Bulletin of the Royal Entomological Society Volume 40 (2) 2016

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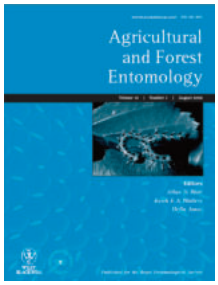
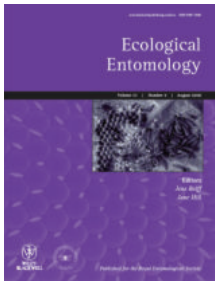
BEETLEMANIA



Publications of the Royal Entomological Society



Agricultural and Forest Entomology provides a multi-disciplinary and international forum in which researchers can present their work on all aspects of agricultural and forest entomology to other researchers, policy makers and professionals. UK RES Members: £83
2017 print or online prices: UK £832, Euroland €1,059, USA $1,538, Rest of World $1,791
2017 print and online prices: UK £999, Euroland €1,271, USA $1,847, Rest of World $2,150

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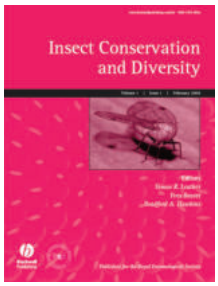

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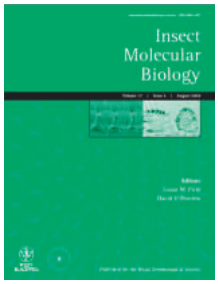

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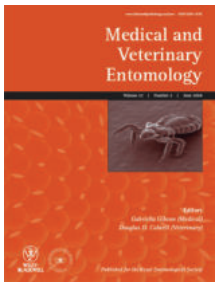

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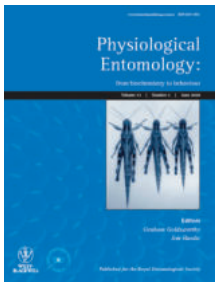

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Antenna (Bulletin of the Society). Free to Members/Fellows. Published quarterly at an annual subscription rate of £50 (Europe), £55 (outside Europe), $90 (United States). This journal contains entomological news, comments, reports, reviews and notice of forthcoming meetings and other events. While emphasising the Society's affairs, *Antenna* aims at providing entomologists in general with a forum for their views and news of what is going on in entomology. Subscriptions and advertising enquiries should be sent to the Business Manager at The Mansion House, Chiswell Green Lane, Chiswell Green, St. Albans, Hertfordshire AL2 3NS and any other enquiries to the Editors.

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

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COVER PICTURE

M G Leonard with the object of her desires.
Photograph courtesy of Riot Communications

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EDITORIAL

Hello and welcome to *Antenna* 40(2). Before summarising what you'll find in the pages of this issue, a rather significant correction to the previous issue needs to be made, in reference to the report from Ento '15. As many of you will have noticed, the image caption provided for the photograph on the bottom left-hand side of page 30 incorrectly names Jane Stout as Lyn Dicks, this being of particular embarrassment given Jane's vital input into Ento '15 as the local (Trinity College) Convenor. We'd like to send our sincere apologies to Jane (and indeed Lyn) for this error, also clarifying that the *Antenna* team, and not the article author, were at fault when adding figure captions to photographs provided separately to the main text. The image is reprinted below with the correct caption added. For completeness, it's also worth noting that on the same page Walter Leal can be seen signing, not singing, the Obligations Book, and that the surname of Marsh Award Winner David Sheppard is missing a 'p'. In addition, on page 29 (2nd column) the runner up poster prize was awarded to Saorla Kavanagh, not Kennedy.

Dave Goulson and Jane Stout relax at the conference dinner

Perhaps fittingly, nomenclature issues make an appearance in the current issue, though (hopefully!) only as observed by our roving reporter Richard Kelly on his latest excursion to review the entomological collections held at Yorkshire Museum. The collections here are dominated by the Coleoptera, and, as Peter Smithers reports in his interview with 'Beetle Boy' author M. G. Leonard, the same may soon be true of the shelves in your local book store as 'Beetlemania' is set to sweep the nation. In addition to an interview with M. G. Leonard at the start of this issue, you'll also find Peter's review of her exciting new book towards the end. Coleopteran content can also be found within the winning entries for the RES 2015 Student Awards, the top three of which are all featured in this issue's Society News, along with reports on the latest Postgraduate Forum and Taxonomy SIG. Beetles appear to be off the menu in an article by Rudi Verspoor et al. ('Bugs for Life bites back: Edible insects in northern Benin'), though this continues a now regular run of copy on entomophagy that reinforce the increasing importance of this field. Conservation, rather than consumption, is the subject of Veronica Khoo et al.'s article on work to monitor firefly populations along the Selangor River using digital photography. Imaging is also the subject of Philip Spradbery et al.'s short but visually stunning offering on CT scanning of a wasps nest. The Hymenoptera receive further focus in 'Monarchy or Democracy; who's really in charge of the ant colony?', a report covering past and present research by Elizabeth Evesham. Past and present combine again in 'Wallies for 30 years and still going strong', written by John S. Noyes.

In addition to the above, this issue also features our usual range of correspondence, additional book reviews, Schedule of New Fellows and Members, and Meetings Diary. The latter includes early notice of a joint RES Northern and Post-Harvest SIG Meeting being held at Stockbridge Technology Centre, featured in more detail on the back cover. I'm reliably informed that it will be well worth attending if you're available in Feb 2017 and have an interest in 'Pre- and Post-Harvest Pest Management'.

Dave George

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

Back copies of *Antenna*

Dr R Barrass FRES has a collection of *Antenna* magazines that he would like to offer to an entomologist who can give them a good home. The *Antennas* date from 1950 up to 2011. If anyone would like to avail themselves of this kind offer please write to Dr Barrass at the address below. The new owner must be prepared to collect the *Antennas* from Sunderland.

Dr R Barrass FRES
3 Valebrook Gardens
Sunderland
Tyne And Wear
SR2 7HU

The format and binding of RES publications

I am sorry to say that I find myself so annoyed about the binding of a recent Society publication that I feel the need to write and vent my frustration. I refer to the otherwise excellent 2013 *Checklist of the Lepidoptera of the British Isles* by D. J. L. Agassiz, S. D. Beavan and R. J. Heckford, published for us by the Field Studies Council. I am involved almost daily in the collation of records of microlepidoptera and so use this checklist very frequently, but unfortunately it took only the first two days of normal usage for the volume to start to shed pages.

The problem is that the binding style seems to be what is called 'perfect binding', a real oxymoron, in which batches of pages are just glued to the spine, and this is a recipe for binding disaster. Perhaps it is adequate for the sort of cheap paperbacks designed to be bought, read and discarded on railway stations, but it is notoriously useless for serious books, which are designed to be long-lasting and well-used. I have a number of friends who also use the Checklist frequently and every single one of them has suffered a similar fate. However, we must be an uncomplaining lot because, when I asked for assistance from the FSC, I was told that no-one else had ever complained and that anyway they could do nothing for me. I know of only one person who has succeeded in getting a replacement but I imagine that even that is probably now falling apart. I have resorted to the liberal use of glue but even so more pages are currently loose.

By contrast I am now looking at the *Guide to Freshwater Invertebrates* published in 2012 by Freshwater Biological Association and it has a sewn binding and is nicely robust. Why can't we do that – presumably just expense? Our Handbook series is so internationally important that I feel that we should ensure that every volume is of high quality, both in content and in production.

This brings me to another point about the checklist. It sits on my desk at home and its A4 format is suitable for that. However, I am primarily a field lepidopterist and it is utterly unsuitable for use in field conditions. John Bradley published the most widely used recent checklist privately in 2000, also in A4 format, but this was an updated version of an A5-sized *Recorder's Log Book or Label List of British Butterflies and Moths* (1979) by J. D. Bradley and D. S. Fletcher, and this is my indispensable field companion even now. Of course, I would like to replace it with a field version of our new checklist but this doesn't exist! Please don't tell me that these days there is an app that I should use – I so much prefer a pocket-sized book, in which to scribble notes. Please can our Society consider the field worker and discuss whether it is possible to produce a field-friendly checklist , sufficiently securely bound to be usable. I would be so grateful!

Mark Young FRES
Aberdeenshire

RESPONSE:

Dear Mark,

Many thanks for your letter to *Antenna* (above). Though the *Antenna* team and printer are not involved in the production of RES Handbooks, we have ensured that the above letter has been forwarded to both the RES Printers and the RES Publications Committee.

Dave George
Antenna

Something Coleopteran This Way Comes

Peter Smithers

psmithers@plymouth.ac.uk

The nation is about to be swept with beetle fever. Not a return to the 1960's musical group but a new novel in which the main characters are children and beetles. The book, *Beetle Boy* by M. G. Leonard, was published on March the 3rd this year and is currently being translated into 24 languages. Waterstones cut a deal with the publishers to have the exclusive right to sell the book in their shops for a month prior to publication and sold over 8,000 copies in three weeks (most new authors sell 10,000 copies in their first year if they're lucky). The book is already on its third print run. So brace yourself, *Beetle Boy* is about to sweep into a bookshop or school near you.

So how does this happen and who is M. G. Leonard?

I arranged to meet her at Bournville Primary School in Weston Super Mare where she had a book signing. I had a 45 min slot between a school in Cardiff and this one. I was met at the school by Sue Wilsher, the teacher who had organised the visit. Sue had kindly laid on coffee and sandwiches to keep me and M. G. Leonard going while we talked. My sincere thanks to Sue and the Head for squeezing me into another busy day at the school. While I waited I reflected on my introduction to this book.

Sarah Beynon had introduced me to *Beetle Boy* at the Society's annual conference Dinner in Dublin last autumn. In a pause between courses she passed the book across the table saying, "you have to read this". The book was unassuming with a plain yellow cover, the last proof before going to print. It's a rare thing to have a novel submitted to *Antenna* for review but even more unusual to receive one prior to publication. Sarah was so animated and enthusiastic about the book that my curiosity was

instantly peaked. I opened it that night and read the first few pages; I recall telling my wife how good it was. "Show me" she said. The book vanished for the next week while she was absorbed into M. G. Leonard's world. Once I had it back I devoured it in two sittings. (For more on the book see the review in this issue).

M. G. Leonard slips into the room in conversation with Sue Wilsher. I introduce myself, her quiet calm demeanor belying an intense energy.

"Sorry I'm late, we were delayed at the school in Cardiff. At the book signing one child had asked me to draw a beetle in her book and then the rest of the school decided this was a great idea". Time flies when you are drawing beetles.

M. G. Leonard comes from the world of performing arts. She is currently a digital producer at the National Theatre but has also worked in similar roles for the Royal Opera House and the Globe Theatre, London.

Where did a novel about beetles come from?

"At work I tell stories with a camera, but I have always wanted to write a novel and I had begun to build a plot around an evil villain who lived in a lair filled with creepy-crawlies, but I soon realised I had no idea how to describe a creepy-crawly. I searched the internet and was amazed. I hadn't realised the diversity or complexity of the invertebrate world and it soon became apparent that the beetles were the most interesting to me. I am not an entomologist, but I have become an enthusiastic beetle tourist. Driven by curiosity and shame, at my shocking level of ignorance about beetles, the proto novel quickly evolved to being all about beetles and eventually became *Beetle Boy*. So, I'm afraid the book was born out of ignorance related to fear. I was scared of insects as a child and assumed I would always be. I like to think if I had read this book as a little girl I might not have been frightened."

"Once I realised I wanted the beetles to be the good guys, and to highlight their talents and importance to the eco-system of the planet, I knew the story would be about human relationships with beetles, and that children would have to be the protagonists. I worked with my publishing company to hone the manuscript, but all the time I had this acute desire to do the beetles justice, I wanted the readers to absorb as many facts about beetles as possible and for that to happen, I needed a real entomologist to proof the book. I saw Dr Sarah Beynon on *Country File* talking about her dung beetles and her bug farm, and before the programme was over I was searching the internet for her email address. She sent me a polite reply explaining how busy she was, but that she would have a look at the book. A few days later I got a midnight email from The Bug Farm. She loved it, and I cried with relief. I do so care that I'm doing beetles justice. Sarah proofed the book, and thank goodness she did. I had made a number of rookie errors, referring to beetles as having shells for one. Now I can proudly say the book has educational value, and no child will walk around thinking a beetle has a shell rather than an exoskeleton!"

What were your influences?

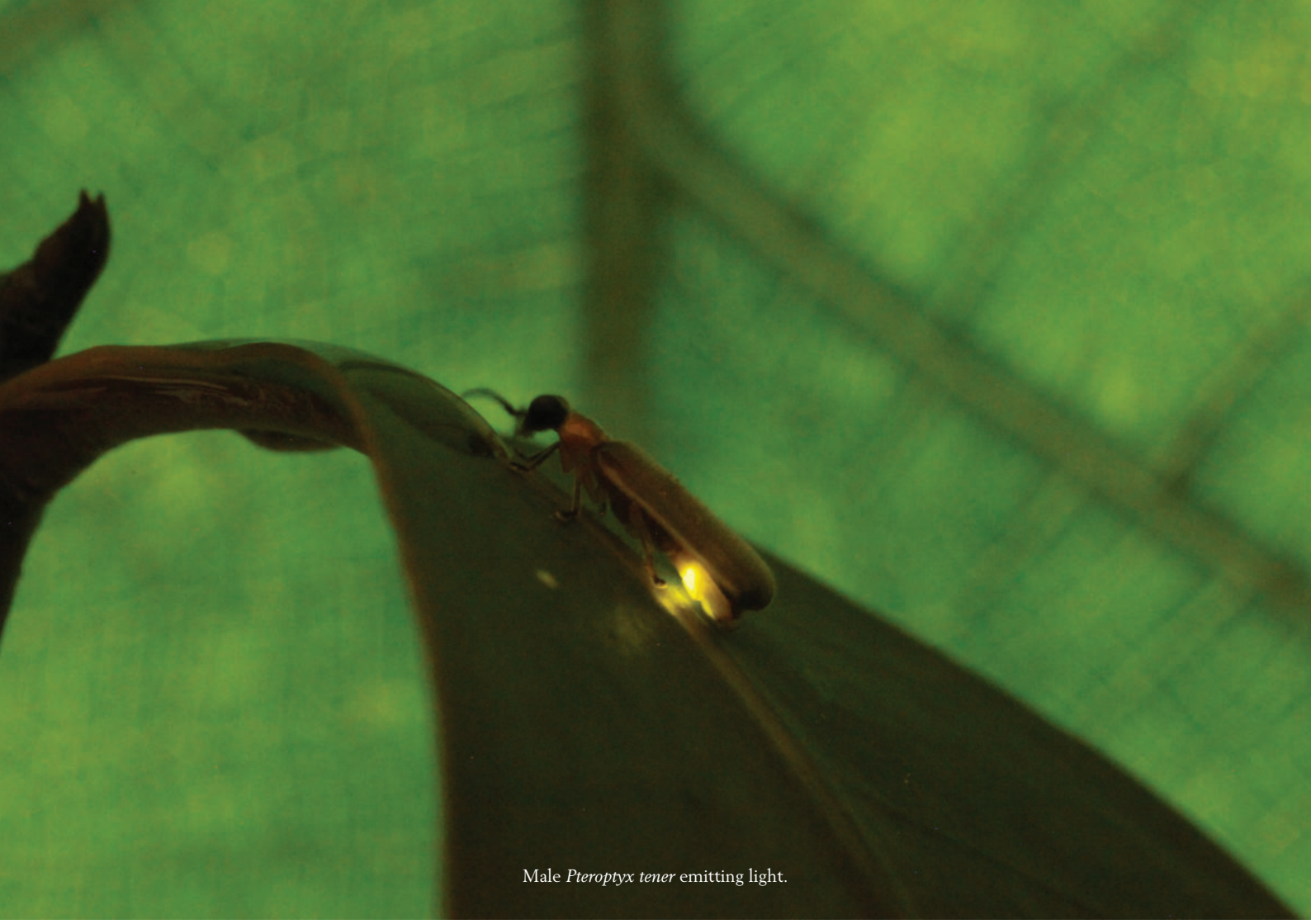
"I'm influenced by authors such as Dahl and Pullman, and I loved *The Famous Five* and *The Secret Garden* when I was little. The characters are composites of people I have met or read about, but the scary villain, Lucretia Cutter, is based on a mixture of the infamous Vogue editor Anna Wintour, and Jeff Goldblum in *The Fly*."

Is *Beetle Boy* aimed at children alone?

"Not at all. While the book is marketed as a children's novel, I wrote it for readers of all ages. The children in the novel are an excellent way to introduce the reader to the beetles. They are cautious and wary, unsure of their new beetle friends at first but quickly form a bond and grow to like them and the reader accompanies them on this journey. At the heart of the story is a desire to share my fascination and love of beetles with the reader".

Book two, *Beetle Queen*, waits in the wings. The meteoric success of *Beetle Boy* has robbed M. G. Leonard of much of the time she had set aside to work on the next volume, but it is on its way. Keep a watchful eye on your local bookshop for it in the summer of next year, and book three is due in the autumn of 2018.

The instant and global success of *Beetle Boy* may be a publishing enigma, but as entomologists it is one in our favour. For a person with no scientific or entomological background M. G. Leonard will single handily inspire an entire generation of future entomologists and is destined to be one of the finest ambassadors for entomology (and the study of beetles in particular) that we have seen this millennia. We as entomologists offer her a very warm welcome and wish her every success.



Male *Pteroptyx tener* emitting light.

Firefly conservation: Monitoring the synchronous fireflies of the Selangor River in Malaysia

Veronica Khoo, Laurence G. Kirton & Nada Badruddin

Fireflies of the genus *Pteroptyx* Olivier range from South and Southeast Asia to Papua New Guinea (Ballantyne & McLean, 1970). They are known for their marvellous group displays on mangrove trees along riverbanks (Lloyd, 1973; Nallakumar, 1999; Nagelkerken *et al.*, 2008). At least two species, *P. tener* and *P. malaccae*, are able to flash in synchrony (Buck & Buck, 1968; Case, 1980). The firefly displays serve as a communication tool to attract potential mates. While some firefly species in North America exhibit synchronous flashing, they do not congregate on trees, and their synchrony seems to be dependent on the number of flashing males present (Otte & Smiley, 1977).

The Selangor River in Malaysia is well known for its congregating, synchronously-flashing fireflies. The fireflies light up the crabapple mangrove trees (*Sonneratia caseolaris*) in a nightly ritual, creating an atmosphere similar to numerous lighted Christmas trees. The dominant species, *Pteroptyx tener* (Nallakumar, 2002) flashes 3.7 times per second (Case, 1980). It is a small-sized beetle, 4.0-6.2 mm in body length (Ballantyne & McLean, 1970). The males flash rhythmically in groups, with the females producing response flashes (Buck, 1988).

Two localities offer boat rides to watch the displays of the Selangor River fireflies: Kampung Kuantan and

Pteroptyx tener, the dominant species found along the Selangor River, never fails to display its marvelous lights as a nightly ritual.

Bukit Belimbing. Firefly watching along this river is an all-year attraction but best seen during moonless nights. Unfortunately, firefly populations around the world are facing loss of habitat due to urban or agricultural development, and the Selangor River fireflies are no exception. Much of their habitat has been converted, mainly for agriculture and aquaculture (Khoo *et al.*, 2009; Khoo & Nada, 2014), and they face further threats from river pollution and light pollution.

As part of efforts to help in the conservation of the firefly population along the Selangor River, in 2006 the Forest Research Institute Malaysia (FRIM) developed a method of monitoring the firefly population, and conducted monitoring for a period of two years under funding by the Malaysian Department of Irrigation and Drainage (DID) and Danish International Development Agency (DANIDA). Monitoring was continued from 2008 to 2010 under funding by the Malaysian Economic Planning Unit, under the Prime Minister's Department, and thereafter under the Selangor State Government through the Selangor Waters Management Authority (SWMA). The state's Integrated River Basin Management (IRBM) Plan 2007-2012 has a policy to conserve the fireflies by establishing a firefly park in cooperation with the local community as well as to improve conditions for firefly tourism, and to continue monitoring and research related to the fireflies.

A non-destructive method of monitoring using digital night photography was developed for the population (Kirton *et al.*, 2012). The photographs were taken using an SLR camera with a zoom lens, placed on a sturdy tripod. The position of the camera and the images captured were reproduced using a fixed ground marker, a plumb line attached to the tripod, and a compass attached to the camera. A total of seven monitoring sites were chosen along a 1.6 km stretch of the Selangor River. Each site had a wide and continuous stretch of display trees that could be seen clearly from across the riverbank. Images were captured monthly over a three night period centering on the new moon, and were analysed with the aid of image analysis software to obtain counts of bright spots produced by firefly flashes. Each bright spot was produced by one to two flashes. The counts were used as an index of abundance of the adult fireflies.

Over the years, peak annual abundance shifted to a different part of the year. 2006–2008 had peaks in the middle of the year, while in 2009 peak abundance shifted to the year end, and thereafter the population peaked early in the year. The shift could have been caused by changing rainfall patterns. The immature stages of the fireflies are found in the floodplains behind the display trees. *Pteroptyx tener* has a life span of 4 to 7 months (egg to adult), with almost 60% of its lifetime spent as a predatory larva (Nada & Kirton, 2004). The larvae feed on the snail, *Cyclotropis carinata*, which is found abundantly in sago (*Metroxylon*) stands that are periodically inundated by river water (Nada, 2011). During the rainy season, the natural habitat is consistently moist and would be favourable for the larvae and snails. Therefore, an increase in the adult firefly population in the few months following the rainy season would be likely (Nada *et al.*, 2007, 2012). This was evident in the weather patterns

A stretch of *Sonneratia caseolaris* trees along the Selangor River. These trees serve as display trees for the synchronous fireflies.

An SLR camera on a sturdy tripod used in the monthly firefly monitoring programme.

based on data obtained from the Malaysian Meteorological Department and a weather station placed in Kampung Kuantan.

A major problem faced by the firefly population is habitat loss. The firefly population suffered an estimated drop of 38% over a seven-year period, based on the slope of the linear regression line (see later). The main reason is likely to be conversion of natural habitat for agricultural purposes. The firefly monitoring programme detected habitat loss when the images captured showed changes in the tree line. These changes were first detected in mid-2007 and were seen to increase in the following years (Khoo *et al.*, 2009). The changes in vegetation were reported to the Kuala Selangor District Council and the Selangor state government in January 2009 (Khoo *et al.*, 2012). It was also highlighted by the local media. As a result, sections of the Selangor River in the District of Pasangan, Kuala Selangor were gazetted, effective from 2 July 2009, as a protection zone under Section 48 of the Selangor Waters Management Authority Enactment 1999. The Protection zone (1,104 hectares) includes the river reserve ranging from 150-400 meters from the left and right banks of the Selangor River in the District of Pasangan.

Another commendable act by the state government was the reacquiring of affected land for rehabilitation. Initial rehabilitation work took place in late 2011, starting with preliminary pilot-scale planting. A small section of the degraded land was replanted with five riverbank tree species (Ang *et al.*, 2013). The project was enabled by a partnership between the state government and a private company

Above: Sago stands are the habitat for the larvae and host snails.

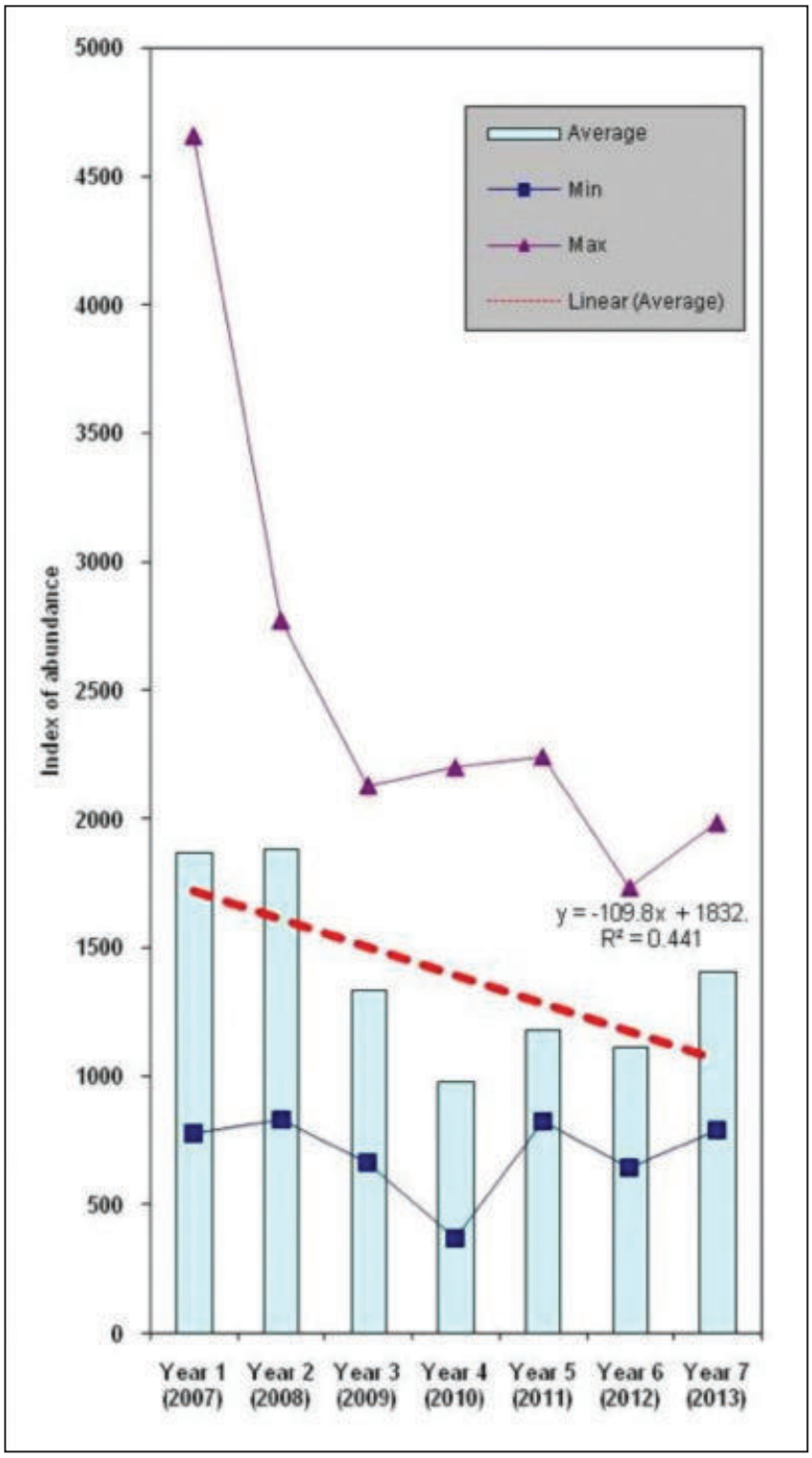
Right: Clearing of natural riverine vegetation to make way for agriculture plantations.

Below: Pilot scale rehabilitation in the degraded site that was reacquired by the state government.

that provided funds to purchase tree saplings and to carry out replanting. However, more effort and action is needed to acquire areas that are pristine in order to protect the overall habitat from further degradation. Mapping work conducted by FRIM (Khali Aziz *et al.*, 2012) had documented the land use along the Selangor River, with small pockets of land that are still undisturbed along the river being identified.

FRIM's involvement in firefly research led to Malaysia hosting the Second International Firefly Symposium in 2010, which was held in the state of Selangor. The symposium was attended by experts from various fields of firefly research, as well as members of government agencies, non-governmental organisations, educational institutions, corporations, and interested members of the public. The participants, who came from 13 countries, drew up the Selangor Declaration (Participants of the Third International Firefly Research Network Meeting, 2012). It stresses the importance of conserving firefly populations throughout the world, and contains recommendations to governments, local authorities, agencies and corporations. The declaration was further discussed at the 2014 International Firefly Symposium held in Florida.

The firefly monitoring programme was able to provide information on the firefly population level along the Selangor River, and further served to detect habitat loss over the course of the monitoring period. As a result, some initial steps have been taken by the state government to address the conservation needs of the firefly population. Various awareness programmes on the importance of firefly conservation were also carried out for both the public and stakeholders as part of this work. It is important that the local community understands the importance of protecting the area to enable future generations to witness the spectacular light shows.



Trends in the size of the firefly population over seven years of monitoring. The red-dotted line shows the linear regression for the average index of abundance.

Acknowledgements

We thank the Malaysian Department of Irrigation and Drainage (DID), the Danish International Development Agency (DANIDA), the Malaysian Economic Planning Unit and the Selangor State Government for providing funds to develop and conduct the firefly monitoring programme. We are also grateful to the Selangor State Government and Selangor Waters Management Authority for their interest and for their cooperation in addressing habitat loss issues and reacquiring degraded land for rehabilitation work. Our gratitude also goes to colleagues at the Entomology Branch, FRIM and the villagers of Kampung Kuantan for their assistance and cooperation.

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Scientists and Phase 2 military support, Project Wallace basecamp (August 1985)

Rear (left to right) - John Tennent (military); Steve Greenwood (scientist); Roger Butlin (scientist); David Dudgeon (Scientist); Jeremy Holloway (scientist); Ashley Kirk-Spriggs (scientist); Paul Nex (military); Chalky White (military); Geoff Scudder (scientist); Paddy Ashe (scientist); Kate Monk (scientist); Ebu (local cook); Barney Page (military); Peter Dinwiddie (military); Penny Dinwiddie (military associate); Chen Young (scientist); Mike Goodfellow (military); Wilfried Paarman (scientist).

Front (left to right) - Hans Huijbregts (scientist); Del Drake (military); Jane Cunningham (later Drake) (military); Pete Woods (military); Nicki Bateman (military); Yvonne Pritchard (military); Andy Gray (military); Debra Ellis (military); Grace O'Donovan (scientist). Photo courtesy of John Tennent

Wallies for 30 years and still going strong

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Project Wallace, the commemorative Royal Entomological Society expedition celebrating the 150th anniversary of the founding of the Royal Entomological Society and centenary of receiving the Royal Charter, took place in northern Sulawesi, Indonesia throughout 1985. It was organised in collaboration with the Indonesian Scientific Institute (Lembaga Ilmu Pengetahuan Indonesia (LIPI)) and was one of the largest scientific expeditions ever mounted. It was named Project Wallace in honour of Alfred Russel Wallace, a previous member of the Society, and was sited in part of an area between Borneo and New Guinea termed Wallacea in recognition of the work done by Wallace as a pioneer in developing modern concepts of evolution and island biogeography. The expedition was located adjacent to a World Bank funded irrigation scheme on the eastern edge of Dumoga-Bone National Park, a recently designated water catchment protection area of about 280,000 hectares (about 10x the size of Lancashire) with altitudes ranging from 200-1,995m. Those that participated in the expedition are affectionately known as "Wallies".

During the year approximately 107 scientists visited base camp and conducted surveys of insects, reptiles, birds, mammals and plants. In the intervening 30 years at least 160 papers dealing with the results of these studies have been published. These have been listed by Knight & Holloway (1990). Most contributions included in this book refer to particular taxonomic groups with a few being more general and dealing with other aspects, such as soils, vegetation, insect-plant relationships, phytotelmata (insects in plant-held water), fungi, insects in agriculture, conservation and general faunistics. Taxonomic and faunistic studies on insects resulting from this expedition include many on Diptera (30 papers), Coleoptera (18 papers), Lepidoptera (22 papers), Hemiptera (17 papers), Hymenoptera (4 papers),

Phase 2 military support before their first "excursion" (April 1985)

Left to right - Nicky Bateman, Sean Brown, Tom Anderson, Debra Ellis, Yvonne Pritchard, Nick Bremner, Paul Nex, Jane Drake, Jim McKenzie, "Chalky" White. Photo courtesy of Jon Martin.

Orthoptera (9 papers), various aquatic insects (19 papers) and parasites of mammals and birds (15 papers). A major exercise conducted through the year by the Natural History Museum (London) served to cross-calibrate and evaluate the value of a range of collecting methods, from pitfall-trapping to canopy fogging, for assessing insect diversity in tropical forests. Material collected during the expedition also contributed to more widespread faunistic studies. One of these was an important account of the mealybugs (Hemiptera: Pseudococcidae) of southern Asia that recorded 28 species of mealybugs from Sulawesi, 19 of which are known only from Project Wallace material. Other papers that include insect material or data collected on Project Wallace continue to be published, but are too numerous to mention here (thanks to Jeremy Holloway for providing a summary of scientific papers resulting directly from Project Wallace).

During the expedition, several local entomologists visited the base camp, including groups of students from Universiti Sam Ratulangi, Menado, who participated in short courses demonstrating collecting techniques that would be useful for biodiversity studies.

The expedition would not have been possible without the help or the logistical support provided by the British military. This support enabled scientists to concentrate on their studies without having to provide the basic requirements themselves. Approximately 60 military personnel took part in the expedition as part of an adventure training scheme that encouraged them to participate in scientific and other expeditions outside their normal military roles. Throughout the year they provided transport between Menado and base camp for scientific visitors, most of the food consumed at base camp and at the various subcamps, transportation of equipment and general assistance to the scientists. They built subcamps at various locations, having first blazed trails to establish transects into the interior and up several mountains, including the major peak of Gunung Poniki. They provided essential medical support and generally ensured that everything ran smoothly. The military were organised into three separate groups or "phases", each of about 4 months with some overlap to ensure smooth continuity. One participant, Barney Page, even stayed throughout the year to act as quartermaster and expedition medic. The food was based on British army "compo" rations, so that scientists became familiar with terms such as "cheese possessed" and "babies heads" (tinned steamed puddings). This was supplemented with fresh, local produce, much of it obtained in Kotamobagu, the nearest large town.

Before Project Wallace had even ended John Tennent organised an informal reunion of the Phase 2 members at the end of November 1985, for both scientists and military support, at the Sergeant's Mess of the London District Provost Company situated in Rochester Row, London. About 30 scientists and military support turned up.

A few years later some preliminary results were presented in a meeting organised by the Royal Entomological Society and held at the nearby Imperial College of Science and Technology (15-16th September 1988). This was published as a book by the Royal Entomological Society (Knight & Holloway, 1990). After this meeting participants were invited to an evening

Group in front of *Flore* at Lorient

Left to right - Pete Dinwiddie, Mary Noyes, John Noyes, Del Drake, Jane Drake, Debra Ellis, Nick Bremner, Pippa Holloway, Jeremy Holloway

Photo courtesy of Peter Dinwiddie and Nick Bremner

Group after the reunion meal in Manoir de Kerledan

Left to right - Nick Bremner, Debra Ellis, Pippa Holloway, Jane Drake, John Noyes, Mary Noyes, Jeremy Holloway, Barney Page, Pete Dinwiddie, Penny Dinwiddie, Del Drake, Hilary Bremner

Photo courtesy of Nick Bremner

celebrating the event held in a marquee erected in the grounds of the British Museum (Natural History), now the Natural History Museum. Unfortunately very few of the military personnel were invited, although a few did get to hear of it and came along, uninvited but welcomed, to give their support.

Not to be outdone, Del and Jane Drake (phase 2 military support), with others, decided that it would be a good idea to have regular reunions of phase 2 scientists and military. The first of these took place in 1992 at the Beaufort Hotel in Chepstow, organised by Del and Jane, where about 24 participants attended. It was a great success and finished with the obligatory curry at a local Indian restaurant. Since then phase two reunions have taken place informally every 2-6 years with the most recent being held 30th October - 2nd November 2015 at Manoir Kerledan in Carhaix, Brittany, France, a luxury B&B owned and run by Peter Dinwiddie and his wife Penny, both of whom participated in phase 2 of Project Wallace. One of the highlights at this reunion was a visit to the Kéroman submarine pens at Lorient which included a tour of the decommissioned diesel electric submarine *Flore* at the base. We also had a memorable lunch at a nearby crêperie and visited La Citadel at Port Louis in the afternoon with a tour of the French East India Company museum (Musée de la Compagnie des Indies) situated within its walls. That evening we had a delicious meal at Kerledan Manor which had been prepared by Penny, her daughter Hannah and Hannah's fiancée Goulven. Barney Page joined us for the evening meal.

We all agreed to continue with these reunions because many firm friendships had been formed between the scientist and military participants in Project Wallace. I am not sure how many of us will make the 50th anniversary, but we shall all try very hard!

A summary of the phase 2 reunions is

Phase 2 Project Wallace reunions (scientists and military support)

1985 Sergeant's Mess, London District Provost Company, Rochester Row, London; organiser John Tennent; 30 participants.

1992 Beaufort Hotel, Chepstow, Monmouthshire; organisers Del and Jane Drake; 24 participants.

1994 The School of Military Survey, 39 Engineer Regiment, Sergeants Mess, Hermitage, Berkshire; organiser Andy Gray; 22 participants.

1996 RAF Upavon, Larkhill, Wiltshire; organiser Mike Goodfellow; 18 participants

1998 Sergeant's Mess, Waterbeach near Cambridge, Cambridgeshire; organisers Del & Jane Drake; 20 participants; this reunion was memorable because of the ceremonial tasting of a durian provided by Jon Martin (scientist).

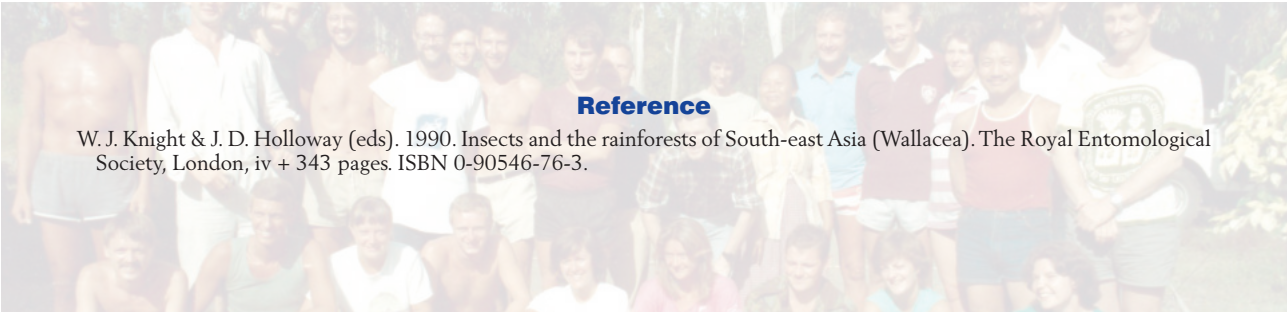
2004 Crown & Cushion, Pub, Minley near Farnborough, Hampshire; organisers Del and Jane Drake; 20 participants (21 August).

2007 Otmoor Lodge near Oxford, Oxfordhire; organisers Del and Jane Drake; 20 participants (26 August)

2010 Anglesey Hotel, Gosport; Hampshire; organiser Nick Bremner; 20 participants; the second day included an exciting ride in a RIB in Portsmouth harbour (30-31 October).

2013 Three Salmons Hotel, Usk, Monmouthsire; organiser John Noyes and Andy Gray; 22 participants; included a pilgrimage to Kensington Cottage near Usk where Alfred Russel Wallace was born and spent his early childhood, the following day we visited the nearby "Big Pit" at Blaenavon (26-27th October).

2015 Manoir de Kerledan, Carhaix, Brittany, France; organisers Peter & Penelope Dinwiddie; 10 participants (30 October - 1 November).



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Monarchy or Democracy; who's really in charge of the ant colony?

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Introduction

Have you ever been to a meeting where you are asked to get into groups to discuss an idea or task? You may or may not be given the opportunity to choose your groups, but who decides the group leader? What makes a good commander? When you are asked to report back as a main group again, are you a little resistant to join the others or more willing? Does this depend on how you all got on as a group, what you were discussing, or whether your discussions led to a positive outcome? Does the success of a group depend on the venue, the chairs, arrangement of the seating, the ambient temperature?

Well, it would seem from Evesham's recent study that the ant *Myrmica rubra* L. is faced with the same decisions. It forms large groups or "clusters" comprising a combination of castes. These clusters then appear to break up into smaller groups which re-join again to form larger ones over a period of time. This grouping has a cyclical pattern that occurs on a four-to-five-day basis and is also influenced by sunrise and sunset on a daily basis. But what drives this arrangement of members of an ant colony to breakup and re-arrange clusters?

Queen/worker interactions, in social insects, have been studied for a number of years. Evesham has concentrated her work on the ant *Myrmica rubra* for over 30 years (Fig. 1). Evesham (1984 (b)) distinguished queens as dominant or subordinate, depending on their degree of mobility and their behaviour with other queens and workers. She then went on to look at the role of workers in queen movement (Evesham 1985). Brian (1988) observed synthetic groups of queens and characterised queens as unsociable (dispersed), intermediate or social (highly aggregated), also reporting that the social state of queens changed as larvae grew. Evesham investigated queen sociability in natural populations of *Myrmica rubra* and the impact of this on cluster size.

Do the workers control the positioning of queens and, therefore, their influence on the colony as a

Fig. 1. *Myrmica rubra* nest showing tiered structure.

whole, or are queens resisting the control of workers in an attempt to have a greater impact on the growth of the colony? Could the distribution of ants be a "team effect" in an attempt to optimise resources, larval growth and to balance the energy taken into the colony and the energy output? Are there stronger forces at play which affect colony behaviour?

It would appear, from the recent study described herein, that there is a cyclical activity going on between ant clusters involving workers and queens. The queens have been known (Evesham 1985 and Brian 1988) to evoke aggressive behaviour with one another if in larger groups. Perhaps they are trying to move away to avoid this, while the workers are bringing them back into a group, because communication and food distribution is more manageable and cost effective in terms of energy.

Over the past 30 years, changes in farmland management have had an observable impact on the size and distribution of *Myrmica rubra* and *Lasius flavus* and some *Lasius niger* colonies at Kimmeridge Bay, Dorset (Fig. 2). In the 1980s, limestone walls divided the pastureland and it is under the fallen limestones that these ants build their nests, using the root systems of nettles *(Urtica dioica*) (Brian, 1977) to construct their tunnels (Fig. 3). *Myrmica rubra* colonies were, on average, 1000 ants in size and populated the area extensively. This has now changed, with *Myrmica rubra* colonies few and far between. Colony sizes now vary between 60-900 ants and they are more interspersed with *Lasius flavus* colonies, with both species, on occasion, occupying the same nest amicably.

Fig. 2. Ant site on south-facing pastureland at Kimmeridge Bay, Dorset UK.

Farmers routinely burn off the nettles to maximise cattle grazing. Therefore, could these environmental influences create a stronger "team effect" to ensure the survival of the colony and force completely different ant species to coexist? Perhaps both species share their food sources (Fig. 4), such as root aphids, or just exist as

Fig. 3 (left). Fallen stones from dilapidated dry-stone walls; Fig. 4 (right). *Myrmica rubra* farming aphids on nearby nettles.

neighbours under one roof, but continue to survive independently. Further work needs to be carried out on this.

Have you ever been to meetings when not many people have turned up? Perhaps there are more conference organisers than guests? Do you all sit together or spread out as though there are more people present than there really are? Through the study described herein, it was found that *Myrmica rubra* ants cluster in a loose arrangement, occupying a wider area, when there are fewer workers present in a colony; and form a tight cluster over a small area when the population is larger. The sociability of a queen may have an effect on the close proximity of the individual members of a group and the cyclical arrangement of clusters.

Evesham (1984b) found that when observing colonies in glass-framed nests (Fig. 5), there was a dominance hierarchy between queens, whereby dominant queens were more sedentary and would be constantly attended to by workers. Subordinate queens were more mobile, but their overall "*queen effect*" could have been more influential than that of dominant queens, since their mobility enabled them to come into contact with many workers within

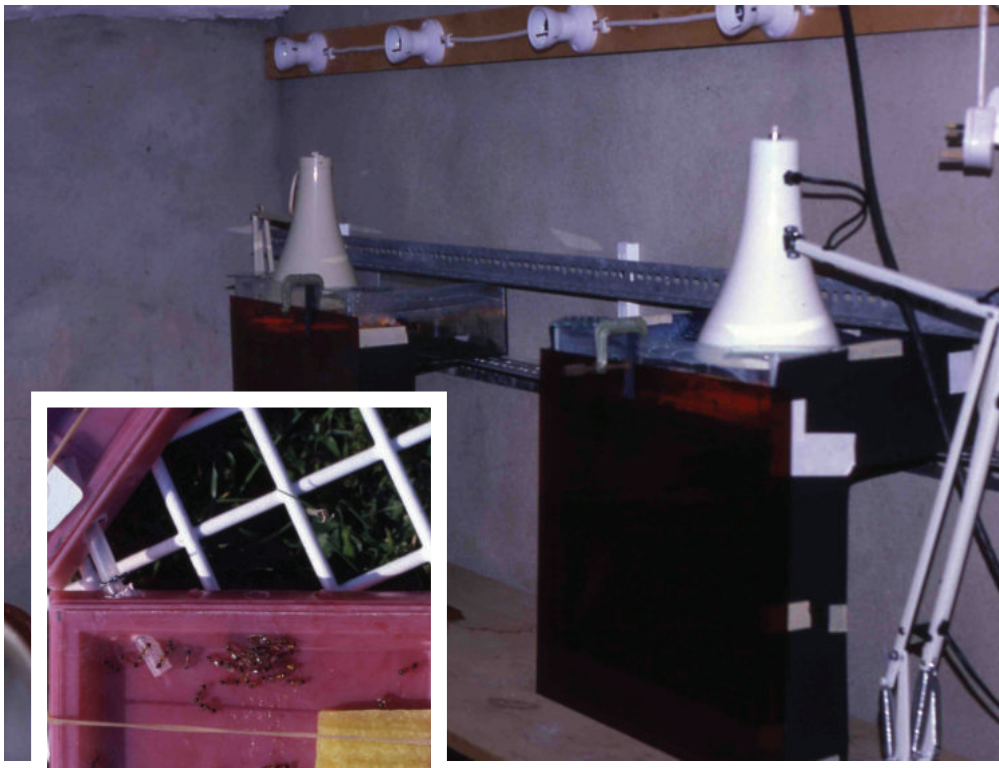

Fig. 5. Glass-framed soil and nests;
Fig. 6 (inset). Standard plastic nests.

the colony. Therefore, queens tended to be widely distributed and relatively intolerant of one another. Could behaviour be influenced by nest design?

Previous work (Evesham 1984c) has shown that larger clusters were more difficult to break up compared to smaller ones in which the workers were loosely arranged around a core. Brian et al. (1981) found that if *Myrmica rubra* ants were provided with a nest of a cellular structure, the general mobility of the ants was reduced.

Evesham (1985) found that when ants were provided with standard plastic nests joined together, the degree of compactness of the ant cluster, together with the number of queens within it, determined the mobility of the ants (Fig. 6). A compact cluster containing several queens, for example, was more stable and less disturbed by an influx of workers than a loosely arranged group around a single queen. The numbers of workers in a cluster is difficult to measure as the arrangement changes, so measurements were of area of floor space occupied.

It is possible that full access to individual queens can be achieved more easily, by workers, when queens are close together compared to when they are spaced out. Do workers assess the total number of queens present and "*decide*" where they should be placed within the space available? In natural nests, with unlimited space, the worker task of gathering all the queens together must be difficult to achieve, since they are known to clump together to a lesser degree than was originally thought (Smeeton 1981, Evesham 1982, 1984b). Why do workers aggregate the queens if it then becomes difficult to access individuals?

It is known (Evesham 1985a) that many queens together restrict the distribution of food to individual members of the society and prevent workers from tending larvae by getting in the way. Queens and larvae compete for food and worker attention. As queen numbers increase, fewer larvae acquired food and queens foraged for food and fed themselves. Queens and larvae received more food from workers when there were fewer of them. Evesham (1985) found that the observed frequency of different numbers of queens occurring together differed according to the total number of queens in the nests. For example, single queens occurred more often when a total of 6 queens was present and pairs of queens were more common when a total of 12 queens was present. Do workers adjust their behaviour according to the queen/worker/larvae ratio?

It is difficult to comprehend why queens are encouraged to cluster together when it is known (Evesham 1984b) that they can be intolerant of one another. It would seem that with the constant dispersion and re-assemblage of clusters by workers, the workers are striving to maintain an optimum population size for efficient food distribution and maximum queen/worker contact, while the queens prefer to disperse in order to minimise queen/queen interactions.

The remainder of this article describes an experiment undertaken by the author to attempt to shed light on the questions above and understand who's really in charge of the ant colony.

Fig. 7. Marking individual Queen ants with Humbrol quick-drying, non-toxic paint.

Methodology

Five nests were collected from Kimmeridge (map ref. GR 917 800) and placed in maintenance nests made of circular washing-up bowls with a floor space of 33cm diameter x 10cm deep. Polytetrafluoroethylene ("Fluon") was coated around the rim of the bowl. Fluon provides a slippery surface up which ants cannot climb. A wetex pad, soaked in distilled water, provided moisture and this was replenished daily. A sugar lump and fresh mealworms supplied carbohydrates and protein and these were replenished when necessary. The washing-up bowl was covered with black card, leaving a small crack to provide natural daylight. A lamp with 40W bulb, attached to a time switch provided a 14h day length and this was replaced with a red bulb when observations were made. Room temperature was between 20-22°C.

All queens were marked with Humbrol, quick drying, non-toxic paint on their abdomen and/or thorax (Fig. 7). The nests were left undisturbed for a fortnight before observations were carried out.

In order to eliminate nest design and any form of disturbance as a result of transferring ants to new nests as influences upon colony behaviour, the ants were left in their maintenance nests and as near to natural conditions as possible provided. Observations were made daily for a period of 10 days and results were recorded using acetate sheets laid over the nest area. Positions of queens and workers were noted together with the identification of each

Nest number	Queen number	Queen identification	Worker number	Presence of larvae
1	8	wa,wt, wa+ t, wa +gt, ga, gt, ga + t	94	yes
2	1	Blank	120	yes
3	1	Blank	170	yes
4	0		60	yes
5	7	wa,wt, wa+ t, ga, gt, ga + t, blank	185	yes

Key	
wa	White abdomen
wt	White thorax
wa+ t	White abdomen and thorax
wa +gt	White abdomen and green thorax
ga	Green abdomen
gt	Green thorax
ga + t	Green abdomen and thorax
blank	No marking

Table 1. Nest structure and Queen identification.

Results

There were many occasions when queens were found on top of a cluster of workers rather than within the group. It was not clear whether this resulted from the queens moving by themselves or the workers trying to move the queens in an attempt to take greater control over them. Could it be a one way thing; workers bringing queens together to have more influence over egg production, larval development and food distribution? Could queen sociability have less to do with a hierarchical structure of the queens and more to do with worker influence? The observations and data collected from this study would suggest that worker influence had more effect on the arrangement of clusters compared to the queens.

There were daily variations in cluster arrangements over the study period and there is evidence to suggest this by a correlation coefficient. A cluster tended to expand over a 4- or 5-day period (Fig. 8) to become reduced on the following day. This sequence would then be repeated.

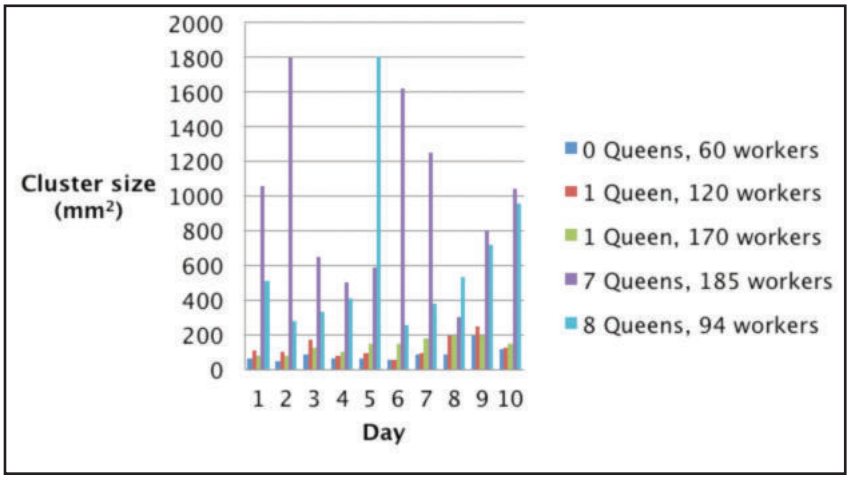

Fig. 8. Graph to show cluster size with different Queen and Worker densities over a 10-day period.

For nest 1 with 8 Queens and nest 5 with 7 Queens (Fig. 9 & 10), there is some evidence to suggest that there is a relationship between cluster size and day. With no Queens present, clustering was more random over the 10 day period.

In all nests, there were 28 times when cluster size increased from one day to another, but 17 times when it decreased. Therefore, a slight upward trend occurred which was confirmed by correlation.

In nests with 0 queens and 1 queen, there was less daily variation, as compared to nests containing 7 and 8 queens. For example, in nest 2 with 1Q and 120W, the variation is between 55-

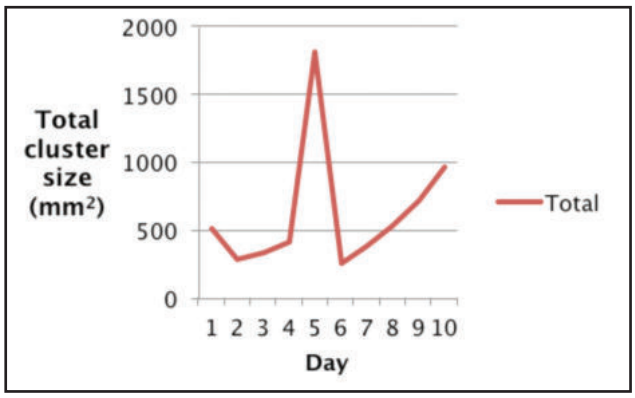

Fig. 9. Cluster size (mm²) and Queen location of nest 1 (8 Queens + 94 Workers).

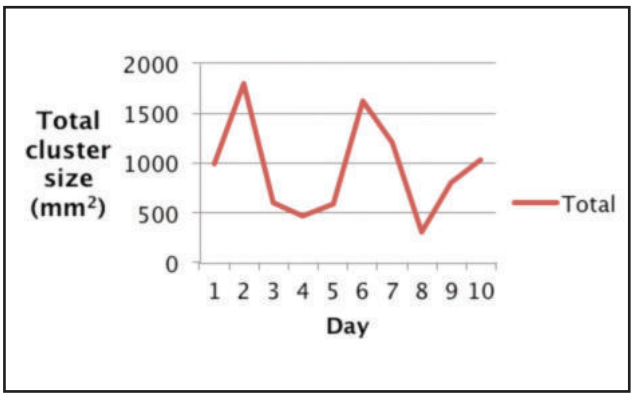

Fig. 10. Cluster size and Queen location of nest 5 (7 Queens + 185 Workers).

248mm², a factor of less than 5, whereas in nest 1 with 8Q and 94W, the variation is between 254-1808mm², a factor of more than 7. Although this effect is not large, it does imply that larger queen groups are more mobile and more difficult to manipulate, by workers, than smaller queen groups.

There must be much energy expended, by workers, in the process of grouping queens that have moved away. Therefore, moving queens into one large group, or into smaller groups, could perhaps provide a more stable structure to the colony allowing energy to be channelled into caring for queen-laid eggs, larvae, and collecting and distributing food. But this does not answer the question as to why the queens make it more difficult for the workers to organise the colony by moving away.

Since the variation is more random in the nest containing 0 queens (nest 4 with 0Q and 60W), it is queen presence which is influencing the activity of the nest. This was confirmed by comparing one nest with another and looking, each day, to see which of the two had larger clusters (Table 2).

The results suggest that there are some deliberate behavioural patterns occurring and that both queens and workers are important in determining the cluster size over the study period. However, it is the queen presence that seems to be the driving force. When the average cluster size was considered, queen number appears to be more important than worker number in determining cluster size (Table 3).

Queen number is therefore of significance. However, although the effect is not large, this table also shows there to be more variation, day by day, when there are less workers to manoeuvre the queens. When comparing the average cluster size across all nests, in nest 1 (8Q and 94W) this was found to be 2/3rds (618mm²) that of nest 5 (7Q and 185W, with average cluster size 961 mm²), which contained almost twice as many workers.

Observations have shown, in this study and in previous studies, that workers spread out more, occupying a larger area, when there are fewer of them (Table 4). This could be a way of overcoming their inability to preside over the queens effectively at lower numbers, and so they tend to occupy a

Nests compared		Times/10 cluster size larger	Deliberate behaviour	Random behaviour
Queen number	Worker number			
7 8	185 94	8 2	✓	
1 1	120 170	4 and =1 5		✓
1 0	120 60	10 0	✓✓	
1 0	120 60	10 0	✓✓	

Table 2. Cluster size and behavioural patterns in each nest.

Queen number	Worker number	Average cluster size (mm²)	Factor of times (x)
1	120	126	5
7	185	961	6
8	94	618	7

Table 3. Average cluster size in the ant nests.

Number of Queens	Number of workers	Cluster size per worker (mm²)
0	60	14.2
1	120	10.5
1	170	8.2
7	185	51.9
8	94	65.7

Table 4. Cluster size per worker in each nest.

Nest number	Queen number	Worker number	Times queens alone	Times queens together
1	8	94	0.6	4.9
5	7	185	0.3	7.3

Table 5. Number of times Queens were found alone and together in same nests.

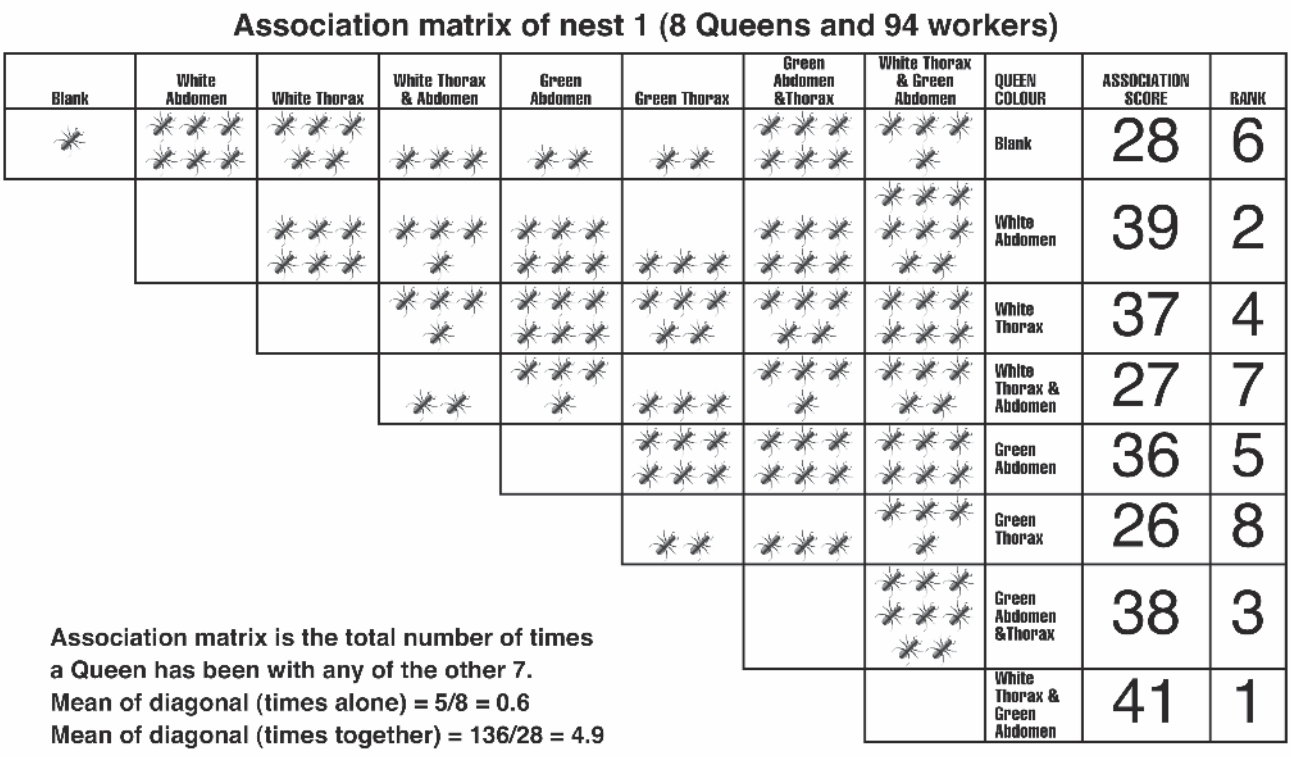

Fig. 11. Association matrix of nest 1 with 8 Queens.

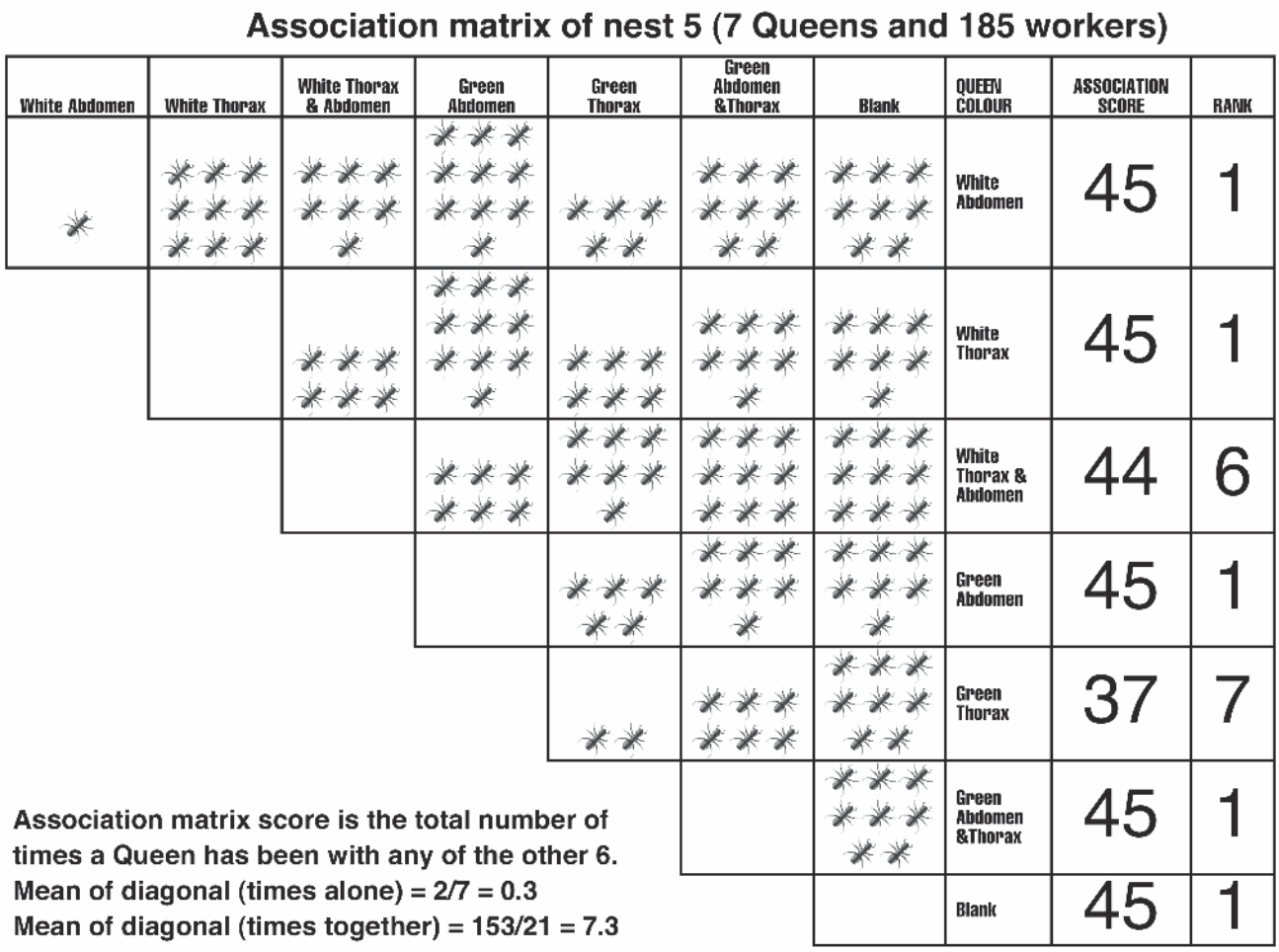

Fig. 12. Association matrix of nest 5 with 7 Queens.

wider area, almost creating a barrier and reducing queen mobility. There could, however, be a number of factors involved and more nests need to be observed, and for longer periods, to be able to come to a firm conclusion. Perhaps, when the population density of queens increases, worker influence becomes outweighed by queen effect.

Perhaps the colonies of *Myrmica rubra* are moving away from a polygynous society to a monogynous one as a result of the environmental pressures placed upon the population of the species as a whole. That is, the change from colonies made up of larger population densities, consisting of a greater numbers of queens and workers, which existed in the past, to smaller population densities of today, containing fewer queens and workers.

The Association Matrix was used to find out whether, when queens occupied clusters containing other queens, they associated with any one particular other queen. It was found that for nest 1 with 8Q and 94W (Table 5), the mean number of times queens were found to be alone was 0.6 and the mean number of times they were together was 4.9. However, the Association Matrix of nest 5 with 7Q and 185W (twice as many workers, Fig. 12), had a mean number of times queens were found alone to be half that of nest 1 (Fig 11). That is, alone = 0.3 and together = 7.3.

When the mean and variance were compared in the two association matrices, for nest 1 (8Q and 94W) it would appear that the queens were showing some signs of preferences, but in nest 5 (7Q and 185W) the preferences were far stronger.

Nest number	Queen number	Worker number	Mean	Variance
1	8	94	1.0	1.03
5	7	185	1.0	2.55

Table 6. The mean and variance of nests 1 and 5

Summary

- The results presented would seem to suggest that when workers are in low densities, they struggle to gather queens together who are possibly avoiding aggressive encounters with other queens by being in larger groups.
- It is also possible that workers are making the choice to bring queens together into social groups, rather than the queens themselves, but it is the queens choosing to be away from large queen groups to avoid aggressive encounters, perhaps 'buddying up' with other queens that are more tolerant.
- It is likely that queens have more influence over the colony as a whole, in terms of determining the growth rate of larvae, despite environmental pressures, if they are spread out rather than in one area of the nest.
- There appears to be cyclical activity occurring every 4-5 days in all nests of varying densities.
- The queens have been known to evoke aggressive behaviour with one another when encountering other larger queen groups.
- It is possible that queens are trying to move away from each other to avoid aggression, while the workers are bringing them back into a group because communication and food distribution is more manageable and cost effective in terms of energy.
- The behaviours of such ant societies have not been influenced by nest design since patterns of activity have been similar.
- Nest design has been either:-
  1. Vertical or horizontal.
  2. Soil or no soil.
  3. Open plan or segmented.
  4. Ground area of various sizes.

Could environmental influences create a stronger "team effect" to ensure the survival of the colony? Clearly there is a need for further research to be carried out.

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Photo of the nest before collection.

Supercomputer reveals internal structure of wasp nest

Philip Spradbery
Michael Turner
Ajay Limaye

This early-season nest of the introduced 'European wasp', *Vespula germanica*, was built under the eaves of a house in the Australian capital, and collected by wasp specialist Dr Philip Spradbery after anaesthetizing with ether. It was stored frozen until scanned at the Australian National University (ANU) in Canberra.

Michael Turner of the ANU Department of Applied Mathematics used high-resolution X-ray computerised tomography (CT) scanning and Ajay Limaye of the ANU-based National Computational Infrastructure (NCI) generated 3D images and animations from the radiographs. For each point in space, the hardware processes the X-ray data from every angle that passed through that location. The result is a measurement of how dense the material is at that point. This is repeated for each and every miniscule element of the scan and produces a reconstructed volume as large as 50 gigabytes or more. The wasp nest was scanned at a resolution of 40 microns, generating billions of data points. The dataset was imported into the NCI-developed display software package, called Drishti, which enhances contrast and adds colour.

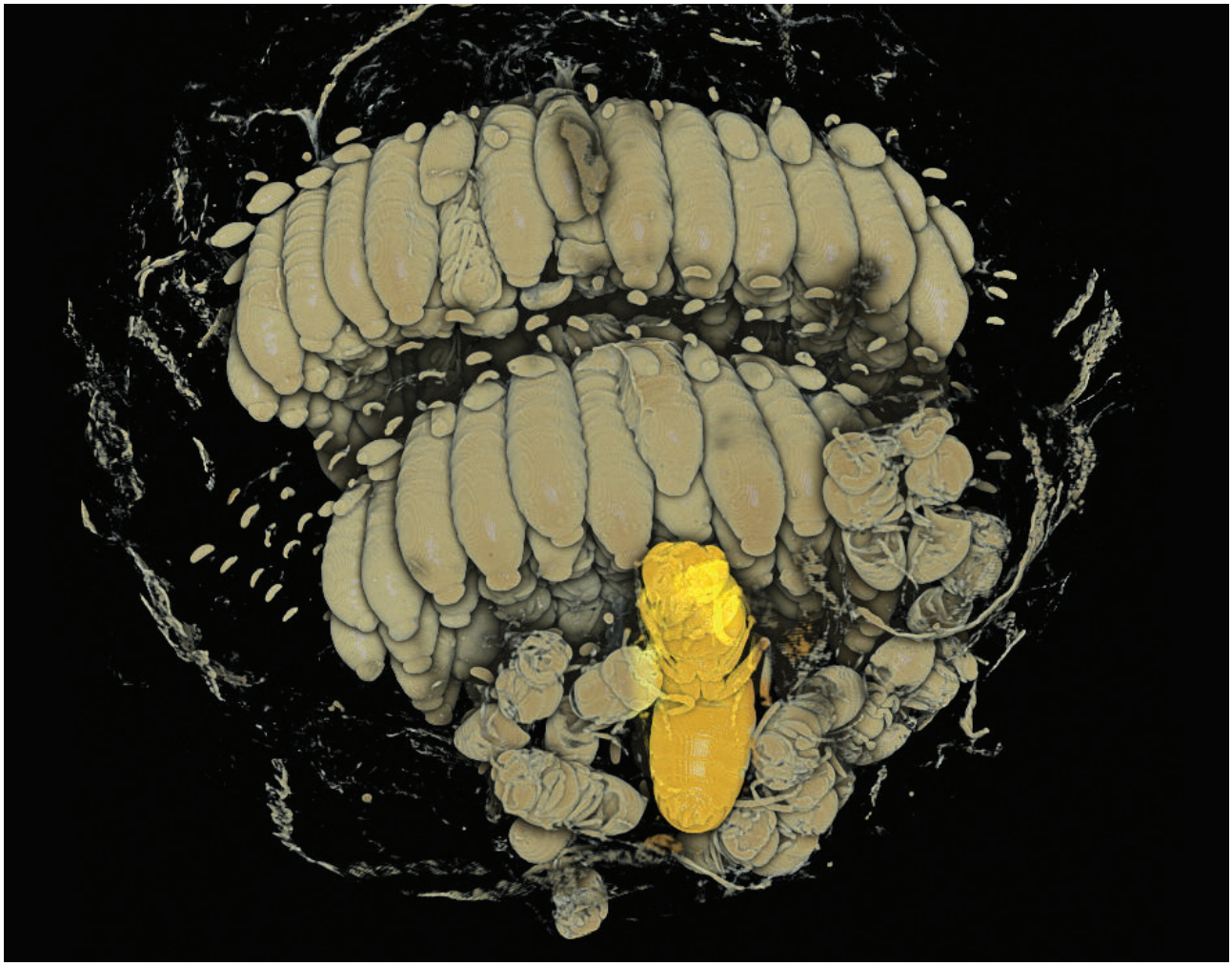
The CT images include a vertical-section of the nest as well as 3D images and also a video presentation providing a dynamic exploration of the internal structure (see URL, file labelled 'nest.wmv'). The highlighted founding queen and her adult worker daughters are recognizable as well as the eggs and developing larvae and pupae of this 3-comb nest. The brood combs are surrounded by a multi-layered sphere of insulating wasp carton or *papier mâché*, made from foraged wood pulp.

A conventional digital photograph of the nest was taken by Philip Spradbery just prior to collection.

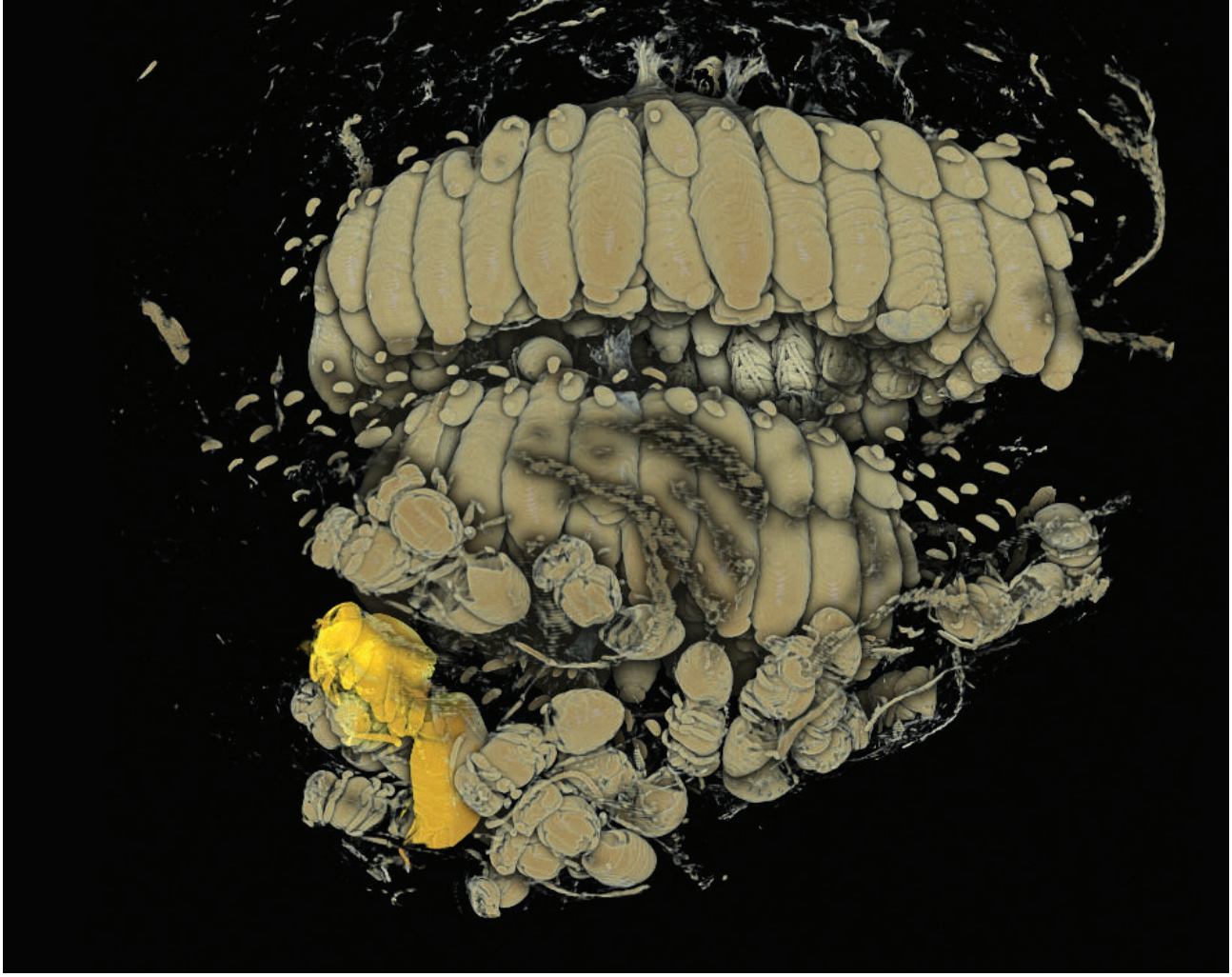
Dr Philip Spradbery FRES is the author of "Wasps: an account of the biology and natural history of solitary and social wasps" published by Sidgwick & Jackson (1973) and is studying chemical communication in colonies of the social wasp, *Vespula germanica*, in Canberra.

http://anusf.anu.edu.au/~acl900/waspnest/

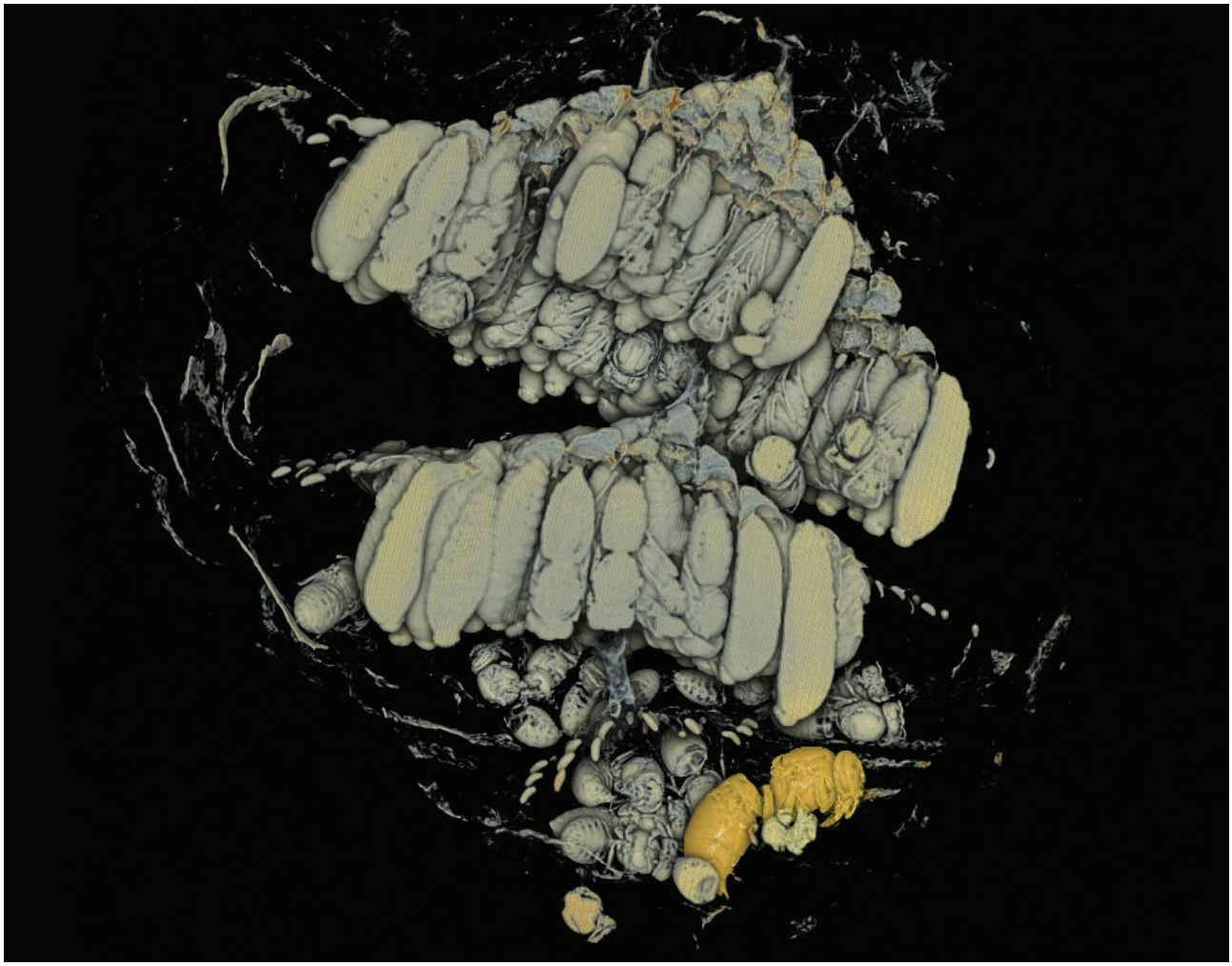
"Vertical section" of the nest using CT tomography.



Viewed from slightly below, the nest showing the founding queen (highlighted), and adult worker wasps and the larvae and eggs in their cells. The paper cells are invisible allowing all the brood to be seen quite clearly.



Similar to previous with queen in profile. The eggs in their invisible cells look like satellites in space!



Probably the most illuminating image with the queen in profile and details of the immature stages including the pupae. The lowest (third) comb defined by rings of suspended eggs!

The class from Cotiakou school that we worked with this time in Benin.

Bugs for Life bites back: Edible insects in northern Benin

Bugs for Life' is a charitable organization focused on traditional entomophagy and the role it could play in food security. Delivering public talks, interactive school classes and attending science festivals; Bugs for Life also promotes ideas about insects as food and feed more generally.

Rudi Verspoor
Marthe Jacobsen
Laura Riggi
Mariangela Veronesi

Since Bugs for Life began, in 2012, the subject of entomophagy has exploded in both the national and international media. Only three years later and 2015 has seen the opening of the first dedicated insect restaurant in the UK - 'Grub' in Pembrokeshire – putting edible insects on the UK map. Meanwhile, research and development on insects as a sustainable source of protein across the world has been blooming, much of which has contributed towards a comprehensive global review of insects as food and feed from the Food and Agricultural Organization (FAO 2013). More recently the Royal Entomological Society (RES) has formed a special interest group specifically to share ideas and address issues on the subject of eating insects. It really does seem an exciting time for entomophagy with niches to be filled in almost every aspect and across disciplines - from researching 'entoculture' in the lab and field through to delivering insects to kitchens around the world.

The particular interest of Bugs for Life is the role that insects play as a traditional food in areas where food scarcity is an issue. During our earlier visit in 2012 we learned from the Waama community in northern Benin (Tanguieta commune, Atakora region) about how the Waama use insects traditionally (Riggi et al. 2013, available at www.bugsforlife.com). Building on this knowledge, on our most recent trip (October 2015) we worked with the school of Cotiakou, the hospital of Tanguieta and the wider Waama community of Kosso on three main subjects of entomophagy.

Firstly, working in the local School of Cotiakou and nutritional centre of the Tanguieta hospital we aimed *to engage students and women about the*

A selection of tasty insects collected by the kids, and brought in during our class about entomophagy around the world. Inset: An image of the flying sexual forms of termites. Termites like these are collected across many areas of Africa when they emerge in huge numbers.

Laura and Ouro (the representative of Kosso village) discussing how different insects are farmed in different parts of the world.

nutritional value of insects. In addition to understanding the value of insects nutritionally, we also aimed to put traditional entomophagy in northern Benin in the context of global entomophagy, explaining that insects are eaten in two thirds of countries around the world. Secondly, by working with people at the level of the household about individual habits of entomophagy we are hoping to build a more *complete picture of how insects are traditionally eaten* in the area and understand individual preferences and use of insects as food. Finally, working with the village of Kosso, we aimed to develop a dialogue about the *potential of farming insects locally* and how this might compliment traditional entomophagy in the future.

Nutrition: Education and outreach at the college of Cotiakou

In the last twenty years there has been increasing recognition that insects have comparable nutrition to other protein rich foods (FAO 2013) and can play a major role in food sovereignty and sustainability in rural Africa (Van Huis 2003). Many insects are rich in fats, as well as a range of micronutrients. Termites for example, which are favoured by groups in northern Benin, are rich in protein, fats, iron and calcium (Banjo et al. 2006). Sharing this information with the pupils of Cotiakou School, we found that they were particularly interested in the specific nutritional values of some of the insects they eat traditionally. While for some of the insects they eat the nutritional value is known from other parts of Africa, many still remain to be examined in the future.

Another particular hit involved talking more widely to the classes about entomophagy worldwide. With over 2,000 species of insects eaten worldwide we had a plethora of examples to choose from - from the mopane worm (*Gonimbrasia belina*) in South Africa, which can sell for the same price as beef at market, to giant water bugs (*Lethocerus indicus*) whose meat apparently tastes a bit like scallops and prawns (Jongeema 2015). Putting the Waama traditions of eating insects within a global perspective captured the imagination of the students and by the time we offered dried edible insect products that we can find in Europe for a taster session there were queues around the class. Perhaps seeing the insects packaged and processed even caught the attention of a few of the more entrepreneurially minded students.

Insect favourites: A closer look at household habits of entomophagy in Kosso

It is remarkable that, at almost any scale, differences in preferences for eating insects are so variable, be it comparing across continents through to individuals within communities. We believe that understanding variation in habits of entomophagy locally is one of the fundamental first steps towards developing insects as a reliable food source that could contribute to food security. Speaking to the Waama communities, and various ethnic groups, it was instantly apparent that there were very distinctive attitudes towards the different species of insects

Mariangela speaking to the household head about preferences for insects within his family.

that are eaten in the area. Some insects were no longer eaten at all, or only by the older generations. For example, a species of leaf footed bug (family: Coreidae) that was eaten in the past is now no longer consumed by anyone in the community except for one older man. Looking from household to household there were also large differences in the number and types of insects eaten (ranging from none to up to 15 species), as well as the amount of time that they were willing to spend collecting them. In Benin, where there are more than 45 ethnic groups with their own languages, cultures, and food habits, understanding fundamental preferences and even culinary rules within villages can be extremely interesting. For example, in Kosso, lizard's meat (*Agama* genus) is considered a food that is only for young men to eat before they are married.

In addition to differences between individuals, we were interested in learning if there were some insects that were generally favoured across all or most of the people we spoke to. In the end, there were two clear winners. The tobacco cricket (*Brachytrupes membranaceus*), a nocturnal species which lives underground in burrows up to 30 cm long, ended up coming out on top with almost everyone we spoke to eating it already. It also topped the list of insects that people would like to have greater access to. Although difficult to collect in the wild in large quantities, it seemed the taste of this cricket grilled on a fire sets it apart. Winged termites came out a close second (*Macrotermes falciger*), as the highly nutritious sexual forms can be collected in large quantities during their synchronized dispersal flight. Either cooked fresh straight after collection, or dried and incorporated into sauces, termites were enjoyed by all ages in the family. They were also one of the few insects eaten more widely in other ethnic groups in the area, perhaps due to the ease with which they can be collected due to their seasonal abundance.

Grow your own: Developing access to edible insects within communities

While insects are consumed in Benin, the practice differs hugely between ethnic groups. In addition, some groups do not consume insects at all and many people stop eating insects when they live in cities. This is linked to the fact that insect collection is usually done in fields, and there is also a stigma towards traditionally rural practices in urban centres. These issues brought us to the third aim of our trip; asking if insects, an available but only seasonally abundant food, can play a larger role in food security in the area. Considering the seasonal shortage of food that coincides with the end of the long dry season in this part of sub-Saharan Africa, both the amount of insects available and when they would be available are important aspects to consider. With the aim to continue to work with communities that already collect and eat insects traditionally, we decided to gauge the interest and attitudes of the communities, using targeted questionnaires. We also explored whether they believed there would be a market for insect products locally.

After speaking to a number of households in the village of Kosso it became clear that there was an interest in having greater access to insects, particularly for some species of cricket and grasshoppers, as well as termites. They were interested in the potential of farming crickets, especially their favourite the tobacco cricket. Having

The tobacco cricket (*Brachytrupes membranaceus*) is one of the favourite insects to eat in Kosso.

brought some examples and images from Thailand and Cambodia, where cricket farming is more widespread, we sparked an immediate interest from a number of adults in Kosso. Overall, the preferred method of trialling farming was considered to be at the community level (as opposed to individually owned farms), where the work could be distributed across multiple households. This could be a way of spreading risks and costs amongst different families, as well as allowing them to collectively support one another in the process of rearing the insects. Interestingly, most of the community also felt there would be a market value for insects if they could be produced in sufficient quantity. In their terms, 'since people do eat them – why would they not buy them? As long as they are affordable, people will buy insects'. Such enthusiasm certainly could provide a good basis on which to pilot community based farming projects during our next visit. Indeed, one such project in Kenya is carrying out a similar initiative whereby individual farmers are pre-paid to trial the efficiency of farming crickets as an alternate source of income (www.flyingfoodproject.com).

What Next?

Following our visit to northern Benin, we are excited to build on the results of this trip. Reconnecting with old friends and working more closely with the Waama communities of Kosso and Cotiakou has certainly provided a fresh perspective on future directions for Bugs for Life. Discussing the potential of insect farming and food preservation techniques and realising the appetite for trialling projects with the community led to plenty of ideas for the next chapters of Bugs for Life's work. Meanwhile, engaging with the next generation of 15-20 year old students about the nutritional value and potential of insects as food might provide a platform on which to expand the reach of this work. Already, there has been some interest from neighbouring schools in the programme. We are keen to produce additional educational material, and develop our interactive outreach activities further.

2016 is also going to provide many exciting opportunities to continue with our events and work in the UK. National Insect Week promises to be an excellent opportunity to showcase all things that are great about insects and we look forward to being involved and getting as many people as possible to think about insects as food, and maybe even eat them. Undoubtedly, the interest generated by discussing insect farming and insect nutritional value, as well as the positive responses of many people in the communities we worked with, will help to develop and gather funds for future projects in northern Benin and across the UK. What an exciting few months to come! For more information about our activities, or to get in touch, please visit our website www.bugsforlife.com, or follow our work on Facebook and Twitter.

Acknowledgements

It just leaves me to thank the RES and British Ecological Society for their generous support to the project via their outreach grant programmes. In addition, this project would not have been possible without all the generous donors from our crowdsource fundraiser and the support of those that helped us on our fundraising campaign. Finally, we would like to acknowledge the huge contributions and help from the communities of Kosso and Cotiakou, in particular Ouro Botto, Yatto Doko, Elizabeth Kassa and Mathieu Doko.

All images are from Bugs for Life except for the image of flying termites. The details of the images permissions and licences can be found under the caption.

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A view from the North: Yorkshire

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Yorkshire is a county with a long and proud history, a place where rolling green hills lead you into vast natural parks and a treasure trove of historical stately homes and castles. This is also a place, like many other places in the country, where natural history has flourished at times and diminished at others. There have been times when council funding has led to collections with research potential to rival the national museums, and there have of course been times more recently where natural history has not been seen as important enough to warrant funding. Whether deemed important or not by the powers-that-be, the wealth of natural history to be found in Yorkshire is inspiring and the history of natural history is, as ever, complex. This is where I visited for this issue of our tour around the UK's entomological collections, to investigate the diversity of Yorkshire Museum's insects and to provide you with enough information to decide on the potential of the collections in your own research. In past issues we have visited museums in Reading, Cardiff, Bristol and Birmingham, each with their own slightly unique way of dealing with natural history collections. Some, like the Cole Museum of Zoology at the University of Reading, are dedicated specifically to zoological collections and the insects have a priority not seen in many places. And in others, such as Birmingham Museum, the arts seem to dominate and the natural history curators have had to be creative in their bids for funding and exhibition space.

Yorkshire Museum is near the centre of the historic walled city of York and is set within a beautiful Greek revival style Grade 1 listed building built in 1830. The building is part of ten acres of botanical gardens which run from

Figure 1. Yorkshire Museum building and gardens.

the River Ouse in the south to York Art Gallery in the north, and all of this is set in the ruins of St. Mary's Abbey to which the grounds used to belong. The whole effect is stunning and on a sunny day the sandy coloured building standing out against the green shrub surrounding it makes for a relaxing place to eat your lunch and take some photos (fig. 1). The museum was founded by the Yorkshire Philosophical Society to hold and display the collections they had built up and to provide a space for encouraging discussion and curiosity. In the 1960s the museum and gardens were entrusted to the city council. In 2002 the council set up the independent charitable York Museums Trust to take responsibility for the museum and other sites of historical and cultural importance around the York area.

Unfortunately, in recent times York City Council has cut the museum's budget by around 60%, making museums and historical sites in the city some of the least funded by their local council in the country, despite having one of the largest regional collections. This has, some might say inevitably, led to the introduction of admission charges. The Museums Association has been monitoring the effects of government funding cuts on museums and has found that almost 20% have had to close at least part of their museum due to declining government support, with a further 44 closing completely. Eight percent of museums have started introducing admission charges to try to mitigate funding cuts and to stave off closure, including York Museums Trust and Brighton Museums. For more information on the results of these surveys readers can refer to the Museums Association website (www.museumsassociation.org/campaigns/funding-cuts/cuts-survey). These cuts are inevitably leading to a decrease in services, and therefore visitors, and an increase in unpaid staff. Some museums have decided to remain free but have begun introducing more shops and cafes to the museum space to try to entice visitors to spend more money. But if it is a choice between paying £7.50 entry or being bombarded by a mall-like space when entering a museum, I would much rather the former. Of course the ideal situation would be for the government to continue supporting our cultural and natural heritage, but that does not seem likely in the near future. So although it seems strange to pay entrance to museums in England, it may be the only way to save our museums from closure. As York Museums Trust has done there should always be reduced (or preferably free) entry for local residents. Admissions profits should come from tourists, not from local residents, many of whom use the museum space regularly. I know of several art students who use museum collections to practice drawing, or others who use their local museums for project inspiration or for space to think outside of busy city life. Museums shouldn't become one-time visitor attractions, but rather remain as public spaces for sharing ideas and inspiration.

Today the natural science collections at York are overseen by Dr. Sarah King with the help of Assistant Curator, Stuart Ogilvy. As well as developing the collections in Yorkshire, Sarah is a palaeontological researcher at the University of Birmingham, focusing on Palaeozoic plant life.

Collections on display

Public facing exhibition spaces in Yorkshire Museum are unfortunately rather sparse for insects, even though Sarah tells me that visitor survey results have indicated that people would like to see more entomological content on

Figure 2. Stag beetles (Lucanidae: *Lucanus cervus*) duelling.

Figure 3. My newly evolved super bug.

display. Birmingham Museums had a relatively small exhibition space, but proportionally much more entomological content than we see at Yorkshire Museum. There are very few insect specimens on display in the exhibitions, although the museum holds an extensive and important collection of insects. Interestingly, as is a theme with Yorkshire Museum, the only insects represented in the displays are beetles. There are a couple of stag beetles fighting as you first walk into the natural history area (fig. 2) and a trail of tansy beetles through the case. The tansy beetle is somewhat of a symbol for entomological conservation at the museum and this will be explored in more detail later.

The natural history galleries provide content which flows nicely from extinct ancient fossil species, through more recently extinct animals to conservation efforts hoping to save those species which are currently at risk of extinction. The exhibition begins with a look at the five big mass extinctions in what is described as a child-friendly, classic case by case display. Stuart Ogilvy explains to me that the curatorial team had ideas for a display more integrated into the museum style. Much of the archaeological exhibition is set in a more immersive style where you feel as though you are part of an expedition. This would have worked very well with the extinction theme, working through from a rocky fossil area to a vegetated modern area with specimens placed as though *in situ*. Although there are no fossil insects on display at the moment, Stuart explains that there have been dedicated exhibitions in the past. I did suggest that perhaps some more permanent fossil insects could be placed in the extinction exhibit.

Although there are not many insect specimens on display there are several interactive elements, such as videos explaining extinctions of the large blue butterfly and crashes in honey bee populations. There is also a fun game in which visitors can make up their own 'super bug' (fig. 3) from different insect parts to understand how evolutionary adaptation works.

Behind the scenes

Of the 610,000 natural history items stored at the museum, approximately 400,000 are insect specimens with good coverage of several of the main orders. The collections are mostly organised taxonomically, similarly to the National Museum of Cardiff, but there are still several Victorian chests and boxes of the lesser worked on orders which need to be revised and integrated. There are small collections of: Orthoptera (fig. 4) including ensiferan Gryllidae (*Gryllus*) and Tettigonidae (*Meconema* and *Tettigonia*) and caeliferan Acrididae (*Stenobothrus* and *Corthippus*); Odonata including zygopteran Calopterygidae (*Agrion*) and anisopteran Aeshnidae (*Aeshna*); Blattodea (fig. 5) including Oriental, American and Australian cockroaches (Blattidae). There are also several individuals of Mantodea, Phasmida, Dermaptera, Siphonaptera and Neuroptera. There are a fair number of Hemiptera with nine drawers of specimens, mostly heteropterans including Pentatomidae (stink bugs), Coreidae (leaf footed bugs), Acanthosomatidae (shield bugs), Gerridae (water striders) and Belostomatidae (giant water bugs) (fig. 6).

The Hymenoptera are well represented with the majority of the specimens coming from the Elliott collection. J.H. Elliott was a prolific collector of Hymenoptera in the York area around the middle of the 20th century and his collection contains many specimens from "Parasitica" (non-

Figure 4 (above left). Orthoptera: a) Gryllidae: *Gryllus campestris*; b) Tettigonidae: *Tettigonia viridissima*; Figure 5 (above right). Australian cockroach (Blattidae: *Periplaneta australasiae*).

Figure 6. Hemiptera: a) *Sternocephalus medius*, b) Drawer of Heteroptera with inset green shield bug (Pentatomidae: *Palomena prasina*).

Figure 7. Hymenopteran "Parasitica": Drawer of *Podalonia* (cutworm wasps) with insets of *Podalonia affinis* and the ichnumonid wasp *Ophion luteus*.

Figure 8. Hymenopteran Aculeata: a) Drawer of *Bombus* with inset *Bombus terrestris* and b) the true wasp Vespidae: *Vespa crabro*.

Figure 9. Drawer of various dipterans with inset Sarcophagidae (flesh flies).

aculeate Apocrita) (fig. 7), Aculeata (wasps, ants and bees) (fig. 8) and Symphyta (sawflies). There are plenty of representatives of the Apidae, including different species of *Bombus* as well as Vespidae (true wasps), Pompilidae (spider wasps), Andrenidae (digger bees), Ichneumonidae and Sphecidae. Elliott's collection was used alongside other records from Manchester, Leeds, Keighley and Liverpool to report on the diversity of Aculeata of York for the development of biodiversity action plans (Archer, 2012). Also, his ichneumon collection has been developed by Bill Ely over the years and has added much to the knowledge of this group in the Yorkshire area, including several species not collected by anyone else. As well as the historical collections from the 20th century there are also new additions to the collection with specimens collected as recently as 2008/09.

Similar to Bristol Museum & Art Gallery, Yorkshire Museum has a large and well documented Diptera collection. The flies form the second most developed collection, with up-to-date data, after the Coleoptera. Grayson (1994) published a book through the Yorkshire Museum based on the voluntary work of a local Dipterist, Percy Grimshaw. Grimshaw spent a great deal of time bringing the Diptera collection up to modern standards so that it could be used for research. He was born in Leeds and although he spent much of his professional life in Scotland he maintained links with Yorkshire, becoming the president of the Yorkshire Naturalists' Union in 1924. The majority of flies at Yorkshire Museum were collected by Grimshaw himself, although his main collection is held at the National Museum Scotland. As well as increasing the knowledge of Diptera in Yorkshire, his contributions to the Diptera faunal lists of Scotland and Ireland are said to be second-to-none. As well as re-identifying species, Grimshaw organised them into a reference collection and conserved specimens for future work.

There are 801 species of Diptera detailed in the book and collected after 1868. Alongside Grimshaw's own specimens there are collections from H. Britten senior, A. Smith, J.H. Elliott, R. Wagstaffe and D.H. Smith. There are representatives from Tephritidae (fruit flies), Ottidae, Micropezidae (stilt-legged flies), Dryomyzidae, Sepsidae (black scavenger flies), Culicidae (mosquitos) and Syrphidae (hoverflies) (figs. 9-11), as well as many other families. The list is prepared taxonomically and includes data for each species including the number of specimens held, locality and date of collection.

The main bulk of the collection, and the group which has seen the most work in the past, unlike the other museums we've visited previously, is the Coleoptera. The abundance and diversity of the beetle collection far outweighs the other groups, including the usually popular Lepidoptera. There are still plenty of butterflies and moths, but it is the beetles that Yorkshire Museum chose to concentrate on. The beetles are organised taxonomically and have been carefully curated so that all examples of a particular species are together, in order and informatively labelled. The provenance of specimens is often vitally important to research and knowing the name of the collector and where something was collected is often a good starting place for uncovering all sorts of interesting information about them.

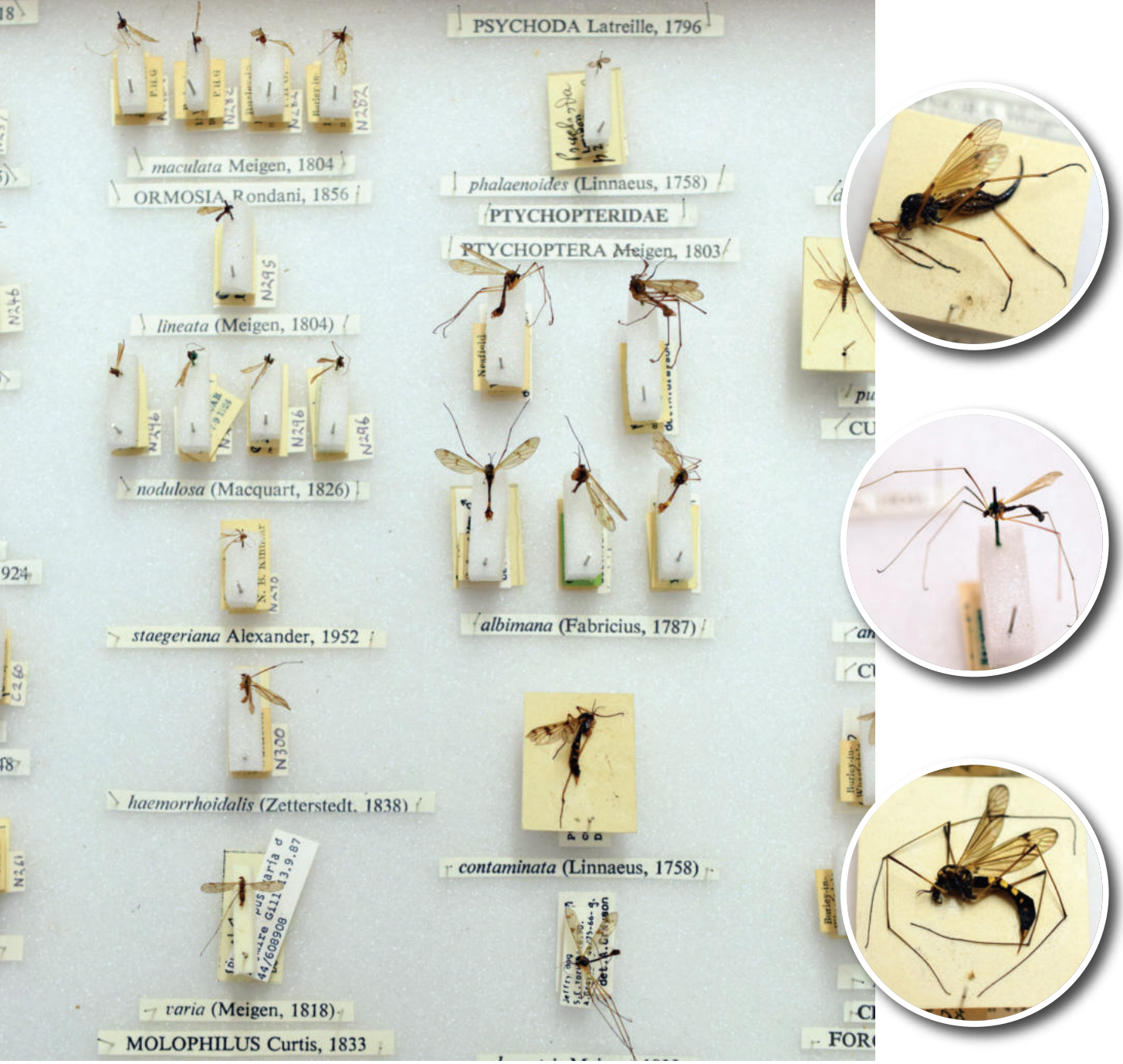

Figure 10. Drawer of Diptera: Nematocera with inset Tipulidae: *Limnophila meigeni*; *Nephrotoma crocata*; *Ctenophora nigricornis*.

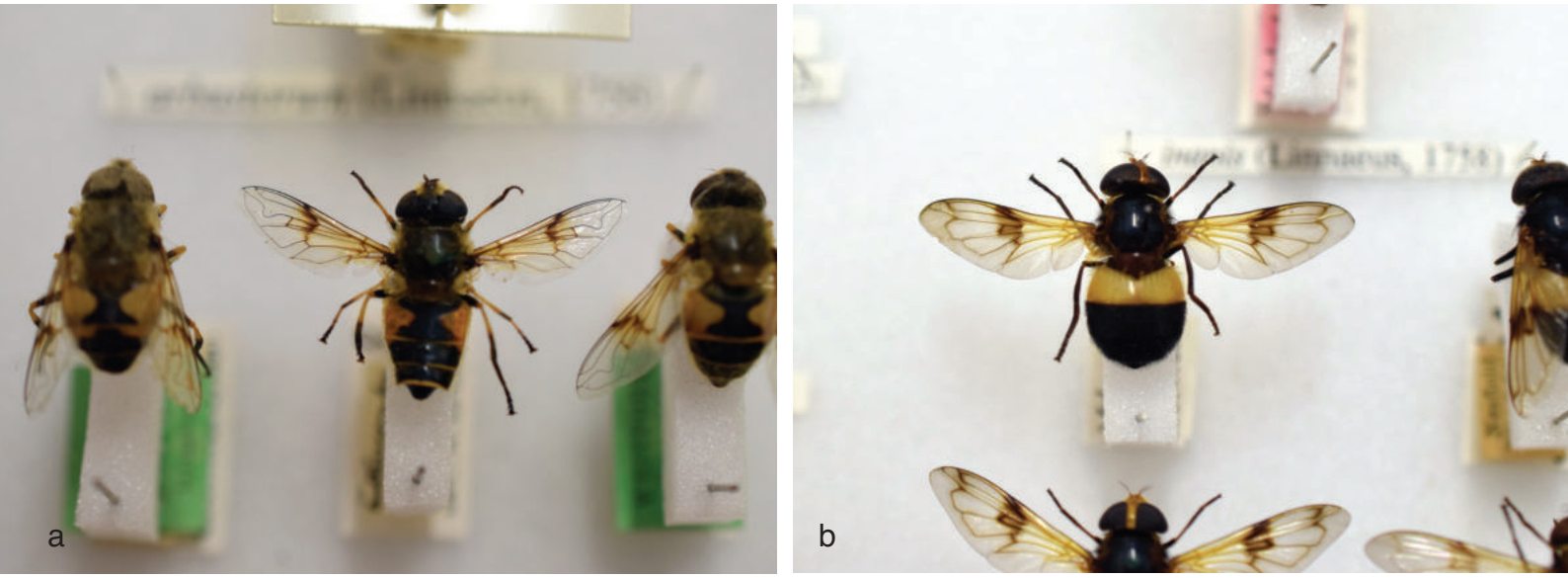

Figure 11. Diptera: Syrphidae a) *Eristalis pertinax*; b) *Volucella pellucens*.

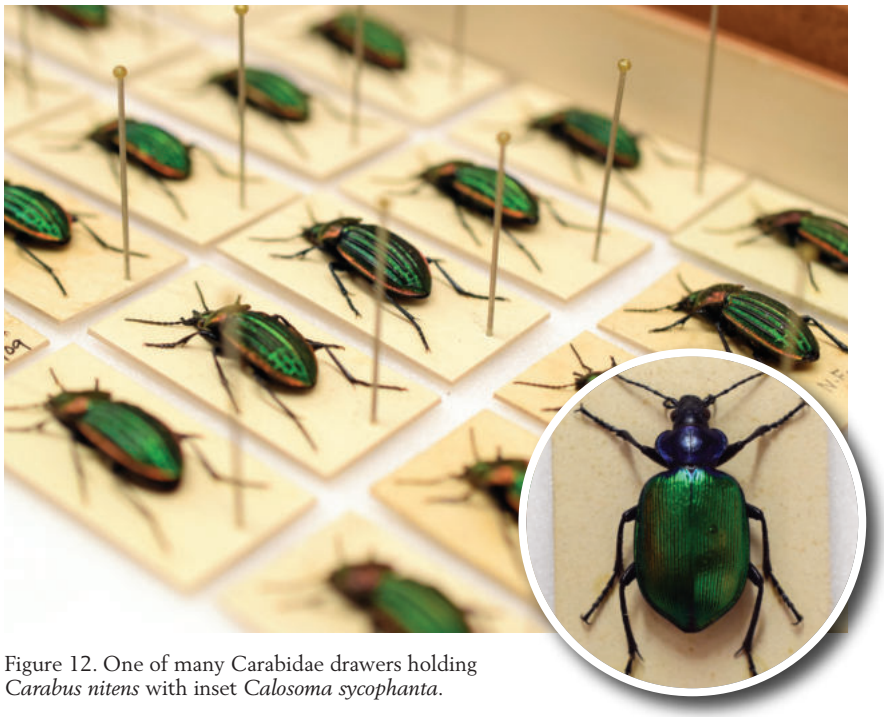

Figure 12. One of many Carabidae drawers holding *Carabus nitens* with inset *Calosoma sycophanta*.

Figure 13. Dytiscidae: *Dytiscus circumflexus* from both dorsal and ventral aspects.

There are 87 families of Coleoptera in the collection representing a broad taxonomic and ecological swath of the order. These include Carabidae (ground beetles), Coccinellidae (ladybirds), Histeridae (water beetles), Staphylinidae (rove beetles), Scarabaeidae (scarab beetles), Elateridae (click beetles), Nitidulidae (pollen beetles), Tenebrionidae (darkling beetles) and Scraptiidae (figs. 12-14).

There are several hundred Curculionidae (weevils) which were identified by Michael L. Denton, a vice-president of the Yorkshire Naturalists' Union and a keen amateur coleopterist. The data from these weevils, as well as data from other families in the Yorkshire Museum and other museums, were added to newly collected field data from 1947-1950 to build up a picture of the faunal composition of beetles on the Spurn Peninsula, a narrow spit of land off the coast of East Riding (Denton, 1995). Michael Denton also published a book about the carabids found in the Yorkshire Museum collections (Denton, 1993), which has been updated several times since (Denton, 1997; 2004; 2007, 2011). There is also a fifth update available but there is no date on the publication (Denton, year unknown). The purpose of the publication was much the same as this article series, to document insect collections in a lesser known museum so that interested parties may be better able to find them. Denton was employed by the museum for a three-year period with funding from the council to make the collections more research-accessible. The then director of Yorkshire & Humberside Museums Council, Barbara Woroncow, explains in the book's foreword the vital importance of this kind of funding for smaller museums to be able to carry out such projects, and that without it this kind of research would be very difficult if not impossible to organise.

The book is based on the Herbert Willoughby Ellis collection of over 80,000 beetles (12,000 carabids). Ellis was based in Birmingham but was a prolific collector throughout the UK, and his collection has been said to be "one of the finest and most extensive collections of British Coleoptera ever brought together" (Hincks, 1944). Denton modernised the identification of the collection, revising Ellis's species with updated methods, including genitalia dissection, and provides a list of the species present in the collection along with distribution data and a few words regarding conservation status.

The museum also holds large collections of both British and foreign Lepidoptera (fig. 15 & 16), though they are not as well researched as the beetles and are often still found with their old Victorian labels with out-dated nomenclature (for example *Hyles euphorbiae* is still labelled as *Deilephila euphorbiae*). Nevertheless, it is doubtless an important collection to anyone researching butterfly diversity. As with the other insect groups the Lepidoptera are principally from the UK, with an emphasis on Yorkshire and the north of England, but there are also collections from New Guinea, South America, the Maldives and some 'foreign' moths without specific location labels including Sphingidae, Sesiidae and Cossidae. The majority of the collections are from Thomas Allis,

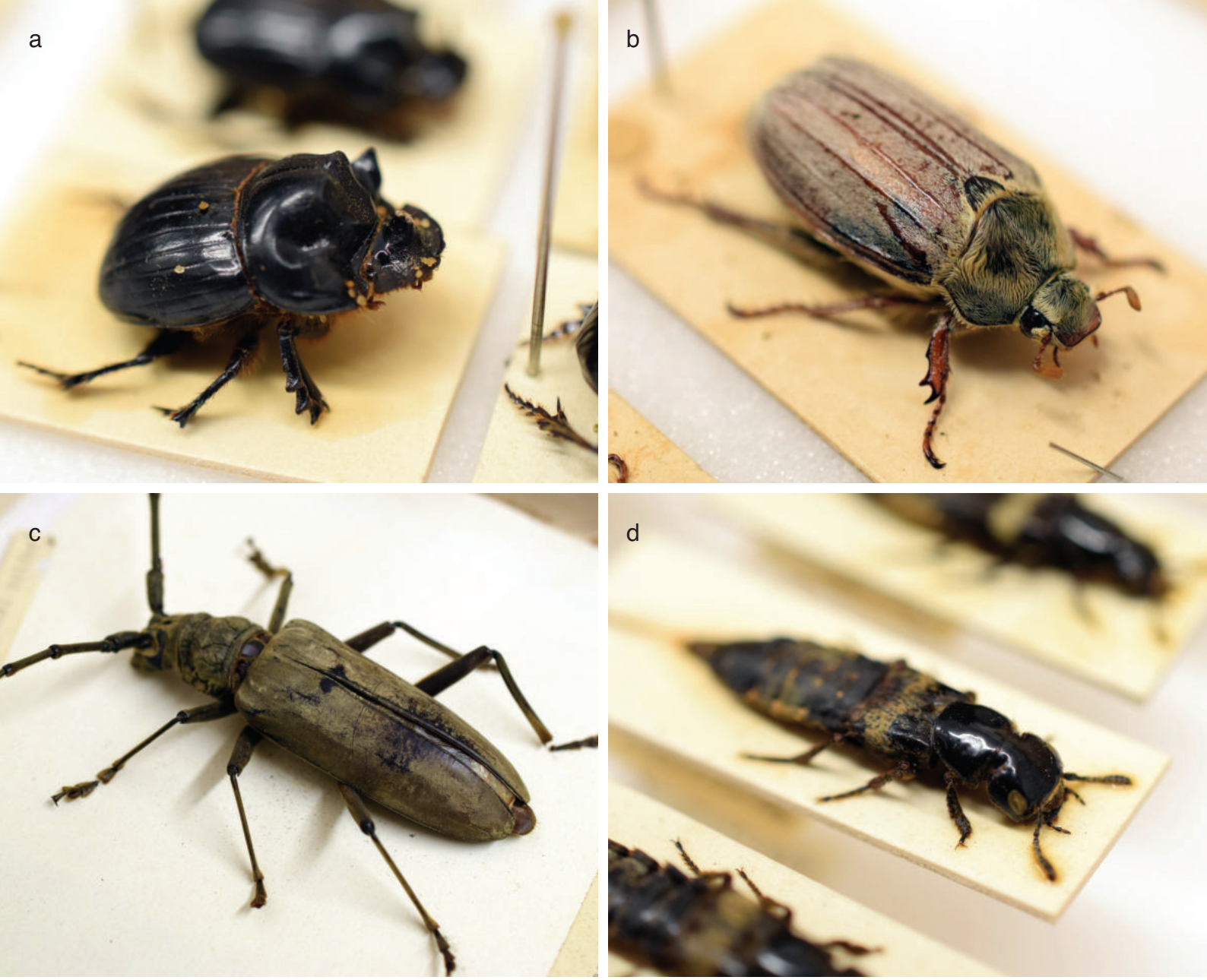

Figure 14. a) Scarabidae: *Copris minutus* (dung beetle); b) *Melolontha melolontha* (cockchafer); c) Cerambycidae: *Batocera wallacei* (longhorn beetle) and d) Staphylinidae: *Creophilus mexillosus* (rove beetle).

Archie Heron and George E. Hyde who was known for breeding through his captures and setting the resulting progeny free to limit his impact on local populations. George and Archie collected together, sometimes spending weekends away in the Yorkshire rain collecting moths, as detailed in an article by George recalling collecting trips and attempts to rear larval Lepidoptera without much luck (Hyde, 1957).

Palaeoentomology

The fossil insect collections at Yorkshire Museum are reasonable and there seems to be much more available than is known about. Regarding my own research, the curators only knew that there were some Triassic insects in the collection, but had no further details. When I arrived to take a look I found a useful collection of relatively well-preserved specimens. There are around 70 fossils from the Rhaetian (Upper Triassic) of Gloucestershire including a reasonable diversity through Coleoptera, Mecoptera, Orthoptera, Trichoptera, Hemiptera and Odonata. In Pyrah (1976) the holotype of *Hemerobius higginsii* Brodie, 1845 was listed as being present at the Yorkshire Museum. It turns out that this is actually the counterpart of the *Necrotaulius furcatus* (Giebel) holotype found at the Natural History Museum, London. This is something a palaeoentomological researcher must be wary of. Many Victorian collectors enjoyed swapping their fossils with other collectors and curators and you can often find collections spread out across several countries. The fossil insect collection of Rev. Peter Brodie, a prominent collector in the early to mid-1800s, is spread throughout at least 15 UK museums and even made it across to several institutes in the USA. The problem with this is that collectors often did not keep parts and counterparts together, so one museum would hold the part and the other the counterpart of the same specimen. Care should be taken when working on dispersed collections to make sure parts and counterparts are not considered separately. It has been known for parts and counterparts of the same individual insect to be named in different families! There are also specimens from the Early Cretaceous Purbeck Group from southern England, the Middle Jurassic 'Stonesfield Slates' or Taynton Limestone Formation of Oxfordshire and the 'insect limestone' from the Late Eocene of the Bembridge Marls Member from the Isle of Wight.

Unfortunately, there are no fossil insects in the collection from Yorkshire itself and you would be hard pressed to find more than a few in other collections. There are a handful of

Figure 15. Drawer of lepidopterans with inset Saturniidae: *Saturnia pavonia* (male).

Figure 16. Examples of butterflies of the family Nymphalidae: *Aglais io* (left) and *Vanessa atalanta* (right).

Figure 17. A mass of insects from the Upper Triassic Aust Cliff, South Gloucestershire. Preserved are Coleoptera: *Holcoptera*, *Liassicupes*; Trichoptera: *Necrotaulius* and Orthoptera wings.

Figure 18. The tansy beetle (Chrysomelidae: *Chrysolina graminis*), a symbol for insect conservation at Yorkshire Museum.

specimens from the Lias Group of Horsham, Skelton and Rosedale Wyke near Whitby held at the Natural History Museum, London, and a few beetle elytra from the Oolite Series coal shales and Pleistocene peat beds (Taylor, 1830; Scudder, 1891). Interestingly though, the Centre for Human Palaeoecology at York University deals quite a lot with sub-fossil insects and their use in archaeology for determining near past ecology of human settlements (for example: Hall *et al*. 2007). This is not to say that fossil insects are not present in Yorkshire deposits, or even that they are rare, but it is more likely that there have been no specific efforts to look for fossil insects, unlike in other counties where certain collectors have concentrated on looking for often difficult to see insect remains.

Conservation efforts

Tansy beetles

The tansy beetle (Chrysomelidae: *Chrysolina graminis*) is an important symbol for the museum's conservation efforts in the local area. The brightly coloured beetle (fig. 18) was once widespread throughout Britain but is now thought to be restricted to a 45km stretch of the River Ouse in Yorkshire (although it has also rather mysteriously been identified in Cambridgeshire in the past year) and is of increasing conservation concern as the population declines. Sarah and Stuart explained the museum's efforts to keep the tansy beetle from extinction, working with the Tansy Beetle Action Group (TBAG). TBAG is run by Buglife and is funded by the Heritage Lottery Fund and the Ernst Cook Trust. For more information see their website at: www.buglife.org.uk/tansy-beetle-hub.

The museum staff put together a patch of tansy in the Museum Gardens and reintroduced a population of the beetles to act as a core population from which the declining population along the river could be replenished. Museum staff, along with other people from TBAG, go out regularly to survey the populations of tansy beetles along the river to decide on how best to action conservation efforts. Visitors to the museum are encouraged to go out looking for the tansy beetle in the Museum Gardens and the beetle is used as a tool to explain about the importance of surveying species populations and conservation efforts to keep these beautiful creatures that we enjoy so much from going extinct.

Yorkshire Museum is dedicated to preserving and developing the research potential of its natural history collections and they urge anyone interested in accessing the collections to get in touch. Sarah tells me that there have been several taxa specific requests for information, but that they are keen to facilitate more in depth research projects. Both the Coleoptera and Diptera collections have been developed to national standards relatively recently and their research potential is clear, but there are still other groups of insects in the museum which could reveal the same research potential. The Lepidoptera are still in need of updating and a review of these

specimens could increase the research potential of the collection even further. Unfortunately, the funding from local or national government seems to have dried up for now, but funding is often linked to the importance of collections and this is only realised if researchers know about the collections. Birmingham Museum has reported that since the last article in this series was published they have had several interested researchers enquiring about working with their collections. This has led to re-evaluating the importance of their insect collections, which could impact on future bids for research or exhibition funding.

In the next issue we will be heading to *Kernow* to visit the Royal Cornwall Museum in Truro to take a look at another regionally important collection. As always, if you are the curator of an insect collection in the UK, and would like your collection featured in a future issue of this series, please get in touch using the email address provided and we can arrange a visit.

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Enquiries to: enquiries@ymt.org.uk

Museum funding cuts:
www.museumsassociation.org/campaigns/funding-cuts/cuts-survey

Tansy beetle action group: www.buglife.org.uk/tansy-beetle-hub

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Society News

Student Essay Competition 2015

Once again, the judges found the task of selecting the winners an extremely difficult one. The standard of writing was generally very high but the tricky factor was the diversity of styles that they were presented with. Many entrants had abandoned the traditional article feel and presented a more personal view of their selected topic. Faced with this profusion of styles the judges initially came up with three entirely different lists, but after much deliberation a consensus was reached and the winning three were selected. Congratulations to the winners and also to all the entrants who put so much work into their submissions. We hope this has initiated an interest in presenting entomology to the wider community and has helped to develop a skill which will be valuable to future careers.

Peter Smithers

1st Prize

Moths – the masters of mimicry

Matthew Wheelwright

University of Bristol

A common way to avoid being eaten in the animal kingdom is to convince a potential predator that you are not in fact a tasty morsel, but rather either something uninteresting or even potentially harmful. One group of animals which have mastered this method of deception are the moths which have evolved a variety of ingenious methods to fool their foes.

The first way of deceiving a potential predator is to pretend you are an inconspicuous object which is normally found in the background, this is called mimesis or masquerade, and moths have evolved a variety of different disguises to pretend to be background detritus. For instance, the beautiful wood nymph, *Eudryas grata*, looks like a freshly deposited bird dropping which will obviously be ignored by any predator on the hunt for a tasty moth. A geometrid moth from South East Asia, *Macrocilix maia*, has taken this disguise a step further and has evolved to mimic two flies feasting on a bird dropping, it even managed to mimic the smell. However, one of the most stunning examples of mimesis can be seen in the notodontid moth, *Uropyia meticulodina*, which has flat wings which are patterned in such a way that they look 3D, so, to any passing predator, this moth looks like just another curled-up dead leaf.

More incredible still are the moths which have evolved to mimic several different background objects. The caterpillars of the American peppered moth, *Biston betulatia cognataria*, feed on willow and birch and, depending on which they are living on, either look like willow twigs or birch twigs by changing colour to match their background [1]. Caterpillars of the moth, *Nemoria arizonaria*, either mimic the catkins of oaks or they resemble oak twigs depending on what they eat; they look like catkins if they eat catkins, or they look like twigs if they eat leaves. [2]

Mimesis, although interesting in its own right, is not mimicry in the strictest sense. Mimicry is where one species has evolved to resemble another in some way, this can happen for a number of different reasons and so there are several forms of mimicry, the most widely known of which is Batesian mimicry. Batesian mimicry is where an organism mimics an unpalatable or potentially harmful species in order to ward off predators. This can be seen in the clearwing moths, family Sesiidae, which resemble various species of wasps and hornets. Predators then avoid them so they don't get stung; however it is all a cunning ruse as these moths lack the apparatus to sting anything.

A rather more audacious form of mimicry is to pretend to be the species which is hunting you. This is known as predator mimicry and has been carried out with great effect in *Brenthia* moths from Costa Rica which look and move like jumping spiders. In fact their disguise is so convincing that jumping spiders, which would normally prey on moths of a similar size, instead treat them like rivals and upon seeing the moth carry out territorial displays [3], thus proving that they have been fooled.

It is not just the visual appearance of other species which moths can mimic. The Death's head hawkmoth, *Acherontia atropos*, which raids honeybee hives to eat the honey stored inside, does not look like a bee at all, however once it is inside the colony it is ignored. This may seem odd as everyone knows that bees are very protective over their stores so why do they allow this intruder to live among them unmolested? The reason is very simple: The death's head hawkmoth smells like a bee. This fools the bees into thinking the moth is just a

very large nest mate and it can go about its business undisturbed [4].

So as you can see, moths have evolved a number of incredible and beautiful disguises to aid in their everyday survival and, despite often being overlooked for being drab in comparison to their colourful butterfly relatives, can provide us with an extraordinary insight into one of the great mysteries of evolution: Mimicry.

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2nd Prize

Jeff's New Hat

Stephanie K. Skipp

University of East Anglia

'Jeff! Long time no see. I must say, that is some exceptional headgear that you are sporting today! Where, might I ask, did you get it?'

'I am glad you asked that Bob, for I have actually been quite the busy wasp recently.'

'Really?'

'Oh yes, particularly on the female front - if you know what I mean!'

'Oh, THAT sort of busy! Do tell!'

'Well, y'know how we spend our days buzzing around in search of the sweet pheromones of lurve?'

'Of course.'

'Well, yesterday I was doing just that when the most pungent perfume that has ever met my antennal receptors caught my attention'

'Oi oi!'

'Naturally I followed it and what do I find… not one, not two, but three lovely females, all perched on the same stem! Imagine that!'

'No!'

'Yes! I know I could hardly believe it myself!'

'What did you do?'

'Naturally I proceeded to woo all of 'em!'

'All of 'em!'

'Yeah! One after the other!'

'You cad, you!'

'A-thank you very much!'

'What's that got to do with the hat then?'

'Ah yes, well one of 'em gave it to me didn't she.'

'Just gave it to you?'

'Yeah, I guess it was to remember her by or somethin"

'You lucky buzzer, you.'

'I know, and quite smart it is too, though I say so myself!'

Poor Jeff. He doesn't realize that he has been taken advantage of… and by a plant no less! A fly orchid (*Ophrys insectifera*) to be exact. You see, Jeff is a wasp of the species, *Argogorytes mystaceus* and it just so happens that by the

wonders of evolution, the fly orchid has evolved flowers that have a remarkable resemblance to the females of his species!

… Ok, perhaps the resemblance isn't particularly clear to the human eye, but is seems to be enough to entice unsuspecting *A. mystaceus* males. And the fly orchid's disguise isn't just visual – it extends to the other senses too! Fly orchid flowers also produce volatile chemicals similar to the wasps' mating pheromones. These stimulate *A. mystaceus'* mating instincts and render the flowers almost irresistible to the male wasps.

When a male (such as our friend Jeff) encounters one of these botanical femme fatales, he buzzes around it curiously for a few seconds before suddenly flying to a flower as if drawn by a magnet. He lands on the flower's labellum and proceeds to spend few minutes attempting to mate with it. This tends not to go very well… it is a flower after all! For this reason the mating attempts that occur between *A. mystaceus* and fly orchids are described as 'pseudocopulations'.

During pseudocopulation, the male's head is positioned against the structure of the flower known as the column. Here, two pollen sacks called pollinia are neatly stored away, awaiting just such a visitor. If all goes to plan, a sticky pad called a viscidium will attach to the males head, so that when he leaves he will have acquired a shiny new pollinium shaped accessory.

Once in place, the caudicle (a stem attaching the pollinium to the viscidium) begins to dry out, bending as it does so. This structural change places the pollinium into the perfect position to connect with the stigma of any fly orchid flower that may subsequently attract the wasp's attention. Lo and behold, pollination is achieved!

The fly orchid isn't the only species to use this sneaky pollination strategy. In fact, numerous groups of orchids have independently evolved to play the temptress role. The fly orchid's European genus, *Ophrys*, also houses a number of other sexually deceptive species including the early spider orchid (*Ophrys sphegodes*), and the bee orchid (*Ophrys apifera*). Unfortunately the bee orchid's target pollinator isn't present in the UK, so this species has evolved the ability to pollinate itself (geitonogamy) without the need for its underhand tactics. As well as *Ophrys*, there are also many other sexually deceptive genera from Australia, New Zealand South Africa and America. It is thought that there are around 400 sexually deceptive orchid species overall!

In addition to these conniving orchids, there are also other types of falsifying flowers. About one third of orchid species have evolved a 'food deceptive' tactic. These appear similar to other flowers that use colorful petals and sweet scents to advertise a delectable nectar or pollen reward. However, when the pollinator visits a food deceptive imposter anticipating its tasty treat, it is met with nothing but disappointment.

We have seen that orchids can use deceptive strategies to exploit their poor, unsuspecting pollinators, appearing to offer something desirable, whether food or a mating opportunity, only to leave them empty handed. So, unfortunately it seems that the fly orchid provided nothing to poor Jeff … apart from, of course, some fashionable headgear.

3rd Prize

A Day in the Life of a Female Dung Beetle

Laura Healy

Harper Adams University

Don't be put off by my name. Missus *Dung Beetle*. I didn't choose it. It's how I make my living.

I am a roller but some of my friends are tunnellers.

As rollers, our legs are adapted to the task of rolling dung. My legs are long and strong. This is what my tunneling friends lack. Their legs are much shorter than mine. However, their heads are well equipped for the task of tunneling.

After a morning spent flying up-wind through the refreshing African mist, I found a suitable pad while the air was still cool. The distinct scent of butanone, among other essences, is what caught my attention. Once landed on the pad, I checked out the competition. I chose a suitable male already in the process of making a masterpiece. Though some of us female dung beetles can release our own perfume, it's usually up to the males. An intriguing head-stand is even performed by some of the eager males.

My partner was strong and capable looking. Plus, he had already begun the task at hand, which impressed me greatly. I helped him finalize the ball's features. It was not easy. The sound of my fellow beetles moulding their work was getting louder and louder as the pile quickly diminished. Tensions were rising. The herd had moved on, so if we were not successful in creating a ball here, we would have to follow the scent and fly elsewhere. Luckily for me though, my partner was well-equipped and able to ward off those who tried to steal our work.

However, the real mission comes next; to get our masterpiece to a suitable location. I will soon have to lay. Once I have my young, I will devote all of my time to raising them. I cannot do this unless our destination is reached. My mate may even help me raise the young. But this is wishful

thinking, we must first be successful in getting to our destination.

My mate will let me rest for most of the intense journey, clinging to the ball he made and will now roll until we reach a suitable location to make our home.

Our journey began quite well, I was impressed with the strength of my mate and quite pleased with my ability to choose a "good one". As the sun rises higher in the sky, our spirits are changing. It's growing hotter and hotter. I notice my partner stopping a lot more than usual to look for the path. We are meant to be going in a straight line so I don't understand his confusion. And, of course, being of the male orientation, he refuses to ask for any directions.

I can feel my back ready to crack under the African sun. All around us is a vast sheet of golden hot sand. It seems endless. The skyscrapers of green leaves and boulders of pebbles and sand are difficult to maneuver around.

My mate's legs are burning in the sand as he rolls the ball I cling on to. Every once in a while I get a brief relief as I am tossed in the shade as my mate diligently rolls us towards our haven. It's not looking good. Survival is slipping away like the sand beneath us.

We must push the ball to a suitable location before it gets too hot for us to survive; even if it means abandoning our masterpiece. We take a break. My partner cleans his sandy face with his legs. He is tense, I can smell his stress.

Although I usually adore the great yellow sphere above that guides us, it can be cruel and put us under strain. I long for the cool midnight sky with it's new scents and sounds.

Finally, the sun disappears and gives us some relief. It dips below the lip of the equator in a shimmering exit. Now, we must tune into a new map; the beautiful glow of earth's polarizing pattern. The tracing is ablaze and directs us to our safe harbour.

Every once in a while we check that we are following the right path. Standing high on our masterpiece we survey the sky and once we see our path as directed by the new stellar ceiling above, we follow it's guidance.

I can smell it. I wait for confirmation from my partner but I think he sees it too. We are close. We can bury our nest before the scorching sphere rises again on the African horizon. My partner must be tired. But his task is now complete, it is up to me to follow up on my half of the bargain.

Happy with our final stop, we begin digging into the cool sand, now smooth and refreshing as we swipe it over our backs. Our masterpiece is nestled beneath the surface, it joins part of this majestic plain, full of other animals like us, fulfilling our fate. I complete my duty proudly. I can hardly keep in my excitement. I wait with my partner, wondering if he will now desert me or stay to help raise our brood.

We have completed our purpose. Our young will go on to fulfill their missions and reach their individual harbours. I glimpse at my mate and we both gaze up, taking in the twinkling blue celestial map above us, grateful for nature's guidance.

An early-career entomological gathering: #RESPG16

Jordan Ryder and Claire Blowers

Forty-seven entomologists attended this year's Postgraduate Student Forum on February 11th and 12th 2016 at Harper Adams University. Students gathered from all across the UK, including a range of both PhD and MSc students and one post-doctoral researcher. We pored over thirteen student posters, listened to ten student talks, and heard from five invited senior entomologists on our theme of applied entomology.

Following a hearty lunch, we started proceedings with our first invited speaker, Harper Adams' own Professor Simon Leather, with a talk titled "Adventures and Opportunities in Applied Entomology". This was an exciting talk introducing Simon's progression from childhood interest to education and then research entomologist, all backed up with pictures showcasing his adventures and various haircuts! He went on to demonstrate the variety of research that can result from a career in entomology along with the possibilities for researching outside of one's PhD area.

Following this were our first two talks from our delegates. Charlotte Rowley kicked us off with a talk on identifying invertebrate predators of the sporadic pest, the saddle gall midge (*Haplodiplosis marginata*) using PCR-based gut contents analysis. Mathew Wheelwright followed with a talk on electroreception in insects.

After coffee our second invited speaker, Dr Sarah Beynon from Dr Beynon's Bug Farm, gave us a talk on "Bug Farm: From Research to Practice?". Dr Beynon gave us a run though of all the exciting adventures she had undertaken and the journey to setting up the Bug Farm. Sarah now runs the highly successful and ever-expanding Bug Farm located in Pembrokeshire, complete with its own entomophagy inspired café. The Bug Farm, nested between three SSSI's, helps in education for children and conservation of surrounding areas.

Ento quiz winners: left to right Scott Dwyer; Anthony Abbott; Louise Malmgren; Alice Mockford; Jordan Cuff and Ben Clunie. Credit Scott Dwyer.

The next two talks from our delegates covered a range of ecological topics: David Stanford-Beale talked about investigating morphological variation in Honduras moths, and Claire Blowers intrigued us with a talk on collating evidence on plant traits and ecosystem services to inform multifunctional field margin design.

Our third speaker, Dr Richard GreatRex from Syngenta Bioline, introduced the evening session with his talk "'Applied Entomology in Commercial Biological Control". Sticking very close to our theme, Dr GreatRex outlined the need to address consumer demands and the importance for entomological insight in a commercial setting. He went on to outline issues with utilising biological control and the need for an integrated approach to pest management, utilising cultural, biological and chemical control methods.

The final talks for the evening were given by Trevor Grigg, with an introduction to novel species-specific insecticidal strategy using siRNA, and Robert Holdbrook, who gave an exciting talk on how pathogen growth rate is constrained by host diet.

Discussions and networking, aided by wine and cheese, followed around the student posters in the foyer, with research topics ranging from disease vectors, insect ecology, pollinators, pest management, insect conservation and insect behaviour. We were then off to the new onsite conference dining hall for our conference dinner and more wine, accompanied by Jordan Ryder's entomological pub quiz, which included a rather difficult music round and a picture round, including 'name

Enjoying the cheese and wine. Credit Fran Sconce.

David Stanford-Beale being awarded his prize by Dr Luke Tilley. Credit Harper Adams University.

the insect genitalia'. It is fair to say that there was some feisty competition between our entomologists!

Following coffee on Friday morning we were treated to our fourth guest speaker, Dr Simon Carpenter from the Pirbright Institute with a talk titled, "How does entomology influence policy during arbovirus outbreaks?". Dr Carpenter gave us a background to his research and the history of the Pirbright's involvement with policy making, applying entomological knowledge to influence disease control, with a focus on the control and predictions of blue tongue outbreak.

The next session kept to the theme of disease vectors, kicking off with Richard Halfpenny, who talked about sugar feeding behaviour of two sympatric sibling male mosquito species. The final talk of the session came from Georgette Kluiters with nematode parasitism of arbovirus vectors.

Following a brief break, we had a very interesting talk from our final guest speaker, Dr Amoret Whitaker, with the colourfully named talk "CSI: Crime scene insects". Dr Whitaker gave us an insight into some cases from her career and how important entomology is in forensics.

Moving on to the final session of student talks, we had Min Cao speaking on the limitations of RNA interference as a potential technique for crop protection against insect pests. The final talk, ending on a high note, was Thomas McDaniel who spoke on the novel resistance mechanisms of a wild tomato against the glasshouse whitefly.

To round off the final day Dr Luke Tilley, from the Royal Entomological Society, highlighted the importance of outreach in entomology and encouraged us all to take part. Luke also highlighted the importance of networking with a wealth of different disciplines within entomology, this being a huge advantage of Society membership, with a small and very difficult insect quiz included.

Accompanying Friday's lunch, we announced the winners of the Royal Entomological Society prizes for the best student talks and posters as judged 50:50 by the senior entomologists and votes by our student delegates. Joint third place for the poster prizes were Vicki Senior, Anthony Abbott and Ailie Robinson. These three lucky people received a voucher for a year's free membership to Butterfly Conservation, kindly donated by this organisation. Second place went to Katie Bott and the first place poster was won by Jordan Cuff, with the title "Home is where the heart-rot is." Third place for oral presentations went to our very own Claire Blowers and she received a voucher for a year's free membership to the Bumblebee Conservation Trust, second place was awarded to Thomas McDaniel and first place went to David Stanford-Beale for his brilliant talk on "Investigating morphological variation in *Rothschildia* moths in Honduras, Central America".

On a personal note, we greatly enjoyed our role as your postgraduate representatives. Organising and running the forum was a very rewarding challenge and we hope that all who attended it this year had a great time. We wish to thank all our delegates for coming and taking part, whether to present a talk or a poster or to show off your entomological expertise in our quiz! We would also like to thank all our invited speakers, Kirsty Whiteford at the Royal Entomological Society for managing all the paperwork and finances and Harper Adams University for hosting us. We also wish to thank our sponsors for their support: Harper Adams University, Koppert Biological Systems UK and Syngenta UK. The 2017 Postgraduate Student Forum will be held at Warwick Crop Centre, The University of Warwick. We look forward to seeing you there.

Taxonomy Special Interest Group

Inaugural meeting 3rd December 2015, Natural History Museum London

Andy Polaszek

Natural History Museum, RES Taxonomy SIG convenor

The most recently formed RES Special Interest Group (SIG) had its first meeting on December 3rd 2015. There were 40 attendees, 12 of whom presented papers on a wide range of topics, all of which had a theme with some connection to insect taxonomy. After an introduction from Dr Richard Harrington (Rothamsted, retired; RES SIG coordinator), Dr Robert Scotland (Department of Plant Sciences, Oxford University) gave the plenary presentation, entitled "Descriptive Taxonomy: A Botanist's Perspective". Robert explored in some detail the lessons we can learn from his team's major achievements in monographic taxonomy. One broad lesson is to aim for the low-hanging fruit - the more easily characterised taxa - putting taxonomically "difficult" groups to one side to be approached differently. Using this approach highly speciose genera - in Robert's case most recently *Convulvulus* and *Ipomoea* – can be monographed rapidly and effectively.

Among the non-entomologists at the meeting was Andy Musgrove of the British Trust for Ornithology, presenting "Insect Identification: A Birdwatcher's Perspective". Andy's talk was followed by the first of eight presentations by Natural History Museum entomologists, which covered topics including the role of systematics in butterfly conservation, modern approaches and methods in taxonomy, and systematics of ichneumonids and bumblebees. The final three talks were Alex Reid on "Entomology at SASA" (Science and Advice for Scottish Agriculture); Chris Shortall (Rothamsted Research) "Potential Uses of the Rothamsted Insect Survey Sample Collection for Taxonomic Research" and finally Alan Stubbs (Buglife) on "Instant Fossils". A list of all speakers and titles is provided below.

The day finished with a round-up and discussion of future steps, which concluded that a mixed approach to the development of taxonomic tools for UK entomology is needed. While there is still a role for the more traditional, albeit greatly improved, RES handbook series, internet-based keys and mobile apps for insect identification are essential. It is hoped that the RES will support the development of some of these cutting edge taxonomic resources to aid the identification of British insects.

Speaker	Institution	Title	Time
Andy Polaszek	NHM	Welcome	14.00-14.05
Richard Harrington	Rothamsted Research	Introduction To Res And Sigs	14.05-14.10
Robert Scotland	Oxford University	Descriptive Taxonomy: A Botanist's Perspective	14.10-14.30
Andy Musgrove	British Trust For Ornithology	Insect Identification: A Birdwatcher's Perspective	14.30-14.45
Blanca Huertas	Natural History Museum	The Key Role Of Systematics In Conservation Assessments Of Butterflies	14.45-15.00
Chris Lyal	Natural History Museum	Finding A Way In: How Do We Fill The Gaps In UK Field Guides And Other Identification Tools?"	15.00-15.15
Beulah Garner	Natural History Museum	Resurrecting the RES Handbook to British Beetle Larvae	15.15-15.30
Laurence Livermore	Natural History Museum	Emerging Informatics Technologies: Potential Application In Applied Taxonomy	15.30-15.45
Andy Polaszek	Natural History Museum	Developing a Workflow for Accelerating Cumulative Taxon Descriptions, from Fieldwork to Publication.	15.45-16.00
Tea break	16.00-16.15		
Ben Price	Natural History Museum	Taxonomy 2.0: Making Mobile Data And Data Mobile	16.15-16.30
Gavin Broad	Natural History Museum	New Hymenoptera	16.30-16.45
Paul Williams	Natural History Museum	Revising Species Of Bumblebees	16.45-17.00
Alex Reid	SASA	Entomology At SASA	17.00-17.15
Chris Shortall	Rothamsted Research	Potential Uses of the Rothamsted Insect Survey Sample Collection for Taxonomic Research	17.15-17.30
Alan Stubbs	Buglife	Instant Fossils	17.30-17.45
Andy Polaszek	Natural History Museum	Wrap-up and next steps	17.45-18.00

SCHEDULE OF NEW FELLOWS AND MEMBERS

as at 2nd March 2016

New Honorary Fellows
None

New Fellows (1st Announcement)
Dr Michelle T Fountain
Mr John Anthony Lloyd
Dr Ramiro Morales-Hojas
Professor Abid Farid

Upgrade to Fellowship (1st Announcement)
Professor Dr Seetharaman Suresh
Mr Paul Lee
Dr Christopher David Williams
Dr Bilal Saeed Khan

New Fellows (2nd Announcement and Election)
Dr Gajanan Tryambak Behere
Mr Christopher Cathrine
Dr Peter Alexander Maddison

Upgrade to Fellowship (2nd Announcement and Election)
Dr Andrew Salisbury (as at 2-12-15)

New Members Admitted
Mr Stephen Douglas Howard (as at 2-12-15)
Dr Colin Derek Mcclure (as at 2-12-15)
Dr Elvira Simone De Lange
Miss Alicia Katie-Mae Hodson
Mr Viktor A Baranov
Mr David Stanford-Beale
Dr Graham Thomas Maybank
Miss Sophie Catherine Peacock
Dr Muhammad Irfan Ullah
Dr Rashmi Shanbhag
Dr Catharina G E Van Noordwijk
Dr Peter Francis Mcgrath
Mr Nigel Robert Haywood
Miss Krittika Uniyal

New Student Members Admitted
Mr Matthew Esh (as at 2-12-15)
Miss Alice Mockford (as at 2-12-15)
Mr Hasan Mohammad Al Toufailia
Miss Kathleen Victoria Humphreys
Mr Joseph Middleton-Welling
Ms Rebecca Louise Corkill
Ms Gillian Weyman
Mr Phillip Buckham-Bonnett
Ms Ana Isabel Morais Natalio
Mr Ali Kareem
Miss Molly Mactaggart
Miss Louise Malmgren
Miss Lea Carlesso
Mr Jordan Patrick Cuff
Miss Denise Dalbosco Dell'aglio
Ms Tanith Mcgarry
Ms Stephanie Maher
Mr Khaldoun Ali
Mr Daniel James Mcdowell

Re-Instatements to Fellowship
Dr Ian Peter Johnson

Re-Instatements to Membership
None

Re-Instatements to Student Membership
None

Deaths
Mr L S Plester, 1970, Finland
Professor R D Ward, 1967, Keele
Dr N W Moore (Hon. Fellow), 1949, Cambridge
Professor A Macfadyen, 1956, Sheffield
Dr J Owen, 1994, Leicester
Dr C J Luckens, 1991, Rye
Professor J Green, 1951, Teddington
Dr C G Butler (Hon. Fellow), 1939, Cambridge

Book Reviews

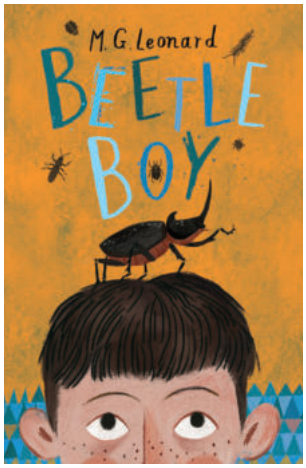
Beetle Boy

M G Leonard

Published by Chicken House

ISBN 978-1-910002-70-4

£6.99



Beetle Boy is an entomological adventure for older children of all ages. It is a riotous story that teems with unlikely heroes, appalling villains and inept henchmen. The main character is a young boy named Darkus, whose father (an entomologist who worked on beetles) has disappeared from a locked room in the vaults of the Natural History Museum. Darkus is determined to find his father and begins to investigate the circumstances of his disappearance. This leads to finding new friends (some of which are very coleopteran) and desperate scrapes with the dreaded Lucricia Cutter, a villain that makes Cruella Deville look like a Sunday school teacher.

As the secrets of his father's past slowly emerge there are hints that his early work on insect communication may be a vital clue. Darkus and his friends are flung into a desperate battle to rescue his father and save their new coleopteran friends.

Beetle Boy is a fast moving ripping yarn, a boys' own adventure. Beetles and high adventure are perhaps unlikely companions but M G Leonard has the alchemists touch and has produced an unstoppable tale of entomological daring-do.

It could easily be described as an entomological Harry Potter, but that would be a disservice to this book. It is much more than this. While Harry Potter drew a generation of children into the world of wizardry, Beetle Boy is set to make entomology cool and could inspire a future generation of entomologists.

Beetle boy is not just a great story; it also teams with information about beetles. All of the beetle characters are based on described taxa and their behaviours are based on real biology. It is a wonderful example of subliminal entomology.

The good news is that this is only the first in a trilogy, the story continues in the Beetle Queen which will be coming soon. The entomological anticipation will be palpable.

Beetle Boy is a great read for any entomologists with a taste for adventure but a must for anyone who has a proto-entomologist in the family.

Harry Potter look out, Darkus and his coleopteran friends are set to displace you as the top read in classrooms across the UK.

Peter Smithers

Outstanding Birdwing Butterflies (Papilionidae: Genus Ornithoptera)

Gilles Deslisle and Jean-Pierre Sclavo

Published by Ornitho Press, Nimes, France

ISBN 978-2-9552831-0-3,

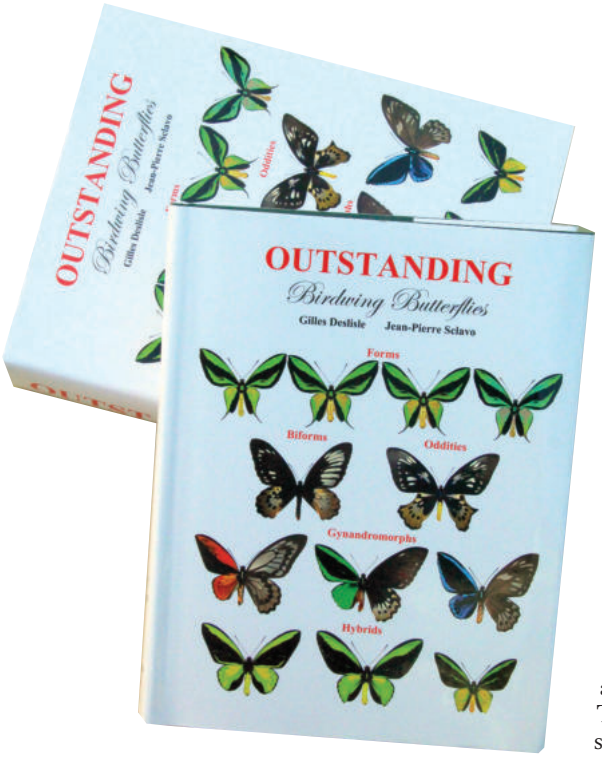
2 volumes (boxed), 1,642pp. (page numbers run consecutively through both volumes),
9,300 photographs, 139 maps

Size approximately (smaller than) A4

Cost £420.00

These are unusual volumes. When standing on the bookshelf in their smart case, each of the twin tomes trumpets the word "outstanding" on the spine in a very large upper case red font, which is quite disconcerting. On one level, they really are magnificent: 1,642 pages and 9,300 pictures, dealing with 11 recognised species and 33 subspecies, making an average of 150 pages and 850 pictures for each species, although obviously some are given more space than others: with 640 pages, *Ornithoptera priamus* occupies more than a third of the work.

The work begins with a list of contents and an alphabetical list of taxa including 85 new names raised for local forms and aberrations (in effect placing a systematic index at the front). There follows a foreword by Japanese *Ornithoptera* specialist Takasho Ohya, and flattering tributes to *Ornithoptera* specialist Gilles Deslisle by the Conservateur de l'Insectarium de Montréal and to botanist Jean-Pierre Sclavo by the Director of the Botanical Garden in Naples. A one page introduction is followed by a further taxonomic list of Ornithoptera, a list of "Collectors and Ornithopterists, Authors of Taxa and Major Works", "Historical Specimens of the Precursor Period" (pre-WW2) with brief historical detail, "Fabulous Collectors in the Precursor Period" (not in any discernible sequence), "Fabulous Collectors of the Contemporary Period" (post-WW2), "Suppliers



of specimens", rather selective "Authors of Major Works of the Contemporary Period", "Introductory Notes" (including the sequence of presentation to come – relating almost exclusively to forms and aberrations), some curious "abbreviations", "Morphology", "Definitions", "Aberrant specimens", "Distribution of Birdwing Butterflies" and "Key to the Genera in Birdwing Butterflies" (the notion that a key might be required to differentiate *Ornithoptera*, Trogonoptera and Troides is interesting). The second volume ends with an index of "Biforms" and hybrids, selected references (disappointingly, for example, none of the *Ornithoptera* papers of Mike Parsons is included) and a brief index of localities.

The main body of the text begins on p. 140, with *O. goliath*. Distribution is roughly mapped and is followed by very good quality photographs of adults and early stages, as well as host-plants. There are three photographs of "*Aristolachia* sp." (sic: = *Aristolochia*) species, none identified. Since host-plants are arguably of some importance to potential users, and one of the authors is a botanist, one might have hoped for them to be identified, but this is as far as identification goes in most (though not all) cases throughout the volumes. There follows several pages of dozens of forewings and hindwings of both sexes, depicting variation in spots, other markings and colour, with many variants provided with "new" names. A list of "synonyms", complete with author and year of publication, presented in similar format here and throughout was rather confusing, until it was realised that authors and dates relate to the publications in which those names have been presented by others and are unconnected to original descriptions. For example, "*huebneri* D'Abrera, 1975" is presented as a "synonym" of *O. goliath f. titan* (p. 156); the reviewer happened to know that *huebneri* is a name given to a population of *O. goliath* on Goodenough Island by Rumbucher, in 1973. But it does not appear in the index; nor in any systematic list, although the name appears again on a list of "synonyms", with the correct author and date and with "Goodenough Island" listed under distribution on p. 251. More-or-less by accident, a sentence was found under "Man and Birdwing Butterflies" on p. 45, dismissing *huebneri* as a form that occurs throughout the range of what the authors recognise as *f. titan*. It would have been helpful to have reference to this in a relevant place in the text, and in an index.

It was a surprise to find that species accounts ignore the considerable volume of published literature, and disappointing to find that such data as are presented are often inaccurate. The section on *O. alexandrae* includes extracts from some letters which seem of dubious relevance (pp. 673-674). A few lines on Meek (p. 53) claim that the holotype of *O. alexandrae* was shot by Meek at Biagi, close to the head of the Mambare River in what was then the Territory of Papua. It wasn't; it was shot two days inland from the coast, en route to the Mambare River, at low elevation, a circumstance which some straightforward research would have established. Also (p. 42), a picture of John MacGillivray (misspelled on the same page as McGillivray), gives no indication of where the picture came from (it originated in a paper relating to the capture of the holotype female of *O. victoriae* by the reviewer, not mentioned anywhere) and it is declared (p. 36) that *O. rothschildi* Kenrick, 1911, was the only *Ornithoptera* species to be described "in the 20th century", despite the fact that *aesacus* Ney, 1903; *chimaera* Rothschild, 1904; *alexandrae* Rothschild, 1907, are all listed on the previous page. All new names introduced are allocated to local forms, which seem to be an admixture of geographical and minor individual variation. It is noted that many are said to be in undisclosed private collections.

Geography is problematic in places. For example, distribution of *O. victoriae* (p. 1344) includes "Nggella" in the text (spelled "Ngella" elsewhere: e.g. p. 1561), but this island is not shown on the Solomon Islands map on the same page; Nggella is a historic name for what is generally known today as Florida Island, which is on the map. On p. 51, on the subject of *priamus caelestis*, the authors state "first discovered by Meek at Bogota Harbourg (sic), Saint Aignan …"; this presumably means Bwagoia on Misima – the more usual modern name for what used to be called St. Aignan. And on p. 1247, the map, and text above it, declares that the Island of Kitava (also wrongly spelled as Kitawa on the same page) is one of the islands of the Marshall Bennett group. It isn't. Kitava belongs to the Trobriands. On p. 1425 (and elsewhere), the name of the Russell Islands is wrongly spelled "Russel", and the type locality of *O. victoriae*, given correctly as Wanderer Bay, Guadalcanal (but without reference to different localities noted in Gray's original description), does not appear on the Guadalcanal map presented, when it would have been so easy to include it. Most of this requires no specialist knowledge – basic fact-checking and an adequate modern map would help to avoid elementary mistakes.

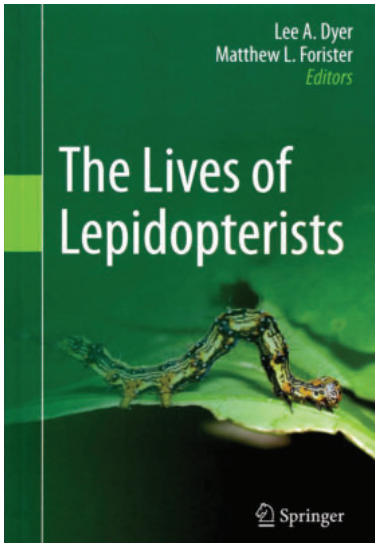
In addition to a lack of basic information, a major frustration is that text is in places very disjointed (cf *huebneri*, above), to a degree whereby recovery of some scrap of information noticed on a scan through 1,600+ pages is invariably serendipitous; indices are inadequate, and data are not always in a logical place. The author's magnum opus is highly idiosyncratic, full of curiosities and has a preoccupation with variable and misplaced spots and streaks – the long list of "local" and other forms pay no more than lip-service to conventional taxonomy. Lack of a definitive – or at least comprehensive – bibliography is a major omission; there are some 180 references listed, firstly in chronological and then alphabetical sequence. A one-word simple search of the Zoological Record resulted in 388 references to *Ornithoptera* alone.

One must admire the time and effort expended by the authors in producing such a massive work – the production standard of these heavy tomes is high and the pictures are excellent. It is a work of art rather than science, which has clearly taken many years to complete. Looking at the size and scope of this work, one can't help thinking that this is a missed opportunity on a monumental scale – it is a very long way from being the monograph on the genus *Ornithoptera* that 1,632 pages and 9,300 pictures might presume. But, as it states clearly in the introduction (p. 19) "… this work is the first of its kind to be largely dedicated to specimens considered aberrant". Regardless of whether such emphasis will be widely regarded as being of practical value, this is its stated aim, and on that basis the work must be considered entirely successful.

John Tennent

The Lives of Lepidopterists

Lee A. Dyer & Matthew L. Forrister (eds) 2015
Published by Springer International Publisher, Switzerland
ISBN 9783319204567
273 pages. Hardback. 106 Colour Plates
Price €23.79



This is a charming and enjoyable book but needs to be considered on various levels. At its simplest, twenty eminent lepidopterists have been asked to provide a brief account of their scientific lives and all of them include anecdotes and examples of the various ways in which lepidopterists approach the task of studying butterflies and moths. It is at this level that the book is so entertaining. There are a wealth of traveller's tales and reminiscences about exotic places, exciting insects, encounters with many luminary figures from the past and generally the experiences of lives full of fascination. The editors are American and so fourteen of the lepidopterists are also from North America, joined by one from Scandinavia, three from South and Central America and by two Brits. Obviously, I would have preferred to hear more from other European lepidopterists, and from others from around the world, but the book is clearly designed for the American market. The different chapters are subdivided rather strangely into sections such as 'Adventure', 'Discovery' or 'Secret lives of Lepidoptera' but these seem to have no basis in reality and don't really help. Each chapter is self-contained, by a single author, and a reader can dip in and out as takes their fancy.

The authors have mostly used a light touch, with sincere and engaging modesty and with their enthusiasm for these wonderful insects shining through. It is particularly interesting to hear of their dealings with so many redoubtable older lepidopterists, such as Miriam Rothschild and E B Ford, and a clear message is how readily new lepidopterists are welcomed to the field by senior figures. Most authors started their careers with an existing passion for butterflies and moths but one or two came to them with a sense of trepidation, only to be won over very quickly by the charm of the insects.

This leads me to the second theme that was so clearly present. For a budding entomologist, this book offers an amazing range of advice about how to get started and how to build a career as a lepidopterist. Almost no-one had what you could call an uncomplicated and direct entry into the world of scientific entomology. Most started as an enthusiast but a surprising number studied different degree subjects and then lurched across into lepidopterology and the ways that they made useful contacts, built up their experience and became a useful part of research teams will provide very important direction to new recruits. I hope this will help inspire people to study Lepidoptera, as it soon becomes clear that with dedication it is certainly possible to succeed, and there are many important fields of work, to suit field and laboratory types, almost anywhere in the world. Work on Lepidoptera has been fundamentally important to almost every aspect of biology in general and the authors show clearly how fulfilled and content they are in their work.

So to another theme. This is not a text book and the amount of scientific fact included is rather small, but it is made obvious how important the work on Lepidoptera has been at every level of science from molecular ecology to climate change. Many insights and philosophical musings are scattered throughout the book and these give pause for much interesting thought.

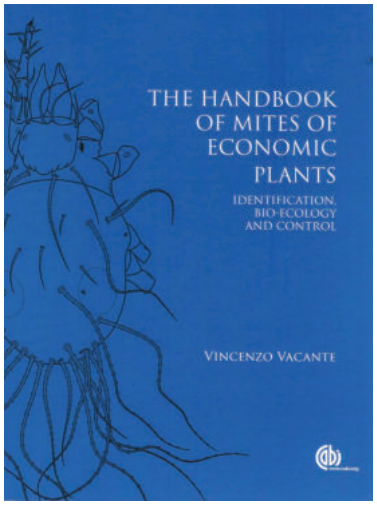
Overall, this is certainly an enjoyable and interesting read and I shall probably return to the various chapters again in the future, but how nice it would be to hear similar musings from lepidopterists closer to home.

Mark Young

The handbook of mites of economic plants

Vincenzo Vacante

Published by CABI
ISBN: 978 1 84593 994 6
23 chapters; 872 pages;
Price £185.00



Mites are globally diverse and abundant, occupying a wide array of ecological niches within all the different biospheres possible – from the arctic to the desert. This variety of ecological niche leads to many differences in functional ecology and behaviour. This handbook of mites of economic plants focuses on those mites that cause problems to crops/plants. Therefore, because its focus is on these mites of economic importance, it has been able to go into greater depths than a volume trying to cover all mites (e.g. the complete manual of acarology). The book follows a similar pattern to the authors' previous book on citrus mites, concentrating on the Eriophyoidea (herbivorous Eleutherengonides), Tetranychidae (spider mites), Tenuipalpidae (false spider mites), and Tarsonemidae (Heterostigmata) in the introductory chapters, whilst the second section of the book focuses on mites from a wider range of families, including two from the Astigmatina and the aforementioned superfamilies.

This handbook provides a very well written overview of the biology and ecology of pest mites providing detailed chapters on the possible plant damage caused by different mite species and the methods used to control them. However, this book should not be used as an introduction to acarology as it assumes the reader has a basic knowledge of the subject already. I found the section on how predator dynamics and agriculture in general affect pest mites particularly interesting, as well as the potential for some mite species to be used as biocontrol agents of weeds – which I did not know about prior to reading. The book is split into two main sections; the first is introductory and concentrates on providing an overview of mite morphology, bio-ecology and control of mites, whilst the second section is divided into twelve chapters that focus on 11 individual families of pest mites (and one chapter on minor families of pest mites). Within each of these chapters a description of morphology, systematics and bio-ecology is provided, as well as a key to genus for the families with more than one pest mite genus within it.

In the first section there is a key to major mite taxa which is useful if investigating mites that were found to be causing damage to plants, otherwise this might be confusing to the amateur taxonomist as it doesn't include a full taxonomic resolution to the same level for all groups mentioned. This key does link very well to the second main section within the book (individual mite families), although it could be even more useful if the chapter number/page number of the family was included at this stage, so the reader could then jump to that section to confirm identification and find out more information; rather than having to look at the contents page. Again, the individual family chapters are focused solely on mites that are injurious to plants, so only a reader interested in IPM can obtain the full benefits from this wealth of information. However, they do provide the reader with insight into just how numerous and diverse mites are, and also cite many key references that will guide a reader to the right information for mites that are not injurious to plants from within those families.

This handbook is full of elegant illustrations that highlight key mite taxonomic features, aiding the taxonomist in making the correct identifications. The information provided alongside the keys and morphological features for individual families allows the reader to develop a greater understanding of important bio-ecology and control measures tailored to specific mite families. Overall, due to the author being based in Europe, the handbook has a refreshing world focus in comparison to the sometimes North America-centric works that are often published.

Felicity Crotty

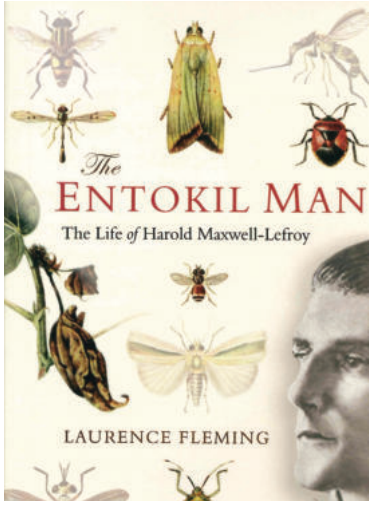
The Entokil Man
The Life of Harold Maxwell-Lefroy

Laurence Fleming

Dexter Haven Publishing

ISBN: 9781903660171

£14.99



"*he scoffed at the use of a gas mask, but neither of the misfortunes that befell him this year, would have happened had he worn one*". There have been quite a few entomologists who have died whilst on field trips, but I suspect that very few have managed to kill themselves with the chemicals that they were developing to provide a more effective fly killer.

I really enjoyed this book and not just because a distant cousin of mine gets a mention on page 68. Maxwell-Lefroy was a remarkable man and an even more remarkable entomologist and Laurence Fleming does an excellent job in summarising his life and achievements in a very readable manner. Fleming weaves genealogy, family anecdotes, Imperial history and entomology into a remarkably entertaining and informative book. The first chapter is a series of extracts from some of the many obituaries that appeared worldwide after his untimely death in 1925, the quote at the beginning of this review coming from the one published in *The Westminster Gazette*. I am not going to attempt to describe what is in each of the remaining chapters, there are twenty-three of them, but have however, taken the liberty of 'borrowing' phrases from Fleming to get across the character and achievements of Maxwell-Lefroy and to give you a flavour of the contents of the book.

The name of Maxwell-Lefroy was not unknown to me before reading this book. I taught at Imperial College for twenty years, delivering lectures on many occasions in the Lefroy room at Silwood Park and was of course familiar with the story of his early demise from his own potent fumigant. I had not, however, realised how much of a pioneer he was, and how hard he fought to establish economic entomology, what we would now call applied entomology or integrated pest management, as a respectable academic subject and career. Lefroy spent much of his career in the West Indies and India working for the Imperial Department of Agriculture. He was an incredibly gifted researcher and was prepared to stand up to authority in his attempts to have locally-trained entomological technicians as well as a cadre of applied entomologists. He was a man ahead of his time, he produced a report in 1909 whilst in India, not only advocating the need for proper port inspections of plant material, but also of their fumigation at port of entry if they were on a list of dangerous plants, i.e. those likely to be carrying pests that could establish on native plants. It was also the year in which he launched a one year postgraduate course in Entomology at the Agricultural Research Institute and College at Pusa in India. The syllabus has much in common with the MSc in Entomology that was many years later run from the Silwood Park campus of Imperial College.

In 1911 Lefroy was appointed as Special Lecturer on Applied Entomology at Imperial College to deliver a course of lectures, the first of their kind in the UK, to enable applied entomological training to be carried out in the UK, rather than sending students to the USA to be trained. His inaugural lecture states "*Even now the value of the economic entomologist and the part he plays in daily life is very little appreciated in this country; there is in England no Government Entomologist, no entomological experimental station and no organisation which does for the country as a whole what economic entomologists do in India, in our colonies and in the United States*". At first read, I found it incredible to think that up until then there had been no formal training in applied entomology, but then remembered how during the 1980s that most of those universities in the UK that did have such courses (Agricultural Zoology) closed them and how, even now, applied entomology, and other crop protection disciplines such as plant nematology, plant pathology and weed science are largely ignored by our universities and research councils. By December 1912, Lefroy was Professor of Entomology at Imperial College which was to host the premier entomology department in the UK for the next 80 years or so. Lefroy taught entomology at both undergraduate and postgraduate level until his untimely death in 1925 and continued his research into pest management, scoring some notable successes, such as the control of the death watch beetle in Westminster Hall, that was reported in such august organs as *The Times*. Despite his early death and the initial difficulties he had in persuading the government of the time that the training of economic entomologists was essential for the well-being of the Empire, his course and the recognition of the need for such entomologists lived on, the postgraduate course developing in the fullness of time into the world famous MSc in Applied Entomology which ran from the Silwood Park campus of Imperial College from 1966 until 2012.

This book is definitely worth buying, even for non-entomologists. For entomologists it will be a source of inspiration to see how much one man can achieve given the vision and the courage and energy to persevere in the face of bureaucracy and penny-pinching officialdom.

I have only one minor quibble. In the concluding pages of the final chapter, Fleming writes, "*There is still a Chair of Entomology at Imperial College*". Ah if only that were true; even when I joined the staff at Silwood Park in 1992, although there were entomologists in plenty (sadly not the case now), there was no Professor of Entomology. Even more sadly, the Imperial College entomology MSc course is no more, although it now flourishes in much the same form, but further north in Shropshire at Harper Adams University. Lefroy would no doubt have been saddened to know this, but I am sure that he would be glad to know that all the staff teaching on the present-day course were either Imperial College trained or previously taught on the course at Silwood Park. His legacy lives on and not just in the form of Rentokil which he founded.

Simon R Leather
Harper Adams University

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

2016

May 20 – 21 — **South-East Regional Meeting**
Venue: RSPB Dungeness Nature Reserve
Convenors: John Badmin (jbadmin@btinternet.com); Alan Stewart (a.j.a.stewart@sussex.ac.uk)

Jun 8 — ***Annual General Meeting***
Venue: The Mansion House, Chiswell Green Lane, St Albans, AL2 3NS; 14:00

Jun 20 – 26 — **National Insect Week**
www.nationalinsectweek.co.uk

Sep 6 – 8 — **Ento' 16 Annual Science Meeting**
Venue: Harper Adams University College, Shropshire
Convenor: Prof. Simon Leather

Nov 2 — **Climate Change SIG Meeting**
Venue: The Mansion House, Chiswell Green Lane, St Albans, Herts, AL2 3NS
Convenors: Keith Walters (keith.walters@imperial.ac.uk); Richard Harrington (richard.harrington@rothamsted.ac.uk)

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)

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, Geraldine Wright, James Gilbert

Other Meetings

2016

May 18 — **Edinburgh Entomological Club AGM, ISI reports and update on conservation strategy**
Venue: Room 304, Crew Building, King's Buildings, University of Edinburgh, 4pm
For details see www.buglife.org.uk/local/edinburgh-entomological-club

Aug 29 – Sep 2 — **Ecology of Aphidophaga 13: The 13th International Symposium on the biology and ecology of natural enemies of aphids**
Venue: Technical University of Munich, Freising, Germany
Convenor: Professor Wolfgang Weisser
The purpose of Aphidophaga conferences is to provide an international forum for the presentation and discussion of research on the biology, ecology and behaviour of organisms contributing to mortality of aphids (Hemiptera: Aphididae). Special sessions are held on the Chemical Ecology of Aphid Natural Enemies, Aphidophaga Genomics, Invasive Aphidophaga, and on the Biological control of sugarcane aphid, an emergent pest of sorghum in the USA. A number keynote speakers will present their work related to the topics of the conference. Please visit the website www.aphidophaga.de for more information.
This is the first time that Ecology of Aphidophaga will be held in Germany and we hope that many ecologists and entomologists are interested in attending.

Sep 25 – 30 — **XXV International Congress of Entomology**
"Entomology without Borders"
Venue: Orange County Convention Centre, Orlando, Florida USA
For further details, please visit: http://ice2016orlando.org/

2018

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

LITTLE THINGS THAT RUN THE WORLD

THE ROYAL ENTOMOLOGICAL SOCIETY'S

NATIONAL insect WEEK

20 to 26 JUNE 2016

...visit www.nationalinsectweek.co.uk to find out more

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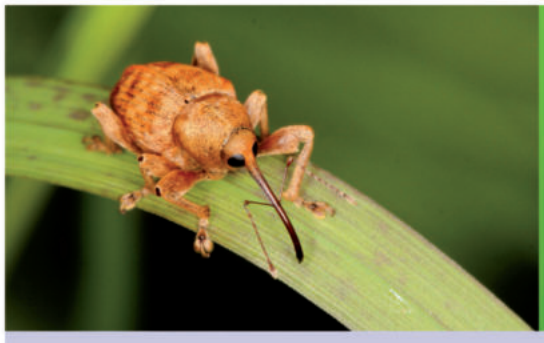
ENTO'16

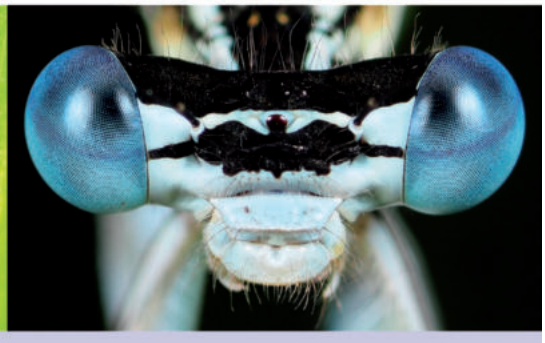
Harper Adams University, Newport, Shropshire

Tuesday 6th to Thursday 8th September 2016

Celebrating 180 years of the R&S journals

Agricultural entomology, behaviour, conservation, detritivores, diseases, diversity, ecology, evolution, forensic science, forestry, molecular biology, pathogens, pest management, physiology, plant-soil-insect interactions, pollinators, urban entomology, vectors, xylophages…





Plenary speakers include:

Peter Witzgall Swedish University of Agricultural Sciences, Uppsala, Sweden
Pathogens, insects and volatiles

Saskia Hogenhout John Innes Centre, Norwich
How virulence proteins modulate plant processes to promote insect colonisation

Helen Roy Centre for Ecology & Hydrology, Wallingford
Citizen science and invasive species

Session speakers include:

Mary Cameron London School of Hygiene & Tropical Medicine
Current and future trends in medical and veterinary entomology

Raphael Didham CSIRO Australia
Emerging issues in insect conservation

Paul Eggleston University of Keele
Insect molecular biology – the way forward?

Jane Hill University of York
Responses of species to climate change – range margin shifts and distribution changes

Rob Weaver FERA, York
Physiological Entomology – celebrating 40 years of behaviour to biochemistry and beyond

Christiane Weirauch University of California, Riverside
Tbc

To register visit: **www.royensoc.co.uk/meetings**

ROYAL ENTOMOLOGICAL SOCIETY · FOUNDED 1833 ·

ENTO'16

2017 Northern Meeting and Meeting of The Post-Harvest Special Interest Group of the Royal Entomological Society

22 February 2017

Stockbridge Technology Centre, Cawood, YO8 3TZ

10.00am-17.30pm

"PRE- AND POST-HARVEST INSECT PEST MANAGEMENT"

Organisers: Dr David George, Dr Jennifer Banfield-Zanin, Dr Maureen Wakefield & Prof Steven Belmain

With increasing pressures to reduce our reliance on 'conventional' pest management, it is becoming ever more challenging for the crop production industry to control pest insects, both pre- and post-harvest. The aim of this one-day meeting will be to discuss recent and ongoing research that may lead to improved pest control across the arable and horticultural supply chain. A field tour with a focus on 'Entomology under LED crop production' will be run at the end of the day for those wishing to learn more about how pest and beneficial insects respond to the increasingly popular practice of producing high value crops independently of sunlight using LED technology.

We have allotted space for a number of oral presentations, as well as time and space for a limited number of poster presentations. Offers of talks/posters should be relevant to crop production pre- or post-harvest and might cover subjects including novel pesticide chemistry, improvements in product application techniques, pest repellents, biopesticides, biological control, cultural control or combinations of the above via work with an IPM focus. Talks/posters on relevant aspects of pest and natural enemy behaviour, plant physiology and agro-ecology are also welcomed.

If you wish to offer an oral presentation or a poster, or attend without presenting, please visit the RES Website and fill in a registration form as soon as possible. The meeting venue will accommodate around 80 people and although we don't expect to exceed this number, early registration is advised to avoid disappointment.

Should you have any queries relating to the meeting please contact Dr David George in the first instance (david.george@stc-nyorks.co.uk).