Bulletin of the Royal Entomological Society Volume 41 (1) 2017

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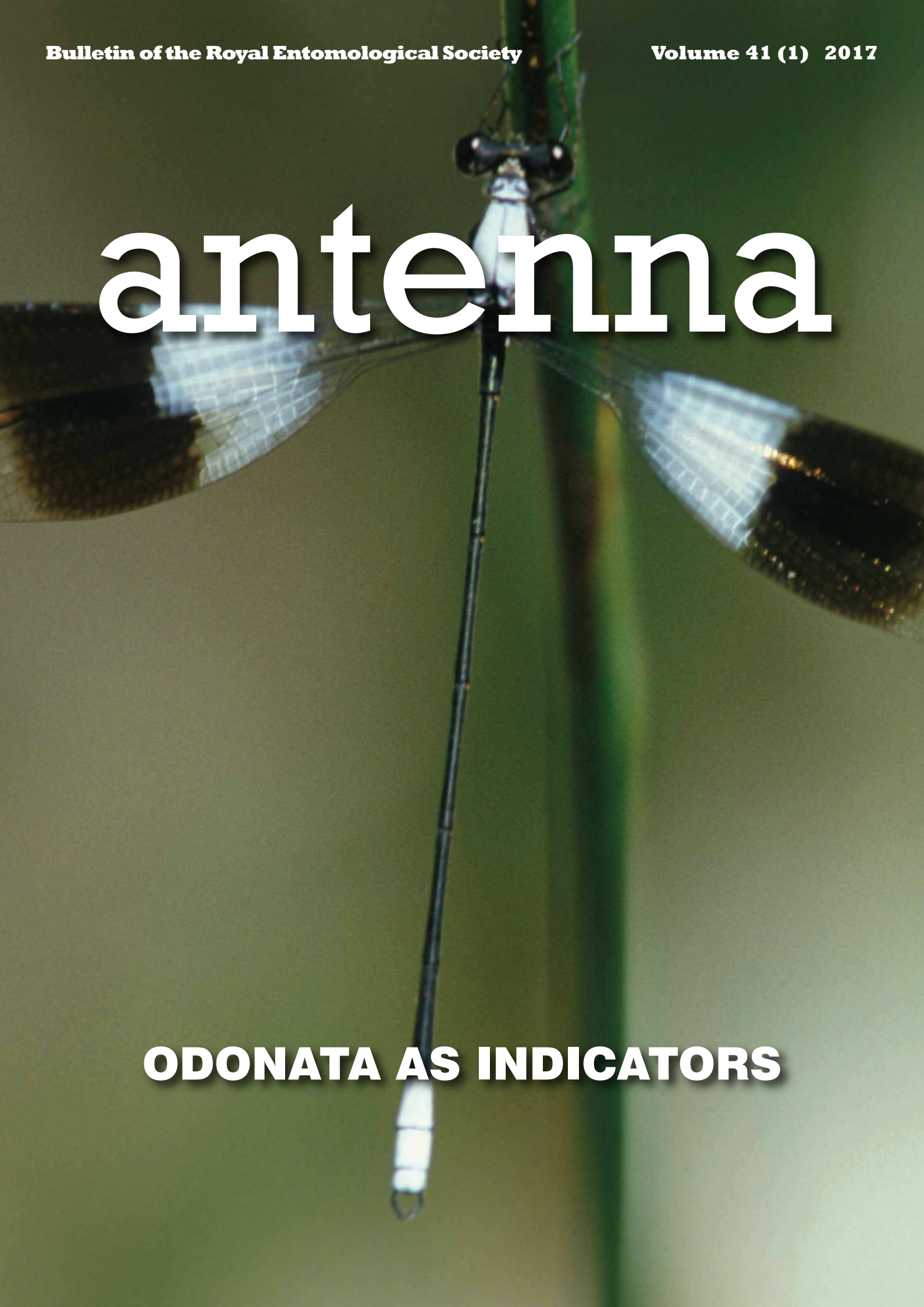

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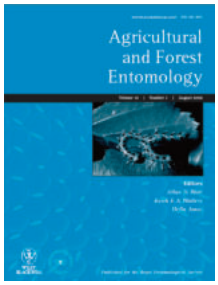

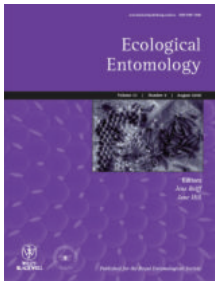

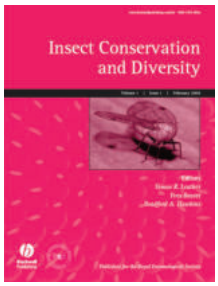

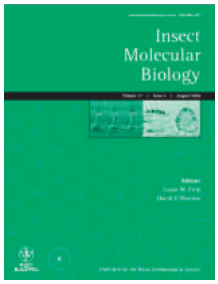

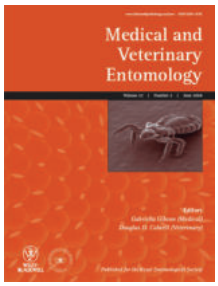

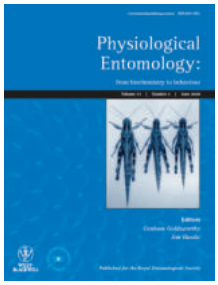

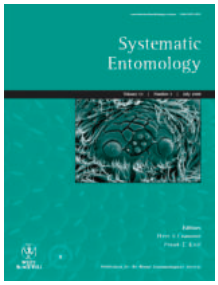

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COVER PICTURE

The White Malachite (*Chlorolestes umbratus*). Photograph is published courtesy of Michael J. Samways & John P. Simaika

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EDITORIAL

Welcome to the first edition of 2017, a year that on a global scale is potentially full of challenge and opportunity. As the old Chinese proverb says, "we live in interesting times".

This edition offers an international set of articles that deal with a wide range of taxa, with challenge and opportunity reflected in their nature: a review of the diversity and biology of poultry mature mites, Odonata as indicators of water quality, bumble bee diversity in China and observations of unusual behaviour in Austrian butterflies. We are also reminded of the challenge of maintaining the quality of our research in an article that discusses the use of Standard Operating Procedures to guarantee consistent and accurate results, something that can be overlooked when faced with the pressures and constraints of modern research environments.

One of the opportunities and challenges that the Society faces in 2017 results from the acquisition of the Daneway Banks nature reserve in partnership with Gloucester Wildlife Trust. Daneway is an SSSI of entomological importance that will be managed jointly and will be used by the Society for outreach, training and research.

Challenges continue as the Society expands the remit of the York Insect Festival to a second location in Bristol. The SW Insect Festival will be hosted by Bristol City Museum over the weekend of September 23rd & 24th. The judges of the Student Essay Competition also faced a new challenge with a bumper crop of 53 entries to read and select the winners from. The winners will appear in Issue 2 or 3.

As entomologists, we are faced with the most diverse and abundant group of organisms in the biosphere so challenge is no stranger to us, but it is the passion and dedication that we bring to bear that allows us to unravel the complexities of the insect world. Passion that is clearly demonstrated in Ian Loe's new book that charts his life as an entomological illustrator, and also by Richard Jones's foray into the often warm and aromatic world of dung. Dedication is also apparent in the form of three scholarly books on the taxonomy of the Ennominae of Europe, the beetles of the Palaearctic and Adrian Spalding's long-term study of the Sandhill Rustic in Cornwall. All of the above have been reviewed for this edition.

As entomologists we try to make a difference. Last year we lost another iconic musician, Leonard Cohen. At his last London concert he opened the evening by saying, "it's been fifteen years since I was last here, I was sixty then. Just a kid with a crazy dream." As entomologists we are probably all kids with a crazy dream but it is our passion and dedication that allows us to respond to the challenges of understanding the world around us.

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

CORRESPONDENCE

Antenna 40(4) cover image

Another great issue of Antenna (Vol. 40, #4) arrived in the mail yesterday just in time for the holidays. And with a delightful cover photo of dung beetles enjoying a veritable feast of elephant dung. Sadly the scarabs were misidentified in both locations as *Heliocopris pirmal* (Fabricius) (*nec* primal) when in fact they are *Pachylomera femoralis* Kirby. *Pachylomera* are day-flying ball rollers very far removed from *Heliocopris* as are horses from hippos. Perhaps then the *Pachylomera* can stop supping the intoxicating liquor of elephant dung and hold their heads high with proper recognition!

Best wishes for the holidays and the New Year.
Dr. Bruce D. Gill, F.R.E.S.
Ottawa, Canada

The need for quality management in entomological research: lessons from contract research

Dr Graham Small
FRES MRQA

IVCC, the Innovative Vector Control Consortium

I realise that, with the title of this piece, I may already have lost some of my target audience. However, for those of you who have read on, please bear with me while I explain.

Academic Research v. Contract Research

My career in entomological research has seen two distinct phases. The first twenty years were spent in academia and concentrated on the characterisation and monitoring of insecticide resistance in insects of public health importance. This was followed by ten years as a Technical Director in a contract research organisation (CRO) conducting product testing for the agrochemicals and household pesticide industry. Whilst both phases of my career involved scientific studies, sometimes using the same methods and the same types of equipment, the biggest difference was regarding quality management at the CRO which had both Good Experimental Practice (GEP; EPPO, 2012) certification for the efficacy testing of products for agriculture and horticulture and also Good Laboratory Practice (GLP; OECD, 1998) certification for bioefficacy and ecotoxicology testing.

Reliability & Reproducibility

There has been much focus in recent years on the issue of reproducibility of data generated during the conduct of scientific studies (Ioannidis, 2005; McNutt, 2014; Baker, 2016b). A number of explanations have been advanced for why research findings may prove to be false including poor experimental design, a poor understanding of the complexity of biological systems, bias during the generation and analysis of study data and scientific fraud (Goldstein, 2002; Thomas, 2015). However, little has been said about the likely role of poor quality control in scientific research (Baker, 2016a).

My experience of quality management (quality control and quality assurance) at the CRO prompted me to look afresh at the studies that I had conducted during the academic phase of my career and, I have to admit, this gave rise to significant concerns. My academic research required me to follow sometimes complex methodologies which were often taught to me by a supervisor or colleague and then written into a lab book. In addition, I used a variety of equipment types, the usage, maintenance and calibration of which was pretty much uncontrolled. For example, I used thermometers, precision balances, pipettes and thermal cyclers, none of which had been calibrated since purchase. It was assumed incorrectly that, because these items of equipment were calibrated by the manufacturer, they would remain accurate for their entire lifetime. In fact, equipment can and does become inaccurate depending on how it is used, how it is maintained and what environmental conditions it is exposed to.

During recent years, I have been a consultant on the development and implementation of quality management systems for academic and government facilities conducting

entomological research in Europe, Africa and Asia. From this experience it is clear that things have changed little since my time in academia. There is a general lack of appreciation in entomology laboratories of the possible causes of variability while conducting studies and how this variability can be reduced to provide data that are both reliable and reproducible.

Implementing Quality Management in Academic Research

The steps required to promote the reliability and reproducibility of data generated during entomological studies in academia are actually relatively straightforward. The first step is to list all of the methods used in your laboratory and all of the types of equipment that need to operate within a defined range of accuracy. Using this list, you can then write standard operating procedures (SOPs) to describe exactly how a method is to be conducted and exactly how your equipment is to be used, maintained and calibrated.

For the uninitiated, a SOP is a set of written instructions that describe a routine activity followed by a research facility. SOPs provide staff and students with the information to perform tasks properly and they can help to ensure consistency in the quality and integrity of the end-results. SOPs must be written in a concise, step-by-step, easy-to-read format. Keep them as simple and short as possible so that staff and students will be more motivated to read and follow them. Information should be conveyed clearly and explicitly to remove any doubt as to what is required. It's often a good idea to share draft SOPs with members of your research group so that they can provide comment on steps that may be missing or may be unclear. It may be useful to include flow charts, diagrams or photos to illustrate the process being described. It is also important to consider how you will ensure that SOPs are being followed. For example, the SOPs you develop for laboratory equipment may require that equipment is calibrated for accuracy at defined intervals: checking the accuracy of environmental monitoring devices (e.g. thermometers, hygrometers and data loggers) using devices calibrated by a certified external service provider; checking the accuracy of precision balances using certified calibration weights; checking the accuracy of pipettes by weighing a set volume of water using your calibrated precision balance. For these types of equipment, you can assign log books in which all of the maintenance and calibration can be recorded.

Training & Safety

Having developed and implemented a set of SOPs for your research facility, these can be an important training aid for new staff and students joining your lab. Having asked them to read and understand the relevant SOP, you can then get someone experienced in the use of the method or equipment to take them through the SOP and ensure that they are competent in following the SOP before they are allowed to use the method or equipment unsupervised. This will not only help to promote the reliability and consistency of the data generated in your lab, but it will also help to minimise the risk of equipment being misused and broken.

SOPs can also be used to address issues of health and safety. The entomological research conducted in your lab may require staff and students to use equipment that may be dangerous if not used correctly and may also require them to handle hazardous chemicals (e.g. pesticides, strong acids and alkalis and organic solvents). The implementation of SOPs can, therefore, be used to help them protect their own safety and the safety of their colleagues.

References

Baker, M. (2016a). How quality control could save your science. *Nature* **529**(7587), 456-8

Baker, M (2016b). 41,500 scientists lift the lid on reproducibility. *Nature* **533**(7604), 452

European and Mediterranean Plant Protection Organization (2012). Conduct and reporting of efficacy evaluation trials, including good experimental practice. *Bulletin OEPP/EPPO Bulletin* **42**(3), 382–393

Goodstein, D (2002). Scientific misconduct. *Academe* **88**(1), 28-31

Ioannidis, JPA (2005). Why most published research findings are false. *PLoS Med*. **2**(8), e124. *doi:10.1371/journal.pmed.0020124*

McNutt, M. (2014). Reproducibility. *Science* **343**(6168), 229

OECD Principles of Good Laboratory Practice and Compliance Monitoring (1998). Number 1, OECD Principles on Good Laboratory Practice (as revised in 1997). ENV/MC/CHEM(98)17, 41 pages.

Thomas, JR (2015). Scientific Misconduct: Red Flags. *The Scientist* December 2015 Issue, http://www.the-scientist.com/?articles.view/articleNo/44582/title/Scientific-Misconduct—Red-Flags/

Figure 1: View of a typical sampling site (poultry shed).

Poultry Manure-inhabiting Mites (Mesostigmata: Acari)

Muhammad Asif Qayyoum and Bilal Saeed Khan

Introduction

The sub-class Acari is divided into two superorders: Parasitiformes, which includes four orders (Opilioacarida, Holothyrida, Ixodida and Mesostigmata), and Acariformes, which includes two orders (Trombidiformes and Sarcoptiformes). Order Mesostigmata includes three suborders: Sejida, Trigynaspida, Monogynasipida; Order Trombididiformes includes two suborders: Prostigmata and Sphaerolichida; Order Sarcoptiformes includes three suborders: Endeostigmata, Oribatida (including Cohort Astigmatina) and Oribatida (excluding Cohort Astigmatina) (Krantz and Walter 2009). Many mites are considered to be key pests in agriculture and human/veterinary medicine, either directly or by serving as vectors and reservoirs of significant pathogens. Conversely, certain species may be considered as beneficial in these systems, serving a role in biological control and integrated pest management.

The majority of mites range from 0.5 to 2.0 mm in length. Taking advantage of their small size, mites have evolved to occupy a range of both micro- and macro-habitats at a global level. There are more than 200 families and 1,700 genera, with 30,000 species of mites having been identified (to date) from different regions of world. Among the Acari, the majority of mites are free-living in their specific habitat, with many species showing parasitic behavior on other animals (both vertebrate and invertebrate) and plants. The vast majority of such species are ectoparasitic, though some infest the ears, lungs, intestine, skin and internal body parts of vertebrates. Mites of public health significance belong to Mesostigmata, Prostigmata and Astigmata. The order Mesostigmata,

comprising free-living predatory and parasitic mites, are of particular significance (Lindquist et al. 2009) and can be recognized by a single pair of spiracles positioned laterally on the body. This group contains more than 100 families and in excess of 12,000 species.

Though some Mesostigmata are beneficial predators, feeding on other mites and small invertebrate pests, others are notable parasites (Lindquist et al. 2009). Within the latter grouping, species exist that may transmit diseases, including possible zoonoses, and cause allergic reactions, lesions, discomfort and even anemia in hosts during severe infestations. Due to high species richness, widespread prevalence, varying trophic occupancy and high sensitivity to environmental perturbations, the Mesostigmata have also been recognized as strong bio-indicators (Coja and Bruckner 2003) also being of potential value to forensic entomology; Mesostigmatic mites and carrion flies are typically the first arthropods to colonise a corpse. Among the habitats occupied by Mesotigmatic mites, animal and poultry manures are well suited for the productivity and growth of many species. For the most part, poultry manure-inhabiting mites are phoretic, and also exhibit both predatory and parasitic behaviour. Many families belonging to Mesostigmata, such as Macrochelidae, Parasitidae, Laelapidae, Eviphididae, Pachylaelapidae, Urpodina (Infraorder), Digamasellidae and Dermanyssidae are commonly found in poultry manure; many of them predate soft-bodied insects, nematodes and fly larvae that co-habit this substrate, though Dermanyssidae are parasitic, utilizing manure for shelter only between bouts of host seeking/feeding in the wider environment (Arjomandi et al. 2016).

Due to the potential of manure inhabiting mites to deliver the beneficial 'ecosystem service' of pest regulation, or conversely serve as pests, many acarologists and zoologists from all over the world have studied this system to identify the species that exist therein (e.g. Hyatt 1980, Axtell 1963, Geden and Axtell 1988, Rodríguez-Navarro et al. 2008, Ito 1977, and Mašán et al. 2014). The present study was conducted to explore the poultry manure-inhabiting (Figure 1) mite fauna from Pakistan for the first time, partially supported by the RES (Royal Entomological Society).

Methods

Samples were collected from nine districts of Punjab province (Figure 2), Pakistan, from poultry cages (semi-controlled sheds and households) (Figure 3). A sample of 500 grams of manure from each sampling site was placed into a Berlese funnel for the extraction and preservation of mites into 70% alcohol. Sample contents were processed to species level with taxonomic identifications made via microscopy using the available literature (Figure 4).

Results and Discussion

Mesostigmatic mites from the families Macrochelidae, Parasitidae, Laelapidae, Dermanyssidae and Urpodidae were reported as new records for Pakistan during this study; further detail of these groups is provided below. This work represents an important first step in cataloging Mesostigmatic mite families present in poultry manure in this region. Family level diversity and numbers of species of the overall population from Punjab is provided in Figure 5.

Macrochelidae: The Macrochelidae is a wide-spread family of predatory mesotigmatic mites, present in numerous habitats such as soil, litter, leaf debris, dung and manure, as well as within mammalian and avian nesting material. Macrochelid mites compete with other insect predators for nematodes, arthropod eggs and larvae, and have been reported from many different parts of world including the British Isles (Emberson 2010), China (Lin and Zhang 2010), Australia (Halliday and Holm 1985; Halliday 2000), Iran (Faraji et al. 2008), Turkey (Özbek and Halliday 2015; Özbek and Bal 2014; Qayyoum et al. 2016), South Africa (Krantz 1965), Italy (Plumari 2010) and Slovakia (Mašán 2003). The Macrochelid group as whole display rapid reproductive potential in comparison to other phoretic mites. Specialised receptors are present on the tarsi of these mites for perception of volatile compounds, which help to locate their prey and assist oviposition in prey-rich localities (Farish and Axtell 1966; Krantz 1998). Many macrochelids are efficient predators of

Figure 2: Sampling sites from Punjab province, Pakistan.

Figure 3: PhD student (Muhammad Asif Qayyoum) collecting samples

Figure 4: Bilal Saeed Khan working on permanent slides of Mesostigmata mites.

fly eggs and larvae (Doube 1986), being important in controlling fly populations in agricultural/livestock systems (Wallace and Holm 1985). Phoresy is commonplace in macrochelid mites, with scarabaeid dung beetles and flies, amongst others, often used as carriers to reach suitable habitats (Glida and Bertrand 2003). Due to their high biological control potential, Koppert Biological Systems (Netherlands) have started commercial production of *Macrocheles robustulus* as biological control agent against eggs, larvae and pupae of sciarid flies and thrips. In Pakistan, only one species of Macrochelid has been previously reported, from a wheat field in Lyallpur (Faisalabad) (Anwarullah and Irshad 1971). During this study eight new records were identified from Punjab province, Pakistan, from two genera: *Macrocheles* and *Glyptholaspis*.

Laelapidae: The family Laelapidae includes free-living mites as well as arthropod, mammal and bird-associated forms. Numerous species of mites within this group occasionally infest humans and are known to transmit diseases. The family of Laelapid mites includes a large number of parasitic genera, common in the nests or on the bodies of various terrestrial mammals. Some species are strictly nest dwellers, feeding on small animals and organic debris, either as facultative parasites taking occasional blood meals, or as obligate parasites feeding exclusively on the blood of their host. As a result of the current work, three new species were added to the Pakistan fauna from two genera: *Gaeolaelaps* and *Pneumolaelaps*.

Uropodina: Uropodina are commonly reported from soil, litter and organic manure, typically feeding on a wide range of diets, e.g. soft-bodied insects, especially muscid eggs, invertebrate larvae, nematodes, fungi, decayed organic materials and collembolans. Species of *Uropoda* have been recovered from a diverse range of habitats, including decaying matter, soil, tree litter, animal dung and manure heaps, ant nests, decayed wood and almost all types of agricultural habitats (Bal and Özkan 2006). More than 240 species have been identified around the world, and assigned to some 33 groups to ease identification (Błoszyk et al. 2013; Kontschán 2015). Phoresy is relatively commonplace in the Uropodina and has evolved to great effect in numerous species of (mainly) small wingless arthropods. A special structure is typically developed to connect the traveller with its host and in the case of the superfamily Uropodina, pedicels fulfil this purpose. Three new uropodins for Pakistan were collected during the current study, from the families Urodinychidae (*Uroobovella*) and Trematuridae (*Trichouropoda*).

Parasitidae: The Parasitidae family consists of more than 400 mite species, globally distributed and split into two subfamilies, Parasitinae and Pergamasinae, commonly present across a range of microhabitats (litter, soil, dung, manure and nests of birds and insects). Parasitinae may display phoretic behavior, often with insects, though phoretic association has, to the authors knowledge, not been recorded to date in the Pergamasinae. A monograph has been published on the Parasitidae in which 218 species were described with a taxonomic key (Micherdzinski and Lukoschus 1980).

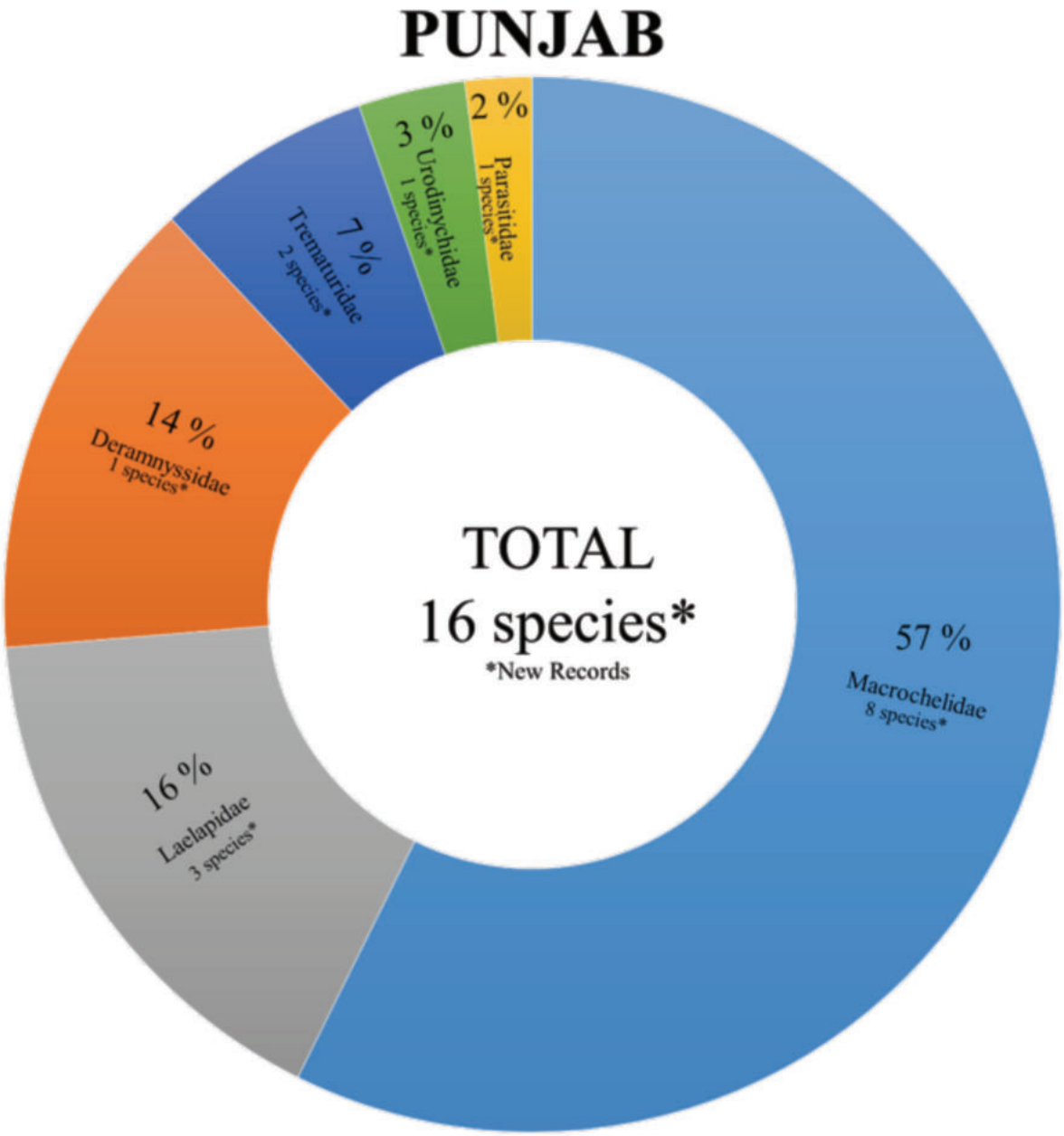

Figure 5: Make-up of the order Mesostigmata, with number of new species records, from Punjab province, Pakistan.

Evans and Till (1979) have also produced a key, again to species level, with revisions to nine and five genera from Parasitinae and Pergamasinae, respectively. Among Mesostigmatic mites, Parasitidae is one of the most ubiquitous families recovered from poultry manure and animal dung (Szafranek et al. 2013). Existing as free-living predators, the majority of the Mesostigmata feed on micro-arthropods and nematodes, this being similarly true of the Parasitidae. Only one species was identified from the genus *Parasitus* by the current study, though this single species represents a new record for the Pakistan fauna.

Dermanyssidae: Dermanyssids are mostly obligate hematophagous ectoparasites of birds, mammals and humans, and are widely distributed all over the world. A classic example is the poultry red mite *Dermanyssus gallinae*, which is one of the most common species, especially in temperate regions, and is known to feed upon more than 30 different avian hosts. According to a recent review, the enzootic nature of *D. gallinae* has been confirmed, contributing to its high pest status in all types of laying egg production systems (Sparagano et al. 2014). The reclusive nature of *D. gallinae* make infestations very hard to treat effectively, with mites feeding only intermittently (and not at all for some life stages) for brief periods of up to an hour, spending the rest of their time secluded within refugia in the vicinity of their hosts

Among the Acari, the mode of pathogen transmission of *D. gallinae* is quite complex, with *Erysipelothrix rhusiopathiae*, *Salmonella gallinarum*, *Listeria monocytogenes* and Newcastle disease virus (NDV) all having been recorded from these mites. This vector capacity is particularly concerning given the potential of these mites to (at least adventitiously) feed upon humans; a case of skin lesions and pruritus was reported on a patient from Kutahya, Turkey (Akdemir et al. 2009), with further examples of *D. gallinae* feeding upon humans (and other mammals) provided by recent review (George et al. 2015). *Dermanyssus gallinae* is the only widely distributed and ubiquitous species identified from Pakistan.

Current and future of Mesostigmatic mites

Currently, many acarologists are working on the taxonomic study of the Mesostigmatic mites from Pakistan, but no work has been done relating to soil and manure inhabiting mites. This study was the first attempt at exploration and taxonomic classification of manure-inhabiting mites in selected regions of Punjab Province, Pakistan. Due to a heterogeneous environment and high seasonal and geographic variation, Pakistan boasts significant diversity in its Mesostigmatic fauna. Though poorly studied, it would be safe to assume that an estimated 10,000 or more Mesostigmatic mite species await proper identification from this region.

Keeping in mind the economic importance and diversity of this group, it is hoped that future research regarding exploration, systematics, infestation and integrated control of the Mesostigmata will be encouraged and undertaken in developing countries like Pakistan.

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References

Akdemir C., Gülcan E., Tanritanir P. 2009. Case report: *Dermanyssus gallinae* in a patient with pruritus and skin lesions. *Turkiye Parazitol. Derg.* 33:242–244.

Anwarullah M., Irshad M. 971. A new species of *Macrocheles* (Acarina: Macrochelidae) from Pakistan. *Sind Univ. Res. J.* (Science Ser. 2:145–150.

Arjomandi E., Kazemi S., Afshari A. 2016. Fauna and diversity of the manure-inhabiting Mesostigmata (Acari) in Kerman County, South Eastern Iran. *Persian J. Acarol.* 2:253–263.

Axtell R.C. 1963. Acarina Occurring in Domestic Animal Manure. Ann. Entomol. Soc. Am. 56:628–633.

Bal D.A., Özkan M. 2006. A new species of the genus *Oplitis* (Acarina, Mesostigmata, Uropodina) from Turkey. *Biologia (Bratisl).* 61:121–124.

Błoszyk J., Gutowski J., Gwiazdowicz D., M dra A. 2013. Phoresy of *Trichouropoda shcherbakae* Hirschmann, 1972 (Acari: Mesostigmata) on beetles of the genus *Tetropium* Kirby, 1837 (Coleoptera: Cerambycidae) in Białowie a Forest, Poland. *Open Life Sci.* 8:986–992.

oja T., Bruckner A. 2003. Soil microhabitat diversity of a temperate norway spruce (*Picea abies*) forest does not influence the community composition of gamasid mites (*Gamasida*, Acari). *Eur. J. Soil Biol.* 39:79–84.

Doube B.M. 1986. Biological control of the buffalo fly in Australia: the potential of the southern Africa dung fauna. 1986, No.:In Biological control of muscoid flies [edited by Patterson, RS. & Rutz, DA.).

Emberson R.M. 2010. A reappraisal of some basal lineages of the family Macrochelidae, with the description of a new genus (Acarina: Mesostigmata). *Zootaxa*:37–53.

Evans G.O., Till W.M. 1979. Mesostigmatic mites of Britain and Ireland (Chelicerata: Acari-Parasitiformes): An introduction to their external morphology and classification. *Trans. Zool. Soc. London*. 35:139–262.

Faraji F., Hajizadeh J., Saboori a, Rafatifard M. 2008. Three new records and a key to the Iranian species of Macrochelidae (Acari: Mesostigmata). Syst. *Appl. Acarol.* 13:231–236.

Farish D.J., Axtell R.C. 1966. Sensory functions of the palps and first tarsi of *Macrocheles muscadomesticae* (Acarina: Macrochelidae), a predator of the house fly. *Ann. Entomol. Soc. Am.* 59:165–170.

Geden C., Axtell R. 1988. Predation by *Carcinops pumilio* (Coleoptera: Histeridae) and *Macrocheles muscaedomesticae* (Acarina: Macrochelidae) on the house fly (Diptera: Muscidae) - functional-response, effects of temperature and availability of alternative prey. *Environ. Entomol.* 17:739–744.

George D.R., Finn R.D., Graham K.M., Mul M.F., Maurer V., Moro C.V., and Sparagano O.A.E. 2015. Should the poultry red mite *Dermanyssus gallinae* be of wider concern for veterinary and medical science? *Parasit. Vectors.* 8: 178.

Glida H., Bertrand M. 2003. Two rare species of Macrocheles (groupe glaber). Consideration on the status of the glaber group (Acari: Macrochelidae). *Acarologia*. 43:15–22.

Halliday R.B., Holm E. 1985. Experimental taxonomy of Australian mites in the *Macrocheles glaber* group (Acarina: Macrochelidae). *Exp. Appl. Acarol.* 1:277–286.

Halliday R.B. 2000. The Australian species of *Macrocheles* (Acarina: Macrochelidae). *Invertebr. Taxon.* 14:273–326.

Hyatt K.H. 1980. Mites of the subfamily Parasitinae (Mesostigmata: Parasitidae) in the British Isles. *Bull. Br. Museum (Natural Hist.) Zool.* 38:237–378.

Ito Y. 1977. Predatory activity of mesotigmatic mites (Acarina : Mesostigmata) for house fly eggs and larvae under feeding of nematodes. *Med. Entomol. Zool.* 28:167–173.

Kontschán J. 2015. Two new *Uropodina* species (Acari: Uropodidae) from a Pinus radiata plantation in Kenya. *Acta Zool. Acad. Sci. Hungaricae.* 61:33–45.

Krantz G.W. 1965. A new species of *Macrocheles* (Acarina: Macrochelidae) associated with bark beetles of the genera *Ips* and *Dendroctonus*. *J. Kansas Entomol. Soc.* 38:145–153.

Krantz W. 1998. Review Re ections on the biology, morphology and ecology of the Macrochelidae. *Rev. Lit. Arts Am.* 22:125–137.

Krantz G.W., Walter D.E. 2009. *A Manual of Acarology* (3rd Ed.). Texas Tech University Press, USA.

Lin J., Zhang Z. 2010. Macrochelidae of China : a review of progress , with a checklist *. Zoosymposia.

Lindquist E.E., Krantz G.W., Walter D.E. 2009. Order Mesostigmata. In: (eds) K.G.. and D.E.W., editor. *A Manual of Acarology*. Texas Tech University Press, Lubbock, Texas. p. 124–232.

Mašán, P. 2003. Macrochelid Mites of Slovakia (Acari, Mesostigmata, Macrochelidae). Bratislava, Slovakia: Institute of Zoology, Slovak Academy of Sciences.

Mašán P., Fen a P., Krištofík J.Á.N., Halliday B. 2014. A review of the ectoparasitic mites (Acari: Dermanyssoidea) associated with birds and their nests in Slovakia, with notes on identification of some species. 3893:77–100.

Micherdzinski W., Lukoschus F.S. 1980. *Rhinoseius rafinskii*, a new species from Ecuador and Venezuela (Acari, Gamasina, Ascidae). *Zool. Meded.* 55:65–79.

Özbek H., Bal D. 2014. New Species of the Genus *Geholaspis* Berlese, 1918 (Acari: Mesostigmata: Macrochelidae) for Turkish fauna from Kelkit Valley. *Munis Entomol. Zool. J.* 9:468–472.

Özbek H.H., Halliday B. 2015. A new species and a new form of sexual dimorphism in *Nothrholaspis* (Acari: Macrochelidae) from Turkey, with a key to the world species. *Int. J. Acarol.*:1–8.

Plumari M. 2010. New records of macrochelid mites from Italy (Acari : Mesostigmata : Macro- chelidae). :197–221.

Qayyoum M.A., Khan B.S., Bashir M.H., Sahi S.T., Ozman-Sullivan S.K. 2016. First record of *Macrochelesmatrius* (Hull, 1925) (Acari: Macrochelidae) from Turkey. Int. *J. Agri. Biol.* 18:813-816.

Rodríguez-Navarro S., Flores-Macías A., Torres-Martínez G. 2008. Evaluation of infesting field bindweed (*Convolvulus arvensis* L.) with *Aceria malherbae* Nuzzaci (Acari: Eriophyidae) under glasshouse conditions. *Int. J. Acarol.* 34:151–154.

Sparagano O.A., George D.R., Harrington D.W., Giangaspero A. 2014. Significance and control of the poultry red mite, *Dermanyssus gallinae*. *Annu. Rev. Entomol.* 59:447-66.

Szafranek P., Lewandowski M., Kozak M. 2013. Prey preference and life tables of the predatory mite *Parasitus bituberosus* (Acari: Parasitidae) when offered various prey combinations. *Exp. Appl. Acarol.* 61:53–67.

Wallace M.M.H., Holm E. 1985. The seasonal abundance of phoretic predatory mites associated with dung beetles in south eastern Australia (Acari: Macrochelidae, Parasitidae). *Int. J. Acarol.* 11:183–189.

Butterflies playing 'possum': An adaptive behaviour related to winter survival?

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As I write this article at 10.30am on the 5th July, 2016 on the veranda of a small wooden summer house in Utting by the Lake of Ammersee in Bavaria, Germany, under a cloudless blue sky except for a few light, fluffy cumulus clouds moving slowly north-east carried on a slight breeze, and with the swifts screaming and zooming unashamedly overhead, the thermometer in the garden stands at 31°C in the full sun, even at this hour in the morning. A few days ago I recorded 45°C on the same thermometer at midday. Around the same date last year (7th July), I recorded 46°C on this same thermometer, the highest I have ever personally recorded anywhere in the world, including in Arizona which I visited with my wife Nicola some 20 years ago. So Bavaria has experienced very hot, sunny weather in recent years, a trend that seems to have continued in 2016 (see websites 1-5), although the weather had been unsettled, cool and rainy before we arrived on vacation here on the 19th June.

In July 2015, as is proving with July 2016, it was so incredibly hot that it was unwise to venture out at midday, certainly not without suitably protective headgear and a good dosing of high factor sun cream on face, arms and legs. As an entomologist keen to see what insects were flying in the local meadows, I decided it would be prudent to leave wandering about until later in the day, when the sun had dipped a bit and the ambient temperature declined. So I started going out at around 5.00pm, which was actually still quite hot in the full sunshine, to say the least. On Wednesday, 15th July, 2015, I headed south towards the Gasteiger-Haus near the small village of Holtzhausen (website 6), one of my favourite places within easy walking distance of where we live. The small two storey house itself (Fig. 1a,b), in the Art Nouveau style, dates from 1908-13, designed and built as the county retreat of the famous Munich artists, the Gasteigers, Mathias (1871-1934), sculptor, and his wife Anna (1877-1954), watercolourist specialising in painting flowers (Schmidt & Heym, 1985). It is partially surrounded by a wood on its northern side, through which runs a stream draining into a small pond (Fig. 1c), whilst a large meadow filled with wild flowers, especially purple-blue cornflowers, stretches down to the western shore of the lake (Fig 1d). The beautiful small garden immediately around the house itself, which is open to the public (as is the house on Sunday afternoons in the spring and summer) and which displays some of Mathias's statues (Fig. 1e), is maintained by the Free State of Bavaria. The front of the house is approached by a gravel path, culminating in an octagonal-sided pond with pink and white waterlilies (Fig. 1a), and bordered on each side by thick lavender bushes, with rows of highly scented standard rose bushes behind (Fig. 1a,f).

The area is generally good for butterflies, including some localised species like the Marbled Fritillary, *Brenthis daphne* Bergsträsser, 1780 (Fig. 2), which Nicola and I observed and she photographed in a nearby damp meadow on a sunny day earlier in June the same year. *En route* to the Gasteiger house on the day in question, July, 15th, I passed a piece of scrub land with about five large buddleia bushes growing and in full bloom, mainly purple. These were literally covered in butterflies feeding, mainly Nymphalids – Red Admiral, *Vanessa atalanta* (L.), Peacock, *Aglais* (*Inachis*) *io* (L.), Small Tortoiseshell, *Aglais urticae* (L.), Painted Lady, *Vanessa cardui* (L.) and Silver-washed Fritillary, *Argynnis paphia* (L.), some Pierids, mainly Brimstone, *Gonepteryx rhamni* (L.), Large, Small and Green-veined White, *Pieris brassicae* (L.), *P. rapae* (L.) and *P. napi* (L.), respectively, and one or two Meadow Brown, *Maniola jurtina* (L.) (Satyridae)… the whole scene reminiscent of a busy airport with lots of traffic flying in and out from

Fig. 1 (a) Front aspect (looking west) of the Gasteiger House and garden showing lavender bushes, roses and octagonal lily pond and with Nicola standing in the distance; (b) Side of house looking north; (c) Stream running past the house to feed pond via sluice; (d) Flower meadow reaching down to the western edge of the Lake of Ammersee, southern Bavaria; (e) Statue by Mathias Gasteiger of Red Deer hind and calf at the front gate of the Gasteiger House; (f) Lavender bushes along front path as they appeared in the late afternoon of Thursday, 16th July, 2015. Note white butterfly nectaring on left of picture.

Fig. 2. Marbled Fritillary butterfly, *Brenthis daphne* photographed on Sunday, 14th June, 2015 in a damp meadow near the Gasteiger House.

Fig. 3 (a) Author attempting to capture a male Brimstone butterfly by hand; (b) Male Brimstone butterfly playing 'possum' on capture, with legs drawn up close to body and antennae still; (c) Green-veined White butterfly displaying active struggling behaviour, with legs away from body and antennae moving.

individual blooms.

On arrival at the Gasteiger house and gardens at about 5.40pm, I also saw many species of butterfly nectaring on the lavender blooms along the front path and flitting lazily from flower to flower, especially including both sexes of the Brimstone, Large, Small and Green-veined Whites, Meadow Brown, Ringlet, *Aphantopus hyperantus* (L.), and a few Small Tortoiseshells, Peacocks and a Comma, *Polygonia c-album* (L.). Because the butterflies were concentrating on their task of imbibing nectar, it was possible with patience and deftness to catch them between thumb and index finger by the forewings when their wings were temporarily closed. To my surprise, on capturing Brimstones, Peacocks and Small Tortoiseshells in this way, the butterflies immediately fell still, apparently feigning death, with their antennae immobile and their legs tightly held against their bodies (Fig. 3b). They remained in this pose so long as they were held tightly, especially when holding them near the forewing margin (costal edge), which I did for around 10-20 seconds before releasing them again to continue their feeding. They did not seem to be too upset by this treatment. In contrast, when I

captured the White and Brown butterflies in identical fashion, they struggled actively, with their antennae and legs moving vigorously (Fig. 3c). I returned with Nicola the following day at about the same time to repeat the experiment using further individuals of the aforementioned species representing the Families Nymphalidae, Pieridae and Satyridae (Browns), whilst she also took photographs of me capturing the butterflies and then holding them by their closed forewings (Figs. 3a-c).

Whilst these are but a few casual observations made in the field and without a proper series of collected data to confirm this apparent phenomenon using these and a wider series of butterfly species, there did appear to be a real behavioural difference between the different groups of butterflies here tested (In the case of the Brimstone, n = 8, the other species n = 1-4). It was generally rather difficult to capture the butterflies in this way, because of their keen visual acuity and amazingly quick escape response when settled on a lavender flower spike…that is, if you didn't manage to capture them on the first attempt! [If you don't believe me, have a go yourself! It's certainly not easy, especially on a hot day when the butterflies are fully active. For example, a Meadow Brown can readily escape capture at lightning speed even when your thumb and index finger are poised to strike only a few millimetres each side of its forewings!]. Thereafter, the butterflies were generally more wary and difficult to approach and capture. I later thought about using a net, but decided against this because it seemed likely to be more stressful to capture them in this way, especially when one put one's hand it to try and grab the fluttering insect within. Furthermore, capturing them using a net does not closely mimic – as capture using finger and thumb does – seizure by a bird in its beak, probably the main diurnal predator of these animals.

If these observations are confirmed, I can only surmise that the behavioural response is something to do with the overwintering strategies of the butterflies here examined. The three species playing 'possum' on capture by hand overwinter as hibernating adults, whereas the 'wrigglers' overwinter as larvae (the two Browns) or pupae (the three Whites) (website 7). The phenomenon may relate to the idea, which I posited in an earlier *Antenna* article, that cool temperatures have acted as a selectional driver for crypsis in insects (see Loxdale, 2014, for further details). In the case of the above mentioned hibernating butterfly species such as the Peacock, if disturbed on a cool winter's day by an endothermic attacker such as a field mouse, the best survival strategy may well be to feign death… in other words, play possum, since the butterfly, being poikilothermic, is too cold and inactive to react by flashing its warning eye-spots (sudden startle wing-flicking display) or by flying away, or even, as is known in the case of this particular butterfly species, too lethargic to release sounds which act as a deterrent to these small mammals (Olofsson *et al.*, 2011; see also Vallin *et al.*, 2005). According to Vallin *et al.* (2005), citing an earlier study by Møhl & Miller (1976):

> "The sound produced by the peacock during the eyespot display can be separated into three components: the hissing sound produced when the wing-veins are rubbed together and two components, outside the hearing range of humans, consisting of low- and high intensity clicks (Møhl & Miller 1976)."

The phenomenon of butterflies playing possum to evade would-be attackers has been documented much earlier. Thus for example, Dr. Clarence Moores Weed*, D.Sc., in his enchanting book about the biology of North American butterflies entitled '*Butterflies Worth Knowing*' (Weed, 1923; Fig. 4a) states under the sub-heading '*Feigning Death*':

> "The fact has long been noticed that various butterflies have the habit at times of feigning death and dropping to the ground where they may lie motionless for a considerable period. This habit is most easily observed in some of the Angle-wings [Nymphalid butterflies of the genus *Polygoni*a, e.g. *P. c-album*, the Comma], especially those which hibernate as adults. Those species have the under surfaces of their wings coloured in various bark-picturing patterns and apparently live through the winter to some extent, resting beneath the bark of large

Fig. 4 (a). Front cover of 1923 edition of Clarence M. Weed's butterfly book; (b) Mourning Cloak, *Nymphalis antiopa* feigning death on being disturbed by a would-be predator. Photo copied from Weed's book as published online (see Weed, 1923 and URL cited below).

*For a biography of Clarence M. Weed (1864-1947), an expert on Harvestmen (Arachnida: Opiliones), see Cokendolpher & Zeiders (2004).

branches or upon the trunks of trees. Many of them also secrete themselves in hollow trees or beneath loose bark or in board piles or stone walls. It is probable, however, that during the long ages when insects were adapting themselves to their life conditions, before man interfered with the natural order and furnished various more or less artificial places for hibernation, these butterflies rested more generally upon the underside of branches than they do now.

Even in warm weather when one of these butterflies is disturbed it is likely to fold its legs upon its body and drop to the ground, allowing itself to be handled without showing any signs of life. This habit is doubtless of value, especially during hibernation or possibly during the summer lethargy or aestivation, the latter being a habit which is possibly more general among these butterflies than is currently supposed. As the insect lies motionless upon the ground it is very likely to blend so thoroughly with its surroundings that it becomes concealed, and any bird which had startled it from the branch above would have difficulty in finding it.

Some very interesting observations have been made on the death-feigning instincts of various other insects, especially the beetles. But no one so far as I know has yet made an extended study of the subject in relation to our butterflies. It is an excellent field for investigation and offers unusual opportunities for photographic records.

One of the figures included herein, of page 32 in Weed (1923), shows a photograph taken of a Mourning Cloak [= Camberwell Beauty, *Nymphalis antiopa* (L.)] as it was playing 'possum'. This species exhibits the instinct to a marked degree." (This photo is here reproduced as Fig. 4b; Weed's caption is: 'Butterfly feigning death, hanging to bark by one foot').

So there you have it; I have been 'pipped to the post' by at least 90 years. Oh well, whilst recognition of the phenomenon of butterflies playing possum is clearly not new and has been documented almost a century before, I like to think that my idea, also drawn from direct observation in the field, about low temperature being a driver for insect crypsis still has some reality attached to it.

Just out of interest, in the large tome by Edward M. Barrows (2011) *Animal Behavior Desk reference: A Dictionary of Animal Behavior, Ecology and Evolution*, under the sub-heading *Playing Dead* he states:

> Playing dead occurs in some Anole lizard, bat, bee, beetle, butterfly, frog, hog-nosed snake, mantid, sawfly, spider and wasp species; the African Ground Squirrel, Domestic Chicken, Gundi (rodent), Human, Monarch Butterfly, Turkey Vulture and Virginia Opossum.

Thus the phenomenon of feigning death cuts across phyla, class, orders, families, genera and species and presumably is very ancient, probably going back to the Mesozoic, the age of the dinosaurs, and maybe long before that. Nature, ever adaptive, seemingly stops at nothing in the great game of life, even feigning death…if necessary to survive.

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I thank my wife Nicola for taking the photographs of the lavender walk in full bloom (Fig. 1f), the Marbled Fritillary (Fig. 2), me capturing a butterfly by hand (Fig. 3a), and the close-ups of the two captured specimens (Figs. 3b, c). She also took the picture of me at the RES *Insect Festival* held at the Yorkshire Museum and Gardens, York, on Sunday, 5th July, 2015. I took the other photos on several earlier visits to the Gasteiger

References

Barrows, E.M. (2011). *Animal Behavior Desk Reference: A Dictionary of Animal Behavior, Ecology, and Evolution*, 3rd edn. CRC Press, Boca Raton, Florida, USA. Pp. 800.

Cokendolpher, J.C. & Zeiders,, K.R. (2004). Clarence Moores Weed (1864-1947) and notes on his species of Opiliones (Arachnida). *Occasional Papers; Museum of Texas Tech University*, No. **237,** 8 June, 2004, pp. 16. Available online at: (http://www.nsrl.ttu.edu/publications/opapers/ops/op237.pdf).

Loxdale, H.D. (2014). Musings on the birds and bees...and flies and butterflies too. *Antenna*, 38, 219-225.

Möhl, B. & Miller, L. A. (1976). Ultrasonic clicks produced by the peacock butterfly: a possible bat-repellent mechanism. *Journal of Experimental Biology*, **64**, 639–644.

Olofsson, M., Jakobsson, S. & Wiklund, C. (2011). Auditory defence in the peacock butterfly (*Inachis io*) against mice (*Apodemus flavicollis* and *A. sylvaticus*). *Behavioral Ecology and Sociobiology*, 66, 209-215. (Available online at : www.researchgate.net/profile/Christer_Wiklund/).

Schmid, E.D. & Heym, S. (1985). *Mathias und Anna Gasteiger: Aus einem Münchner Künsterleben um 1900*. Bayerland, Dachau, Germany, pp. 168.

Vallin, A., Jakobsson, S., Lind, J. & Wiklund, C. (2005). Prey survival by predator intimidation: an experimental study of peacock butterfly defence against blue tits. *Proceedings of the Royal Society B, Biological Sciences*, **272**(1569), 1203-1207. (Available online at: http://mail.zoologi.su.se/research/anti-predator/VallinEtAlIntimidation2005ProcRSoc.pdf).

Weed, C.M. (1923). *Little Nature Library: Butterflies Worth Knowing*. Doubleday, Page & Co., Garden City, New York, USA, 32 plates, 16 in colour, pp. 286. (Available online at: http://www.kellscraft.com/Butterflies/butterflycontent.html).

Websites cited

http://cib.knmi.nl/mediawiki/index.php/2015:_joint_warmest_year_on_record_in_Europe

https://www.ncdc.noaa.gov/sotc/global/201513

https://www.theguardian.com/environment/2016/jan/20/2015-smashes-record-for-hottest-year-final-figures-confirm

http://www.nytimes.com/2016/04/20/science/2016-global-warming-record-temperatures-climate-change.html?_r=0

https://www.washingtonpost.com/news/capital-weather-gang/wp/2015/07/06/germany-sets-new-all-time-hottest-temperature-record-during-europe-heatwave/

http://www.utting.de/gasteiger0.html

http://www.ukbutterflies.co.uk/

Assessing freshwater condition and health using dragonflies

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Viewed from space, our planet is a blue speck of largely water in a seemingly endless expanse of darkness. It is this water that is vital for life as we know it. All this wonderful life is amazingly complex, yet very fragile. Away from the sea, it is fresh water on which terrestrial life depends, especially free running water and precious wetlands, all of which are teeming with life. Yet fresh water is the most threatened ecosystem on earth, and so essential for everything we do. It is at the heart of our very survival. Strangely though, it is a system that we have so little regard for. It now needs every effort we can muster for human and the rest of nature's continuance into the future.

One of the most prominent groups associated with water are the dragonflies (both Anisoptera and Zygoptera). There are several thousand species worldwide that live in the smallest ponds through to the largest rivers. Some are highly sensitive to any human impact, barely able to tolerate human-induced changes, while others are absolute opportunists that will inhabit the most artificial of habitats, such as cattle troughs, bird baths and rice paddies. It is precisely this range of sensitivities that make dragonflies collectively very useful as a measure of the quality of fresh water. When a water system becomes degraded through human impact such as pollution or damming there is a change in the species profile away from sensitive specialists towards insensitive generalists. We can quantify this and relate it to extent that a fresh-water system is deteriorating. Conversely we may be engaged in restoring a water system, and we may wish to know how well we are doing in bringing back the original condition and complement of species.

Globally, the use of dragonflies as indicators of changing or stable water and bank conditions is becoming increasingly popular. As a group, dragonflies can be used to assess both still and running water. They can also be umbrellas, at least in part, for representing other aquatic fauna, especially benthic macro-invertebrates in general. In South Africa, there is a strong cross correlation between characteristic assemblages of dragonflies and that of other aquatic invertebrates. One advantage of dragonflies as indices of water change over indices using macro-invertebrates in general is that the operational level in dragonflies is at the species level rather than at the family or higher level. This species-level approach gives more sensitivity to the metric than if higher level taxa are used.

There has been much debate as to whether adult dragonflies truly reflect in-water conditions. This is largely the case, but they also reflect condition of the bank, particularly relating to level of shade cover. In the case of the shade-loving endemic species of Mayotte Island in the Comoros, it does not always matter whether that shade is provided by alien or native trees. Yet in South Africa, which has a largely a sun-loving dragonfly fauna, invasive alien trees can be devastating to the local odonate fauna, or at least can reduce species richness and swing it from many endemic specialists to a few widespread generalists.

Further debate on the topic of whether adults truly reflect the in-water conditions centres on whether they do so at the point where they are recorded, and whether it might be better to record the larvae or the exuviae. There is no absolute answer here, as it depends on global location and conservation objective, but one of the reasons that dragonfly indices have become so popular is that it is relatively easy to record the adults with the only requirement really being a sunny day and a pair of close-focus binoculars.

Figure 1. The four species seen here range from one with a very low Dragonfly Biotic Index (DBI) to one with a very high value. Top left: The Highland dropwing (*Trithemis dorasalis*): a common, widespread species frequently found in artificial reservoirs, with a very low DBI value. Top right: The Common thorntail (*Ceratogomphus pictus*): a fairly common and widespread species occasionally found in artificial ponds, with a medium DBI value. Bottom left: The White malachite (*Chlorolestes umbratus*): a fairly localized Cape Floristic Region endemic species, very occasionally found in artificial ponds, with a high DBI value. Bottom right: The Blue streamjack (*Metacnemis valida*): a very rare, highly localized and threatened (Endangered) Eastern Cape endemic species, with a very high DBI value.

There also appear to be area differences, with larvae and exuviae being more valuable in Europe where the dragonfly fauna is better known. Assessment may be related to a specific species such as *Oxygastra curtisii* where the exuviae are particularly good for assessing population numbers. But in many regions of the world the larvae and even the exuviae are poorly known and/or are difficult to find, with the returns from searches not representing the complete local dragonfly fauna. Also, in Africa, edges of rivers can be very difficult to access and have many large and dangerous animals like crocodiles and hippopotamuses, as well as pathogens like bilharzia.

South Africa is a water-scarce country, and it is critical that water supplies are cared for and restored. Impacts include: over demand on water supply, sedimentation of water, and change in water chemistry. There is one other aspect that also needs to be considered as South Africa's species, nearly all 162 of them, like sunny conditions. It is the impact of invasive alien trees like eucalypts, wattles and pines, which can shade the water and bank and so push away the dragonflies, at times driving some species to become locally extinct. This means that the removal of alien trees from the banks of rivers in particular has been an important nature conservation exercise. It also has been one of the really great contributions to the National Biodiversity and Strategic Action Plan and the international Aichi Biodiversity Targets, especially through the governmental Working for Water Programme, which aims to remove all invasive trees from water systems. This programme has had immense success along many rivers, especially in protected areas. Dragonflies have been widely used to monitor the success of the restoration activities along these rivers.

But we must not think that all human activities are harmful to dragonflies and other water fauna and flora. Reservoirs on farms used for irrigation can encourage many species which would otherwise be very scarce in the area. Really good conservation reservoirs are those with constant water levels, much water weed and marginal vegetation, and no pollutants, especially the fertilizers and pesticides used in agriculture. But these reservoirs tend mostly to attract the widespread generalists rather than any threatened specialists, although narrow range specialists will occasionally colonize them.

Here at Stellenbosch University, we have been working on new ways forward for assessing the quality and ecological health of fresh water systems using dragonflies. We have developed an index which is based on three main features of each species in turn. These features are: 1) the general distribution of a species, 2) its threat status (its rating on the IUCN Red List), and 3) its sensitivity to human modifications

Figure 2. The Dragonfly Biotic Index (DBI) can be used to compare the biotic value of different streams for conservation priority. This stream in the Tsitsikamma Forest (a southern hemisphere temperate rain forest in South Africa) has several high scoring species, including the Mahogany presba (*Syncordulia venator*) (inset).

Figure 3. When alien trees such as *Acacia* spp. are removed (seen here as the dead twigs on the right of the picture), fresh, indigenous vegetation springs up. This small pool attracted the Endangered Mauve bluet (*Proischnura polychromatica*) (inset), which would have been shaded out if the alien trees still dominated the site.

Figure 4. When rivers are cleared of alien trees (shown here by the fallen pine logs), the natural sunlit plant community re-establishes. With it, so does the dragonfly assemblage. Shown here is Disa Stream on top of Table Mountain in the heart of Cape Town, fully restored with the return of its aquatic fauna, including the Cape endemic Conspicuous malachite (*Chlorolestes conspicuus*) (inset).

of the water system. When a system deteriorates, there is a shift in the total scores of all the species present from high to low. When systems are restored there is a shift in the assemblage in the other direction, from low to high. In short, using dragonflies, we can determine whether we should be worried about a system which is deteriorating, or, where we are improving a system, we can measure how well we are doing. The point is also that using dragonflies to do this is so simple.

Recently all our research has been synthesized into a user-friendly manual (*Manual of Freshwater Assessment for South Africa: Dragonfly Biotic Index*, SANBI, Pretoria) showing how to undertake fresh water assessments. As this index operates at the level of species, it is highly sensitive. And as dragonflies are relatively easy to identify, it is easy to use. The whole process of fresh water assessment is even very pleasant, like going bird watching. This new approach makes freshwater assessment much easier than in the past, and makes a major contribution to nature conservation in this special part of the world.

A downloadable version of the *Manual of Freshwater Assessment for South Africa: Dragonfly Biotic Index*, is available on the SANBI Graphics & Editing page on the Biodiversity Advisor website (http://biodiversityadvisor.sanbi.org/literature/4327-2/).

Figure 5. The recently published and also downloadable *Manual of Freshwater Assessment for South Africa: Dragonfly Biotic Index*.

References

Rosset, V., Simaika, J.P., Arthaud, F., Bornette, G., Vallod, D., Samways, M.J. & Oertli, B. 2013. Comparative assessment of scoring methods of the conservation value of biodiversity in ponds and small lakes. *Aquatic Conservation: Marine and Freshwater* **23:** 23-36.

Samways, M.J. 2006. Threat levels to odonate assemblages from invasive alien tree canopies. In: Cordero, A. (Ed.) *Forests and Dragonflies*. 209-224. Pensoft, Sofia, Bulgaria.

Samways, M.J. & Sharratt, N.J. 2010. Recovery of endemic dragonflies after removal of invasive alien trees. *Conservation Biology* **24:** 267-277.

Samways, M.J., Sharratt, N.J. & Simaika, J.P. 2011. Effect of alien riparian vegetation and its removal on a highly endemic macroinvertebrate community. *Biological Invasions* **13:** 1305-1324.

Simaika, J.P. & Samways, M.J. 2009. An easy-to-use index of ecological integrity for prioritizing freshwater sites and for assessing habitat quality. *Biodiversity and Conservation* **18:** 1171-1185.

Simaika, J.P. & Samways, M.J. 2011. Comparative assessment of indices of freshwater habitat conditions using different invertebrate taxon sets. *Ecological Indicators* **11:** 370-378.

Simaika, J.P. & Samways, M.J. 2012. Using dragonflies to monitor and prioritize lotic systems: A South African perspective. *Organisms Diversity and Evolution* **12:** 251-259.

Bear wasps of the Middle Kingdom: a decade of discovering China's bumblebees

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Bumblebees are well known for being among the most important pollinators in the world's north-temperate regions. Perhaps more surprisingly, half of the world's bumblebee species are concentrated in just one country, China. With an area only slightly smaller than the US, China has almost three times as many species. Understanding the bumblebees of China is difficult because the mountains are high and the type specimens far away. So despite much invaluable work over many years, China has the least well known bumblebee fauna. For the last ten years we have been trying to address this in order to discover the full richness of China's bumblebee diversity, to map the species' distributions, to assess their conservation status, and to assess their potential for increasing crop yields (Fig. 1).

Sorting out China's bumblebees is not simply a question of matching a bee's appearance with published descriptions or with museum specimens. Bumblebees have been described as morphologically homogeneous compared with other bees. However, they do have strikingly varied colour patterns, with many studies showing that even single bumblebee species can be impressively variable in terms of their colour pattern, both locally and especially across different geographical regions. In addition, many of the species within the same region can look identical. Despite this, people still try to use colour patterns to identify them, even when describing

Fig. 1. A queen of *Bombus lantschouensis* Vogt, a cryptic species recognised as separate as a result of this project and one of the species now being reared for crop pollination by the CAAS Institute of Apicultural Research.

Fig. 2. Field work sampling bumblebees in the Burhan Budai mountains (ca 3500 m a.s.l.), Qinghai.

new species. This is like trying to study plant taxonomy by looking just at leaves, without flowers, let alone DNA. It can lead to problems.

In 1998, an analysis of the rates of discovery of all the bumblebee species accepted at the time showed that rates varied widely around the world, with recent rates of discovery being highest in the Oriental Region, including China. This pattern is complicated by the intraspecific variation. When people were focussing on the variation in colour patterns, they published many names for supposedly different species which were later rejected as 'good' species when those groups were subsequently revised in more detailed morphological studies. The result by 1998 was an average of more than 10 names for each species. This illustrates the pitfalls of simply going out into the field and naming something that appears to be different.

So we are still in need of reliable identifications and names, to allow the information on species to be linked together and searched easily.

Since then, work on Chinese bumblebees has been gathering pace. Our team has made the project a priority for the last decade (https://www.researchgate.net/project/Bumblebees-of-China-Initiative) as a joint endeavour among institutes across China. This has been coordinated by the CAAS Institute of Apicultural Research in Beijing, with taxonomic research by the Natural History Museum in London, funded largely through grants from China. With the help of enthusiastic students, we have been surveying bumblebees from new sites across China every summer (Fig. 2). We seek to follow best practice in making every step in the work transparent and accountable – by collecting reference voucher specimens, labelling each with a unique specimen-identifier number together with precise GPS location and elevation data, and identifying species as far as possible using consistent and repeatable methods. All of this information is then entered into a database so that it can be easily accessed, queried, and mapped (Fig. 3). We expect to have close to 50,000 fully databased specimens in the project's reference collection by the end of 2016. Identification from morphological comparisons has been an important starting point, but now we can use DNA analysis to discover more about the evolutionary relationships among the bumblebees we encounter. We are now making progress with DNA sequencing for at least the most problematic groups, which should help us to make better-informed interpretations. This genetic evidence is pointing, on the one hand, to the synonymising of some taxa with very different colour patterns (e.g. *Bombus breviceps* Smith in Fig. 3 and 4), and on the other hand, to discovering new cryptic species that scarcely differ in colour and morphology (Fig. 1).

In 2007, soon after the beginning of this project, we had a list of 108 bumblebee species for China. Now in 2016, we have a provisional list of 130 species. This is exactly half of the currently estimated total number of bumblebee species world-wide (http://www.nhm.ac.uk/bombus). A few of the new species have never been recorded before but most have been added because, although they had been considered previously as parts of known species, recent DNA studies now indicate that they are separate species in the currently accepted sense of evolutionarily-independent lineages. This kind of work is never finished as information continually changes. This is frustrating in some ways but such shifting ground is a necessary consequence of the progress of ideas on the nature of species, in analytical techniques, and in data compilation.

As a result of both the recent increase in survey effort across China and of the changing concepts of species, we have added to the faunal lists for nearly all of the provinces (Fig. 5A). This shows that information has improved across the entire breadth of the country. There are more new records for the more mountainous provinces in northern China (especially

Fig. 3. Field surveys are being made every year all over China to collect voucher specimens (shown here *Bombus breviceps*) along with precision data in order to provide a detailed database for the project.

Ningxia and Gansu) than in lowland regions.

The new records provide an improved quantitative estimate of the pattern of bumblebee diversity across China (Fig. 5B). It had long been known in broad terms that the mountains around the edge of the Qinghai-Tibetan plateau (particularly in Sichuan and Gansu) are the principal hotspot for bumblebee species' diversity world-wide. In contrast, the lower mountains and lowlands of southern and eastern China are warmer and have fewer of these cool-climate-loving bees.

However, the pattern in the species' richness map (Fig. 5B) is complicated by variation in the sizes of the provinces, especially because the largest provinces are all concentrated together in the north and west of China. To reduce the effect of area, we can map any excess (or deficit) in species' richness relative to the China-wide relationship between species' richness and province size (Fig. 5C). This map shows that the provinces with the largest excess species' richness for their size are those along the eastern edge of the Qinghai-Tibetan plateau, and to a lesser extent those

Fig. 4. A common southern species, *Bombus breviceps*, shows distinctive colour patterns in different regions (this is the same species as in Fig. 3), although it shares each of these colour patterns with several other species.

provinces to the east along the mountains of North China. Mountain regions may have richer bumblebee faunas for several reasons: mountains have a greater variety of habitats over a larger range of elevational zones, each with different faunas; the high subalpine meadows tend to be especially rich in the cool-adapted bumblebee species; and areas with high relief have been suggested to facilitate the speciation process. One of the largest provinces (Neimenggu in the north) has slightly fewer species than expected, probably because it includes large areas of desert that are inhospitable to bumblebees. Perhaps surprisingly the same is not true of Xinjiang in the northwest, also with extensive deserts, but only because the fauna is augmented with the rich and distinctive Altai and Tian Shan mountain faunas shared with Russia, Mongolia, and Central Asia. The deserts of Neimenggu and Xinjiang are the major barriers separating the Oriental and Palaearctic bumblebee faunas.

Ultimately the *Bumblebees of China* initiative is aiming for practical applications, including selecting the best indigenous bumblebee species for rearing to improve crop pollination. Currently, four species have been selected by this project and are being reared through their complete life cycles at the institute in Beijing. They are now being used in trials with fruit crops on local farms. But one of our first aims is to provide identification tools. We are in the process of writing keys to help with the identification of all of the bumblebee species in China, as well as working on mapping their distributions. We hope to complete a preliminary atlas of the bumblebees of China in 2017. We will then be in a position to assess all of the species for their IUCN Red List threat status.

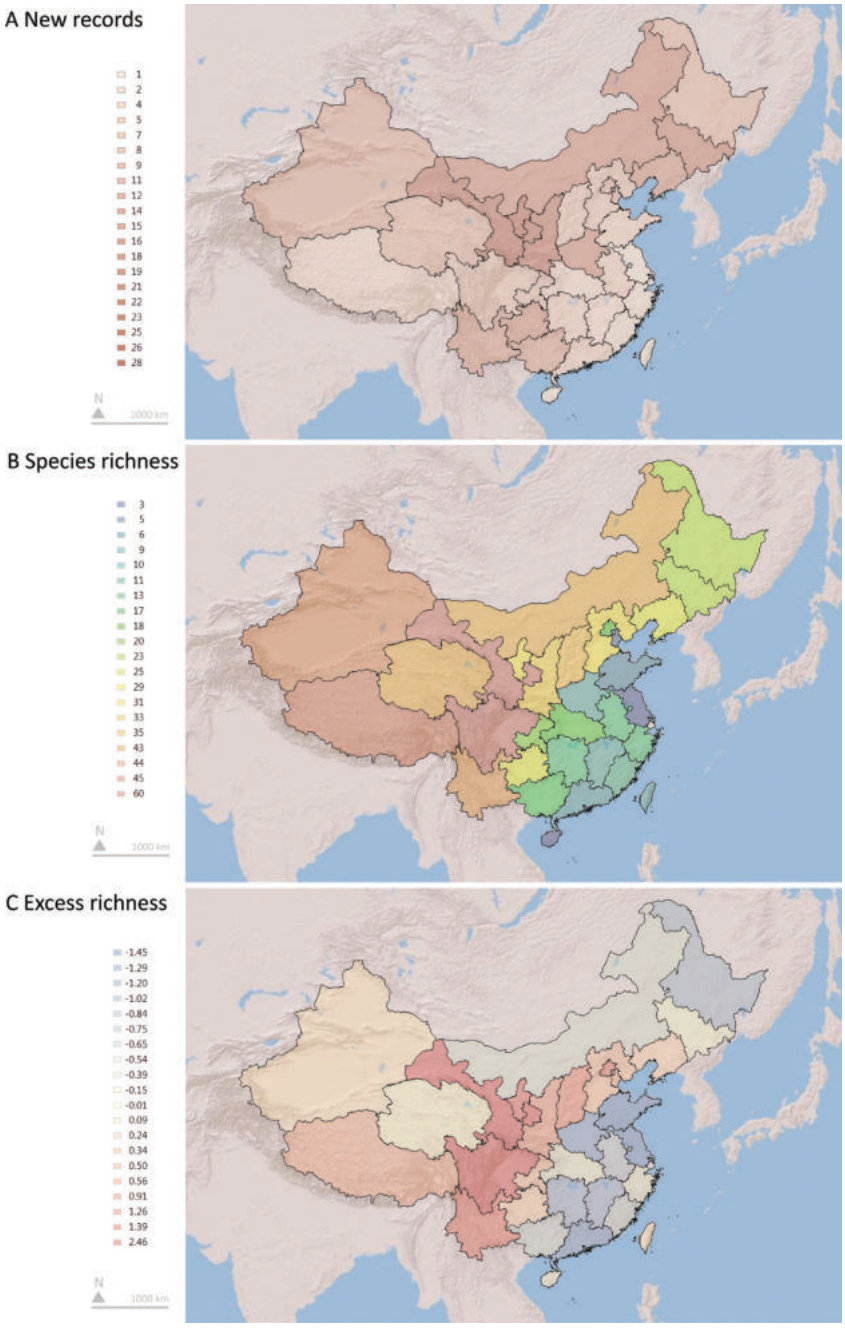


Fig. 5. Maps of the distribution of bumblebee species in China: (A) increase in recorded numbers of bumblebee species per province between 2007 and 2016; (B) total numbers of bumblebee species recorded per province by 2016; and (C) excess in the numbers of bumblebee species per province in relation to the numbers expected for the size of the province (calculated as standard residuals from the country-wide relationship, from a linear model fitted to semi-log-transformed data, which explains more variance than using log-log transformed data). Image created in ArcGIS using World_Shaded_Relief basemap © 2014 Esri.

FURTHER READING

An, J.-D., Huang, J.-X., Shao, Y.-Q., Zhang, S.-W., Wang, B., Liu, X.-Y., Wu, J. & Williams, P.H. (2014). The bumblebees of North China (Apidae, Bombus Latreille). *Zootaxa*, 3830, 1-89.

Huang, J.-X., Wu, J., An, J.-D. & Williams, P.H. (2014) Newly discovered colour-pattern polymorphism of *Bombus koreanus* females (Hymenoptera: Apidae) demonstrated by DNA barcoding. *Apidologie*, 46, 250-261.

Michener, C.D. (2007) *The Bees of the World (2 ed.)*. Baltimore, John Hopkins University Press.

Williams, P.H. (1998) An annotated checklist of bumble bees with an analysis of patterns of description (Hymenoptera: Apidae, Bombini). *Bulletin of The Natural History Museum (Entomology)*, 67, 79-152.

Williams, P.H. (2007) The distribution of bumblebee colour patterns world-wide: possible significance for thermoregulation, crypsis, and warning mimicry. *Biological Journal of the Linnean Society*, 92, 97-118.

Williams, P.H., Tang, Y., Yao, J. & Cameron, S. (2009) The bumblebees of Sichuan (Hymenoptera: Apidae, Bombini). *Systematics and Biodiversity*, 7, 101-190.

Williams, P.H., An, J.-D., Brown, M.J.F., Carolan, J.C., Goulson, D., Huang, J.-X. & Ito, M. (2012) Cryptic bumblebee species: consequences for conservation and the trade in greenhouse pollinators. *PLoSONE*, 7, 1-8

Williams, P.H., Huang, J.-X., Rasmont, P. & An, J.-D. (2016) Early-diverging bumblebees from across the roof of the world: the high-mountain subgenus Mendacibombus revised from species' gene coalescents and morphology (Hymenoptera, Apidae). *Zootaxa*, 4204, 1-72.

Society News

Council Matters

The President, Professor Michael Hassell, chaired the October 2016 meeting. The Registrar reported that the co-purchase of Daneway Banks SSSI with Gloucestershire Wildlife Trust was nearing completion. He explained the Society's desire to have a robust set of operating guidelines for the management committee, given the unique nature of the site and the input of both ourselves (as a learned society) and the wildlife trust. The Registrar said that he was continuing to pursue the matter of the leafcutter ant sculpture that the Society had purchased for Butterfly World, now that Butterfly World had closed. Mr Clive Farrell had been in touch with the Breheny Group and indications are positive. Council were advised that Dr Banfield-Zanin had accepted the role as Chair of the Membership Committee, with a meeting planned for spring 2017. Dr Banfield-Zanin along with Dr George were elected Vice Presidents for the 16/17 session. Council considered the remit and operation of the LJ Goodman Award.

Dr Tilley spoke to a written report on National Insect Week (NIW) and associated activities. Seventy two partner organisations supported NIW 2016, with 541 events on the week and 50 more taking place on adjacent days. A wide range of activities were undertaken across the length and breadth of the country, attracting 80,000+ members of the public to insect science. The events generated 581 press articles of various descriptions, from national newspapers, television and radio coverage through to regional and local press articles. Council duly commended Dr Tilley and the NIW team for fulfilling their remit to promote public awareness of the importance of entomology and enhance our public benefit activities.

The Honorary Secretary, Dr Murchie, gave a brief overview of our national meeting Ento'16, which was held at Harper Adams University in September 2016. One hundred and twenty delegates attended the three-day meeting. The meeting had been well-received by all who attended and, on behalf of Council, Dr Murchie expressed thanks to the convenors. He particularly noted the end-session on outreach that had some innovative elements, including a reading from 'Beetle Boy', an insect-centred novel, and a presentation by Ms Jess French, presenter of 'Minibeast Adventure with Jess' on the CBeebies channel. Ms Whiteford provided an update on progress with Ento'17, which is due to be held at Newcastle University with the Symposium theme of "Entomological Networks: Ecology, Behaviour & Evolution".

Royal Entomological Society – Natural History Museum Westwood Medal 2016: Dr Adam Slipiński and Dr Hermes Escalona

Andrew Polaszek

The Westwood Medal, named after John Obadiah Westwood (1805-1893), is a biennial award presented jointly by the Royal Entomological Society and the Natural History Museum since 2006. The 5th recipients of this award for excellence in insect taxonomy are Adam Slipiński & Hermes Escalona for their volume: "*Australian Longhorn Beetles (Coleoptera: Cerambycidae) Volume 1: Introduction and Subfamily Lamiinae*". On September 29th 2016 during the joint International Congress of Entomology and Entomological Society of America meeting in Orlando, Florida, it was our pleasure to present the medal to Adam, who also received it on behalf of Hermes who was unable to attend the meeting. This splendid monograph runs to over 500 pages, providing a comprehensive introduction to Australian longhorns, with keys to all subfamilies and a thorough treatment of the 74 Australian genera of Lamiinae. The book is thoroughly and beautifully illustrated, including a key to all the lamiine genera. We look forward to receiving nominations for the 2018 award, which should be sent to Andrew: ap@nhm.ac.uk

Adam Slipiński (centre) receiving the Westwood Medal from Archie Murchie (left) representing the Royal Entomological Society, and Andrew Polaszek (right), representing the Natural History Museum.

Ento'17 International Symposium & National Science Meeting

"Entomological Networks: Ecology, Behaviour and Evolution"

Newcastle University

Tuesday 12th to Thursday 14th September 2017

Celebrating 20 years since Ento '97 at Newcastle

The theme of *Entomological Networks* has implications at all scales within entomology from the role of genes in evolution of complex social behaviour, to the impacts of environmental change on species-interaction networks. The invited speakers will address topics across this range of scales.

Speakers who are currently confirmed include:

- Lars Chittka - Queen Mary University: Analysing plant-pollinator interactions with spatial networks
- Charlotte Miller & Sheena Cotter – University of Lincoln: Nutritional complexity and its role in the mediation of host-parasite interactions
- Audrey Dussutour - University of Toulouse: Recent advances in the integrative nutrition of ants
- Janice Edgerley-Rooks - Santa Clara University: Silk as armour and a web of adaptation (the Order Embioptera)
- Jenny Hodgson – University of Liverpool: Networks to enable species to survive climate change
- Mathieu Lihoreau – University of Toulouse: Nutritional interactions in insect societies
- Allen Moore – University of Georgia: The role of genes and networks in the evolution of complex social behaviour
- Ramiro Morales-Hojas – Rothamsted Research: New molecular approaches and the use of collections in insect molecular ecology
- Nicola Nadeau – University of Sheffield: How did the butterfly get its colours? The evolution and genetics of colour and pattern in *Heliconius* butterflies
- Ana Sendova-Franks – University of West of England: Ants as a model of social interaction
- David Shuker – University of St Andrews: Reproductive interference and the behavioural ecology of insects
- Nina Wedell – University of Exeter: Sex, conflict and selfish genes
- Yoshifumi Yamawaki – Kyushu University: Decision-making and motor control in predatory insects

The Keynote Presentations will be complemented by a range of symposium sessions on the following broad themes:

- Social insects
- Cognition
- Quantitative genetics
- Sexual selection
- Molecular Ecology
- Community ecology
- Ecological networks

If you have suggestions for other symposium sessions please contact one of the convenors.

In addition the meeting will see the first meeting of a new Special Interest Group for the Public Understanding of Entomology.

Registration and submission details will be available on the website (www.royensoc.co.uk/meetings) shortly and further information will be published in the next issue of *Antenna*.

Ento'17 Convenors: Gordon Port (Gordon.Port@newcastle.ac.uk) , Darren Evans (Darren.Evans@newcastle.ac.uk) Newcastle University, James Gilbert (James.Gilbert@hull.ac.uk) University of Hull

International Society of Hymenopterists – Distinguished Research Medal 2016: Dr Mark Shaw

Andrew Polaszek

At a meeting of the International Society of Hymenopterists (ISH) in Orlando, Florida, on 24th September 2016, Dr Mark Shaw of the National Museums of Scotland, Edinburgh, was awarded the Society's Distinguished Research Medal, presented every four years. Because Mark was not able to attend that meeting, as current ISH President I received it on his behalf from the Society, and was able to present it to Mark in person at a meeting at the Natural History Museum on 11th November 2016. Mark's impressive catalogue of achievements and publications that earned him this prestigious award is too extensive to detail here, so instead I quote verbatim from part of his nomination support letter, submitted by Gavin Broad, John Noyes (himself a former recipient) and Jose Fernández-Triana: "For those of us seriously interested in parasitoid biology, Mark Shaw is quite a hero. He has probably done more than anybody else to explore the biology and taxonomy of ichneumonoid wasps in terms of how they fit in their environment. Mark is intensely interested in what these wasps do, and has spent his life tackling this with amazing rigour. Over the years, Mark has built up a collection of reared Ichneumonoidea that is on a par with Dan Janzen's rearing programme in Costa Rica, but Mark has done it single-handedly, and has reared extensively from Coleoptera and spiders, in addition to Lepidoptera." Indeed Mark's meticulous programme of rearing parasitoid from their hosts has solved a huge number of problems in our understanding of parasitoid biology, and consequently their taxonomy. When attempting to identify difficult ichneumonoids reared from known hosts, Mark's publications are so often my first port of call.

At the medal ceremony at the NHM in November, Mark also treated us to an excellent and enjoyable seminar "Host range in koinobiont ichneumonoid wasps as parasitoids of European Lepidoptera". Thank you Mark, on behalf of the International Society of Hymenopterists, and all your other international entomologist colleagues and friends, for your very distinguished achievements, including those still to come.

Mark Shaw receiving the International Society of Hymenopterists Distinguished Research Award from Andrew Polaszek.

Mark (centre) with Gavin Broad (left) and John Noyes (right), two of his nominees for the award.

Wigglesworth Award 2016

Archie K. Murchie (Hon. Sec.)

The Wigglesworth Award was presented to Professor John Hildebrand of the University of Arizona at the 25th International Congress of Entomology in Orlando Florida in September 2016. The Wigglesworth Award is one of the Society's highest honours and is for outstanding services to the science of entomology. More specifically, it is awarded to an individual whose work reflects Professor Sir Vincent Wigglesworth's exceptionally high standards of involvement in every aspect of research. Professor Hildebrand's research aims to understand the olfactory basis of insect behaviour that impacts both positively and negatively on human health and welfare. In doing so, he oversees a multidisciplinary programme incorporating: neurophysiology, behaviour, chemical ecology, anatomy, molecular biology and embryology. His Wigglesworth Memorial Lecture was titled '*How Insects Smell, and Why We Should Care*' and was the best attended plenary lecture at the whole of the International Congress. At the conclusion of the lecture and on behalf of the Society, Professor John Pickett, Honorary Treasurer and former RES President, presented Professor Hildebrand with the Wigglesworth Medal. The Society is very grateful to the organisers of the International Congress and the Entomological Society of America for facilitating the lecture and by providing such an ideal slot in their

Professor John Hildebrand of the University of Arizona (right), the 2016 recipient of the Wigglesworth Award, receives the Royal Entomological Society's Wigglesworth Medal from Professor John Pickett (left). Photograph courtesy of the Entomological Society of America.

Professor John Hildebrand pays homage to Professor Sir Vincent Wigglesworth during his lecture, '*How Insects Smell, and Why We Should Care*'. Photograph courtesy of the Entomological Society of America.

Honorary Fellowship for Professor Phil Mulder

It was the Society's pleasure to convey an Honorary Fellowship on our colleague, Professor Phil Mulder from Oklahoma State University. Professor Mulder is an extension entomologist with considerable research and advisory experience on a wide range of agricultural and horticultural pest problems. He is Department Head of Entomology and Plant Pathology at Oklahoma State University and a past President of the Entomological Society of America. Professor Pickett took the occasion of the Wigglesworth Lecture to invite Professor Mulder on stage to congratulate him on receiving an Honorary Fellowship.

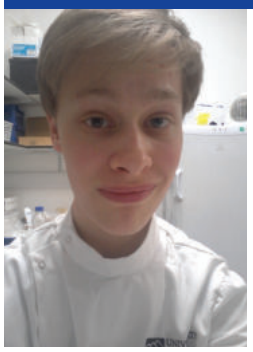
Professor Phil Mulder (left) is congratulated by Professor John Pickett (right) on being awarded an Honorary Fellowship by the Society. Photograph courtesy of the Entomological Society of America.

The Royal Entomological Society MSC Scholars 2016

The Royal Entomological Society has for many years provided scholarships to aid aspiring entomologists wishing to study the MSc in Entomology, first at Silwood Park and since 2012 at Harper Adams University. Thanks to their generosity, the number of students applying to the course and taking up a place on the course has been increasing year on year. We are incredibly grateful to the Royal Entomological Society for their support and it is an indisputable fact that the availability of these scholarships has helped swell the numbers of entomologists graduating in the UK. We had an incredibly tough time deciding who to award the scholarships to and after much soul searching picked the following from a very competitive field.

Here they are in their own words.

Jack Cox



I have selected to study the MSc Entomology at Harper Adams University as I believe insects are the most important taxa in terms of being a vital component of any ecosystem. I also have a burning passion for the subject. It has been my goal to be able to take entomology into a career, and by focusing the majority of my undergraduate degree in Zoology (at the University of Derby) towards entomological areas, I know that this is the area I want to contribute to in the future. For my BSc Zoology I took part in an independent study focussing on sexual selection, specifically female aggression, in the Mediterranean field cricket *Gryllus bimaculatus*, and how age and mating status may affect aggression levels. As a whole female aggression has only recently come to light in the past few years, and scientific knowledge is not clear on this topic. I am currently aiming to publish a manuscript on this topic with my undergraduate independent study tutor Professor Karim Vahed and Dr. Mark Bulling.

Now I am looking to delve into the many areas of entomology and vastly improve my knowledge on vital topic areas. The modules which interest me the most are Ecological Entomology as I believe conservation of insects is a key priority and improving knowledge on interactions between insects and other organisms would be of great benefit to me. Insect Physiology and Behaviour is also of interest as animal behaviour is a topic that I thoroughly enjoyed during my undergraduate degree. I like to try and find explanations as to why animals behave the way they do and how they are adapted to their environment. In addition the Biology and Taxonomy of Insects module piques my interest because I would like to increase my knowledge on the overall taxonomy of insects, as I feel this is such a complex topic that lacks attention in undergraduate studies and the professional workplace. However I would thoroughly enjoy all of the modules being offered.

Words cannot describe how grateful I am to be awarded one of the Royal Entomological Society bursaries to study the MSc Entomology at Harper Adams University. Gaining this receipt has made a huge positive difference to my life, as I would find it difficult to obtain the necessary resources without financial support. Therefore being successful in obtaining this receipt means that I am now able to partake in a fantastic opportunity to pursue my career goal of undertaking entomological research in the future, or potentially going into higher education teaching. As the MSc Entomology is tailored towards what I am looking for, it will allow me to gain many valuable skills and experiences which I can utilise in the future.

I would like to personally thank the Royal Entomological Society and Bursary Selection Committee for giving me this amazing opportunity, as well as all of my friends and family for the support that they have given me throughout.

Siobhan Hillman

Entomology is a subject I discovered a passion for during my time at University. I have studied multiple different aspects of this field of study through completing modules such as an applied entomology module in my third year which has led me to attend a variety of events. These activities range from presenting research on a mate guarding experiment with field crickets at the Royal Entomological Society's annual Orthoptera meeting as well as speaking about my own journey into Entomology at the 2015 annual Derbyshire and Nottinghamshire Entomological Society Exhibition. I have conducted freshwater ecological surveys for the Ecological Consultancy and Applied Entomology modules and have attended a number of different identification workshops. I volunteered at the local museum and art gallery as a Nature Ambassador, interacting with the public and with cataloguing the entomological collection, as well as helping with pest management with the Museum and University collections. I have enjoyed every aspect of these studies and wish to continue them at postgraduate level. During this time I hope to find an aspect of Entomology I would like to focus on with intent of further study and potentially a future career.

For my dissertation I researched host plant resistance in a number of brassica species against the cabbage aphid, *Brevicoryne brassicae*. This led me to want to take the Commercial & Practical Biological Control and Pesticide Technology modules. I believe these two modules would enhance what I have learnt and become passionate about through my research. I am interested in the Ecological Entomology and Biodiversity & Ecosystem Services modules as I have developed an interest in research regarding the impacts of insects within ecosystems and their role in the health of the environment. I am also eager to begin work on my independent research project and I am hoping these modules will help me solidify and pursue my ideas for the project.

I would like to thank the Royal Entomological Society for awarding me the bursary as it has given me the opportunity to focus on my studies without any financial concerns. With more of my time dedicated to my studies, I will be able to work towards further postgraduate study and increase my future career prospects. It is my passion and dream to inspire future entomologists and teach in this field. In the future I wish to create a teaching programme and this bursary will help me towards my goal by enabling me to attend conferences and events which would improve my network of professionals and other contacts that may help with this. This may also lead to opportunities I may not have had the chance to experience before and would also help me to improve my skills and knowledge of fields of research that I may not have otherwise ventured into.

Dani Klassen

I am thrilled to receive the Royal Entomological Society Bursary to study for an MSc in Entomology at Harper Adams University in 2016. Here is the story of how I became interested in this subject.

I grew up petrified of all insects (especially anything that could fly in my face) and I hated getting dirty. Dirt under my fingernails made me shiver. Bugs in my hair made me want to cry. I called myself a nature girl but I preferred to commune with nature from inside a clean and bug-free cabin in my home country of Canada.

Something changed during my undergraduate biology programme at the University of Alberta when by chance—I needed something to fill a gap in my schedule—I took a module called Insect Biology. I discovered a world that I never knew existed and each insect I learned about was so unique and so ideally suited to its environment that I fell in love with science, and specifically with entomology.

For the last year-and-a-half I have been a science teacher in Budapest, Hungary. I was lucky enough to teach 10-12 year olds about science while encouraging them to actively explore their natural environment. In my free time, I exercised my newfound interest in bugs by volunteering at the Hungarian Natural History Museum in the Hemiptera collection (specifically with Cicadellidae) where I learned about curating the specimen collection.

My interest in entomology—and tolerance for getting dirty—continued this summer when I worked on Dr Sarah Beynon's Bug Farm in Wales. I constantly had dirt under my fingernails as I worked long days setting bug traps and counting and recording insect patterns. When I washed my hands, the water that cascaded down my arms was dark. I loved it. Working with insects felt like an adventure to me. No other field of study feels so undiscovered and yet so important to the future health of our planet.

The modules I'm most looking forward to at Harper Adams are *Commercial and Practical Biological Control* and *Diversity and Evolution of Insects*. The first one appeals to my practical side: I wonder how we can use biological control to reduce the use of chemical pesticides without creating a massive chain reaction that collapses local populations. The second module interests me because I'm interested in the origins of animals. Learning how insects are uniquely suited to their habitat, and how they respond to a changing environment is of great interest to me.

The RES scholarship makes a big difference in my ability to focus on my studies this year and gives me the confidence that I am making the right decision about my field of study. I am an international student and although Harper Adams provides good value for money, the programme stretches me financially, especially after working for modest wages in a Hungarian school for the last 18 months and volunteering at the Bug Farm this summer. The RES scholarship allows me to focus full-time on gaining experience in fieldwork and labwork outside of instructional hours, and enables me to gain a wide range of valuable experiences leading to a future career in entomology. I am looking forward to a productive, challenging, and fascinating year studying entomology at Harper Adams University.

Hattie Horsler

My interest in the natural world and desire to study led to the decision to undertake a Masters in Entomology at Harper Adams University. Insects account for around 80% of all animals on earth, with the exciting prospect of new discoveries. They form the infrastructure which makes human life possible though the provision of ecosystem services and the importance of these organisms is great despite their size. Like the Royal Entomological Society, I believe that there is a fundamental relationship between insect ecology, conservation, human health, forestry and food production and I wish to gain and propagate knowledge of and about insect science.

I am committed to wanting to achieve and feel determined that the course will improve my professional skills and career prospects. Having studied 'BSc Countryside and Environmental Management' at Harper Adams at undergraduate level, I am aware of the high quality teaching and excellent facilities offered at the university.

Course modules of particular interest include 'Commercial and Practical Biological Control' as a placement year with a small farm environmental consultancy provided experience of working on farmland in connection with the Campaign for the Farmed Environment. Integrated Pest Management is essential for sustainable agricultural production, as chemical methods of control have a history of adversely impacting non-target species. This module would be very useful as agro-chemical companies may be potential future employers. Having undertaken a literature review regarding the effects of neonicotinoids on European honey bees as part of final

year module 'Applied and Conservation Ecology', taught by Rob Graham and Nicola Randall, I have an understanding of the controversy surrounding widely-used pesticides. I found research gaps concerning bumblebee and solitary bee species and would be keen to conduct further research in this area.

'Ecological Entomology' encompasses major international issues, such as insect conservation, which I am passionate about. I have supported Butterfly Conservation for several years and find the state of macro moths in the U.K. disturbing: since 1980s trends indicate rapid decline of species such as the Garden Tiger *(Arctia caja)* as a result of weed spraying. Forest insects, like the great spruce bark beetle (*Dendroctonus micans*) threaten commercial timber production. Other pests such as the Asian longhorn beetle *(Anoplophora glabripennis)*, affect the aesthetic value of our iconic native tree species, and some impact human health, e.g. the Oak processionary moth *(Thaumetopoea processionea)*. These issues may become intensified with future projections of climate change and this module content will be important for potential consultancy work.

The 'Biodiversity and Ecosystem Services' module continues from my final year module 'Ecosystem Services and Environmental Resource Management' as I have covered the Millennium Ecosystem Assessment and wish to expand my knowledge of the fundamental role of insects in supporting services like soil formation and regulating services such as pollination enabling food production.

I am extremely grateful and proud to receive the prestigious scholarship from the Royal Entomological Society. The award will enable me to pursue my academic goals. I will invest in the following: survey equipment for practical work; a professional camera for photographing insects and recording observations; literature from authors of particular interest, such as Dave Goulson, and identification handbooks published by the Royal Entomological Society. I have completed a 'Pesticide Foundation Module (PA1)' course and aim to gain a 'Hand-held Applicator – knapsack (PA6)' certificate, as this may be required by future employers.

The scholarship will fund membership of the Royal Entomological Society, British Dragonfly Society and Butterfly Conservation, as well as offer an opportunity to

Maximillian Tercel

My interest in the natural world, and specifically insects and other terrestrial arthropods, was apparent shortly after I learnt how to walk, and my capacity to *remain* interested in entomology surpasses all other subjects I have come across. Though I would not consider myself an 'expert' in the subject, I began reading books about insects when I was very young (many of these were figure-rich texts!) and have continued this trend to date, even increasing it at Harper Adams University. I also keep three tarantulas (*Poecilotheria ornata*), much to my housemates' dismay. I am therefore studying entomology because it is my long-standing subject of interest and the idea of working with, reading about and interacting with insects on a day-to-day basis is what I have wanted to do since a very early age.

My entomological interests are very broad, but I have a particular love for orthopterans, odonates, neuropterans in the family Mantispidae, hymenopterans, and, of course, coleopterans; I by no means find any other Order boring though! I feel I have so much to learn about every facet of insects and their ecological interactions, that limiting myself to only those Orders would be detrimental to my education. I am therefore hotly looking forward to many aspects of my course at Harper Adams University. Five modules catch my attention over the remainder. *Insect Physiology and Behaviour*, *Diversity and Evolution of Insects*, and *Biology and Taxonomy of Insects* intrigue me because they are areas where I have some knowledge, but I want to learn more; they will give me an excellent foundation of understanding which I can build, and base future learning and ideas upon. *Ecological Entomology* interests me because of the diversity of ecological interactions within this single taxon and the importance of these interactions in relation to ecosystems; I am not very well versed in this subject though and feel I will benefit hugely from this module. Though I am able to identify to Order level in native British insects (most of the time!), and a few select families, my field identifying skills could be greatly improved. Moreover, *Biodiversity and Ecosystem Services* would build on the ecological aspect and would hopefully fill the insect-shaped gap in my knowledge pertaining to insects and ecosystem services.

Having been awarded the Royal Entomological Society scholarship, I now have a huge mandate to succeed academically; to surpass any of my previous academic achievements. My drive is to become an entomologist and tuition at Harper Adams University, supported by a scholarship from the most prestigious entomological society in the world, brings me closer to that goal than I could have imagined as a child; receipt of this scholarship substantiates that dream and not only makes studying possible, it removes preoccupations about other funding and will allow me to excel academically.

Thank you.

Climate Change Special Interest Group

2nd November 2016

The Mansion House

Richard Harrington and Keith Walters (Convenors)

The sixth meeting of the Climate Change SIG was held at The Mansion House. For many delegates it was their first visit to our impressive HQ. The primary objective of the meeting was to assess progress in generalising responses of insects to climate change and hence in predicting how species which have not been directly studied might be affected.

Invited speaker Stephen Thackeray (Centre for Ecology and Hydrology; pictured) set the scene by discussing a large multi-partner project involving 10,000 time-series from a wide range of insect and other taxa, which aimed to reveal patterns in the climate sensitivity of seasonal events. Using a new analytical methodology, he reported that most of these events varied in direction (earlier or later) in response to climate at different times of year but, overall, the vast majority occurred earlier. Advances were greatest for primary producers, followed by primary consumers, then secondary consumers.

Scott Hayward (University of Birmingham) provided evidence that the diapause characteristics of insects can be affected dramatically by increasing temperature, leading to reduced winter and spring survival.

Paul Parham (University of Liverpool) and Chris Sanders (The Pirbright Institute) spoke about disease vectors. Paul reported the early stages of time-series analyses across many countries looking at the relationship between Zika virus (transmitted by *Aedes aegypti*) incidence and El Nino. Chris showed, using long-term data from the UK, how the flight season of *Culicoides* vectors of bluetongue virus has increased over time, reducing the length of the "vector free period" during which it is safe to move sheep and cattle during an outbreak.

Five excellent posters provided a focus for lunch-time discussions, together with a spectacular display of some of the Society's old and rare books, kindly laid on by Librarian Val. Work presented by Jake Bishop (University of Reading) predicted that pollination will generally increase with temperature until a threshold temperature (varying with species) is reached, beyond which it will decrease. Liam Crowley (University of Birmingham) outlined the opportunities presented by the new Free Air Carbon Enrichment (FACE) facility at the Birmingham Institute of Forest Research. Tom David (Rothamsted Research) showed how he planned to use the Park Grass long-term experiment to assess the impact of soil nutrition on trophic interactions involving pollinators. Simon Mills (University of Sheffield) used data on 11 species from five European butterfly

monitoring schemes to show that populations towards their latitudinal range edges are more sensitive to changes in climate than are populations towards the middle of their range, with populations at southern range edges being especially sensitive. Using 20-year datasets on sycamore budburst and on abundance of two species of sycamore-feeding aphids, Vicki Senior (University of Sheffield) examined the differential temperature responses that may be driving phenological mismatches in a changing climate.

Our second invited speaker, Ally Phillimore (University of Edinburgh), opened the afternoon session with a thought-provoking talk on how, through analysing changes in phenology in space and time separately, tentative conclusions may be drawn about the relative roles of phenotypic plasticity and local genetic adaptation in producing these changes. Potentially this provides a useful method for generalisation and prediction.

Jon Bridle (University of Bristol) explained evolutionary shifts in host plant use by the Brown Argus butterfly in response to climate change. Butterflies in long-established parts of their geographic range typically lay their eggs on the locally most abundant host plants (Rock Rose in this case), whereas butterflies in recently colonised areas show a consistent preference for a host plant species that is geographically widespread in the region of expansion, even if locally rare (*Geranium* in this case). The data showed that future warming is likely to bring about major restructurings of patterns of diversity within species, which may limit the potential for populations to continue to evolve.

Our overseas delegate, Lars Pettersson (Lund University), reported shifts in the distribution of 571 Swedish butterfly and moth species between 1973 and 2013, demonstrating that the rate of northward range expansion is less than the rate of temperature change, the lag increasing with latitude. This suggests that other factors such as climate and habitat connectivity limit survival more severely further north.

Last but not least, Julie Ewald (Game and Wildlife Conservancy Trust) described changes in the abundance of cereal invertebrates since 1970 from a long-running study in Sussex. Of 26 groups examined, 11 proved sensitive to extreme weather events but numbers quickly recovered. Some trends correlated with spring temperature and rainfall but changes in pesticide usage generally explained a greater proportion of the annual variation in abundance.

The day concluded with Scott Hayward leading a discussion drawing together the various strands of the meeting to identify common themes in current work, emerging threats that should be drawn to the attention of policy makers and gaps in our knowledge base which, if filled, will help strengthen our predictions of the impacts of climate change.

Common themes in recent work include changing phenology and the resulting spatial and temporal aspects of synchrony. The clear gap in our understanding of the consequences of climate change in autumn was identified as a candidate for further research. Genotypic variation was also discussed and the question of whether it generates resilience was thought to be an area that needed further research.

Discussion of phenology and genotypic variation led on to consideration of spatial scale, important questions including those around species resilience, for example whether a large spatial range of a species offers a buffer against climate change, and the importance of temperature differences that operate over small spatial scales. It was suggested that one approach might be hindcasting, for example by predicting the past habitats of butterflies in agricultural landscapes and checking the predictions against records. The importance of integrating an improved understanding of the impacts of CO_2 when considering other questions was also suggested as a priority.

Work on trophic interactions was considered to be an area requiring further attention, in particular an improved understanding of how changes in predator phenology cascade through systems. It was recognised that studies of trophic interactions are often limited by availability of plant data. It was also suggested that greater attention should be paid to the responses of symbionts to climatic changes, as these can have a major impact on individuals and on trophic interactions.

Apart from identifying targets for future research, the science presented had provided important information for policy support on ecosystem service provision, disease vectors and conservation, each of which should be drawn to the attention of appropriate departments.

At one time we were concerned that the HQ meeting room might be too small for a SIG which, in the past, has attracted 100 or more. Whilst we may have been a little disappointed (and puzzled) by the low number of delegates (18), it was more than made up for by their quality. Feedback on the meeting was excellent and there is no doubt that useful new links were made amidst the coffee-break and lunch-time chatter.

A full programme, abstracts and most of the presentations are available on the website.

With one of us retired and the other not having climate change as a front line interest, we are delighted to report that Scott Hayward, University of Birmingham, has agreed to take over as convenor of this SIG.

Aphidophaga 13

Helmut van Emden
University of Reading

The 13th in the "Aphidophaga" series of international conferences on the biology and ecology of the natural enemies of aphids was held from 29th August to 2nd September 2016 at the Technical University of Munich. The campus is situated at Weihenstephan, on the outskirts of the attractive small Bavarian town of Freising (Fig. 1), populated by some 200 life-size sculptures of bears and situated conveniently near Munich International airport. The organisers had negotiated discounted rates with several of the town's hotels, and an efficient and punctual bus service took one to the Forestry Center, where the meeting was held. Also, detailed advance information on the programme, accommodation, venues and travel had been sent out by e-mail, making one's arrival to hotel and conference very simple.

The facilities were very good for such a meeting. The lecture room (Fig. 2) was at the end of a wide corridor with ample space for the posters to be displayed (Fig. 3), also forming the area where refreshment breaks (the cakes were ace!) were held. Nearby was the registration desk, staffed by a very helpful team. The members of this "Aphidophaga team" (as identified on the back of their "uniform" green sweatshirts) were very helpful administrative staff and students; whether at breaks, in the auditorium or on activities outside the campus and on the coaches, they were always in evidence to give assistance and provide information. This "Green Team", as many of us called them, was a quite brilliant idea by the organisers. It was also very helpful that the registration pack included all the bus tickets and luncheon vouchers one would need.

The Aphidophaga series of triennial conferences was founded in Prague by Dr Ivo Hodek of the then Czechoslovakia in 1965 and has been a great success. Because of the narrow focus of the meetings, participants find something of interest to them in most of the presentations, and so the scientific reward of attending tends to be rather high compared to that at more general meetings. It is more like a

Fig. 1. Main square in Freising. Inset: one of the many life-size painted bear sculptures scattered around the town.

Fig. 2. The conference lecture room (spot three UK participants?).

much extended RES Special Interest Group meeting. Indeed, there is quite a core of participants who have attended several or even many times. However, this year I found myself the sole representative of that first 1965 meeting among the 75 participants from 24 countries (including 6 from the UK) at Aphidophaga 13.

Both oral and poster presentations were assigned to one of five sections, viz. Invasive Aphidophaga, Chemical Ecology, Parasitoids and Biocontrol, Predators and Biocontrol, and Behavioural Ecology. There were six plenary lectures (2 from UK participants) of 45 min; offered presentations were allocated 20 minutes including discussion. In all there were 35 oral and 38 poster presentations – it is clearly impossible for me to list them all and invidious to single out names – except perhaps that of Paul Lenhart of the University of Kentucky, whose presentation on "Effects of an aphid's toxic defensive phenotypes ripple through the natural enemy community" was awarded the prize for the best presentation by a post-doc. However, just to give some flavour of the other scientific presentations, I can pick out four items from contributions which I found particularly novel – to me, that is; no doubt every participant would make a different selection. One was that the invasive *Harmonia axyridis* was adversely affected by feeding on cowpea aphids containing toxins from their host plant, whereas the indigenous ladybirds were not so affected. Second was the need for the predatory midge *Aphidoletes aphidimyza* to have spider webs available in glasshouses from which they could dangle for mating. Third was the statement that phloem sap is bacteriologically sterile (is it true?). Lastly, I wondered whether the very contrasting times taken for *Aphidoletes* and *Aphidius* parasitoids to complete successful parasitisation after ovipositor insertion was due solely to their very different ovipositor lengths.

Presentations at Aphidophaga do often get the brain buzzing, but they also provide the "excuse" to hold a meeting with plenty of opportunity for informal networking; opportunity at least as valuable as the formal sessions. Again the narrow focus means that participants are bound to have lots in common. Lunch breaks were such an

Fig. 3. The corridor where posters were displayed.

Fig. 4. The quartet accompanying the beer tasting and poster session.

opportunity, but the organisers had also provided plenty of others.

After lectures on the first day (Monday), there was an extended poster session. During this, two beers brewed by the world-famous Department of Brewing and Beverage Technology at the University were tasted, with musical accompaniment by a quartet in traditional Bavarian dress (Fig. 4). This was followed by a real highlight – three superb quality close-up videos made by Professor Urs Wyss of parasitoids parasitising and predators predating. Then it was a walk up the hill opposite the campus to reach the brick vaulted-ceiling cellar restaurant (part of Bavarian State Brewery Weihenstephan, the oldest brewery in the world founded in 1040) for a convivial "Welcome Dinner" (Fig. 5).

The Conference Banquet on the Tuesday evening involved a 15km coach ride to another restaurant able to cope with the numbers involved. We began with a champagne reception outside the building and then went inside for yet again an excellent and ample meal with live music in the background. I had deliciously cooked Bavarian beef for the second night running (no complaints!) – and another late night.

As is traditional, the Wednesday at Aphidophaga conferences is a break from presentations, and gives plenty of networking opportunity during an organised excursion. We travelled to Munich city centre in two coaches, where a professional guide boarded each coach for a tour of some of the major buildings, historic monuments and other sights. At the Nymphenburg Palace a conference group photograph was taken (Fig. 6) and the coaches returned there after further travel

Fig, 5. At the Welcome Dinner. Note how well the green sweatshirts of the "Aphidophaga team" stand out.

round Munich to park. From there we walked to a large open-air beer garden next to a deer park – here we enjoyed a 'stein' of beer with our lunch. In the afternoon, before returning to Freising, we split into two groups. One visited the Bavarian State collection of Zoology and the other the Munich Botanical Garden. I can only report on the second; it was guided by the scientific curator who really made it a most entertaining and informative visit.

Professor Wolfgang Weisser and his organising committee are to be congratulated on running a most rewarding and enjoyable conference. There were numerous novel touches and the organisers had thought of just about everything needed for the convenience of the participants.

Aphidophaga 14 will be held in Autumn 2019 in Canada at the Université du Québec à Montréal.

Fig. 6. Conference photograph at the Nymphenburg Palace in Munich (photo courtesy of TUM Weihenstephan).

SCHEDULE OF NEW FELLOWS AND MEMBERS

as at 7th December 2016

New Honorary Fellows
None

New Fellows (1st Announcement)
Dr Shao-Ji Hu
Professor Andrew Paul Gutierrez
Mr Ayman Ahmed Mohamed Elamin Ahmed

Upgrade to Fellowship (1st Announcement)
Professor Toby Johann Anselm Bruce
Professor Saskia Adriane Hogenhout

New Fellows (2nd Announcement and Election)
Agr. Moreno Dutto
Dr Jonathan Adam Newman
Dr Christoph Thomas Zimmer

Upgrade to Fellowship (2nd Announcement and Election)
None

New Members Admitted
Mr John Smith (as at 5-10-16)
Mr Nicholas Packham (as at 5-10-16)
Mrs Margaret Gill
Dr Bindiya Sachdev

New Student Members Admitted
Miss Amma Simon (as at 5-10-16)
Mr Stewart Rosell
Mr Julian Dudley Routh
Mr Dion Garrett
Mr Maximillian Tercel
Mr Scott William Martin
Miss Xiaorui Chen

Re-Instatements to Fellowship
None

Re-Instatements to Membership
Miss Rosalind Louise Caldwell

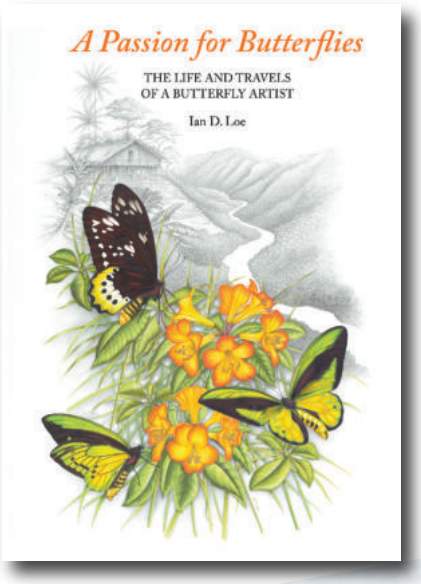
Re-Instatements to Student Membership
None

Deaths
Dr W G Tremewan, 2009, Cornwall
Dr J G Smith, 1969, Nr Salisbury
Dr Professor D S Hill, 1958, Skegness

Book Reviews

A Passion for Butterflies
The Life and Travels of a Butterfly Artist

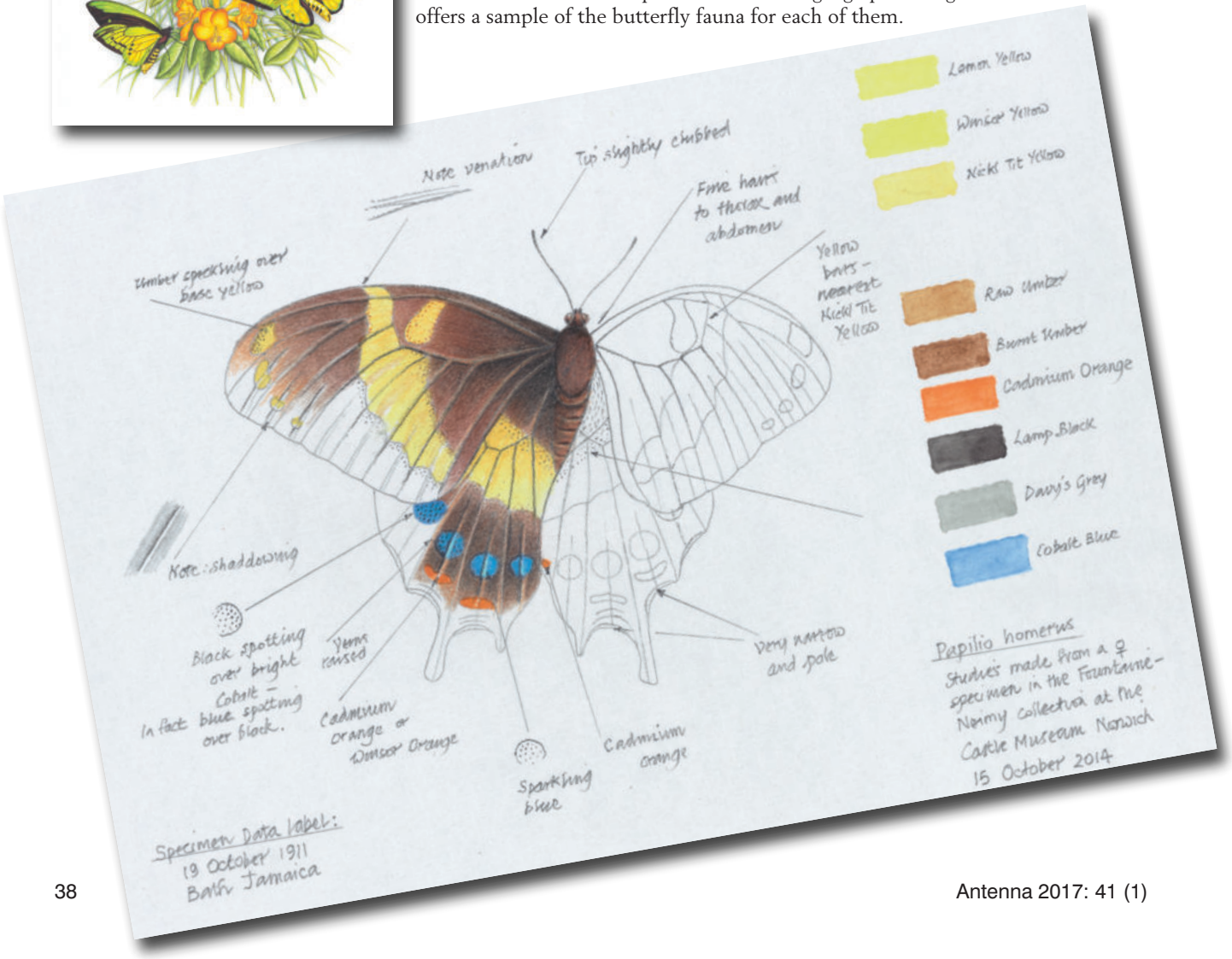
Ian D Loe
Loe Books
180 standard copies are available at £225.00
It is also available in Luxury and De-luxe editions
Enquiries to loe@loebooks.co.uk
ISBN 978-0-9954600-0-3

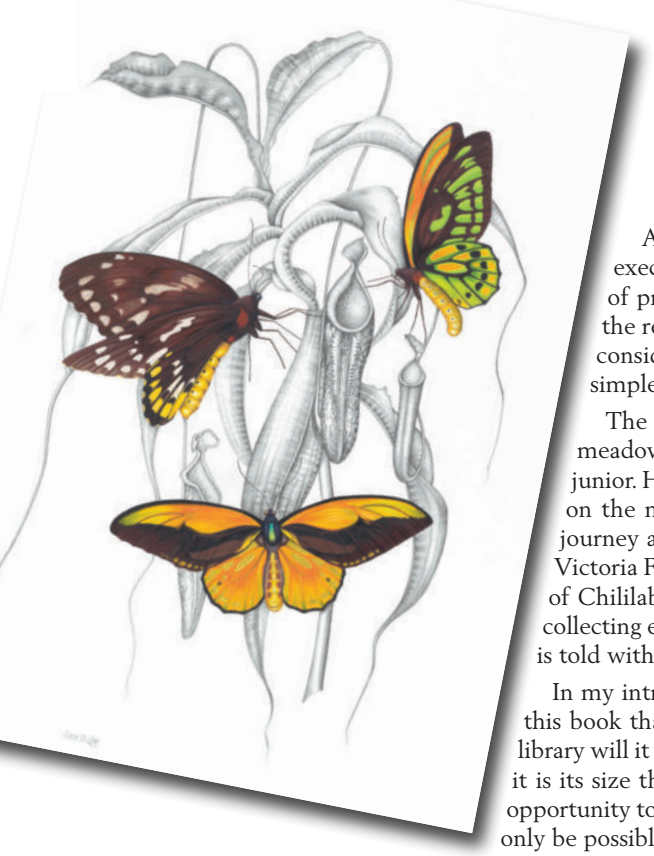


A Passion for Butterflies is more than a book, it is a legacy. A collection of the finest works that Ian Loe has produced accompanied by a potted autobiography that sets the paintings in a geographical and personal context.

The paintings are...? Here is the problem, the superlatives available seem tardy compared to the paintings that they are describing. Paintings of such vivid intensity, such minute detail. Paintings that bring the subject to life so well and set them in its natural surroundings. The artistic slight of hand that juxtaposes the brightly coloured butterflies against a finely detailed but monochrome background. Words such as brilliant, wonderful or superb seem woefully inadequate. So my best attempt is to say that the paintings are truly remarkable representations of some of the most charismatic insects in the biosphere.

In the first half of the book Ian's paintings accompany the biographical text which places the butterflies and landscapes he encountered in the context of his rich and colourful life. The second part focuses on the geographical regions he has visited and offers a sample of the butterfly fauna for each of them.





At the end of the first section Ian offers an insight into how he composes and executes the paintings, a theme which continues in the second half where a series of preliminary sketches are included with the final paintings. While this leaves the reader with an understanding of the process involved it is clear that there is a considerable amount of artistic alchemy involved in the metamorphosis of the simple but skilful mechanics of painting into the final vibrant images.

The text is a wonderful account of a vanished world, from the flower rich meadows of Bentley Prior and Ian's first publication to his time at Selfridges as a junior. His journey to Zambia to take up a teaching post, which included eleven days on the now legendary ship, the RMS Windsor Castle, a four and a half day train journey along the edge of the Kalahari desert and their final traumatic assent to the Victoria Falls station. His account of life as a teacher and naturalist in the mining town of Chililabombwe is full of amusing anecdotes, from his brush with authority while collecting emperor moths to the unfortunate incident of the Christmas Hippo. His story is told with humour and affection, revealing a deep passion for the natural world.

In my introduction I said this was more than a book and indeed there is far more of this book than the average tome, at 476 x 343mm it begs the question, where in your library will it fit and at just over 4kg, it is a book destined for your lower shelves. However, it is its size that enables Ian's paintings to be displayed at their very best, providing the opportunity to enjoy the images in the comfort of ones home in a way that would normally only be possible in a gallery.

A Passion for Butterflies is a masterclass in insect illustration, a stunning celebration of the beauty of the Earths butterflies and a reminder that if you take the time to look, there is beauty all around you. Anyone with even the slightest interest in butterflies must make the effort to at least see this book and for anyone with an interest in butterflies and fine books, this is the volume to obtain.

Ian Loe is to be congratulated on presenting his life's work in a beautiful and elegant format.

A copy of this book has very kindly been donated by the author and publishers to the Society's library, where it can be viewed by appointment with the librarian.

Peter Smithers

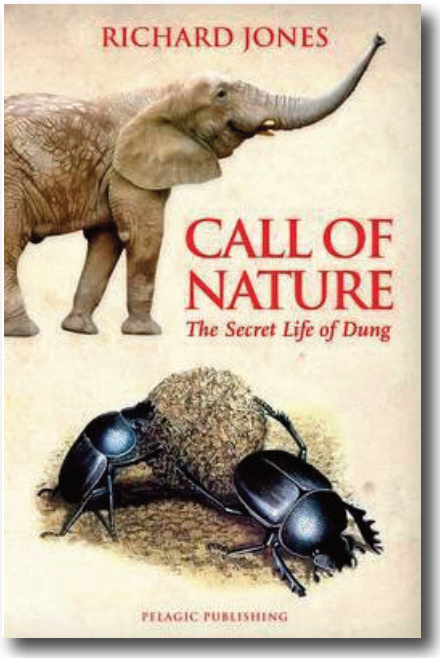
The Call of Nature: The Secret Life of Dung

Richard Jones

Pelagic Publishing

Price £16.99

ISBN 978-1-78427-105-3



In his preface Richard Jones offers a nostalgic account of his introduction to dung beetles. At the age of 10 while sat in his father's study, the tapping of *Aphodius rufipes* on the window drew his attention and triggered a life-long passion for beetles, and passion is what this book is all about.

Richard writes with unbridled coprophilic enthusiasm, producing an enthralling, entertaining and informative account of the biology of dung. It opens with a joke from Monty Python and closes with a dire warning that the stories offered in this book may become just that, stories of animals that are no longer with us. The journey between these points is littered with fascinating accounts that range from the deification of dung beetles in ancient Egypt to the dung beetles as saviours of the Australian grasslands, dung beetles on the African savannah that use the milky way to navigate by and spider beetles that have established a colony 300m underground in a coal mine where they utilise the desiccated dung of the miners that work there.

The Call begins with a brief review of the digestive process in both humans and other mammals followed by a discussion on the nature of the stool. The various modes of sewage treatment are then outlined followed by a review of the wide ranging uses of dung.

The next chapter looks at dung as an ecological resource, discussing the competitive strategies of dung users. This is followed by a breakdown of the dung beetle community by their *modus operandi*. The book goes on to examine the evolution of the dung feeding habit and who in the invertebrate world besides beetles utilises dung. Particular attention is paid to the ubiquitous cow pat, offering a vertical section through this habitat and then a history of the life and final degradation of an average pat.

The main text concludes with a discussion of some dung-related ecological disasters and the proposed solutions, concluding with a plea for a more appreciative approach to environmental management. The penultimate two chapters are more practical in nature and comprise an identification guide to the dung of a range of mainly vertebrates and a catalogue or Rogues Gallery of the dung-related fauna. The latter offers notes on: size, a description of the organism's salient features, life history and ecology, for each species. The final chapter is a Scatalogical dictionary.

The Call of Nature is an eloquent review of what is currently known of the biology of insects in dung. The author's sense of humour bubbles to the surface throughout the text offering an often mischievous counterpoint to the biology under discussion. Here is a book that may even render dung an acceptable topic in polite conversation. It is a must for anyone with an interest in the natural world who does not mind getting their fingers warm and fragrant.

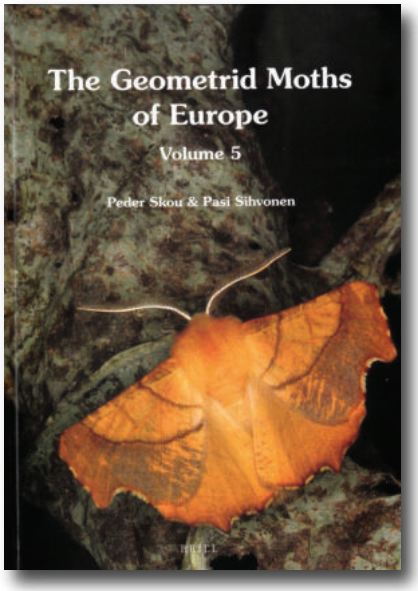
Peter Smithers

The Geometrid Moths of Europe, Volume 5, Subfamily Ennominae I

By Peder Skou & Pasi Sihvonen *in* Axel Hausmann (ed)

657 pp., Brill, Leiden

£185.00; €175; US$ 199.



Taxonomic series often fail to reach completion, with authors, editors and publishers running out of steam or resources well before the finishing line. The Geometrid Moths of Europe, however, seems as if it will be a notable exception as there is now only the final (sixth) volume left - and that is in preparation. This volume (number 5) offers us a top class taxonomic work. It also represents a substantive element of the whole series, which deals with over 900 species of Geometridae under the general editorship of Dr Axel Hausmann of the Zoologische Staatssammlung, Munich. The 657 pages of text and plates of the present volume represent the first part (about half the species) of the authors' taxonomic treatment of the European component of the largest of the world's geometrid subfamilies – the Ennominae.

Peder Skou and Pasi Sihvonen, the Danish and Finnish authors of the treatise, have distilled their considerable experience into this work, and it is worth noting that Peder Skou, as the original publisher of the series through Apollo Books, has been involved intimately with the project throughout its course. This volume comprises a critical taxonomic synthesis, incorporating much original knowledge. New taxa are described, revisionary changes made, distributional data mapped and notes on general biology (immature stages, foodplants, abundance and habitats) are provided. The work was conducted in an admirably collaborative environment, the authors acknowledging the many people who supplied information and expertise. Collaboration is as important in taxonomy as it is in other areas of science: indeed, with funding pressures as they are, the use of distributed knowledge and skills is more valuable than ever.

The book benefits from a valuable Introduction in which the higher classification of the Ennominae is reviewed. In summary, molecular analyses in recent years suggest that if Alsophilinae and Orthostixinae are included the subfamily is probably monophyletic. While progress has been made on resolving the classification below the subfamily level, much uncertainty remains. The authors provide a useful assessment of each of the 15 ennomine tribes represented in Europe, noting the limits of their taxonomic resolution. They consider morphological information and inform it with findings from molecular studies undertaken over recent years.

The substantive part (pp. 41-464) of the volume is composed of detailed treatments of 59 genera and 141 species of European Ennominae – the rest will follow in volume 6. The text is analytical throughout, providing us with an up-to-date, critical synthesis of this substantial group of Lepidoptera. Synonyms are listed under each genus and unavailable names are then noted. Diversity and distribution precede a detailed morphological treatment. These sections are followed by a paragraph on 'Biology', including mostly a listing of foodplants. Information on immature stages is then provided. Generic treatments end with some useful thoughts ('Remarks') on the taxonomic status and relationships of each genus: as with the tribes there remains considerable uncertainty on these matters. Pasi Sihvonen has contributed much to the area of geometrid classification, incorporating molecular studies into his broader morphological work.

Species treatments are structured in a fairly similar way to those of the genera, and in these sections the special depth of field knowledge of the authors is apparent. Peder Skou, especially, has undertaken extensive fieldwork in many parts of Europe over the years and the text benefits immeasurably from his own observations, and those of others, published and unpublished, on foodplants, phenology, distribution and habitats. For each species, similar species are noted and distinguished. In this volume, innovatively, 'genetic data' are recorded in the species treatments, by the editor, Axel Hausmann, in the form of comments on

genetic homogeneity and proximity to related species. Each species account also benefits from a map (dots and shading), showing its European distribution. The text is enhanced not only by the maps, but also by a further 149 text-figures designed to aid the identification of difficult taxa. In addition, the taxonomic treatments are followed by 16 plates composed of colour photographs of the adult moths, and 82 pages of black and white photographs of the male and female genitalia. In the male genitalia, the aedeagus is illustrated with the vesica both intact and inflated. The illustrations alone are a telling example of the time and effort that went into this publication: over 800 microscope slides were prepared and photographed by Pasi Sihvonen and the images post-processed; and all the moths illustrated were photographed individually, the images post-processed and then compiled into plates by Igor Kostjuk.

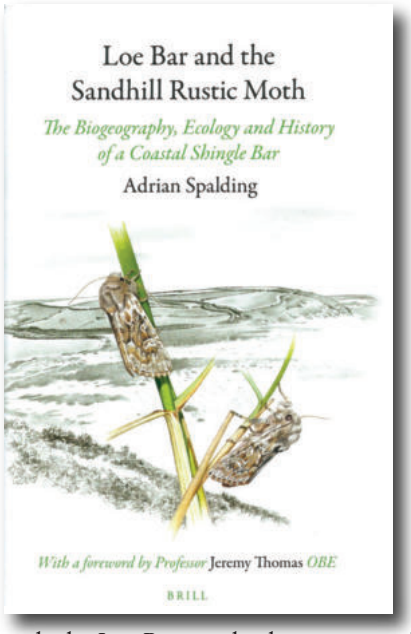
Three websites are associated with the project (noted in Axel Hausmann's Preface), providing access to a continuously updated checklist, digital illustrations and additional data. Such an online association combined with the printed volume offers an ecosystem of information of a kind slowly becoming mainstream in taxonomic work.

The volume is dedicated to the memory of Professor Niels Peder Kristensen, whose death eight months before the publication of the work has left the lepidopterist and wider entomological community bereft of an outstanding scientist and very special person. He would surely have been delighted to have seen this excellent volume published. The authors, editor, publisher and collaborators have done a most worthwhile job in delivering the study to all interested in this group of organisms. Moreover, they have provided a model of how synthetic taxonomic works should be undertaken.

Malcolm J. Scoble
Scientific Associate, Natural History Museum, London

Loe Bar and the Sandhill Rustic Moth: the biogeography, ecology and history of a coastal shingle bar

by Adrian Spalding FRES
Brill, Leiden, 2015, xxv + 346 pp, 57 photographs
£79.00, €75.00, US$ 97.00 published by Brill (hard cover)
ISBN 978-90-04-27029-9 (hard copy); 978-90-04-27030-5 (e-Book)



There is much to enjoy and learn from this charming yet scholarly book, written with lucidity and unparalleled knowledge by Adrian Spalding following many years spent studying one of Cornwall's and Britain's rarest moths on its single site in south-west Cornwall. For the population of Sandhill Rustics that breeds atop the sand and pebble bar separating the freshwater of Loe Pool from the sea of Mounts Bay is a unique British subspecies, *Luperina nickerlii leechi*, of this specialised and variable insect, found nowhere else outside a wiggling 300m x 25m strip of Sand Couch grass growing midway between Lands End and The Lizard.

But this is much more than one entomologist's love and expert study of a local treasure. As Adrian Spalding writes, "*this book is about two things - one* [Loe bar] *huge, dynamic, ever-changing but in itself lifeless; the other tiny, silvery-brown, living but often motionless … its mix of colours matching those of the pebbles on the beach. Whether you start with an interest in the large – the Bar itself – or the small – the moth – it becomes difficult to understand the one without the other.*" And so it does. Much to the enjoyment of the reader, Spalding integrates accounts of the geomorphology and history of the Bar with its natural history and extreme ecology. On the one hand we have beautifully illustrated accounts of Loe's haunting beauty, its dynamics and likely formation, as well as its impacts on humans, including a fascinating chapter on "Man and The Bar" that contains eight pages describing "Drownings and shipwrecks". On the other hand, through four chapters devoted to "Plants", "Sand Couch Grass", "Mammals, Birds and Invertebrates", and "Moths on Loe Bar", we learn of its natural history, its shingle flora, and why Loe Bar is indeed a very special Site of Special Scientific Interest. This sets the mood and environment of the second half of the book: a detailed account of the Sandhill Rustic moth's biology, and in particular that of the distinct subspecies at Loe which spends half of its larval life buried beneath 5-10 cm of sand, eating and tunnelling along the roots and rhizomes of Sand Couch. Here the tone is more scientific, but very readable, as Adrian Spalding distils the results of years of meticulous study into a clear and fascinating narrative.

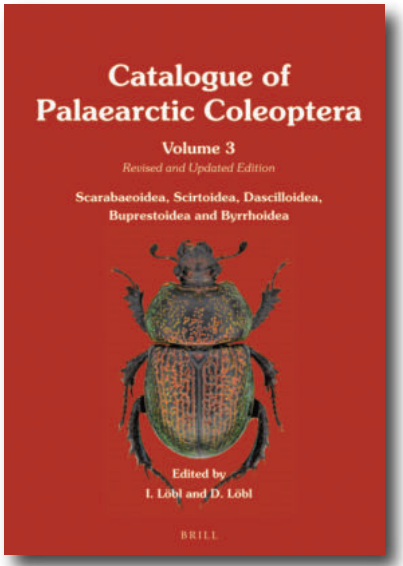
I warmly recommend this book to any entomologist who is interested in natural history and the British landscape. It provides insights into the fascinating world of insect specialisations, set within the context of landscape, history and the dynamism of the sea shore. But be aware that Brill, the publishers, have produced two versions of this book at a similar price. The one to buy is the hard-backed version containing a lovely cover painting by Richard Lewington in which the large majority of the 57 photos and 16 maps are illustrated in colour, as are many of its 26 figures: avoid the paperback version, illustrated in black-and-white throughout, identifiable by its plain yellow-and-fawn coloured cover.

Jeremy Thomas

The Catalogue of Palaearctic Coleoptera

Scarabaeoidea, Scirtoidea, Dascilloidea, Buprestoidea and Byrrhoidea

Edited by I. & D. Löbl
Published by Brill
Price: EUR: 123, US$: 159
ISBN: 978-90-04-30913-5
Revised and Updated Edition – E-Book



This, as with all the volumes of the *Catalogue of Palaearctic Coleoptera*, is a monumental piece of work and a must have for anyone working with Coleoptera, from ecologists to taxonomists. The contributing author list reads like a who's who of top-class coleopterists and demonstrates international collaboration at its best. The present volume includes 22,520 valid taxa and their synonyms, an increase of 2,120 names since the 2006 edition. The book follows the same format as before, with sections on taxonomic, distributional and bibliographic information, acknowledgements, editors and authors, new nomenclatural and taxonomic acts, and comments, catalogue and references.

The section on 'New Nomenclatural and Taxonomic Acts, and Comments' fills thirty-two pages, of which almost ten are dedicated to new combinations for the elevation in rank of *Aphodius* subgenera to genera as proposed by Dellacasa *et al.* (2001). Although these genera were already in use at the time of the first edition, many were hesitant to follow this change at the time. A shortfall of the previous edition and others in the series was that many of the proposed changes and new acts lacked supporting information. In this edition, I am pleased to see this has been improved. One of the most interesting comments, albeit rarely discussed, applies to commercially obtained material. In the case exemplified, an insect dealer provided mislabelled specimens; in this instance labelled 'China' when in fact the material originated from either Laos or Thailand. This resulted in the description of new species now considered 'problematic taxa'. This is an under-emphasised cautionary tale and one that taxonomists should take into consideration when describing taxa from commercially obtained material. There is now a huge international market for specimens and unfortunately not all dealers provide good quality data, with some merely providing vague locality names which rarely, if ever, are georeferenced or supplied with useful habitat data.

One of the 'comments' in this section which I found somewhat perplexing was that on the *Aphodius fimetarius* complex. There was a long and heated debate in the Bulletin of the ICZN concerning the usage of the names *Aphodius fimetarius* (Linnaeus, 1758) and *Aphodius pedellus* (De Geer, 1774). Some, Fery & Rössner being the most vocal, argued for the usage of *Aphodius fimetarius* (Linnaeus) (=*A. pedellus* sensu Wilson 2001) and *Aphodius cardinalis* Reitter, 1892 (=*A. fimetarius* sensu Wilson 2001). Although Rössner (2012) and Fery & Rössner (2015) presented an extremely strong and convincing case for this alternative, Opinion 2,345 of the ICZN (2014) decided in favour of the original usage. The *Catalogue* follows this Opinion, however, Fery in his comment suggests that "The users of this catalogue should feel free to make their own decision about the names which they use in eventual publications or when labelling specimens, but do so in an unambiguous naming of the two species." Surely this goes against one of the aims of this catalogue - nomenclatural stability. Although I agree with Fery & Rössner (2015), the battle was lost and the Opinion should be accepted so that stability is maintained.

The actual *Catalogue* takes up the bulk of the volume, and the arrangement follows the higher classification system of Bouchard *et al.* (2011) and Slipinski *et al.* (2011), with tweaks from more recent papers. Each species includes original combinations, a full list of synonyms and country level distributions, with Russia and China divided further. Each country is represented by a two or three letter abbreviation, so for example "Great Britain (including the Channel Islands)" is GB and Ireland is IR. In the case of introduced species the suffix 'i' is used, although it is not clear if the authors differentiate between established and non-established introductions. Being unfamiliar with the fauna of every country covered in this catalogue, I can only comment on the accuracy of species listed for "Great Britain (including the Channel Islands)" and unfortunately there are some minor errors. For this, I think our native entomologists (myself included) are partly to blame, rather than the contributing authors, as we've probably not made our comments and/or corrections of the previous edition known. Although, in 'our' defence, the UK checklist by Duff (2012) is freely available online but is not listed in the references.

There are several contradictory 'GB' listings between Duff's checklist and this *Catalogue*. In addition, by including the Channel Islands under 'GB', which are not covered by Duff (2012), there are several omissions, such as *Sericotrupes niger* (Marsham) (Geotrupidae), *Onthophagus vacca* (Linnaeus), *Rhizotrogus aestivus* (A.G. Olivier) and *Anisoplia villosa* (Goeze) (Scarabaeidae), which are well-known from the Channel Islands but not recorded from the mainland. The inclusion of *Coprimorphus scrutator* (Herbst) and *Subrinus sturmi* (Harold) as 'GB', when they are non-established introductions and so should not be listed, also deserves correction. Conversely, *Ptilodactyla exotica* Chaplin is listed as 'GB' when it should read 'GBi', as it is an established introduction. Furthermore, there are others listed by Duff (2012) as non-established introductions but given full 'GB' status in the *Catalogue*, and at least one species (*Onthophagus verticicornis* Laicharting) listed as an introduction 'GBi', when it is a recently extinct native.

My only criticism of the books' layout is the lack of the generic names at the top of each page on which they occur. This often requires the reader to flick back and forth between pages for orientation, especially when dealing with large genera (e.g. *Agrilus*) or several subgenera. This frustration becomes more apparent with the E-Book when using the search function for species names. The impressive 300 pages of some 6,592 references may seem a waste of space to some, but this provides an

essential bibliography for Palaearctic beetles. Although there are indices for family-group and genus-group names, there is no index for species-group names. It is hoped, as with other volumes in this series, that a species-group name index will be made available on the publishers' website. In the E-Book format this does not present a problem as the search function in a PDF reader solves this issue. Despite these minor errors and criticisms, the *Catalogue* is an incredible piece of work and will ably see us through to the third edition in another ten years.

Darren Mann, Oxford Museum of Natural History.

References

Bouchard P., Bousquet Y., Davies A.E., Alonzo-Zarazaga M.A., Lawrence J.F., Lyal C.H.C., Newton A.F., Reid C.A.M., Schmitt M., lipi ski S.A. & Smith A.B.T. 2011: Family-group names in Coleoptera (Insecta). *ZooKeys* 188: 1–972.

Dellacasa G., Bordat P. & Dellacasa M. 2001: A revisional essay of world genus-group taxa of Aphodiinae. *Memorie della Società Entomologica Italiana* 79 [2000]: 1–482.

Duff, A. 2012. Checklist of beetles of the British Isles. Pemberley Books (Publishing).

Fery H. & Rössner E. 2015: Notes on the *Aphodius* (s. str.) *fimetarius*-complex – morphology, taxonomy, nomenclature and worldwide distribution (with emphasis on the Iberian Peninsula, Austria and Germany) (Scarabaeoidea: Scarabaeidae: Aphodiinae). *Linzer Biologische Beiträge* 14 (1): 459–489.

ICZN. 2014. OPINION 2345 (Case 3579). *Scarabaeus fimetarius* Linnaeus, 1758 (currently *Aphodius fimetarius*; Insecta, Coleoptera, SCARABAEIDAE): neotype designated. *Bulletin of Zoological Nomenclature* 71(4): 259-261.

Rössner E. 2012: Die Hirschkäfer und Blatthornkäfer Ostdeutschlands (Coleoptera: Scarabaeoidea). *Erfurt: Verein der Freunde & Förderer des Naturkundemuseums Erfurt e.V.*, 508 pp.

lipi ski, S.A., Leschen R.A.B. & Lawrence J.F. (2011). Order Coleoptera Linnaeus, 1758. Pp. 203–208. In: Zhang, Z.-Q. (Ed.) Animal biodiversity: An outline of higher-level classification and survey of taxonomic richness. *Zootaxa* 3148: 1–237.

Diving Beetles of the World. Systematics and Biology of the Dytiscidae

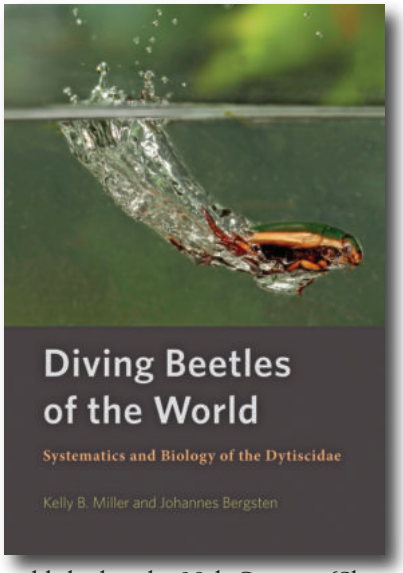
by Kelly B. Miller and Johannes Bergsten

John Hopkins University Press, Baltimore, Maryland, USA.

E-book or Hardback, 336 pages; 300 colour photographs, 5 colour illustrations, 556 line drawings.

US$150

ISBN 9781421420547



Some of us view landscapes in terms of water - where to take an outdoor swim, put in a kayak, cast a line for a fish, and some, including this reviewer, as entomological locations. We 'aquatic bug people' search rivers from springs and glaciers via rapids and riffles to the sea, check out pools, ponds, lakes, bogs and mires, all from the insects' perspectives. This love for water can start early, in defiance of parental warnings - becoming bogged in a morass or falling waist-deep in a pond can be quite 'cool' for a child. The pursuit of aquatic insects legitimises this, and lessens parental disapproval, especially if formal study and a job beckons.

In keeping with the extraordinary interest in all natural history in Britain and Ireland, there are coteries of enthusiasts for most aquatic insects. This is despite a constrained range of aquatic habitats, for example lacking glacial-fed water. Odonata are admired, aquatic Hemiptera and Diptera have their enthusiasts as do mayflies, caddis and stoneflies - and all have national recording schemes. Water beetles are popular with many enthusiasts linked with the Balfour-Browne Club, which instigated the impressive long-standing recording scheme and a newsletter *Latissimus*. The club, now in its 40th year, is named for Professor Frank Balfour-Browne, who pioneered biological recording and did much to promote the study of water beetles.

A problem for those that would study the diving beetles, the Dytiscidae, has been the lack of a modern comprehensive treatment of the group. The last major work was published in the 19th Century (Sharp 1882) and since that time inevitably there have been major changes in nomenclature, and a four-fold increase in known species. To the rescue have come Kelly B. Miller and Johannes Bergsten with the only full treatments of all the 188 currently recognised genera of Dytiscidae ever assembled, in their *Diving Beetles of the World*.

Miller (from New Mexico, USA) and Bergsten (from Stockholm, Sweden) have a wide perspective on their beetles, allowing them to provide keys for identification of all taxa from subfamily to genera, throughout the globe. The extensive taxon accounts are accompanied by detailed pen-and-ink drawings of diagnostic features and at least one high-resolution habitus image of an included specimen per genus. All illustrations are excellent and informative. Every genus account covers diagnostic characteristics, size range, classification, species diversity, a review of known natural history, and distributions portrayed via range maps. The breadth and depth of coverage is extraordinary given the constraints of a succinct template.

As a aquatic biologist but non-specialist in Coleoptera, I learnt much from the introductory chapter to the family, including insights into life histories and the range of behavioural ecologies displayed. I was delighted by the coverage of habitats, each

provided with an appropriate image garnered from throughout the world, from boreal bogs and rivers to waterfalls and ephemeral waterholes in Madagascar. For each of 22 habitat / locations, a legend identifies characteristic and unusual diving beetle occupants - a really nice touch. I like too the details of collecting techniques - for every group there are specialist tricks to the collection of target insects. Short of heading out with a local expert, this section will have you ready to put on the waders and head for your local waterhole.

Given the undoubted increase in diving beetles as models for aquatic ecology, and their value in revealing world biogeography, population ecology, and animal sexual evolution, Miller and Bergsten's book makes the diversity of the group very accessible. I concur with the publisher's blurb that the book will appeal to entomologists, systematists, limnologists, ecologists, and all others with an interest in aquatic systems and insect diversity. Finally, I commend John Hopkins University Press for all aspects of the presentation of this book: it has a good look and feel, and is easy to use by virtue of the layout and easy-on-the-eye fonts: the colour reproduction is unrivalled. John Hopkins, the oldest continuous publishing university press in the Unites States, has an interesting and diverse natural history list. Amongst these, two that may be known to readers are volumes by Rosser Garrison and coauthors, Dragonfly Genera of the New World (2006) and Damselfly Genera of the New World (2010). The *Diving Beetles of the World* is a worthy addition to their list.

References

Garrison, Rosser W., von Ellenrieder, Natalia & Louton, Jerry A. (2006). Dragonfly Genera of the New World. An Illustrated and Annotated Key to the Anisoptera. 384 pp.. John Hopkins University Press, Baltimore, USA. ISBN: 9780801884467

Garrison, Rosser W., von Ellenrieder, Natalia & Louton, Jerry A. (2010). Damselfly Genera of the New World. An Illustrated and Annotated Key to the Zygoptera. 528 pp.. John Hopkins University Press, Baltimore, USA. ISBN: 9780801896705

Sharp, D. 1882. On aquatic carnivorous Coleoptera or Dytiscidae. Transactions of the Royal Dublin Society 2: 179 -1003.

Peter S Cranston
Canberra, Australia

Diary

Details of the Meetings programme can be viewed on the Society 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 typically 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.

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

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

2017

Feb 22 **Northern Meeting and Meeting of the Post-Harvest SIG**
Pre- and Post-harvest insect pest management
Venue: Stockbridge Technology Centre, Cawood, YO8 3TZ
Convenors: David George (david.george@stc-nyorks.co.uk),
Jennifer Banfield-Zanin,
Maureen Wakefield (maureen.wakefield@fera.gsi.gov.uk),
Steven Belmain (s.r.belmain@gre.ac.uk)

Mar 1 **Verrall Lecture by Dr George McGavin, Honorary Research Associate at the Oxford University Museum of Natural History and The Department of Zoology of Oxford University, television presenter and explorer**
Tales from Television: an entomologist's perspective
Venue: Flett lecture theatre, Natural History Museum
Convenor: Dr Archie K. Murchie
Since leaving the world of academia, I have had the chance to travel the world to encounter all manner of wonderful species while making programmes for television. In this lecture we take a 'behind the scenes' look at some of the highs and lows of bringing the lives of insects to a wider audience.
Refreshments from 4 pm.
Lecture 4.30 – 5.30 pm.
The Verrall Association meeting is in the Rembrandt Hotel, 11 Thurloe Place – a c. 5 minute walk from the Exhibition Road entrance to the Museum.

Apr 4 **Entomophagy SIG joint meeting with BES Agro-ecology SIG, the Woven Network and ADAS**
"Insect farming in the UK. Should we do it & can we do it."
Venue: BES HQ, Darwin House, London
Convenor: Peter Smithers p.smithers@plymouth.ac.uk

Apr 7 **RES SW region joint meeting with the Bristol Natural History Society**
Venue: University of Bristol, Life Sciences Building (6pm)
Convenor: Peter Smithers (psmithers@plymouth.ac.uk)
Oil Beetles in the SW – John Walters
The Natural History of the land hopper *Arcitalitrus dorrenei* – Peter Smithers
Dung Beetles in African agricultural ecosystems – Bryony Sands
Last dreams of the butterflies – a short film by Zina Brown
For more information contact the convenor.

Apr 25 **Forest Insects and their Allies SIG**
Venue: Fera Science Ltd, York
Convenor: Dr Anne Oxbrough (anne.oxbrough@edgehill.ac.uk)
The abstract call for a talk or poster will open in January 2017. Enquiries to Anne Oxbrough (anne.oxbrough@edgehill.ac.uk) or contact Larissa Collins (Larissa.Collins@fera.co.uk).

May 16 **Insect Genomics SIG**

Venue: Rothamsted Research, Harpenden, U.K.

Convenors: Ramiro Morales-Hojas (ramiro.morales-hojas@rothamsted.ac.uk)
or Martin Williamson (martin.williamson@rothamsted.ac.uk)

Invited speakers:
Luke Alphey (The Pirbright Institute);
Chris Bass (University of Exeter);
Nicola Nadeau (University of Sheffield).

The purpose of this meeting is to discuss the latest developments in the field of genomics and how they are being applied in entomology. We will bring together researchers with different backgrounds to promote the exchange of ideas and explore collaborations that can further advance insect science.
Deadline for registration: 2nd May 2017. Deadline for abstract submission: 16th March 2017. Registration is a pre-requisite for abstract acceptance.
For any queries, please contact the convenors.

May 17 **Joint meeting of the Insect Ecology and Medical & Veterinary SIGs**

Vector Ecology

Venue: Linnean Society, London

Convenors: Dr Michael Bonsall (michael.bonsall@zoo.ox.ac.uk),
Dr Steve Torr (s.torr@liverpool.ac.uk)

Jul 2 **Insect Festival**

Venue: Yorkshire Museum Gardens and Hospitium, York

Sep 12 – 14 **Ento' 17 Annual Science Meeting and International Symposium**

Entomological Networks: Ecology, Behaviour and Evolution

Venue: Newcastle University

Convenors: Gordon Port,
Darren Evans,
James Gilbert

Symposium speakers:
Lars Chittka (QMUL),
Sheena Cotter (Lincoln),
Mathieu Lihoreau (Toulouse),
David Shuker (St Andrews),
Allen Moore (Georgia),
Yoshifumi Yamawaki (Kyushu),
Ramiro Morales-Hojas (Rothamsted)

Sep 23-24 **Bristol Insect Festival**

Venue: Bristol City Museum

More information from psmithers@plymouth.ac.uk

Oct 24 **Insect Pollination SIG**

Venue: National Museum of Scotland, Edinburgh

Convenors: Drs Jenni Stockan (jenni.stockan@hutton.ac.uk),
Michael Garratt (m.p.garratt@reading.ac.uk)

Confirmed speakers:
Dr Adam Vanbergen (NERC Centre for Ecology and Hydrology);
Dr Lorna Cole (SRUC).

Nov 1 **Orthoptera SIG**

Venue: Neil Chalmers Room, Natural History Museum, London

Convenor: Bjorn Beckmann orthoptera@ceh.ac.uk

Other Meetings

2017

Feb 14 **Aberdeen Entomological Club lecture**
Venues: Macaulay B, James Hutton Institute, Craigiebuckler, Aberdeen and screened live to New Seminar Room, James Hutton Institute, Invergowrie, Dundee
Convenors: Jenni Stockan (jenni.stockan@hutton.ac.uk)
and Jennifer Slater (Jennifer.Slater@hutton.ac.uk)
Speaker: Ashleigh Whiffin (National Museum of Scotland) - "Romance on carrion: the necrophagous insects"

Mar 14 **Aberdeen Entomological Club lecture**
Venues: Macaulay B, James Hutton Institute, Craigiebuckler, Aberdeen and screened live to New Seminar Room, James Hutton Institute, Invergowrie, Dundee
Convenors: Jenni Stockan (jenni.stockan@hutton.ac.uk)
and Jennifer Slater (Jennifer.Slater@hutton.ac.uk)
Speaker: Chris Cathrine (Caledonian Conservation) - "Site condition monitoring for invertebrates"

Mar 25 **BENHS AGM**
Venue: Oxford University Museum of Natural History, Parks Road, Oxford, OX1 3PW
For further details please visit: http://www.benhs.org.uk/events/

Apr 11 **Aberdeen Entomological Club lecture**
Venues: Macaulay B, James Hutton Institute, Craigiebuckler, Aberdeen and screened live to New Seminar Room, James Hutton Institute, Invergowrie, Dundee
Convenors: Jenni Stockan (jenni.stockan@hutton.ac.uk)
and Jennifer Slater (Jennifer.Slater@hutton.ac.uk)
Speaker: Daniel Leybourne (James Hutton Institute) - "Insects and climate change"

Jul 9-12 **9th International Conference on Urban Pests**
Venue: Conference Aston/Aston University, Birmingham, UK
Convenor/Chair: Dr Matthew Davies (Killgerm Chemicals Ltd)
For further information on the ICUP conference please refer to: http://www.icup2017.org.uk/

Sep 4 – 8 **26th International Conference of the World Association for the Advancement of Veterinary Parasitology (WAAVP 2017)**
"Combating Zoonoses: Strength in East - West Partnerships"
Venue: Kuala Lumpur Convention Centre, Kuala Lumpur, Malaysia
For further details please visit: www.waavp2017kl.org

2018

Jul 2-6 **European Congress of Entomology**
Venue: Expo Convention Centre, Naples, Italy

RES STUDENT AWARD 2017

Write an entomological article and WIN!

www.royensoc.co.uk

REQUIREMENT

Write an article about any Entomological topic that would be of interest to the general public. The article must be easy to read and written in a popular style. It should be no more than 800 words in length.

WHO CAN ENTER?

The competition is open to all undergraduates and postgraduates, on both full and part-time study.

PRIZES

First Prize: A £400 cheque and your article submitted for inclusion in *Antenna*.

Second Prize: A £300 cheque and your article submitted for inclusion in *Antenna*.

Third Prize: A £200 cheque and your article submitted for inclusion in *Antenna*.

ENTRIES

You can send electronically via e-mail to: **kirsty@royensoc.co.uk**

Alternatively, complete the entry form, and submit it with five copies of your entry to:

The Deputy Registrar,
Royal Entomological Society,
The Mansion House,
Chiswell Green Lane,
St Albans, Herts
AL2 3NS

For further information telephone: 01727 899387

Please include:

- Your name and address (including postcode)
- Your e-mail address
- The name and address (including postcode) of your academic institution
- Evidence of your student status

THE JUDGES

The judges panel will be made up of three Fellows of the Royal Entomological Society. The judges decision is final.

CLOSING DATE

The closing date for entries is 31 December 2017. The winner will be announced in the Spring 2018 edition of *Antenna* and on our website.

PLEASE CUT AND RETURN THIS PORTION WITH YOUR ENTRY

Articletitle: _____

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Studentname: _____

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Address: _____

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Telephone: _____

E-mail: _____

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Name of academic institution:

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author guidelines

We are always looking for new material for *Antenna* – please see below if you think you have anything for publication

AIMS AND SCOPE

As the Bulletin of the Royal Entomological Society (RES), *Antenna* publishes a broad range of articles of relevance to its readership. Articles submitted to *Antenna* may be of specific or general interest in any field related to entomology. Submissions are not limited to entomological research and may, for example, include work on the history of entomology, biographies of entomologists, reviews of entomological institutions/methodologies, and the relationship between entomology and other disciplines (e.g. art and/or design).

Antenna also publishes Letters to the Editor, Meeting Reports, Book Reviews, Society News, Obituaries and other items that may be of interest to its Readership (e.g. selected Press Releases). *Antenna* further includes details of upcoming entomological meetings in its Diary Section and features information and reports on RES activities including National Insect Week, Insect Festival and National, Regional and Special Interest Group meetings. Details of RES Awards and recipients are also covered, as is notification of new Members (MemRES), Fellows (FRES) and Honorary Fellows (HonFRES).

READERSHIP

Antenna is distributed quarterly to all Members and Fellows of the RES, as well as other independent subscribers.

INSTRUCTIONS FOR AUTHORS

Standard articles are normally 2,000-6,000 words in length, though shorter/longer submissions may be considered with prior approval from the Editorial Team. The length of other submitted copy (e.g. Letters to the Editor and meeting reports) may be shorter, but should not normally exceed 2,000 words. The use of full colour, high quality images is encouraged with all submissions. As a guide, 4-8 images (including figures) are typically included with a standard article. Image resolution should be at least 300 dpi. It is the responsibility of authors to ensure that any necessary image permissions are obtained.

Authors are not required to conform to any set style when submitting to *Antenna*. Our only requirement is that submissions are consistent within themselves in terms of format and style, including that used in any reference list.

PAGE CHARGES

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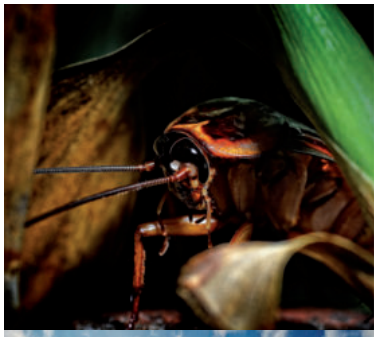
REVIEW AND PUBLICATION PROCESS

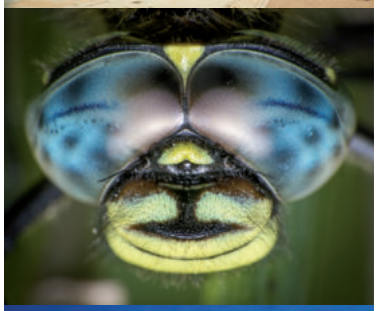
All submissions are reviewed and, where necessary, edited 'in-house' by the *Antenna* Editorial Board, though specialist external review may be sought in some cases (e.g. for submissions that fall outside the Editorial Boards expertise). Receipt of submissions will be provided by email, with submitting authors of accepted articles being offered the opportunity to approve final pdf proofs prior to publication. Where appropriate, authors will be requested to revise manuscripts to meet publication standards.

SUBMISSION PROCESS

All submissions should be sent electronically to 'antenna@royensoc.co.uk', preferably in MS Word format with images sent as separate files (see above). Image captions and figure headings should be included either with the text, or as a separate file.

EDITORIAL BOARD







ENTO '17

International Symposium & National Science Meeting "Entomological Networks: Ecology, Behaviour and Evolution"

12-14 September 2017
Newcastle University

CONVENORS:

Gordon Port, Darren Evans Newcastle University
James Gilbert University of Hull

PLENARY SPEAKERS CONFIRMED:

Lars Chittka Queen Mary University, UK
Sheena Cotter Lincoln, UK
Mathieu Lihoreau Toulouse, France
David Shuker St Andrews, UK
Allen Moore University of Georgia, USA
Ramiro Morales-Hojas Rothamsted Research, UK
Yoshifumi Yamawaki Kyushu University, Japan

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For registration and submission details visit:
www.royensoc.co.uk/meetings