicable (for name badge)
Title of talk or poster, if you would like to present something
Indicate whether you will be staying for the buffet or not, and any special dietary requirements

Nov 11 **South-East Regional Meeting**
Forest Entomology
Venue: Alice Holt Lodge, Surrey
Convenor: Mr John Badmin (jbadmin@btinternet.com)

Nov 12-13 **Vector-borne diseases in the UK Biennial Conference 2014**
Venue: University of Liverpool
Convenors: Prof John Stephenson, Prof Matthew Baylis, Prof Tom Solomon
Contact: Dr Caroline Harcourt (harcourt@liverpool.ac.uk)
The 2nd Biennial Conference will include sessions on Culicoides, Ticks, Mosquitoes, Other Vectors, New Technologies and The European Perspective. The diseases in question are mostly those of animals, including humans, but we hope to cover some plant diseases as well.

Nov 21 **South-West Regional Meeting**
And now for something completely different... Exploring the fringes of entomology
Venue: Plymouth University
Convenor: Mr Peter Smithers (psmithers@plymouth.co.uk)

2015

Mar 4 **Verrall lecture by Prof. Sue Hartley, University of York**
Venue: The Flett Lecture Theatre, NHM
Convenor: Dr Archie K. Murchie

June 3 **RES AGM**
Venue: The Mansion House, St Albans

Sept 2-4 **Ento' 15 Annual Science Meeting and International Symposium**
Insect Ecosystem Services
Venue: Trinity College Dublin
Convenors: Drs Jane Stout, Olaf Schmidt, Archie K. Murchie, Eugenie Regan, Stephen Jess, Brian Nelson
Speakers confirmed to date:
Janne Bengtsson (Uppsala, Sweden)
Sarah Beynon (Pembrokeshire)
Jerry Cross (East Malling)
Tom Bolger (Dublin)
Dave Goulson (Sussex)
Alexandra-Maria Klein (Freiburg, Germany)
Simon Leather (Harper Adams)
Craig Macadam (Buglife, Stirling)
Sarina Macfadyen (CSIRO, Australia)
Jane Memmott (Bristol)
Charles Midega (ICIPE, Kenya)
Michael D. Ulyshen (USDA – Forest Service, USA)

2016

Sep 5-8 **Ento'16**
Venue: Harper Adams University College, Shropshire
Convenor: Prof. Simon Leather

OTHER MEETINGS

2014

Oct 31 **Invertebrate Conservation Conference**
Amateur Entomologists' Society / British Ecological Society, Charles Darwin House
10:00 to 17:00 (GMT)
12 Roger Street, London WC1N 2JU, United Kingdom
£30.00 non AES/BES member £20.00 to members
more information available at http://www.amentsoc.org/conferencebooking

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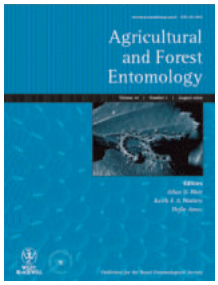

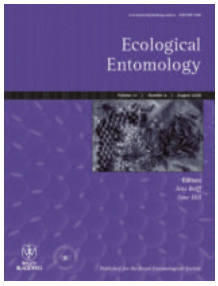

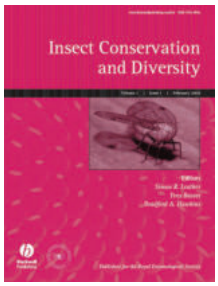

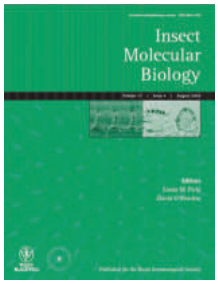

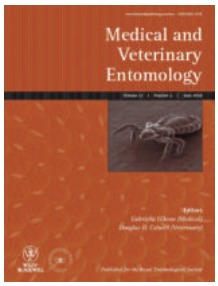

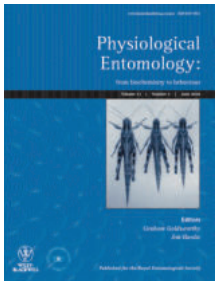

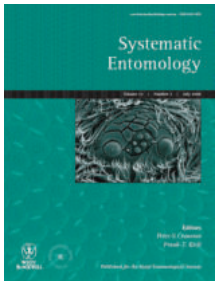

Publications of the Royal Entomological Society

Agricultural and Forest Entomology provides a multi-disciplinary and international forum in which researchers can present their work on all aspects of agricultural and forest entomology to other researchers, policy makers and professionals.
2015 print or online prices: UK £740, Euroland €942, USA $1,368, Rest of World $1,594
2015 print and online prices: UK £888, Euroland €1,131, USA $1,642, Rest of World $1,913

Ecological Entomology publishes top-quality original research on the ecology of terrestrial and aquatic insects and related invertebrate taxa. Our aim is to publish papers that will be of considerable interest to the wide community of ecologists.
2015 print or online prices: (with Insect Conservation and Diversity) UK £1,227, Euroland €1,563, USA $2,274, Rest of World $2,652
2015 print and online prices: UK £1,473, Euroland €1,876, USA $2,729, Rest of World $3,183

Insect Conservation and Diversity explicitly associates the two concepts of insect diversity and insect conservation for the benefit of invertebrate conservation. The journal places an emphasis on wild arthropods and specific relations between arthropod conservation and diversity.
2015 print or online prices: UK £750, Euroland €954, USA $1,386, Rest of World $1,615
2015 print and online prices: UK £900, Euroland €1,145, USA $1,664, Rest of World $1,938

Insect Molecular Biology has been dedicated to providing researchers with the opportunity to publish high quality original research on topics broadly related to insect molecular biology since 1992. *IMB* is particularly interested in publishing research in insect genomics/genes and proteomics/proteins.
2015 print or online prices: UK £1,238, Euroland €1,572, USA $2,288, Rest of World $2,667
2015 print and online prices: UK £1,486, Euroland €1,887, USA $2,746, Rest of World $3,201

Medical and Veterinary Entomology is the leading periodical in its field. The Journal covers all aspects of the biology and control of insects, ticks, mites and other artropods of medical and veterinary importance.
2015 print or online prices: UK £712, Euroland €907, USA $1,318, Rest of World $1,538
2015 print and online prices: UK £855, Euroland €1,089, USA $1,582, Rest of World $1,846

Physiological Entomology is designed primarily to serve the interests of experimentalists who work on the behaviour of insects and other arthropods. It thus has a bias towards physiological and experimental approaches, but retains the Royal Entomological Society's traditional interest in the general physiology of arthropods.
2015 print or online prices: UK £657, Euroland €835, USA $1,212, Rest of World $1,415
2015 print and online prices: UK £789, Euroland €1,002, USA $1,455, Rest of World $1,698

Systematic Entomology encourages the submission of taxonomic papers that contain information of interest to a wider audience, e.g. papers bearing on the theoretical, genetic, agricultural, medical and biodiversity issues. Emphasis is also placed on the selection of comprehensive, revisionary or integrated systematics studies of broader biological or zoogeographical relevance.
2015 print or online prices: UK £1,180, Euroland €1,501, USA $2,183, Rest of World $2,548
2015 print and online prices: UK £1,416, Euroland €1,802, USA $2,620, Rest of World $3,058

Subscriptions and correspondence concerning back numbers, off-prints and advertising for the seven principal journals of the Society should be sent to the publishers, Wiley-Blackwell Publishing Ltd, 9600 Garsington Road, Oxford OX4 2DQ. (customerservices@blackwellpublishing.com)

Antenna (Bulletin of the Society). Free to Members/Fellows. Published quarterly at an annual subscription rate of £40 (Europe), £42 (outside Europe), $70 (United States). This journal contains entomological news, comments, reports, reviews and notice of forthcoming meetings and other events. While emphasising the Society's affairs, *Antenna* aims at providing entomologists in general with a forum for their views and news of what is going on in entomology. Subscriptions and advertising enquiries should be sent to the Business Manager at The Mansion House, Chiswell Green Lane, Chiswell Green, St. Albans, Hertfordshire AL2 3NS and any other enquiries to the Editors.

Handbooks for the Identification of British Insects. This series now covers many families of various Orders. Each Handbook includes illustrated keys, together with concise morphological, bionomic and distributional information. A full list of Handbooks with order form is available. See website www.royensoc.co.uk

Symposia. Nos. 1-3 were published by the Society; Nos. 4-10 by Blackwell Scientific Publications: Nos. 11-17 by Academic Press and No. 18 by Chapman & Hall, No. 19 by Kluwer, No. 20, 21, 22 and 23 by CABI.

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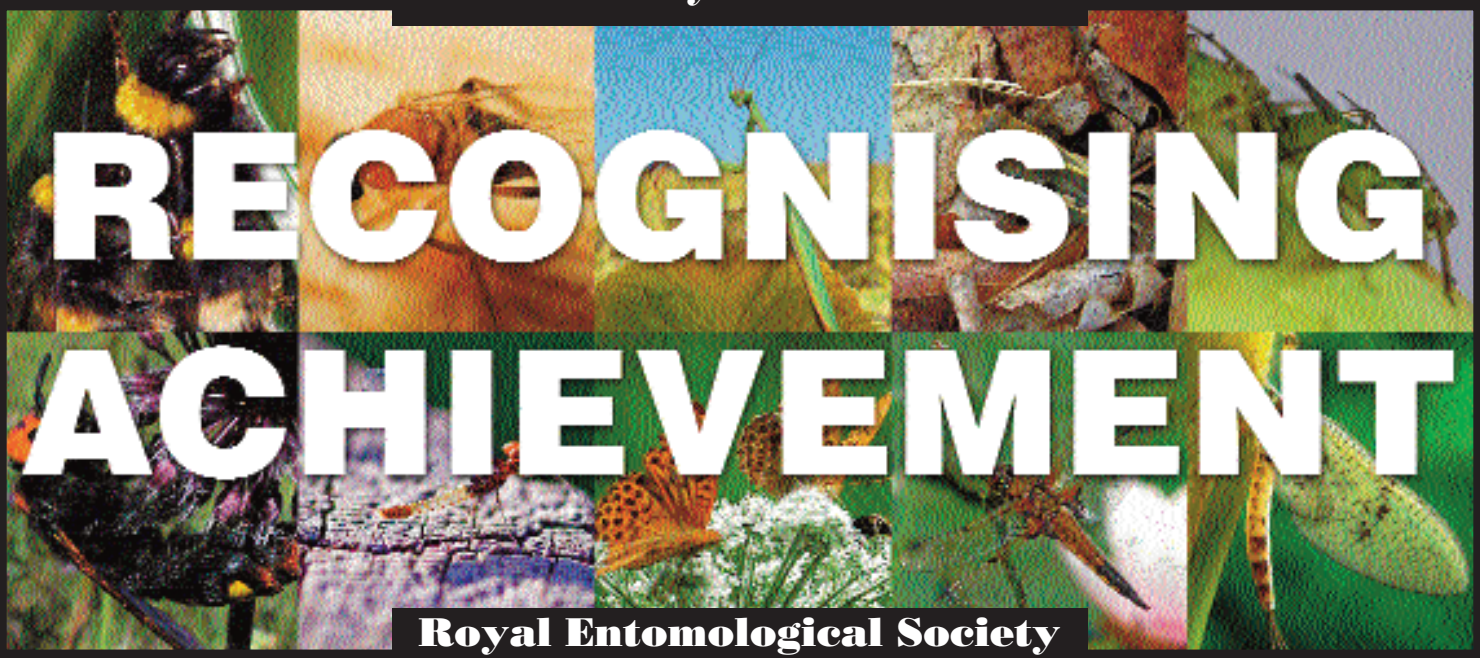

RECOGNISING ACHIEVEMENT

Royal Entomological Society
– Society Awards –

For more details on these Society Awards please see www.royensoc.co.uk

THE ROYAL ENTOMOLOGICAL SOCIETY STUDENT AWARDS

Award Criteria: Any article about an Entomological topic that would be of interest to the general public. The article to be easy to read, in a popular style and no longer than 800 words.

Prize: Winner £300, runner up £200, third place £100, all three articles published in *Antenna*.

RES JOURNAL AWARDS SCHEME

Award Criteria: The best paper published in each Society Journal over a two year period. Each of the Society Journals participate biennially.

Prize: £600 and Certificate for each participating Journal.

THE LJ GOODMAN AWARD FOR INSECT BIOLOGY

Award Criteria: For advancing the education of the public in the knowledge, understanding and appreciation of all aspects of Insect Physiology, thereby promoting the control and conservation of insect species.

Prize: £1,000, also additional awards may be given.

THE MARSH AWARD FOR INSECT CONSERVATION

Award Criteria: For an outstanding contribution to Insect Conservation; on the basis of 'Lifetime Achievement', or 'Considerable and Exemplary Contribution' to a significant project or undertakings. In exceptional circumstances two prizes may be awarded to reflect each criterion.

Prize: £1000 and Certificate.

POSTGRADUATE AWARD: THE ALFRED RUSSEL WALLACE AWARD

Award Criteria: For post-graduates who have been awarded a PhD, whose work is considered by their Head of Department to be outstanding. The research involved should be a major contribution to the Science of Entomology.

Prize: £800 plus Certificate, plus one year's free Membership. The winner will also be invited to present their work at a Society Meeting.

JO WESTWOOD MEDAL – AWARD FOR INSECT TAXONOMY

Award Criteria: The best comprehensive taxonomic work on a group of Insects, or, related Arthropods (including terrestrial and freshwater Hexapods, Myriapods, Arachnids and their relatives). Typically, this will be a taxonomic revision or monograph.

Prize: A specially struck silver gilt medal inscribed with the winners name. Also costs incurred in attending the International Congress of Entomology, European Congress of Entomology, or other major meeting (specified by the Adjudicators) to present his/her work.

THE WIGGLESWORTH MEMORIAL LECTURE AND AWARD

Award criteria: The outstanding services to the science of Entomology. The award will be made to a researcher who has contributed outstanding work to the science and who best reflects Sir Vincent Wigglesworth's standards of personal involvement in every aspect of his/her research.

Prize: A specially struck gilt medal inscribed with the winners name. Also the costs of attending the International Congress of Entomology to give the Wigglesworth Lecture.

BOOK PURCHASE SCHEME FOR FELLOWS AND MEMBERS IN DEVELOPING COUNTRIES

Award Criteria: To provide assistance in purchasing specialist Taxonomic books, that will assist in the identification of Insect groups being studied in developing countries and their regions. Applicants will be required to demonstrate need and specify particular texts.

Prize: Any one applicant may be awarded up to £200 in a three year period. The Society will purchase the texts awarded and send them to the applicant. The applicants may, themselves, provide any additional funds in excess of the amount awarded.

OUTREACH AND CONFERENCE PARTICIPATION FUNDS

Award Criteria: ORF: Grants to support activities which further the Society's aims. This may range from, help to purchase equipment, to help in funding expeditions/meetings. CPF: Grants to assist applicants who are participating in a meeting or conference in some way, e.g. presenting a paper/poster.

Prize: ORF: Monetary grant. CPF: Monetary grant.

MARSH AWARD FOR EARLY CAREER ENTOMOLOGIST

Award Criteria: For an early career contribution to Entomological Science (up to 30 years of age, or, in the early stage of a research career) that is judged to be outstanding or exemplary with single or ongoing impact on the science. The Award is 'open' and not restricted to any particular discipline or specialised area of entomological science.

Prize: £1000 and Certificate

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