Bulletin of the Royal Entomological Society Spring 2010 Volume 34 (2)

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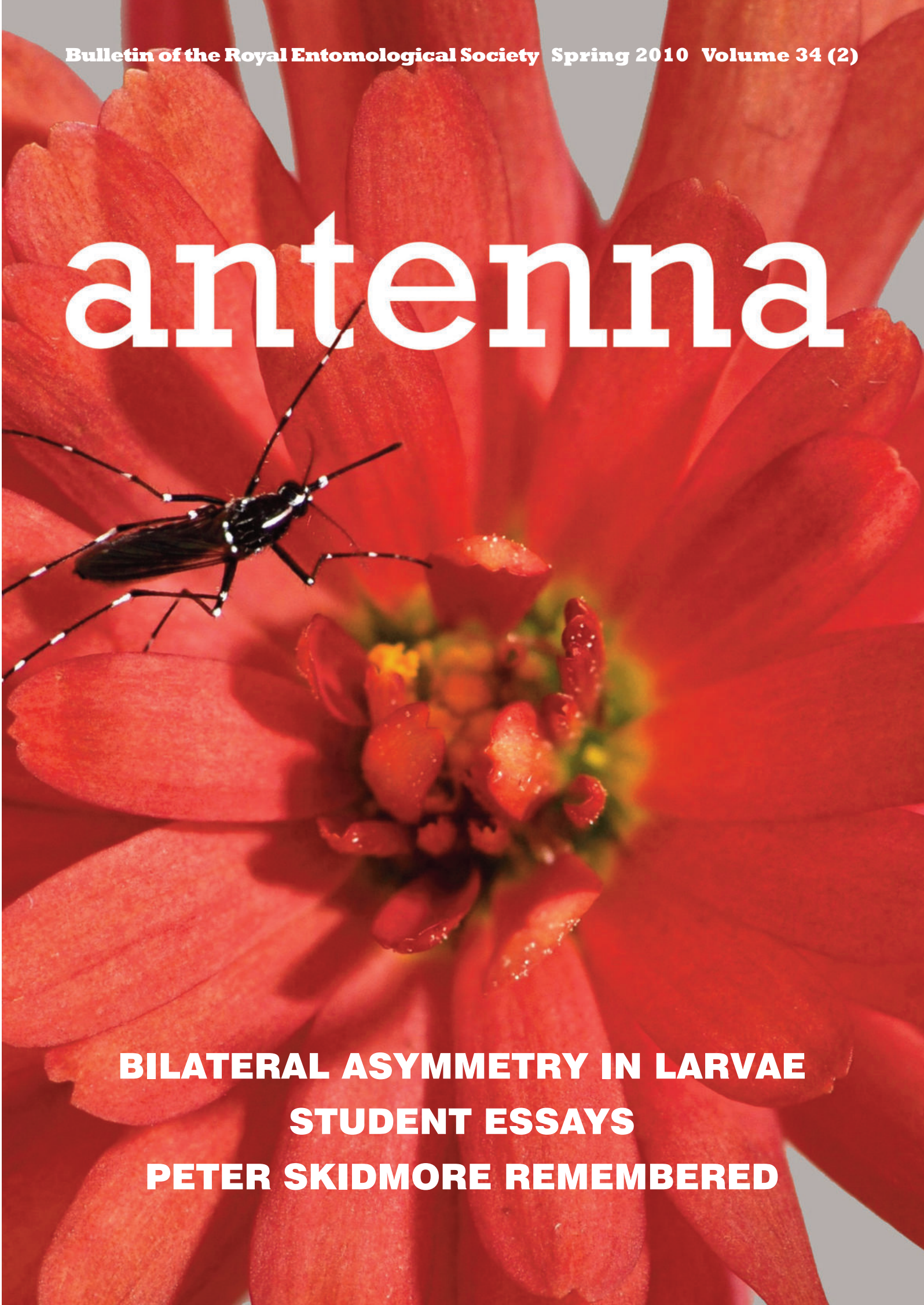

BILATERAL ASYMMETRY IN LARVAE

STUDENT ESSAYS

PETER SKIDMORE REMEMBERED

meetings of the society

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

2010

June 2	**Annual General Meeting and President's Address** **Venue: Rothamsted Research, Harpenden**
June 21-27	**National Insect Week 2010**
June 22	Infection and Immunity Special Interest Group. **Venue: Oxford University.** Convenor: Dr Petros Ligoxygakis
June 30	Scottish Regional Meeting - Insect-plant biology: from genome to the landscape **Venue: Scottish Crop Research Institute, Dundee** Convenor: Dr Scott Johnson
July 26-28	**ENTO '10 RES Annual National meeting. Venue: Swansea University** Convenors: Dr Miranda Whitten, Prof. Tariq Butt, Dr Ed Dudley, Dr Alyson Bexfield, Prof. Norman Ratcliffe
Aug. 22-27	9th European Congress of Entomology. **Venue: Budapest, Hungary** RES Representative Dr Scott Johnson
Sep. 7-9	South-West Regional Meeting with Soil Ecology Society. **Venue: University of Plymouth** Convenors: Mr Peter Smithers and Prof. Rod Blackshaw
Sept. 22	Aphid Special Interest Group. **Venue: Syngenta at Jealott's Hill** Convenor: Dr Rob Lind
Oct. 27	Climate Change Special Interest Group **Venue: The Food and Environment Research Agency (FERA), York** Convenors: Dr Howard Bell and Dr Richard Harrington
Nov. 3	Orthopterists' Special Interest Group. **Venue: Natural History Museum, London** Convenors: Dr David Robinson and Mrs Judith Marshall
Nov. 19	South-West Regional Meeting with Peninsular Invertebrate Forum. **Venue: University of Plymouth** Convenor: Mr Peter Smithers
Nov. 26	Insect Parasitoid Special Interest Group. **Venue: Biology Department, University of York** Convenor: Dr Peter Mayhew
Dec.	Aquatic Insects Special Interest Group. **Venue: Glasgow** Convenor: Craig Macadam

2011

Feb	Postgraduate Forum
March 2	Verrall lecture. Venue: Natural History Museum
April	Joint meeting with the Botanical Society of the British Isles on 'Pollination' **Venue: Rothamsted** Convenors: Dr Ian Denholm and Prof. Jane Memmott
May	Conservation SIG **Venue: Rothamsted** Convenor: Dr Alan Stewart

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

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COVER PICTURE

This image was taken by Mr Ary Farajollahi with a Nikon D90.

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Bulletin of the Royal Entomological Society

Editors:
Gregory J. Masters
(Ecological Conscience Ltd)
and
Peter Smithers
(School of Biological Sciences
University of Plymouth)
with
Vania Cvetanovic

The Royal Entomological Society
The Mansion House,
Chiswell Green Lane, Chiswell Green,
St. Albans, Hertfordshire AL2 3NS
E-mail: antenna@royensoc.co.uk

Assistant Editors:
Craig Macadam
Business Manager: Bill Blakemore
E-mail: bill@royensoc.co.uk

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The Royal Entomological Society
The Mansion House, Chiswell Green Lane,
Chiswell Green, St. Albans, Hertfordshire AL2 3NS.
Tel: 01727 899387 • Fax: 01727 894797
E-mail: info@royensoc.co.uk

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The Library is open to Fellows and Members from 9.00am to 4.30pm Monday to Friday. The Library is not open on Saturdays and Sundays or public holidays, and such other times as may be notified in *Antenna*.

Subscription Rates 2010
The following are the subscription rates due on 1st March 2010: Fellows £49; Members £44; Students £23; Fellows and Members over 65 £29. The journals of the Society are available to individual Fellows and Members at preferential rates via the Subscriptions Department at The Mansion House. *Antenna* is supplied free of charge to Fellows and Members not in subscription arrears. **Cancellation of Journal subscriptions must be notified to Subscriptions Department before the 31st October in the year preceding cancellation.**

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EDITORIAL

New addition...

You know, there are times, many times in fact, when being Editor of *Antenna* and being involved with the RES is great, absolutely great! Don't get me wrong, mindless criticism to one side (who ever said ... "if you have nothing to say then criticise"... was so right...), *Antenna* is a great job, although it can easily take over one's life! I hope you still like the improvements that have been made, and I would like to praise my co-Editor, Pete, who has had a huge impact and I never understand where his enthusiasm and energy comes from at times. We are always striving to improve *Antenna*, and to that end we have two announcements. The first is that we are trying to streamline handling of contributions and to establish an article/contribution bank, aiming to be more efficient and timely. So, all communication regarding *Antenna* and the submission of contributions, photos, thoughts and comments are all to be sent to our new email address:

Antenna@royensoc.co.uk

All emails to this address will be picked up by Vanja, who is helping with organising Pete and me (what a job!), streamlining and increasing efficiency and dealing with proofs. So we welcome Vanja and look forward to working with her. In fact, she has already made a significant contribution to this *Antenna*; she mocked up the cover photo (from one submitted with an article) and the printers Cravitz (who do such a great job – thanks Andrew and Matthew) produced the final thing.

So, what are you doing for **National Insect Week**? It's not too late, come on... there must be something... Personally, at Charlesworth School, my local Primary and Infant school, we will be running a week of activities all centred on insects and linking it to the national curriculum (insects and History, English, Maths, Geography, Art...), there will be a presentation and hopefully an evening event – presentation and "quiz your parents". I'm really looking forward to it! Five and six year olds recording diversity, species, pit fall traps, population abundance, host plant preference and more. And they are so enthusiastic, not forgetting they are the future.

Talking of diversity, this Antenna has lots for all and I hope you enjoy it. We have the three winning entries in the Student Essay competition; in fact, there were so many entries and they were all of such high quality that the Judges have asked that two runners up are published as well. Well done all! There is also an announcement about a major initiative on Afrotropical Flies and a report on the hugely successful Verral Dinner. The articles range from a report on how a RES outreach grant was used, to Hymenopteran bilateral asymmetry, to psyllids and the Florida citrus industry and a report on the moths count project.

Enjoy...

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

Electronic access to RES Journals

Having taken the sideways step from academia into industry, I no longer have access to either hard copies or electronic copies of journals published by the RES. As Mike Wilson has pointed out, notwithstanding the preferential rates offered to individual Fellows and Members for journal subscriptions, the cost of subscribing to RES published journals is still too high to make it readily affordable. Therefore, I would like to join with Mike in urging Council to investigate ways in which electronic access to RES published journals can be made available to Fellows and Members at much reduced subscription rates.

Best regards,
Graham Small

I write in response to the letter from Dr Michael Wilson published in the Winter 2010 Issue of *Antenna* (page 2), entitled 'High cost of electronic access to RES Journals' and concerning the charges made to RES Fellows/Members for both printed copies of our Journals and e-access to them.

To set the scene the current position is that RES Fellows/Members subscriptions are priced at 10% of institutional rates and a subscription to hard copy of any of the seven Journals (average rate £166 per year) allows an optional £35 top-up to get on-line access to all seven Journals and to all RES publications back to 1836. This I think is very good value for money.

However, it would obviously be possible to turn this around so that on-line access was offered as the 'norm' with the choice of a top-up subscription for the print versions. In an age when more and more people read the scientific literature on-line and do not want hard copies this might be a better option. It would also save on the costs of printing and distribution and so should allow a cheaper rate.

What we must bear in mind is that for the RES the Journals are a major source of income (many other Societies receive revenues from other sources) and we need to protect the Journals in the long term. Anything we do to reduce income from Journals has to be seen against our other sources of income and our expenditure on Society activities.

That said it is clear that we should look again at the way we offer our Journals to Fellows/Members and if any one else has views I would be happy to receive them for discussions by the RES 'Publications Committee'. I would like to thank Mike Wilson for his letter and look forward to receiving other comments and views.

Lin Field

Flies on spider webs

In *Antenna* 34 (1), page 37, Peter Smithers published two photographs, taken at Fraser's Hill, Malaysia, of many nematoceran Diptera hanging from silken lines produced by spiders, and asked whether anyone else has observed this phenomenon. It is a well known and ubiquitous habit of various nematocerans, especially some Cecidomyiidae (gall midges), but its purposes are not fully understood. The two photographs in this case show about two hundred cecidomyiids, mostly of the same species, but the identity of the genera and species involved have not been established as no specimens are available for study. Knab (1912) drew attention to the fact that some Diptera rest unharmed on spider webs and noted observations on culicids, ceratopogonids, tipulids and cecidomyiids in various parts of the world, including reference to a comment from Skuse in Australia who noted tens of thousands of adult cecidomyiids frequenting spider webs. Bristowe (1931), in a short paper on 'flies that triumph over spiders', recorded that "In Ceylon, India and Malaya I have frequently seen rows of long-legged Tipulid flies (*Thrypticomyia* sp.) hanging by their front legs on the stay-lines of Epeirid spiders' webs, like washing hung out to dry on a clothes line". He also noted that he had seen cecidomyiids behaving in somewhat the same fashion in England and that F. W. Edwards had seen the mosquito, *Theobaldia morsitans*, making similar use of spiders' webs, also in England. There are other scattered references to this behaviour in subsequent literature but I am not aware of any comprehensive review of the subject.

Gagné (1994), in his account of the cecidomyiids of the Neotropical Region, refers to this habit as 'roosting' and records that species that do it are mostly relatively long-lived Porricondylinae and non-phytophagous Cecidomyiinae. Roosting is certainly an apt description of this activity as the gall midge adults fly off and re-settle on web lines, much as birds perch on telegraph wires; but some at least may be loitering with intent! Sivinski & Stowe (1981) reported that the cecidomyiid *Didactylomyia longimana* is the dominant member of a diverse kleptoparasitic Diptera fauna feeding on spider prey in Florida. Adults commonly hang on the non-sticky supportive lines of spider webs and also seem to hang safely on the viscid spiral lines of the spider *Nephila clavipes*, perhaps by using the comparitively dry sections between glue droplets. Other species may assemble on webs to mate, as established for *Aphidoletes aphidimyza* by van Lenteren & Schettino (2003), who published a paper under the intriguing title 'Kinky sex and suicidal mating behaviour in *Aphidoletes aphidimyza*'. The larvae are predators on aphids and the species has been used as a commercial biocontrol agent since the 1970s. But mass rearing is often hampered by low fertility. By chance, it was realised that better reproduction occurred in dirty rearing cages containing spider webs and investigation revealed that adults mate while hanging from webs, which probably affords some protection from other predators and also assists dispersal of the female pheromone. Mating was completed in both occupied and unoccupied webs and, although spiders seemed aware of midges settling on the webs, the movements of the midges were too slight to trigger attack.

Roosting midges are often abundant in moist, shaded forest habitats with an abundance of dead wood and other decaying vegetation. In the tropics they have been especially noted in cocoa plantations in Central and South America, and in West Africa, and the adult gall midges may be of some importance as cocoa pollinators, augmenting the contribution of ceratopogonid midges, which are the main pollinators. Young (1985) published a detailed literature review and an account of research in Costa Rica and Belize, which included observations on gall midge roosts on spider webs. Roosts persisted over a number of days and were fully occupied during daylight by a number of different species that left the webs at night, returning to them at dawn, between 0600 and 0700 hours. In similar shaded woodland habitats in the UK roosting midges are usually present during the summer and early autumn and can be a source of interesting specimens, especially as there may often be quite a high incidence of males, including representatives of species that are otherwise unlikely to be collected.

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Chironomid midges on the Lough Neagh visitor centre sign.

Lough Neagh midges swarming along the southern shore. The speckles in the sky are midges (not a dirty lens!) and denser swarms can be seen closer to the Lough edge.

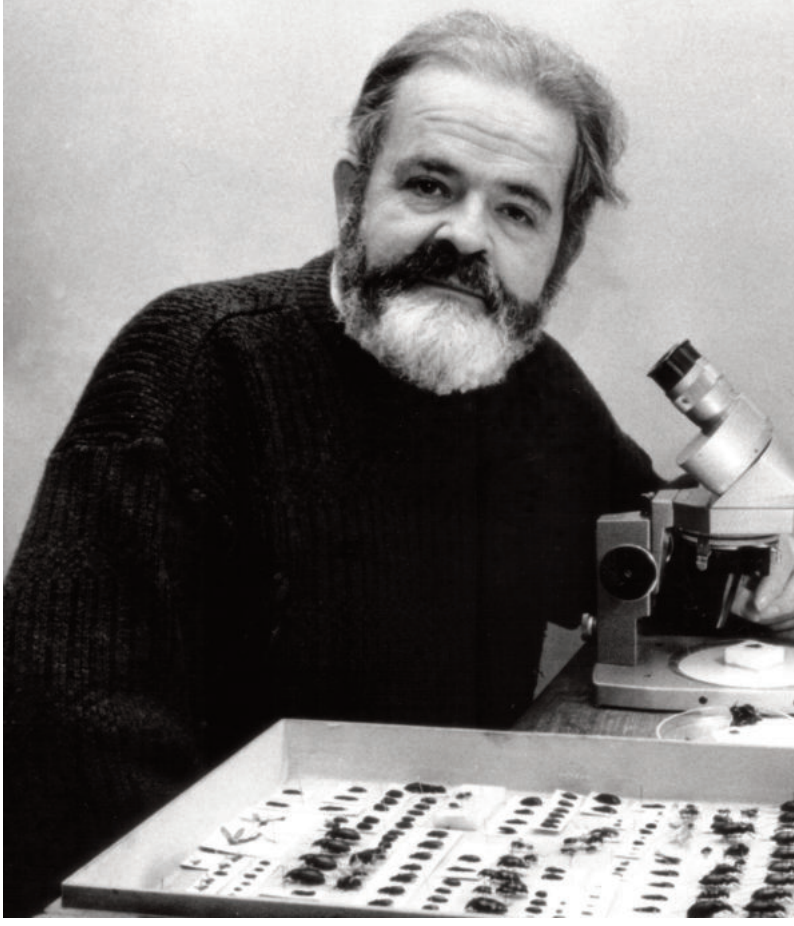
Chironomid midges fill the air on the shores of Lough Neagh.The air is filled with midges and also the sound (a consistent high-pitched whine) is quite noticeable. Is this the most spectacular insect swarm in the British Isles? Any challengers?

According to the literature most of the midges are Chironomus spp. Photography: Dr Archie K. Murchie

OBITUARY

Peter Skidmore: An Appreciation

Martin Limbert
Museum & Art Gallery, Chequer Road, Doncaster, DN1 2AE
martin.limbert@doncaster.gov.uk



Peter Skidmore died in 2009. He was born in Manchester in 1936, but moved to Dog Hill on the edge of Crompton Moor, near Shaw, in 1939. In these semi-rural surroundings he quickly developed an interest in natural history, and later wrote a paper on the moor (Skidmore 1964). It was a seminal publication, marking the beginning of Peter's major research into both cow dung ecology and, as a dipterist, the biology of the Muscidae (*q.v.*). Peter joined the Oldham Natural History Society in 1947 and the Manchester Entomological Society *c.*1950. At Christmas 1951, his sister Mary gave him Colyer & Hammond's *Flies of the British Isles* in Warne's 'Wayside and Woodland Series'. Peter described this as "the touch-paper to ignite an entomological career'' (Skidmore 1996d), with his first steps in studying Diptera guided by Leonard Kidd of Werneth Park Museum, Oldham. Peter's other main entomological interest lay with Coleoptera.

Peter was studying at Oldham Art School for an Art Teacher's Diploma when, in 1954, a friend from the MES and professional entomologist, Baron Alexis de Porochin, offered him work as his assistant at Flatters & Garnett Ltd of Manchester, a firm of scientific instrument makers and biological suppliers. As a result "a traumatic change from arts to science took place within a week!" (Anon. 1995). However, Peter's natural talent and early art training were to serve him well for future entomological illustration. Peter's duties at 'Flatters' mostly consisted of obtaining insects and producing collections of specimens for educational establishments. However, he also wrote a simplified key to the orders of British insects (Skidmore 1958). Alexis de Porochin, of Finnish descent, was a remarkable character, whom Peter remembered with affection and gratitude (Skidmore 1996c, 2003). Peter stated that de Porochin formed "a pivotal role in my career" (Skidmore 2003), and he recalled that, beyond de Porochin's ability as a coleopterist and linguist, his loves were "bad language (in any tongue), anything German (especially bad language), pilchards (or sardines), insects, philately and Sibelius; in approximately that order of priority"! (Skidmore 1996c). It was also through de Porochin that Peter joined the Raven Entomological and Natural History Society. However, de Porochin's most lasting influence was perhaps to imbue Peter with a willingness to embrace foreign language identification keys; "...thanks to him, I learnt my Coleoptera not through Joy or Fowler, but through Reitter's *Fauna Germanica*'' (Skidmore 1996c).

Fellowship of the Royal Entomological Society and membership of the Verrall Association of Entomologists followed. An early and significant work, written with Colin Johnson of the Manchester Museum, appeared in 1969. This was the first major account of the Coleoptera of a Welsh county, 'A Preliminary List of the Coleoptera of Merioneth' (Skidmore & Johnson 1969).

For Peter, his practical involvement with Thorne and Hatfield Moors began in 1966. Even then, these sites were under increasing stress from peat exploitation, though it is gratifying that Peter lived to see them both substantially protected as a National Nature Reserve. Peter moved to Yorkshire in 1965, to take up the post of Assistant Keeper of Natural Sciences – then a purely entomological post – at Doncaster Museum & Art Gallery. The Director was the coleopterist E.F. Gilmour and the Keeper was Michael Clegg. Peter became Keeper in 1967. He continued to build up the entomological collections, and occasionally published on them. He also established, and greatly expanded, the biological records database for the Doncaster borough. Allied to this, Peter played a pioneering role in understanding, evaluating and defending scientifically important local sites, thereby directly contributing to their survival. Peter published, or reported, on the peat moors, Potteric Carr, Edlington Wood and Sandall Beat Wood, but he had an involvement with other sites as well.

Sandall Beat Wood was a long-term interest. Peter produced an ecological introduction to the wood in European Conservation Year (Skidmore 1970c), and followed this with a 241-page ecological account, giving details of all known species from the area (Skidmore 1983). Peter combined his museum work with lecturing and leading entomological courses in the Doncaster district and - for the Field Studies Council – in Wales. Initially through the Doncaster Museum Service, Peter was involved with the Thorne & Hatfield Moors Conservation Forum from its inception in 1989.

Peter remained as Keeper until retirement in 1994. Subsequently, he lived in the Swansea and then Retford districts. His retirement, and move to the former, was prompted by the need for him and his wife to be near their son, David, following a near-fatal road accident. Peter became active as a self-employed entomological consultant, involved with survey work for conservation bodies. He also undertook some lecturing at Sheffield and Swansea universities during 1995-2004. As a hard-working consultant, Peter produced numerous reports, as varied as *Survey of the Insect fauna of bracken-dominated areas of Cornwall and Devon* (English Nature, 1997), *The Status of the Soldierfly* Odontomyia hydroleon *at Banc y Mwldan SSSI* (Countryside Council for Wales, 1999) and 'Saproxylic Insect Survey of the Virginia Water and Bishopsgate Areas of Windsor Park, 2002-2003' (*English Nature Contract Science* No. **514**, 2003).

Following Peter's move to Doncaster Museum & Art Gallery, he joined the Doncaster Naturalists' Society. He also began a parallel involvement with the Yorkshire Naturalists' Union, eventually being the President for 1995 (Anon 1995). Peter's Presidential Address centred on Thorne and Hatfield Moors (Skidmore 1996a). Within the Entomological Section, Peter served as both Chairman and Secretary, and for many years he was the Recorder for Diptera. The above interests, plus Peter's commitment to the Thorne & Hatfield Moors Conservation Forum, underpinned his involvement with the Humberhead Levels and nearby areas. This was centred on Thorne and Hatfield Moors, but also embraced other sites, including Blacktoft Sands, Shirley Pool/Rushy Moor, Denaby Ings, Potteric Carr, and Rossington Bridge where he took the ladybird *Exochomus nigromaculatus* (Goeze), unrecorded in Britain since the early nineteenth century (Skidmore 1985a, Muggleton 1999).

The ladybird was then just the latest of a number of Hemiptera, Coleoptera and Diptera described by Peter – sometimes jointly – as new, almost so, or reinstated, to the relevant British list. They began with the muscid *Helina annosa* (Zett.) (Skidmore 1962); the last was the hopper *Delphax crassicornis* (Pz.) (Skidmore 2008). Peter's interests remained with Diptera (especially the immature stages of Cyclorrhapha) and Coleoptera, though his collecting and recording covered many insect orders. In Britain, Peter's fieldwork ranged widely, largely embracing organized excursions and purposeful visits (*e.g.* Skidmore 1970b, 1979, 1982), Field Studies Council tutoring (Skidmore 1991b), museum-related local recording, and his commissioned work. Peter had an enduring commitment to the Hebrides, which he first visited in 1949. Sixty years on, this interest culminated in 'A review of the Diptera of the Western Isles of Scotland' (Skidmore 2009). Beyond outdoor work, Peter was unfailingly generous with his time and help, furnishing records, specimens, identifications and advice to very many entomologists. These included specialists working on taxonomic reviews, and others involved with geographical surveys like the former Nature Conservancy Council's Welsh Peatland Invertebrate Survey of 1987-91. Peter was equally supportive to those administering recording schemes.

Even before moving to Doncaster, Peter had become involved with conservation issues. The first, in 1962, was to initiate the campaign for the conservation of Moccas Park in Herefordshire (Harding 2000). This was one of the richest 'old forest' (*Urwald*) sites in the UK, but was initially dismissed by the former Nature Conservancy as unimportant parkland. Peter's arrival at Doncaster Museum & Art Gallery coincided with increasing concern at habitat degradation and change in parts of Yorkshire, and with direct threats to some important sites.

In 1968, Thorne Moors was identified by the former Central Electricity Generating Board as a suitable site for the tipping of pulverised fuel ash. Thus began Peter's long and unflagging commitment to the campaigns to defend the Humberhead peatlands from destruction. In 1969, the natural history staff at Doncaster Museum & Art Gallery joined the Thorne naturalist and conservationist William Bunting to establish beyond doubt the natural history credentials of Thorne Moors. This was to counter the CEGB and future proposals to exploit the moorland. Fortunately, Peter wrote about his practical involvement with William Bunting (Skidmore 1970a, 1992, 1996a). Peter was one of the group that became locally infamous as 'Bunting's Beavers' for their dam building on Thorne Moors, in defence of the site in the early years of industrial peat winning (Caufield 1991). The collaboration between museum staff and Bunting led to the production of a substantial report (Bunting *et al.* 1969), with Peter as one of several co-authors. Though initially restricted to 11 copies, the report was of importance as the first summary of the growing data relating to Thorne (and Hatfield) Moors. It clearly showed the significant elements of Thorne Moors, as then understood, and was influential at several levels.

In the following year, Peter augmented the report with an equally persuasive paper, 'Fifty Years Later - Another Look at Thorne Waste' (Skidmore 1970a). This outlined the contemporary actions to preserve Thorne Moors, and provided basic documentation of the scientific importance of the site. It also reviewed the ecological state of Thorne Moors a half century after the pioneering review by Rev. E.A. Woodruffe-Peacock (Woodruffe-Peacock 1920-21). Peter's Presidential Address to the YNU (Skidmore 1996a) provided a retrospective foil to his 1970 paper, a quarter of a century on.

Closely linked with Peter's commitment to conservation was his endeavour to help provide its scientific justification. This was especially relevant to an understanding of how both Thorne and Hatfield Moors should be managed to ensure the survival of their biodiversity. It was largely due to his diligence that the true invertebrate

significance of Thorne Moors became realised in a national context (*e.g.* Ball 1992). The first major review of the entomofauna of Thorne Moors had Peter as its principal author (Skidmore, Limbert & Eversham 1987). In that same year, a programme of malaise trapping by the former Nature Conservancy Council warden on Thorne Moors, Bill Taylor, led to a mass of specimens, most of which (excluding only Hemiptera and aculeate Hymenoptera) were examined by Peter. He subsequently prepared an unpublished summary of all the worked orders.

Peter was a significant contributor to the major invertebrate survey of Thorne Moors (and to a lesser extent Hatfield Moors) undertaken in 1990 on behalf of the Thorne & Hatfield Moors Conservation Forum. He contributed by identifying specimens from several important families of flies. His detailed 'Report on the Diptera Cyclorrhapha taken in the 1990 Entomological Survey of Thorne & Hatfield Moors', appeared as Appendix 1 in the second volume of the survey report (Heaver & Eversham 1991).

Peter was one of the strongest advocates of the ecological distinctness of Hatfield Moors from Thorne Moors. He consistently criticised the attitude, sometimes expressed, of 'trading' Hatfield Moors to the peat industry for the better survival of Thorne Moors. Peter undertook an entomological survey of Hatfield Moors, on behalf of Doncaster Museum Service, in 1991-92. His belief in the importance and distinctness of Hatfield Moors was substantiated by the results. This has since been underlined by work on the fossil insect assemblages by Nicki Whitehouse and others. Indeed, Peter's results indicated how significant the insect fauna of Hatfield Moors must once have been, with a number of important survivors, and indications of further potential. All have given the site a much higher national status. Peter was able to conclude that the total insect fauna of Hatfield Moors, with a greater range of habitats than Thorne Moors, must have been the richer of the two. These findings were discussed in a later paper (Skidmore 1997), followed by the publication of a provisional list of the insects of Hatfield Moors (Skidmore 2001).

In 2003, Peter began work for the Thorne & Hatfield Moors Conservation Forum to produce a computerised compilation of the invertebrates of Thorne and Hatfield Moors, as a prerequisite to a published inventory. This latter eventually appeared as a handsome addition to the Forum's *Monograph* series (Skidmore 2006), and was widely acclaimed. In the 'Editorial and Acknowledgements' to volume 7 of *Thorne & Hatfield Moors Papers*, it was noted that the monograph was "a landmark achievement and one of which we are immensely proud". In the monograph, Peter characterized and described the invertebrate faunas, and provided a keyed listing of 4790 fossil and living species obtained to the end of 2005.

Peter's merit as an entomological illustrator was spectacularly apparent in the monograph. It had a colour cover (of the ground-beetle *Carabus nitens* L.), this being repeated alongside 17 new paintings in the body of the work. The impact of these images led, in 2008, to the Forum offering 13 of them as sets of ten signed and numbered sheets in a presentation folder. In 2010, this was reissued in Peter's memory. The published inventory also includes a drawing of a meticulously observed Scarce Vapourer *Orgyia recens* (Hübn.). More fine Lepidoptera drawings may be seen in Rimington (1992), and a further painting – the crane-fly *Idioptera pulchella* (Mg.) – forms the frontispiece to *THMCF Technical Report* No. 7 (Skidmore 2001). There are many other paintings, some accessible on the www. However, perhaps of greater collective significance are Peter's numerous published and as yet unpublished drawings. Perusing a range of his own work (*e.g.* Skidmore 1970c, 1985b, 1991b) reveals drawings varying in scope from whole organisms to precisely executed microscopic features. Also worthy of note here are Peter's original paintings for museum displays, although inevitably few have survived. Peter was drawing until months before his death. His last task was for the forthcoming *Handbook of the Bees of the British Isles* by G.R. Else. Only a few of the drawings remained to be done when Peter had to give up the assignment.

Peter's other published work includes two papers (Eversham & Skidmore 1991, Skidmore 1992) on the changing invertebrate faunas of Thorne and Hatfield Moors, the second having an interesting autobiographical slant. Particularly important discoveries led to specific papers and notes. For example, in the Diptera, Peter's recognition of female specimens of *Aenigmatias franzi* Schmitz (Phoridae) in the 1987 malaise trap material led to the first formal description of them by Disney (1993). Peter added *Eutaenionotum guttipenne* (Stenh.) var. *olivaceum* Oldenberg (Ephydridae) to the British list from Thorne Moors, and then found it on Hatfield Moors (Skidmore 1996b). This discovery forms an interesting parallel with another essentially sub-arctic fly that Peter found, on Thorne Moors first and then on Hatfield Moors. This was *Zaphne proxima* Mall. (Anthomyiidae), also hitherto unknown in Britain (Ackland 1996, Skidmore & Ackland 2006). An entomological survey of Thorne and Hatfield Moors in 2000, focused on areas possibly harbouring the *Zaphne*, was undertaken by Peter together with Bob Marsh. It was commissioned by the former English Nature, and although the target species was not found during their fieldwork, the report produced (Skidmore & Marsh 2001) is full of other valuable records. Perhaps Peter's most surprising addition to the list of Thorne Moors Diptera was *Stomorhina lunata* (Fab.) (Calliphoridae), an occasional vagrant to Britain, with one of the specimens appearing somewhat teneral, adding to the significance of the record.

Peter became a specialist in the Muscidae. He was thus keenly interested in the extremely rare *Phaonia jaroschewskii* Schnabl, which he discovered on Thorne Moors in 1985 and Hatfield Moors in 1991. Currently, it is only otherwise known from a handful of sites in eastern England from Berkshire to Co. Durham. Peter wrote about the species in Appendix 1 of the 1990 survey report (*q.v.*) and in *The Naturalist* (Skidmore 1991a). In 1995, he was commissioned by the former English Nature to ascertain its status and distribution on Thorne Moors. His unpublished report, *Phaonia jaroschewskii (''The Hairy Canary") (Dipt. Muscidae) on Thorne Moor*

during 1995, with notes on other insects collected in the survey, appeared towards the end of that year. Its title betrays the fact that the report also contains a list of all other insects identified, which is significant in its own right. Further survey work on the *Phaonia* was undertaken in 1996, which again resulted in an unpublished collateral list of other insects.

A distinct facet of Peter's entomological interests was his appreciation of the importance of palaeoentomology in understanding not only the British insect fauna, but also the environmental history of peatlands and archaeological sites wherever organic deposits have survived. Peter corresponded with both Russell Coope and Peter Osborne, the founders of Quaternary entomology, and he quickly appreciated the significance of this work in studies of both climate and environmental change. This Peter demonstrated in his early paper 'The Insect Fauna of a Bog Oak found near Askern' (Skidmore 1971). Peter's profound background knowledge of the European fauna, borne from collecting trips that eventually stretched from Minya, *via* Fontainebleau and Skaftafell to Narssarssuaq, made a very significant, often unseen, contribution to the subject. Peter was accompanied on the Askern site visit by Paul Buckland, who went on to undertake a doctoral thesis in the same decade, on the use of insect remains in the interpretation of archaeological environments in the Vale of York. From this was published *inter alia* a pioneering palaeoentomological study of Thorne Moors (Buckland 1979).

Such work, extending into other aspects of the wetlands, continued in the Humberhead Levels, inspired by Peter and the irascible William Bunting, for whom Peter had an enormous respect. With the support of the University of Sheffield, and specifically of Paul Buckland, Peter's palaeoentomological work on Diptera ultimately embraced sites in several European countries, Greenland, Egypt and Canada. In return, he provided much assistance to several of the university's doctoral students, including Alison Bain, Gretel Boswijk, Eva Panagiotakopulu, Tessa Roper and Nicki Whitehouse, several of whom are now university lecturers. From 1995, Peter conducted post-doctoral research into fossil Diptera from archaeological sites in a project funded by the Leverhulme Trust. It was undertaken with Eva Panagiotakopulu in the Department of Archaeology & Prehistory at the University of Sheffield. When both Paul and Eva moved on to other posts, Peter continued his joint research with them, contributing not only to work on fossil Diptera but also to Coleoptera, where his modern collecting and taxonomic expertise helped to expand both collections and identifications.

Peter's palaeoentomological research saw expression in numerous publications (*e.g.* McGovern *et al.* 1983, Buckland *et al.* 1983, Buckland *et al.* 1994, Panagiotakopulu *et al.* 1997, Panagiotakopulu, Skidmore & Buckland 2007). More than anything else, Peter's work demonstrated that Diptera remains can be regarded as an interpretive tool comparable with Coleoptera and pollen. In 1995, Peter completed his doctoral thesis, *A Dipterological Perspective on the Holocene History of the North Atlantic Area*, and gained his doctorate in the following year. As noted, Peter became Leverhulme post-doctoral fellow in Sheffield's Department of Archaeology & Prehistory. He added not only to the fossil record, but also substantially revised the modern Egyptian dipterous fauna with Samir el-Zawri, and described the immature stages of the Diptera of Greenland for a volume edited by Jens Böcher. This work, along with much else, has still to come to fruition, and Peter's colleagues are determined that it should not be lost.

One of Peter's longest-running projects was a new set of keys to the identification of British Coleoptera. These are illustrated by a series of superb ink drawings, many of which unfortunately remain incomplete. Peter saw that the way forward was to utilize the www to disseminate information for comment before final publication. To that end, he placed his keys, as far as he had taken them, on to the Bugscep www site maintained by Phil Buckland (www.bugscep.com). In a future version, it is intended to include Peter's illustrations.

A fundamental result of the work on fossil and living insects of Thorne and Hatfield Moors has been the conclusion, unavailable from any other source, that these moors are western outliers of a mire type otherwise typical of sites in Poland, Germany and the Baltic states. This, combined with the very low rainfall of eastern England, suggests that Thorne and Hatfield Moors are better regarded as the sole surviving British examples of a largely non-British biotope, rather than damaged and impoverished 'Atlantic' mires such as occur frequently in western Britain (Eversham, Skidmore & Buckland 1995).

Inevitably, this tribute to Peter Skidmore is highly selective, focused on his involvement with Thorne and Hatfield Moors. His other work, publications and activities were numerous, but there is little space to devote to them. Peter's leisure interests, and visits abroad, can also be barely referred to. His interests included family and general history, astronomy, philately and classical music. I remember Peter's amusement on learning of the derivation of his surname as he researched family history. Peter had a particular interest in the biography of naturalists. For example, he studied the Doncaster botanists Thomas Tofield (Skidmore, Dolby & Hooper 1981) and Samuel Appleby (Skidmore 1972), and was instrumental in forging the long-term Museum project to document two early Doncaster taxidermists, William Beilby and Hugh Reid (Limbert in prep.).

However, two further scientific publications have to be referred to here. The first is the outcome of Peter's study of the ecology of cow dung (Skidmore 1991b), entertainingly described by one of his Field Studies Council students (Tate 1994). However, Peter's most important work, extending to 550 pages, is 'The biology of the Muscidae of the world', published as volume **29** of *Series Entomologica* (Skidmore 1985b). It began as a master's dissertation from the University of York. This latter examined taxonomic and biological aspects of the immature stages of Palaearctic Muscidae, and commenced whilst Peter was still studying for a BA with the Open University. After the eventual appearance of 'The biology of the Muscidae of the world', one reviewer (Disney 1985) described it as "a most scholarly book… a resource for

It is gratifying – and significant – that Peter maintained his links with Thorne and Hatfield Moors throughout much of his life. The Thorne & Hatfield Moors Conservation Forum, to mark its first decade, and in recognition of over four decades of dedicated endeavour and support, granted Peter Honorary Membership (Limbert 2003). He was hailed as one of the region's most notable and dedicated entomologists and conservationists. Peter was regarded as one of those rare naturalists who provided the scientific basis and inspiration for what the Forum and others sought – and indeed still seek – to achieve.

It is fitting to close by saying that Peter would be the first to acknowledge a debt of gratitude to Heather, his wife. The muscid tome, and the review of Western Isles Diptera, were dedicated to her. Heather's continued support was appreciated by many more than Peter alone.

Acknowledgements

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Pete Skidmore, a personal recollection

Paul Buckland FRES

In the mid 1960s, when Pete joined the staff, Doncaster Museum was a powerhouse of original research, led by the dynamic, if cerambycid kleptomaniacal Elfie Gilmour, and, alongside Pete, the imposing figure of Mike Clegg – how did a man so large chase house mice down coal mines? Pete carved out his own entomological niche, kept at his original research, and meticulously documented everything – if it moved or grew, Pete knew its name. I am minded of the Gary Larson cartoon – "what's this *Drosophila melanogaster* doing in my soup?" (it was actually *Stegobium paniceum* in the days when the Museum had a café and we would drift there for lunch).

As museums progressively lost their research status to become mere window dressing for the curious, Pete's interests broadened to encompass the biogeography of islands at either end of the World, something which led him to complete a doctorate at Sheffield University, itself building on a York M Phil, which in its published form is the basic text for the biology of the Muscidae. Both in Doncaster and as a research fellow in Sheffield, he was an indispensable adjunct to any work with fossil insect material, and many students, including Jon Sadler, David Smith and Nicki Whitehouse, all now university lecturers, and myself, when a student at Birmingham, owe their success to quiet support from Pete – "have you tried *Temnochila coerulea*?", or, "well it has to be a *Buprestis*, have a look at *rustica*". Those of you who know the extinctions from the Bronze Age Thorne fauna, or have seen Pete's amazing painting of the former, will know what I mean. This broadens the picture from flies to beetles, from modern to fossil – he practically invented, what shall we call it? Archaeodipterology?

There are some events which stick in the mind. I first met Pete when I was a less than successful schoolboy at what was then Doncaster Grammar School. I had a general interest in natural history and archaeology and was volunteering on excavations in Doncaster. In the Museum, morning coffee was taken in Albert White (zoo keeper without a zoo)'s room, and I can still see the figures of Elfie, Mike and Pete all dressed slightly outlandishly – and Pete with his sweepnet – as they prepared to brave Elfie's – as I discovered later – somewhat questionable driving skills to massacre the invertebrate population of some benighted copse (the interest in corpse, rather than

copse, came in later with his friendship with Zak Erzinçlioglu) in some corner of the District rarely visited by civilisation – Thorne Moorends, I guess. Now there's a career I thought! On a subsequent occasion, this group was joined by the geologist Geoff Gaunt, then mapping the region for BGS, and it was this direction I went in – over 6000 species of fly, 3500 of beetle – it takes a Skidmore to identify them – how could he fit so much information into a normal sized brain, and still have space to name every tree and flower? At least Quaternary geology seemed finite, but curiously the two came back together later for both Pete and I

Pete had a deep regard for the varied landscapes of the local region, from the wetlands of Hatfield and Thorne, which with the Thorne and Hatfield Conservation Forum, he fiercely fought for, documenting every last insect, from the days when the official government line was that peatlands were only useful for dumping fly-ash or building runways on, to the limewoods of the Magnesian Limestone, sources of aggregate, and formerly coppiced oakwoods and wood pastures of the Coal Measures, places for open casting. Pete's natural good humoured cynicism showed little faith in either local authorities or national bodies, either of which were as likely to follow pathways inimical to conservation – "landfill on the banks of the Don is perfectly safe as the river has never been known to flood", or, "peat extraction is good, since as soon as all this peat is gone we can start to conserve". I will not embarrass the author of either of these statements by naming… the first is probably an advisor in Hell suggesting that burning all these souls is a waste when there are perfectly good landfill opportunities in South Yorkshire, which would yield higher returns, and he would also have thrown in a council flat to go with it.

Pete had little time for such people, yet unlike his great local mentor, William Bunting, he usually avoided direct confrontation. Using his extensive scientific knowledge, he quietly underpinned many planning enquiries and earned the grudging respect of even the most devious or subservient representative of people or government. The contrast between the two is illustrated by a visit to the newly discovered trackway site on Thorne Moors in 1972 – WB taught the late Maureen Girling, another Quaternary entomologist who owed much to Pete, how to fire a .22, whilst Pete showed her *Osmunda regalis*.

Dealing with enquiries at the desk was one of the highlights of working in the Museum. These ranged from the disturbing – the smoked baby in a shoebox from a chimney in Auckley – to the farcical. It said much for Pete's sense of the absurd when a woman brought in a box and carefully opened it a little way in front of him. Her fear and palpitations made it appear to move; 'Be careful. It's still alive!' 'It's rubber, a rubber locust.' No it isn't, 'it's alive, it's moving, look'… aaarrggghhh don't touch it, it will escape! Pete picks the specimen out of the box and the woman leapt three metres back with a shriek. 'Madam (Pete, at last displaying slight exasperation) it says, 'Made in Hong Kong on its underside!' 'No! It's alive, I am going to report you to the police! At that point she rushed out of the door. I guess the locust has since been accessioned and I am sure it can be found if anyone wishes to check the identification. On another occasion Pete – I can see him now – sat patiently explaining to a young child, who had brought in a fossil, that, contrary to what the then museum director had told him, a long time ago the sea did not wash up against Balby Bridge. It was this same director who stormed out of the only staff meeting ever in the museum after some incisive questioning, accusing Pete of being a dangerous left wing agitator, dangerous yes, because of a highly developed sense of what was right, but left wing, no. Pete could see what was wrong on both sides of the political spectrum, and neither side was doing much for conservation.

I have mentioned Zak, that is, the late Zacharias Erzinçlioglu, foremost forensic entomologist and calliphorid expert, who was Pete's external examiner for his doctorate. In a reversal of roles, I was supervisor for Pete's PhD, and he asked me to sit in on the viva examination. Both the internal, the palynologst Kevin Edwards, and I listened in wonder as these two great men, Zak dressed as the grand inquisitor, gently scored points off one another; Pete won the match and became the well deserved Dr P. Skidmore.

What have I missed? Well, amongst many things, a scientific fascination with the fauna of herbivore dung – cow, horse and sheep shit to the uninitiated, something shared with Colin Johnson on the other side of the Pennines, who has prepared a much more exhaustive obituary and bibliography. The most well known of Pete's publications, at least amongst the student population, must be his *Insects of the Cow Dung Community*, essential reading for many dissertations, and desperately in need of a reprint.

Pete's work is far from finished and there is a long list of people who would wish to be acknowledged in this commemoration. One of the projects from his Leverhulme fellowship in Sheffield was a revision of Egyptian Diptera and he formed a firm friendship with Samir Adad el-Serwy in Cairo. Chasing *Agapanthia* around the campus at Mansoura in the Delta is another of my fond recollections of Pete. John Deeming in the National Museum of Wales in Cardiff will help to bring this work to fruition. Iceland and Greenland were two other areas which excited his interest, whether it was disputing with Carl Lindroth as to which species of *Tipula* it was in the moss around waterfalls in Skaftafell, or with me as to why the Diptera and Lepidoptera were logical and Nearctic whilst the Coleoptera were perverse and Palaearctic. In this he threw an extra card onto the table by training Eva Panagiotakopulu to identify the fossil flies and she continues this work as a lecturer in the University of Edinburgh. Amongst his various papers, is a very substantial part of a volume of new keys to the British Coleoptera. Whenever I have time, I am putting this material into order and the next generation, Phil Buckland, will make it available on the Web, and others are looking into publication.

For those with a south Yorkshire bias, it is easier to see Pete's extensive local contributions, including his firm support of the Thorne and Hatfield Moors Conservation Forum, than those of the internationally respected scientist that lay at the back of it.

I will remember Pete as a kind, gentle, quietly spoken man with a mischievous laugh. We shall all miss him greatly.

THORNE & HATFIELD MOORS CONSERVATION FORUM

ONE-DAY SYMPOSIUM

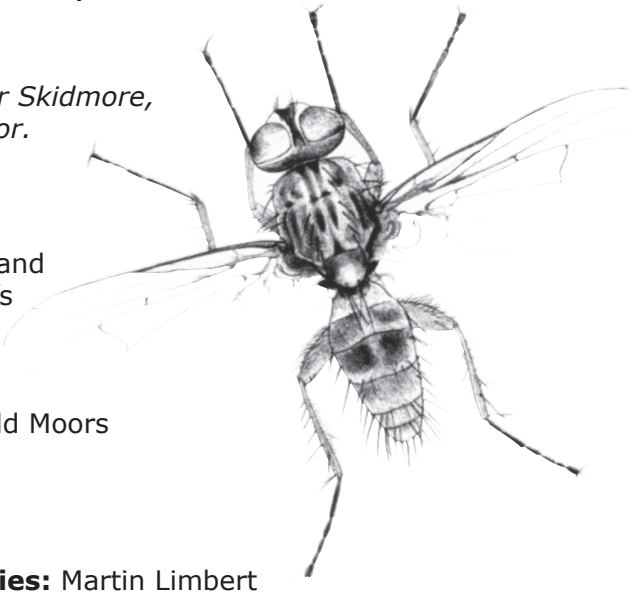
INSECTS AND THE CHANGING SCENE:

commemorating the life and work of Peter Skidmore PhD FRES

ROYAL ENTOMOLOGICAL SOCIETY · FOUNDED 1833 ·

Saturday 2nd October 2010

Doncaster Museum, Chequer Road, Doncaster, DN1 2AE



This symposium celebrates the life and work of Peter Skidmore, a notable entomologist, conservationist and illustrator. Peter was Keeper of Natural Sciences at Doncaster Museum for almost 30 years.

There are linked symposium themes of entomology and conservation, reflecting two central aspects of Peter's life. Some of Peter's artwork will be on show, and folders of his prints will be for sale. Symposium fee **£25** (including refreshments and delegate pack). Cheques should be made out to the Thorne & Hatfield Moors Conservation Forum.

Registration contact: Valerie Holt
22, Rushworth Avenue,
West Bridgford,
Nottingham, NG2 7LF
Tel. (0115) 9822317
email v.holt1@ntlworld.com

Enquiries: Martin Limbert
Museum Officer (Natural Sciences)
Museum & Art Gallery,
Chequer Road, Doncaster, DN1 2AE
Tel. (01302) 735408
email martin.limbert@doncaster.gov.uk

PROGRAMME

10.15am	Tea/coffee	
10.45am	Welcome and introduction	Brian Eversham
	Conservation and the Holocene Insect Record	*Nicki Whitehouse*
	New Light on Urban Faunas	*Jon Sadler*
	Re-wilding the Landscape: where do we go from here?	*Keith Kirby*
1.00-2.00pm	Light buffet lunch	
	Bee and Wasp Assemblages of the Humberhead Levels	*Michael Archer*
	A Dipterist's View of the Humberhead Levels	*Roy Crossley*
	Peter Skidmore: the Regional Legacy	*Colin Howes*
3.45pm	Closing remarks	*Brian Eversham*

Poster presentations are invited, further details from Martin Limbert (above)

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Manual of Afrotropical Diptera
2010–2015

Major initiative on Afrotropical Diptera

Ashley H. Kirk-Spriggs & Mike Mostovski

The Editors and coordinators are pleased to announce the launch of the *Manual of Afrotropical Diptera* project, which is due to take place at the forthcoming 7th International Congress of Dipterology, San José, Costa Rica, in August 2010.

The project is the first major initiative on Afrotropical flies since the publication of Roger Crosskey's (1980) *Catalogue of the Diptera of the Afrotropical Region*, and is also the first such initiative for any insect order on the African continent. The project represents a collaboration between the National Museum, Bloemfontein and the Natal Museum, Pietermaritzburg and is, therefore, instigated and driven from within the Region itself.

The Mission of the *Manual* project is: *to encourage the study of dipterology, both on and beyond the African continent, through the production of a high quality* Manual of Afrotropical Diptera*, for the use of practicing systematists, applied entomologists, conservationists, all students of entomology and the public at large*.

There are currently only a handful of practising dipterologists on the African continent, so if we are to meet the challenges ahead in the description of the vast array of undescribed Diptera species in the Afrotropical Region (upwards of 30,000 species), it is increasingly important that the international dipterological community focuses its interest on the Afrotropical Region.

A first step in this direction is the production in progress of a high-quality, professional *Manual of Afrotropical Diptera*, which will provide information on the Afrotropical fauna at large and identification keys specifically. We have currently secured committed chapter contributions for all 109 systematic chapters and 11 of the 12 introductory chapters. This project is truly an international effort, with contributors from 22 countries (on six continents).

Publication is due in 2015, in two bound volumes. Volume 1 shall include introductory chapters on: Collection and preservation of Diptera, Adult Morphology and Terminology, Natural History, Agricultural and Veterinary Significance, Medical Significance, Forensic Significance, Phytosanitary Significance, Biogeography, Conservation of Diptera, Conservation of Diptera, Adult Family Key, Larval Family Key and shall include chapters on the Nematocera; volume 2 shall deal with the remaining families and Diptera and include an index to both volumes.

Additional information regarding the project can be accessed *via* our comprehensive website http://afrotropicalmanual.net/

We are currently seeking a publisher for the work and sponsorship for the cost of production and colour plates. For additional information contact Ashley H. Kirk-Spriggs (ashley.kirk-spriggs@nasmus.co.za)

Bilateral asymmetry in larvae of some Argidae (Hymenoptera: Tenthredinoidea)

Andrew D. Liston

Senckenberg Deutsches Entomologisches Institut, Eberswalder Str. 90, 15374 Müncheberg, Germany.
andrew.liston@senckenberg.de

Henri Savina

Parc Majorelle, 33 chemin du Ramelet Moundi,bât. C apt. 16, 31100 Toulouse, France
henri.savina@wanadoo.fr

Mark R. Shaw

National Museums of Scotland, Chambers Street, Edinburgh, EH1 1JF, UK.
markshaw@xenarcha.com

Biosketches

Andrew Liston was born in Edinburgh in 1963. An early interest in Lepidoptera switched to sawflies when he was about 12, triggered by an encounter with spectacular birch-feeding cimbicids during a weekend outing. His youthful entomological activities were patiently fostered by Ted Pelham-Clinton. After training in forestry, he moved to Germany in 1991. Whilst maintaining himself with a variety of mainly industrial jobs, activity as an amateur entomologist continued. After a two year contract at the Deutsches Entomologisches Institut (now Senckenberg DEI) to assist with the development of an online database for World Hymenoptera Symphyta (ECatSym) created by Andreas Taeger and Stephan Blank, he took up a permanent position at the DEI in 2008 as Technical Assistant in the Hymenoptera Section, with mainly curatorial duties. Studies on the taxonomy, biology and distribution of mainly European Symphyta are enthusiastically pursued outside working hours.

Henri Savina was born in 1965 and now lives in Toulouse. He works as a meteorologist in Meteo-France, as Head of Operations of the Marine & Oceanography Division. As an amateur entomologist he has developed an interest in sawflies (biology, ethology, photography, rearing) that started about three decades ago during his childhood in Brittany. Already keenly interested in insects in general, the decision to concentrate on sawflies was made at age 13 or 14 after rearing larvae of *Craesus latipes* that failed to produce the expected moths. He is a member of the Société Météorologique de France. His current interest is focused on the Pyrenean fauna.

Mark Shaw was born in 1945 and trained to doctoral level as a chemist, but from an early age was more interested in entomology, with a particular fascination for parasitised caterpillars. After working on parasitic wasps as a Research Assistant with Dick Askew at Manchester University, then independently as Research Fellow at Reading University, he joined the National Museums of Scotland (NMS) in 1980 as Assistant Keeper, Entomology. He became Keeper of Natural History (=Zoology) in 1983, then from 1995 Keeper of Natural Sciences (=Geology and Zoology) until retiring in 2005, and is now an Honorary Research Associate. His long-standing interest in Hymenoptera is focused principally on the biology, host associations and taxonomy of Ichneumonoidea. Since joining NMS in 1980 he has invested considerable time in building there a large and important collection of Western Palaearctic Ichneumonoidea, unusually rich in reared material thanks in part to donations from many entomologists.

ARTICLE

Abstract

Larvae of some European *Arge* species exhibit bilaterally asymmetrical pigmentation, an adaptation that is presumed to improve their camouflage against potential enemies. The appearance of asymmetrical larvae of *A. ustulata* is illustrated for the first time. In the context of asymmetry within the Insecta, the highly unusual nature of this asymmetry is highlighted. Data so far available on *A. ustulata* indicate that asymmetry is directional. The controversial taxonomy of forms resembling *A. ustulata*, one of whose larvae appears to exhibit directional asymmetry which is different-handed, needs to be resolved before the phenomenon can be better understood. Approaches involving simple experiments are suggested which will help to improve the present state of knowledge.

Introduction

In the evolution of the Metazoa, bilateral symmetry is thought to have evolved only once and probably very early, whereas asymmetry has subsequently arisen independently in many taxa (Palmer 1996). Until recently, the study of asymmetry in insects has been rather neglected, compared to other classes of animals. Some authors had even doubted whether a developmental left-right axis existed in insects. There is however a growing body of evidence for developmental mechanisms that establish a left-right axis, although how these function is still poorly

Figs 1-2. Larvae of *Arge ustulata*, feeding on *Salix caprea*, France, Dept. Ariège. Photos: H. Savina. Lateral views of the same larva, showing dark RHS (Fig. 1, above) and pale LHS (Fig. 2, below) body sides; Bethmale, September 2009.

understood (Klingenberg et al. 1998). Various authors have stressed the importance of distinguishing between antisymmetry (where equal numbers of individuals of a species exhibit RHS (right hand side) and LHS (left hand side) asymmetry) and directional asymmetry (all or most asymmetrical individuals of a species are either RHS or LHS). The two categories are thought to involve different developmental triggers (Palmer 1996). Fluctuating asymmetry, a form of antisymmetry, is particularly widespread in insects and has attracted much recent interest, not only because of what it may reveal about ontological and evolutionary processes, but also as a proxy measure of environmental stress acting on populations (Møller & Swaddle 1997). The latter authors concluded that departures from symmetry generally have a negative impact on the fitness of an individual, but this was after consideration mainly of (fluctuating) asymmetry of appendages used for locomotion.

In 2009 Savina made a series of photographs of larvae of *Arge ustulata* (Linnaeus, 1758) (Hymenoptera: Argidae) which clearly exhibit bilateral asymmetry. A search of the literature revealed that this phenomenon was first observed by Pasteels (1952). Claridge & Edington (1965) confirmed most of Pasteels' findings and discussed some aspects in more detail. Surprisingly, the topic appears to have attracted no subsequent interest and is not mentioned in recent literature. The asymmetry occurring in the larvae of some *Arge* species may reasonably be assumed to be adaptive and therefore deserves special consideration. It is hoped that this brief review will stimulate others to undertake more detailed investigations.

Previous observations on asymmetry in *Arge* larvae

Under the thought-provoking subtitle [translated from French] "Asymmetry and the sense of 'right and left' in the larva of *Arge ustulata*", Pasteels (1952) briefly described for the first time the occurrence of asymmetric colouration in the larvae of a sawfly. His samples from two localities comprised 18 larvae and pronymphs collected in Austria and 15 larvae collected in Belgium. All larvae from both sites exhibited bilateral directional asymmetry, all with the right-hand body side darker than the left (hereafter termed RHS asymmetry). Pasteels stated in his introductory sentence that the larva of *A. ustulata* feeds on *Salix caprea* and occasionally on birch, but he does not explicitly name the hostplant(s) on which he found the Austrian or Belgian larvae. It might be inferred, from his introductory sentence, that both samples were from *S. caprea* and that he had not personally encountered the larvae on birch. He noted that, under natural conditions, the leaf-edge feeding larvae always orientated themselves so that the darker body side was aligned with the darker upper surface of the leaf. The

Figs 3-4. Larvae of *Arge ustulata*, feeding on *Salix caprea*, France, Dept. Ariège. Photos: H. Savina. Fig. 3 (above): Dorsal view; the larva is moving, not feeding; Aulus-les-Bains, June 2009. Fig. 4 (below): larvae photographed under rearing conditions, the lower larva unnaturally orientated; note the colouration of the head; Aulus-les-Bains, June 2009.

differences in colour between left and right body sides were found to be the result solely of the distribution of melanin in the integument. Finally, Pasteels commented on the illustration of a larva under the name *A. ustulata* in Cameron (1885) which he thought might possibly show a larva with LHS asymmetry. This coloured figure (Cameron 1885, Plate X, Fig. 3), seems to us to show a larva in slightly oblique (from right) dorsal view. It is not really clear whether the colour pattern is bilaterally asymmetrical. As Pasteels stated, Cameron makes no mention of any asymmetry in his text.

Claridge & Edington (1965) presented notes on an unspecified number of larvae collected from birch (*Betula pendula* and *B. pubescens*) in south-east England and north-west Scotland. These were stated to belong to both *Arge ustulata* and *A. fuscipes* (Fallén, 1808). Some larvae (sample size was too small to allow specification of frequency) exhibited LHS asymmetry, some were symmetrical but none showed RHS asymmetry. Asymmetric larvae always had their dark LHS aligned with the darker upper surface of the leaf and readopted this attitude when placed in the opposite position. The conclusion was reached that the larvae of the species studied were polymorphic with respect to symmetry of body pigmentation.

Both Pasteels (1952) and Claridge & Edington (1965) noted that adults reared from the larvae which they studied showed no obvious asymmetry.

Material and observations

Late instar larvae of *Arge ustulata* were collected by Savina from *Salix caprea* at two localities in Department Ariège, South of France: 10 larvae from one small, young plant (less than 1.5 metres tall) at Aulus-les-Bains (1000 m. above sea-level), 28.06.2009, 8 of which were reared and produced 6 females and 2 males in July 2009; 2 larvae at Bethmale (1050 and 1250 m. above sea-level), 14.09.2008 and 19.09.2009. The larvae from Aulus-les-Bains were not gregarious, in the sense that each was on a different leaf. Perhaps they were the progeny of a single female, because all were in the final instar. Larvae from both localities exhibited RHS asymmetry (Figs 1-4). In nature, the dark RHS was always aligned with the darker upperside of the leaf (Figs 1, 2). The larvae from Aulus-les-Bains probably belong to the first generation and those from Bethmale to the second. One of the photographs made indoors under artificial light (Fig. 4) shows a feeding larva with its dark side orientated towards the pale leaf underside. However, because of considerable disturbance of the larvae during photography, it can not be definitely stated that this was a simple phototropic response.

The line of assymetry does not correspond exactly with the dorsal midline (Fig. 3): a medial brown stripe on the head is developed equally on each side of the midline and the two rows of black spots on the dorsum of the trunk adjacent to the midline are equally developed. The features which comprise the asymmetry in pigmentation of the larva are summarized in Table 1.

In addition to the French larvae of *A. ustulata*, we examined photographs made by Professor Mike Claridge in the 1960s of several British asymmetrically pigmented *Arge* larvae on *Betula*, from Surrey and Sutherland. Left and right sides of a larva on *Betula*, from the Central Highlands of Scotland were also photographed by Shaw in 1982, showing LHS asymmetry in trunk pigmentation. The dark head pattern of larvae from Sutherland and the C. Highlands larva seems to be symmetrical and differs from the French larvae and those from Surrey in having an inverted V-shaped extension from the ventral end of the median brown vitta to the stemmata. The pattern of black dots around the setae is insufficiently clear in the old images of British larvae to permit a comparison with the French larvae, but the differences in head colouration amongst the former suggest that at least two species were involved.

	Left	Right
Head	Entirely pale (yellow) laterad of dark median vitta, at most with traces of a very weakly developed dark marking.	Large brown patch posterior of stemmata clearly visible. Patch not connected to median vitta.
Thorax & abdomen	Area of integument around bases of setae unpigmented.	Area of integument around bases of setae black, forming a pattern of black dots.
	Integument without any visibly perceptible mottling. Ground colour apparently pale green.	Integument with a mottled pattern of minute dark flecks, less strongly pigmented than larger black spots around setae. The superimposed dark pigmentation produces an impression of a deep green ground colour.

Table 1. Differences in pigmentation between left and right sides of mature larvae of *A. ustulata* (material from S. France). See also Figs 1-4.

Discussion

Even if more or less randomly occurring non-adaptive asymmetry affecting individuals (fluctuating asymmetry) is left out of consideration, cases of adaptive asymmetry abound throughout the Insecta. Just a few examples are: mandibular asymmetry, very widespread in both larval and adult insects (Palmer 1996); asymmetric genitalia (Huber 2010); more or less subtle asymmetry in wing structure, widespread in insects, but in general probably of little adaptive significance (Pelabon & Hanson 2008), except perhaps for an extreme case described by Runyon & Hurley (2004). In the sawflies, an asymmetrical labrum in the larvae of *Dolerus* and *Cimbex* species has been noted (Lorenz & Kraus 1957). These types of asymmetry confer advantages that can be regarded as mainly mechanical; enhancing, for example, effectiveness of feeding or copulation. It is noteworthy that in all these examples directional asymmetry is much more frequent than antisymmetry. In contrast, adaptive asymmetry in colouration as a protective measure against potential enemies is very rarely found in insects. Barabás & Hancock (1999) described striking asymmetry in the wing pigmentation of an adult praying mantis. Although asymmetry in this species resembles that in *A. ustulata* larvae insofar as it is thought to enhance cryptic protection, the mantis exhibits antisymmetry of a trait occurring in paired but nevertheless separate structures. The asymmetric pigmentation of *A. ustulata* larvae is of a quite different nature, because it is directional and expressed within a single organ, the integument. These attributes together with its presumed protective function make it a possibly unique occurrence, not so far observed in any other insects.

Under natural conditions, the larva of *A. ustulata* aligns the darker side of the body with the darker upper surface of the leaf. As remarked by Claridge & Edington (1965), the selective advantage to the larva of enhanced concealment seems obvious and begs the question of why this adaptation is not more widespread? After all, leaf-edge feeding occurs in larvae of very many other species throughout the Tenthredinoidea, none of which is known to exhibit bilaterally asymmetrical pigmentation.

Claridge & Edington (1965) emphasized that the taxonomy of species resembling *A. ustulata* needed clarification. This remains true today. It may be significant that nearly all *Arge* species are restricted to a single hostplant genus, but records in the literature include several genera as hosts of *A. ustulata*: Benson (1951) and Lorenz & Kraus (1957) mentioned *Salix*, *Betula* and *Crataegus*; Verzhutskij (1973) recorded *Vaccinium uliginosum*. Benson (1951) gave *Betula* and *Salix* as hosts of *A. fuscipes*. Possibly some of these records refer to as yet unrecognized biological species of *Arge*. Claridge & Edington probably followed the treatment of British *Arge* proposed by Benson (1951) in which *A. ustulata*, *A. fuscipes fuscipes* and *A. fuscipes expansa* (Klug, 1834) were considered to be separate taxa. *A. expansa* has been variously treated in recent literature as a valid species, a synonym of *A. ustulata* and as a subspecies of *A. fuscipes* or the Nearctic *A. clavicornis* (Fabricius, 1781). It is thus by no means clear which taxa, or even how many, were present in Claridge & Edington's samples. The polymorphism in body symmetry which they attributed to *A. ustulata* and *A. fuscipes* larvae therefore requires confirmation. At present it is equally plausible that the three character states (left or right directional asymmetry and symmetry) represent species-specific characters. This alternative hypothesis accords with the conclusion implicit to Pasteels' (1952) text, that the dark

right body side is a species character of *A. ustulata* larvae. On the other hand, some workers (e.g. Lorenz & Kraus 1957, Verzhutskii 1973, Petre et al. 2003) who studied larvae that they identified as *A. ustulata*, did not mention the occurrence of asymmetry. If the larvae were correctly identified in the latter works, and asymmetry was not overlooked, then this would lend support to Claridge & Edington's assertion that the larvae of *A. ustulata* are polymorphic.

Aposematic colouration is widespread in larvae of European *Arge* species (e.g. *A. berberidis* Schrank, 1802, *A. ochropus* (Gmelin, 1790), *A. pagana* (Panzer, 1797) and tends to be coupled with gregariousness. These two attributes render them more conspicuous, and therefore they are better studied than the *Arge* species with solitary, cryptically coloured larvae. Note, however, that no clear distinction of two groups is possible (Petre et al. 2003). Larvae of *A. berberidis*, although brightly coloured, disperse within a plant to feed singly after feeding in groups during the early instars (Liston, pers. obs.) and larvae of *A. pullata* (Zaddach, 1859) maintain a strongly gregarious habit throughout their development, but are not particularly brightly coloured (Nuorteva & Nuorteva 2007). Cryptic bilateral asymmetry in pigmentation seems unlikely to have developed in species with aposematic larvae, but should be looked out for in the larvae of other *Arge* species which tend to be solitary and cryptically coloured (in Europe probably more than half of the total). The larvae of such species are at best poorly known, sometimes completely unknown, and an indication even of the hostplant(s) of species occurring only in southern Europe is so far often entirely lacking.

The available data on asymmetry in larvae of *Arge* raise many intriguing questions, but are insufficient for providing answers. We therefore refrain from drawing premature conclusions from the few observations that have already been made. Instead, we outline below the sort of information which is needed and suggest some relatively simple experiments which will help to obtain such data. The results can be expected to contribute both to the elucidation of the taxonomy of *Arge* species and to the interpretation of the significance of bilateral asymmetry which occurs in some of their larvae.

Suggestions for future lines of investigation

Fresh attempts to resolve the taxonomy of *A. ustulata* and similar forms should include the study of larvae and pay attention to their symmetry / asymmetry. Samples of larvae should be obtained from several widely separated regions and as many different hostplants as possible. Ideally, some larvae from each hostplant and locality should be preserved in ethanol and refrigerated, thus facilitating sequencing of genetic material, whilst others should be reared to the adult stage. A mid leg, as fresh as possible, of each reared adult should also be preserved. The appearance of larvae which are to be reared should be carefully documented. High resolution images of both body sides and the dorsum, together with a facial image of the head, should provide adequate information on pigmentation (which fades in alcohol-stored material). The material in ethanol will, however, allow a precise characterization of morphological details such as chaetotaxy (for example: the number of setae on the abdominal suprapedal lobe, used as a main character for distinguishing the larvae of *A. fuscipes* and *A. ustulata* by Lorenz & Kraus (1957)). Such features are unlikely to be adequately visible in an image of the whole larva made with the photographic equipment that is available to most entomologists.

The mouthparts, particularly the mandibles, should also be examined. If asymmetry is evident, is this consistently directional? This might arise from initial contact of each mandible with only a single leaf cuticle (upper / lower) with different physical properties, thus imposing different demands on each side. Is there a correlation with RHS / LHS pigmentation of the body? How does mouthpart morphology compare with larvae of *Arge* that do not exhibit asymmetry in body pigmentation?

Some possible experiments:

A. Rearing experiments from single females. Preferably at least some should be virgin, so as to yield genetically identical progeny (sawflies, like other Hymenoptera, are haplo-diploid, so unfertilised eggs develop, normally giving rise to males). Sleeve the female singly on its hostplant. (i) is asymmetry present in all progeny? (ii) in which instar is it first evident (do early instars even feed at the leaf edge: this is not known with certainty for most species) (iii) is asymmetry consistently directional (a) if female parent was virgin (b) if female had mated (normally detectable from mixed-sex progeny)? As many replicates as possible are needed, because it is quite possible that within a brood the answer will be "yes" for (a) but might be "no" for (b). Replicates will also be needed to establish if asymmetry is always RHS or always LHS in different species.

B. Using methods as in A, survey as many *Arge* species as possible, to establish if asymmetry is present in others, and to what extent this correlates with colour differences between the two leaf surfaces of the hostplant.

C. Considering different species feeding on different hostplants with different leaf petiolar rigidities, try to test whether the attitude of the larva results from a response to the incidence of light or whether a response to the different colour of upper and lower leaf surfaces takes place (i.e. a larva, particularly if large, on a leaf with a longish and twistable petiole will not necessarily reliably present its darker side skywards, though it will always, as has so far invariably been observed in the field, be able to match its darker side to the darker surface of the leaf). Some simple experiments constraining leaves on which larvae are feeding to be "upside down" would be enough to test this. To find the attitude of the larva to be purely leaf-surface related would be interesting in raising the question as to how the larva assesses its position: the ability to detect light intensity differences is widespread throughout the animal kingdom, but orientating to colour shade differences might suggest the need for a different mechanism (and might explain why cryptic directional asymmetry has not been more widely developed).

D. *Arge ustulata* has at least two generations per year in lowland Central Europe. The freshly developed leaves of its hosts at first show little difference in colour between upper and lower surfaces. Is there a difference in the appearance of larvae of the first (spring) and later (summer) generations? [Note however that the observations by Savina suggest that there is no difference.]

More esoteric possibilities could also be investigated:

E. At least in larger leaf-edge feeding sawfly larvae, the head of a feeding larva is usually orientated towards the leaf apex. This orientation may arise mainly as the simple result of a larva adopting the first "convenient" feeding position when it moves to a new leaf (which will nearly always be reached by walking along the leaf petiole). However, in sawfly larvae with defensive glands in the abdomen, including most *Arge* species (Petre et al. 2003), orientation with the abdomen directed towards the leaf base might be advantageous as a protection against potential predators, such as ants, which must also access the leaf across the petiole. A symmetrical larva should not favour one leaf edge over the other and will therefore be able to consume the whole leaf (as is commonly observed to take place in nature), but if anterior-posterior orientation to the leaf is important to a larva as well as left-right orientation, it may be constrained to consume only about half of a leaf, at least if the leaf is fully developed and has a hard midrib which can not be eaten (this is probably true at least of larger *Salix caprea* leaves). Such a behavioural constraint could represent a significant cost of development of asymmetric pigmentation. Observations in the field paying attention to the feeding pattern of asymmetrical versus symmetrical larvae might throw interesting light on this.

Finally, we would like to include a plea about the (very) interesting parasitoids of *Arge* species. If adult parasitoids are reared in the course of these investigations, the third author (Shaw) would be very pleased to receive and comment upon them.

Acknowledgements

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MOTHS COUNT

National Moth Recording Scheme

ARTICLE

Moths Count, past, present and future

Dr Zoë Randle

Butterfly Conservation,
Manor Yard,
East Lulworth

Butterfly Conservation

Saving butterflies, moths and their habitats

2010 International Year of Biodiversity

Introduction

After several years of planning and consultation, the Moths Count project was officially launched in May 2007, by Sir David Attenborough. The four-year project is led by Butterfly Conservation, but is a partnership of many organisations including the Royal Entomological Society. Contributions to Moths Count have been both in-kind and financial, with the largest financial contribution coming from the Heritage Lottery Fund. The main aim of the Moths Count project is to stimulate and encourage moth recording throughout the UK and to establish an ongoing recording scheme for the 900+ species of macro-moths.

In the UK there is a long standing tradition of moth study and observation. Moths have been a popular group among entomologists for over 300 years. Sadly, the wider public still have misconceptions of moths; many people perceive them to be boring, drab creatures that eat clothes! Needless to say, the truth is very different.

Moths form a substantial part of our biodiversity; over 2500 species have been recorded in the UK. Not only are they vital prey for many bats and birds, (blue tit chicks eat an estimated 35 billion moth caterpillars a year in Britain) but they are also important pollinators of plants. Unfortunately moths are in decline. During the 20th Century 65 species of moth went extinct in the UK (Parsons, 2003 & 2010).

The State of Britain's Larger Moths (Fox, et al., 2006) reported on the long-term monitoring of macro-moths from the Rothamsted Insect Survey (RIS) network of light traps. The number of macro-moths trapped every night across Britain since 1968 were recorded. Population trends were generated for 337 common and widespread species. The results show that over a period of 35 years, two-thirds of these species have suffered population declines. The Garden Tiger, known for its "woolly bear" caterpillars, has declined by 89%. Perhaps even more shocking is the statistic that total moth numbers have declined by 32% since the late 1960's. These messages are key to the

Peach Blossom (*Thyatira batis*) Robert Thompson

outreach activities of the Moths Count project; we have been working extremely hard to get moths portrayed in an accurate and positive light to members of the public, the media and to politicians.

The previous national recording scheme for moths ran from the late 1960s until the early 1980s. It was run by John Heath at the Biological Record Centre (BRC) and produced moth distribution atlases in the *Moths and Butterflies of Great Britain and Ireland*, series (Heath, et al., 1976-2002); however, these are now out of date. In addition to this, the *Geometridae*, one of the largest families of moths, comprising of approximately 300 species UK species, have never had distribution maps published. In order to conserve moths it is important to know where particular species occur. The new National Moth Recording Scheme (NMRS) is up and running and one of the key outputs will be the production of up-to-date distribution maps later this year. These will include both current records and historical records such as those from the BRC and the RIS light-trap network.

The Moths Count project is now entering its final stages. Its achievements have been numerous and this article summarises the main highlights from the past three and a half years.

Moths Count Outreach

Over 2000 people have been illuminated to the beauty and fascination of moths through our series of public moth events alone. These events enable members of the public to attend a moth trapping night, run by a local moth expert, and observe and identify moths being trapped. Alternatively people identify the previous night's catch in the morning to see the variety and splendor of moths. A quarter of the attendees were under 16 and almost a third were women. Giving the younger generation an opportunity to get involved in moths and moth recording is key to the future of moth recording and conservation. In addition to this during a public moth event in 2009, the Tortrix moth *Cydia inquinatana* was discovered at the RSPB's Minsmere reserve. This was a first for Britain, indicating that these events are valuable not only in encouraging people to take an interest in moths but also in generating useful records. A further 2000 or so people participated in *Garden Moths Count* our online survey aimed at the gardening public and their families. This citizen science activity amassed in excess of 4500 records!

Moths and the Moths Count project have reached millions of people through the media. Since the official launch of the project in 2007 there have been seven television appearances, including BBC Breakfast and the One Show and 18 radio interviews, including four evenings on BBC Radio 2 with Chris Evans. Thirty-two articles have been published in national newspapers and the project has been featured in over 60 magazines.

The Moths Count website (www.mothscount.org) underwent a re-vamp in the summer of 2009. There is a vast amount of information about moths, moth identification (including a gallery of commonly encountered species), recording, conservation and training events to be found. The site is suitable for existing moth recorders and beginners alike, so take a look.

National Meetings and Training

National meetings for moth recorders have been held in England, Northern Ireland, Scotland, Wales, the Channel Islands and the Isle of Man. The audiences have included everyone from beginners to eminent moth recorders. These meetings have provided important feedback between the project team and the moth recording community and have highlighted the importance of moth recording and what records can be used for both nationally and locally. Additionally the national meetings provide an opportunity for moth recorders to meet up with friends and colleagues.

To date 110 moth training workshops have been held. These have been aimed at moth recorders with ranging expertise from beginners-level *Introduction to moths and moth recording* courses through to workshops on the identification of difficult species by genitalia dissection. Other training days targeted UK Biodiversity Action Plan species, caterpillar identification and using computer software for biological recording. Almost 1500 people have attended these workshops, improving

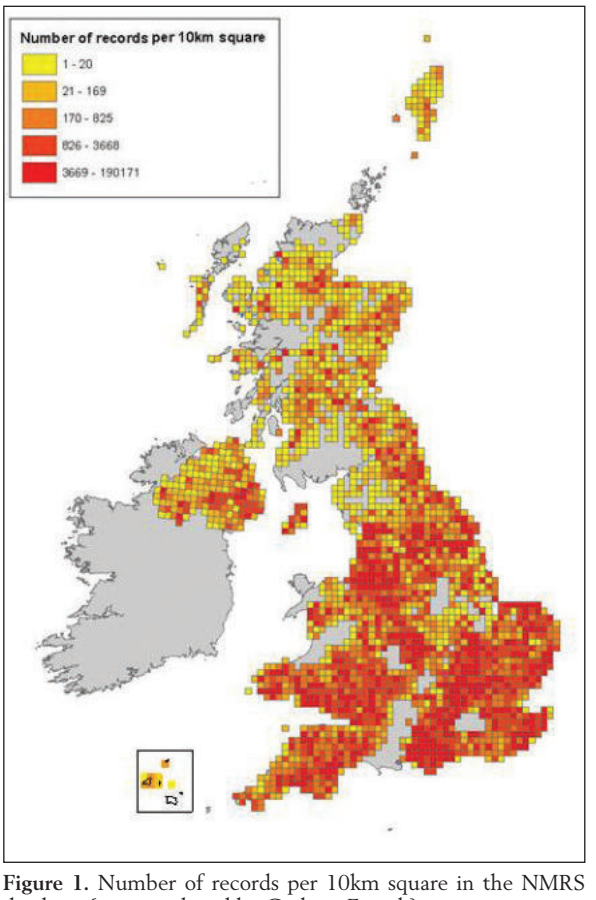

Figure 1. Number of records per 10km square in the NMRS database (map produced by Graham French).

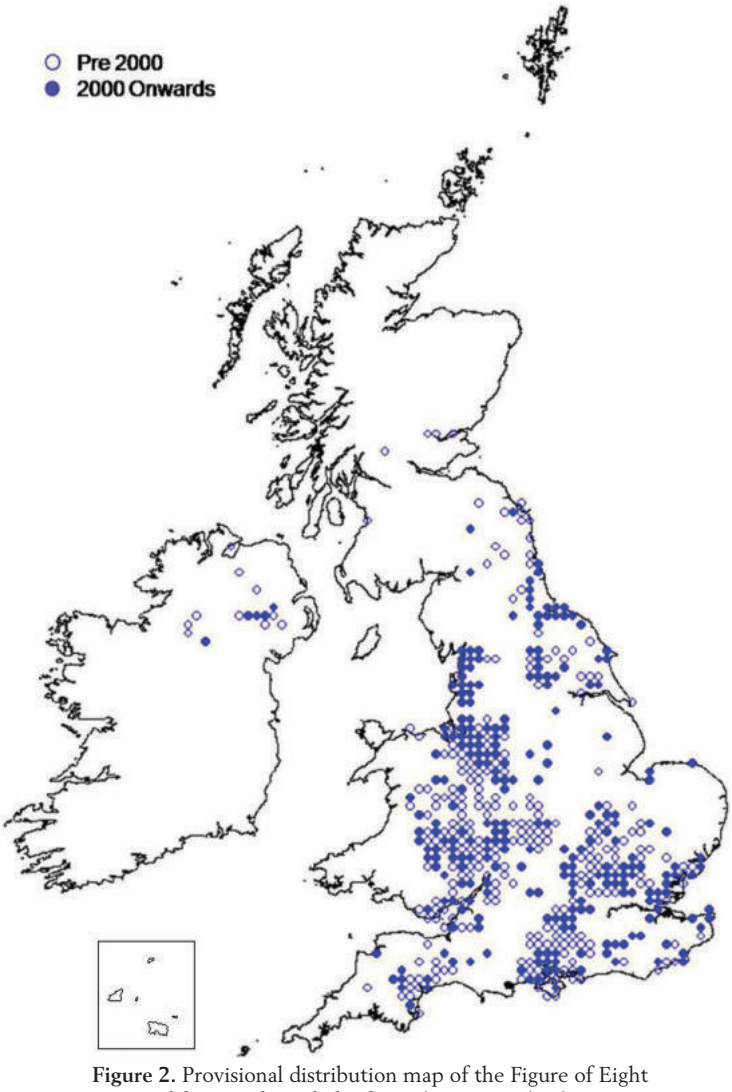

Figure 2. Provisional distribution map of the Figure of Eight (*Diloba caeruleocephala*) from the NMRS database.
Photo: Figure of Eight (*Diloba caeruleocephala*) Robert Thompson

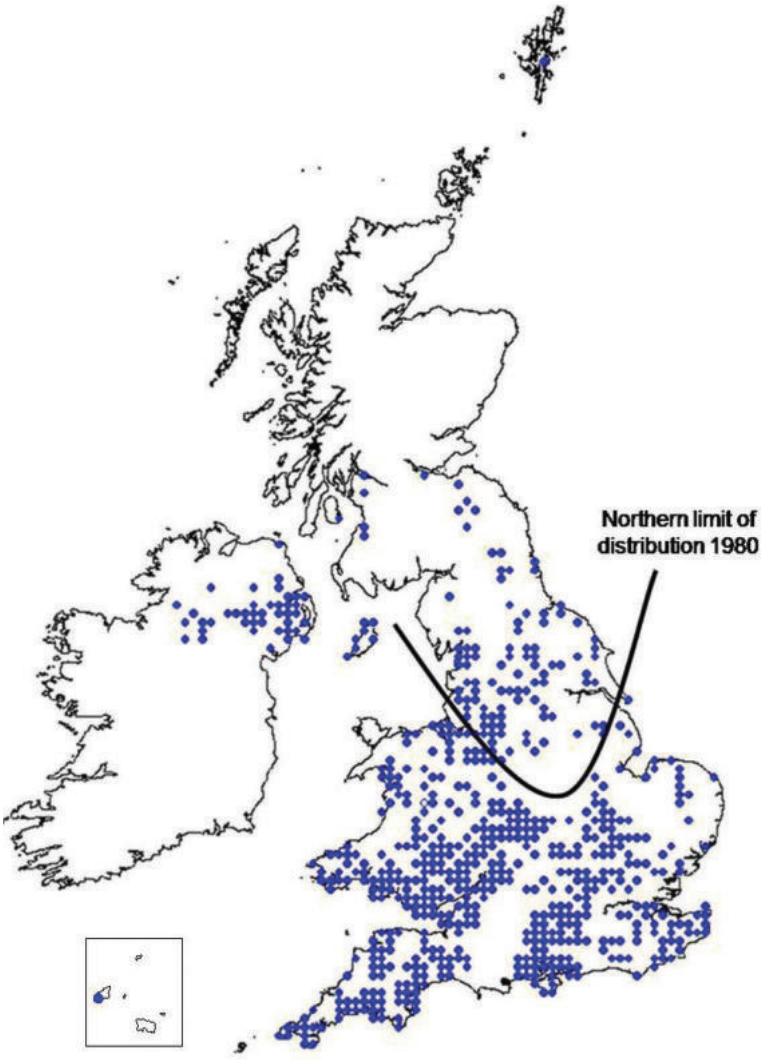

Figure 3. Provisional distribution map of the Pale Pinion (*Lithophane hepatica*) from the NMRS database
Photo: Pale Pinion (*Lithophane hepatica*) Les Hill

and enhancing their existing skills. Further training courses will be run this year and details can be found on the Moths Count website (www.mothscount.org).

The National Moth Recording Scheme

The most important aim of the Moths Count project was to establish an ongoing recording scheme for the 900 or so species of macro-moth found in the UK. The basis of the scheme was developed during 2007 and the first moth records were added to the new National Moth Recording Scheme (NMRS) database at Christmas that year. In two and a half years since then, 8.1 million moth records from 105 vice-counties have been collated, thanks to the fantastic efforts of the network of County Moth Recorders and the wider moth recording community. County Moth Recorders are local moth experts who are responsible for the collation and verification of moth records for their particular area. They are a first point of contact for moth recorders in the field and they are responsible for submitting county datasets to the NMRS. Further datasets will be forwarded to the NMRS in the near future to further improve the coverage. County Moth Recorders are busy collating and verifying records prior to submission.

Butterfly Conservation is committed, as part of the Moths Count project, to produce a provisional moth atlas from the NMRS database in the coming months. This provisional atlas will cover the macro-moths of the UK, Channel Islands and Isle of Man and will provide important feedback to moth recorders and others interested in moth distribution and conservation. It will enable errors to be identified and will, hopefully, encourage recorders to target under-recorded areas in the future. It will be available online, although we will also produce some hard copies, by the end of August 2010 coinciding with the end of the current phase of the Moths Count project. These will be the first published maps for several decades of most species and the first ever for the *Geometridae*.

However, you don't need to wait until then. Provisional distribution maps are already publically available for all macro-moths on the Moths Count website. Some 7.6 million moth records from the NMRS have also been uploaded on to the National Biodiversity Network (NBN) Gateway. The NBN Gateway is refreshed periodically hence the number of records here always lags behind what is in the NMRS database. The current coverage is illustrated by figure 1, which shows the number of records per 10km square.

The maps on the NBN Gateway can be accessed by anyone down to 2km x 2km grid square resolution. Users from the Government Agencies such as Natural England, Countryside Council for Wales and Scottish Natural Heritage will have access to the records at full (typically 100m) resolution. They will be able to use the records to identify important sites, embark upon targeted and monitored protection, designate, manage and restore habitats and sites. We hope that academic researchers will use the data to help improve the understanding of moth declines, the impact of climate and land use change on our moth species.

Although the moth records held in the NMRS database do not represent all 113 vice-counties yet, some patterns are already apparent when looking at the changes in species distributions. Fox et al., (2006) reported that the Figure of Eight (*Diloba caeruleocephala*) populations sampled by the Rothamsted Insect Survey had declined by 95% since the late 1960's. Data now gathered by the NMRS clearly shows that this population-level decline at a limited number of monitored sites is reflected in the moths' national distribution (Figure 2). In contrast, the Pale Pinion (*Lithophane hepatica*) has expanded its range northwards, colonising many new vice-counties in northern England and southern Scotland (Leverton & Palmer, 2009). Again, the data now assembled in the NMRS, shows this range expansion very clearly (Figure 3). We calculate that the northern range margin of this species has moved a staggering 261km northwards (according to the method of Hickling, et al., 2006) since 1980 (Heath, et al., 1983).

By considering the rarity of each moth and, more importantly, whether the distribution of a species is increasing or declining over time, conservation priorities can be determined and action directed to the species at greatest risk. We currently have little idea how most macro-moths are faring. The distribution maps in the *Moths and Butterflies of Great Britain and Ireland* are out of date and *The State of Britain's' Larger Moths* only analysed population trends for approximately 37% of macro-moth species. Lepidoptera are considered to be indicator species, both of environmental factors such as climate change and of other, less-well recorded invertebrate groups and therefore this information will be useful in understanding declines in our wider biodiversity (Thomas, 2005).

It is simple to get involved in the National Moth Recording Scheme; all you need to do is submit your moth records to your County Moth Recorder. An up to date list can be found on the Moths Count website (www.mothscount.org).

Conclusions

Funds are being sought to secure the future running and maintenance of the NMRS. The support of the Royal Entomological Society has been instrumental in the many achievements of the project to date. In these lean economic times, it is particularly welcome that the Society has also pledged future support for the National Moth Recording Scheme, to help ensure that the great progress and momentum of the project does not falter. Despite the Moths Count project in its current form coming to an end later this year, Butterfly Conservation is committed to the future continuation of the National Moth Recording Scheme; the NMRS will continue to run. So please continue to record moths and submit your sightings to your County Moth Recorder.

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COMMENT

Greening = Grants & Greenbacks

Paul Clayson

University of Florida
Institute of Food and
Agricultural Sciences,
Citrus Research and Education Center,
Polk County, Lake Alfred,
FL, USA, 33850

drpaulsmc@gmail.com

"Greening." "Save the Florida citrus industry $9.4 Billion per annum".

Some stark headlines and attention grabbing words have been touted in Florida citrus circles since June 1998 when the Asian citrus psyllid: (ACP), *Diaphorina citri* (Kuwayama) [Hemiptera: Psyllidae] was first trapped in Dade County (Halbert & Manjunath, 2004). Common with other jumping plant lice, ACP is both an economically important pest that targets young shoots and a vector of plant disease.

Since that date, the Florida citrus industry was poised for their first outbreak of ACP vectored Huanglongbing (HLB) or citrus greening disease; this occurred in 2005. A very real cause for concern for those of us who enjoy a glass of orange juice (1.5% of your yearly 17 kg) with our imported muesli in the morning, but what has this to do with entomology at the post graduate level? Well, the answer is a lot. I hope this narrative highlights the role to be played by post grad entomologists in this and other global challenges both current and in the future.

Biography

The author gained his PhD from the Reading University in 2001, after a spell as a teacher and wine salesperson, he then worked at 'The Mosquito Research and Control Unit', Grand Cayman, BWI from 2005-8; and then onto a post doc at Mercer County Mosquito Control, West Trenton, NJ, USA from 2008-9; and now is six months into another post doc under Dr. Lukasz L. Stelinski/Dr. Masoud Salyani at University of Florida; Institute of Food and Agricultural Sciences, Citrus Research and Education Center, Polk County, Lake Alfred, FL, USA, 33850, drpaulsmc@gmail.com

HLB is a phloem-limited bacterial disease endemic to *Rutaceae*, including the non-citrus curry leaf plant (*Murraya koenigii*). Symptoms of this disease are easy to overlook as they can be mistaken for micro-nutrient deficiencies or herbicide damage on the citrus tree itself; appearing as irregular leaf mottle, or yellow shoots. When fruit is formed they often are lop sided, bitter tasting and unfit for the fresh fruit, or juice market (70% of Florida's production).

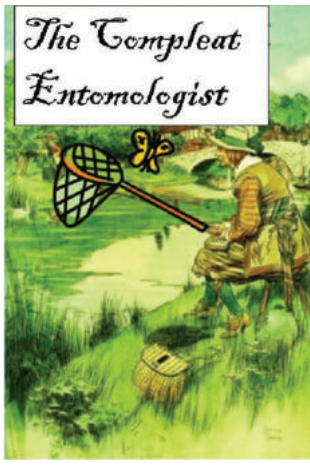
Infected trees are often cut down and burnt *in situ*, a sad site when out in the groves sweep netting and tapping for insect samples. HLB is now being reported throughout the tropical and subtropical regions of the globe. The limitation of the spread is the temperature tolerance of the vector. In the early part of the HLB story, the role of vector was played by an African psyllid: *Trioza erytreae* as the propagation materials were traded between the areas capable of growing citrus. With the advent of PCR, the aetiology of HLB has been investigated; it has been shown to be a bacterial complex of closely related species, found in the liber tissue. As yet a pure culture has not been achieved, hence the name: *Candidatus* Liberibacter asiaticus (africanus and americanus). The distribution of these Gram negative bacteria depends on the temperature profile of the orchard (Aubert, 2009). To date, California, Texas and Australia are HLB free with only a few reports of ACP breaking through quarantines and border checks. This could change any month soon, hence the big interest in this small insect, both here in Florida and on the other coast in California. California accounts for a quarter of national fresh market citrus production and nearly all the domestic lemons. August saw a FedEx package interception by a sniffer dog 'employed' by the Sacramento County Department of Agriculture. 'Tassie' the inspection dog found curry leaves and guavas with approximately 100 live nymphs in a package from Texas.

Psyllids in the UK probably are only generally known for one good reason, the implementation by DEFRA in the biological control of knotweed (*Fallopia japonica*) in 2009 by a Japanese species: *Aphalara itadori*. A heavy infestation of these insects leads to the slow growth and eventual death of this invasive plant (Shaw *et al.*, 2009). As a group psyllids are interesting to study in lab or field situations; they are readily biddable on small greenhouse plants with simple cages, much like aphids. The adults are three to four mm long and mottled an attractive brown. The five nymphal instars range from 0.25 mm to 1.7 mm and are yellow to orange with massive wing pads and Halloween style red eyes. Psyllid eggs are yellow to orange with age, almond shaped, approximately 0.3 mm long and laid on host plants with the long axis vertical to the surface. To the untrained eye, psyllids could be mistaken for aphids, but most aphids exhibit cornicles on the abdomen and psyllids do not. Adult psyllids, though not adept at long distance flights, are fairly active and will fly back onto their host plants when disturbed; aphids are more sessile. Like aphids, honeydew is produced by the psyllids developing on the 'flush' – the citrus growing terminals; this attracts many honeydew feeding insects including ants, eventually sooty moulds colonize the area. When trying to take images of the two species on the same flush, the photographer has to be quick as all stages of the psyllid appear 'camera shy' – the lighting enforcing cryptic behaviour. Aphids are much more agreeable to flash photography!

Pests are bad by definition, but can often be tolerated until an economic level is achieved and investment in a control method is required. When a pest is involved in a host switch by a pathogen, a **pest** becomes a *vector*. Concomitant with this change in adjective is an increase in available grant funding; the amount levied reflects the potential economic severity of the disease vectored. In the case of human disease, potential revenue streams are available from agencies such as the WHO, e.g. the success of insecticide-treated bed nets in Africa that have reduced malaria mediated mortality by as much as 20 per cent (Centers for Disease Control data). In the agricultural disciplines, funding arises from the USDA (US equivalent of DEFRA) and unique industry sources such as Florida "citrus box tax" grants. Here the growers are directly feeding back resources via the USDA extension agency (Florida department of citrus). These cooperative services were established in 1914 under the Smith-Lever act and are part of a federal, non formal educational program allowing people to use research based knowledge to improve their working lives. The box tax group funds directed projects such as canker or greening to the tune of ca. $1.75 million each year

Since working with beetles for my undergraduate work, stored product beetles for my MSc and aphids during my PhD, my post doctoral career has also led me from vector to vector. In the Cayman Islands I worked on, amongst other mosquito species, *Aedes aegypti* (yellow fever mosquito), then onto her more aggressive cousin *Aedes albopictus* (the Asian tiger mosquito) in Mercer County, New Jersey (where West Nile virus and Eastern equine encephalitis are real threats) and now the Asian citrus psyllid in central Florida.

One abiding fact that has been apparent to me throughout this unusual career path is that the number of holes in our knowledge of pest/vectors would resemble a mosquito bed net. In the US, the world of mosquito and sandfly (both old and new world) is the leading edge in terms of knowledge of the target species' behaviour, e.g. responses to: light, frequency, intensity and period; physical attributes of sampling equipment and of course the correct 'smell' to lure the adults to their fate as data. Years of malaria money have meant many research papers on lures, lights and of course the area of ULV (ultra-low volume spray, droplets of 1-50µm, less than 5 L/ha) and residual type pesticide application. This area has seen a recent influx of funds and resources (Sadasivaiah *et al*. 2007); even permitting DDT to be used as an indoor spray, due to its excito-repellent properties (1 million kg used globally in 2005). With the Bill and Melinda Gates foundations' recent $100,000 - 76 small project research initiatives and the Global Malaria Action Plan "Roll Back Malaria" campaign (which projects the global cost of malaria being $6.5 billion for 2009), at least malaria research looks 'healthy'. Figures such as these and images of stricken African villages mean malaria control receives much attention. However, it took an also-ran generalist pest and an unusual disease to attract similar headlines for agricultural vectors. In 1996, the South West Californian Temecula valley reported its first glassy winged sharpshooter (*Homalodisca vitripennis*). This hemipteran is responsible for the transference of Pierces' disease (*Xylella fastidiosa*) from ornamental plants to vines which are extremely susceptible to its leaf scorching effects. This switch threatened the $9.5 billion per annum output of Napa valley, people took notice! Such is the influence of this crop and the associated pests, that University of California Davis' plant pathology and entomology research is dominated by its study.



Sampling for agricultural pests focuses on the observation that yellow is attractive to most herbivorous insects and so we have that well known piece of equipment, the yellow sticky trap. This appears great, but is quite biased and very tricky to actually work with. If knowledge of each insect's sensory system were to hand, adaptation of similar sampling systems could be quickly fabricated and put to experimental use in the way fly fishermen know the relevant structural biology of insects landing on the water surface. Our chosen discipline needs an Izaak Walton character(s); an entomological equivalent to his 1653 work is required: '*A compleat entomologist*'. This should take the form of a resource for researchers to search for information on how to sample a particular group of insects. 'Pherobase', a web resource for pheromones exists – why not something similar for trapping?

vibrating orifice mono-sized aerosol generator (for droplet application studies).

I now know how to operate, flush, service and calibrate machines used to apply hundreds of gallons of spray per hour.

Most importantly, keep your eyes and minds open when out doing field research, talk to as many different people as possible at your current establishment and be ready to put finger to keyboard to express your thoughts!

With their ease of distribution and searching, PDF makes arcane treatises gathering dust an anachronism; simple observations as unread correspondence can be searched – the world of entomology is smaller but broader.

A proactive approach would be to study as many species that can use crop plants as a host, garnering basic knowledge on each insect: attraction, repulsion, diel activity and so on. This seemingly Sisyphean task could be approached in a systematic manner, given recent advances in comparative taxonomy. Armed with this knowledge, when a novel disease decides to piggy-back itself into a pest-host system, the wheels turn more quickly and research becomes more directed and efficient. More importantly in terms of the IPM triangle (van Emden, 1989) the 'ace up the sleeve' of broad spectrum chemical control is not the first line of defense. For those that are responsible for pest control in heavily legislated regions with a litigious, sessile and vocal human population such as California, not relying on a wide area chemical application is a worthy goal.

One great example of cross-fertilization of research is the success of mating disruption and more directed population sampling by the application of insect pheromones. This was initially a success controlling the pink boll worm (*Pectinophora gossypiella*) for the University of California, Riverside during the late 1970's. Harry Shorey and his team used a sex pheromone with the name "gossyplure". The chemical was impregnated into NoMate® fibres and broadcast from crop dusting aircraft (Shorey & McKelvey, 1977) and resulted in significant increases in cotton yield. Following on from these techniques, work in our lab and at USDA's Fort Pierce uses nascent application technologies in conjunction with novel organic chemicals to produce general repellents and female attractants (Lapointe *et al.*, 2009) to upset and therefore reduce mating success in the citrus leaf miner (*Phyllocnistis citrella*). This traditionally lower ranking pest of younger trees has recently received greater attention as the leaf mines produced by the larvae act as harbourage for the destructive bacterial citrus canker disease (*Xanthomonas axonopodis*).

There is a lot post graduates can do in this arena, cross fertilization is to be encouraged and routine screening of potential pests, though not the most edifying of research proposals has the potential to be one of the most influential. Take for example the observations of Boller and Yang HE in *Science* of this May. Here, these researchers explain the role of pathogen associated molecular patterns in the 'triggered immunity of plants'. This association is also involved in the plant's qualitative response to insect herbivory. This is an area of study that could lead to novel solutions for crop protection, such as application of derived semiochemicals to trick pests into feeding on sacrificial plants or traps.

When your research takes you from the comfort zone of what you studied at University, don't be afraid to ask obvious questions. Your thoughts will not be those of an ingénue, but a scientist who is now using another discipline to solve a problem, often giving new insights. My research work now sees me spend half of my time in a laboratory or workshop using reference spray application equipment that I have serviced myself e.g.

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Microscope outputted to a monitor is an ideal display tool.

Some of the volunteers manning a National Insect Week display at Belfast Zoo.

Insect Displays and Exhibitions

Archie Murchie

With National Insect Week this year (21st - 27th June 2010) I thought it might be useful to share some thoughts on manning insect displays or exhibitions for the public, in particular those aimed at children. I have done this on a number of occasions for previous National Insect Weeks but also as outreach events on behalf of my Institute (a Government agricultural station). Although these have been targeted at farmers, the overall approach has been similar.

For an event, we would typically have three tables, with a colourful backdrop. We are fortunate to have professionally produced pull-up displays but what seems to have most effect is a splash of colour. For one event we simply printed out lots of insect photographs on A4, laminated them and blue-tacked them to the wall.

The three tables in front of the display form 'stations'. On the central station we have our laboratory microscope, which has a video camera attached and outputs live images to a monitor just beside it. The microscope is our main display tool. Beside the microscope, we have a selection of live insects and other invertebrates, preferably collected that day from the local environment. One thing that we have found is that the most 'mundane' and common of insects are perfectly suited for exhibition purposes. Most people have not seen a woodlouse or earwig down the microscope. The other advantage of locally-collected insects is that they can be returned to their habitat and new 'insect volunteers' recruited during the day.

It is important to ensure that people manning the stand have some good information about the specimens. Earwigs make an ideal talking point. For example, you can discuss the fact that their large elegant wings are tightly packaged away underneath the small leathery forewings or that the male earwigs have curved pincers, whilst those of the females are straight. The maternal care exhibited by earwigs is another good fact and often people are genuinely taken by this. Be prepared however for questions relating to pest control or insect contaminants (e.g. earwigs crawling into peoples' ears)… to name but only a few. Another approach is to have different lifestages of an insect.

We have used caterpillars, chrysalises and mounted adults of the cabbage white butterfly to illustrate this. The options are pretty much wide-open and it is best to go with something with which you are familiar and develop your own spiel as the day progresses.

We have the microscope facing the Public and encourage them to look down the eyepieces, as well as looking at the monitor. Although many of us take microscopes for granted, they can have tremendous educational value in themselves. For example, at one event, we ran an informal 'Dirty Fingernails Competition' using the microscope. For small children, you need to have some sort of solid platform for them to stand on, to allow them to look down the microscope. A fold-out stool, found in most hardware shops, will do at a push but a custom-made wooden platform is better and easy to make. Microscopes are expensive and have to be manned at all times. Although we encourage the public to focus the microscope for themselves, a determined child (or adult) can strip a focussing column thread if not supervised! We have had no problems at all with theft, even at large public events; nevertheless the microscope, light-box, and television are all secured with a Kensington lock.

At the second station we have mounted specimens, model insects and a laptop (also Kensington-locked). We run the lifecycle of the 7-spot lady bird on the laptop. Spectacular close-up footage is available from www.entofilm.com on DVD. Another possibility with the laptop is to use a USB digital microscope to present live images. The image is not as good as with a dedicated microscope but it does allow specimens to be examined from different angles and is considerably cheaper (these are available from the likes of Maplins www.maplin.co.uk). The insect models we have are laboratory quality models from Somso Modelle (www.somso.de/english/index.htm). These are not cheap but are excellent teaching tools. We tend to take along the relatively robust housefly head and, as it is just slightly smaller than a child's head, you can hold it up and make a direct comparison of the size of eyes, position of the nose (antennae) and mouth. Mounted specimens, whilst useful, are not as popular as live insects. Again, I would not worry too much about displaying spectacular specimens and definitely not those that are valuable or delicate. What is key here is to have specimens that can be picked up and looked at, either by eye or down the microscope. As with the live specimens, having a good patter behind the specimen is paramount and if they can be linked in with other specimens (mounted or live) in a 'story', so much the better. An example that we have used is that of disease transmission by flies, with some mounted blowflies leading on to the housefly head, then the mosquito head and finally some living examples of mosquito larvae collected from about one mile away… leading to the comment "I never knew we had mosquitoes in Ireland!"

An entomology display at the National Ploughing Championship (Co. Kildare).

The final station is a box containing leaf litter, soil and some stones (or alternatively, pond water, weeds and associated fauna). We use white storage boxes from IKEA. These are relatively shallow and allow children to explore the litter habitat close up, turning over the leaves to see millipedes, centipedes, springtails, slugs, snails etc. We have found that slugs and snails are surprisingly popular, and again, especially if you can explain some of the structures and biology. We allow the children to gently handle the beasties but try and refresh the litter box every so often so no creatures are harmed. Afterwards it is important to make sure that the children wash their hands or that you have an antimicrobial gel wash for hygiene purposes.

In our case, each station would be manned by a different person and when we have a group of children then they would be split-up and rotated between stations. As a general rule of thumb, we prefer to have 6-7 children at any one station at a time. That sort of number allows you to talk to each child. Once you get more children, then those at the back cannot see and they start to lose interest. Freebies such as pencils, lapel stickers and information leaflets are always handy to have and are appreciated. For school groups, we normally put together a small information pack for the teacher so that he/she can discuss with the class afterwards.

Science communication is becoming increasingly important these days, with the public not only interested in natural history but wanting to understand more about how their money is spent by researchers. I have found being involved in exhibitions to be hectic and great fun in probably equal measure. There is something rewarding about talking directly to the public (especially children) and sharing your own passion and enthusiasm. I have also found that the public do not expect you to know everything about insects (thankfully!) but are often quite content just to hear about your own work or interests. Give it a go, especially now that the RES has teamed up with the Amateur Entomologists' Society to run the Bug Club – there is Bug Club literature available to display in your places of work and/or event displays.

A Myrmecologist and a Great Society

The use of an Outreach grant from the Royal Entomological Society to the author

REPORT

Dr Mostafa Sharaf
Assistant Professor,
Plant Protection Department

College of Food and Agriculture Sciences
King Saud University,
Riyadh 11451,
PO Box 2460,
Kingdom of Saudi Arabia
E-mail:antsharaf@yahoo.com

One of the most important problems facing workers in the career of taxonomy and faunistic studies is the deficiency of funding. In common with others in that field, I have struggled to meet the requests of many specialists all over the world to send them ant specimens for studies, including molecular systematic and chemotaxonomy. My own field surveys, during my doctoral study and after, were not funded. Being aware of the problems, my sincere friend Dr. Brian Taylor suggested we ask the Royal Entomological Society for a grant for these scientific purposes. In due course, Prof Jim Hardie informed me that the RES would meet the request.

Although the grant was not large, I have tried to use it well so as to maximise the benefits. I used it in making field trips to survey many poorly collected areas in Egypt and these yielded additions of many interesting local species. A number of them were poorly represented in Egyptian entomological collections, e.g. *Tetramorium lanuginosum*, *T. bicarinatum*, *Pheidole* spp., *Plagiolepis* spp.. A field trip carried out to St. Catherine Protectorate (South Sinai) in 2009 yielded the rare species *Cataglyphis ruber*, *Tetramorium depressiceps* and several *Tetramorium* species that appear to be undescribed. All these species will be important in a comprehensive future revision of the Egyptian ant genera.

I have also used the grant to provide many researchers with ant samples collected from Egypt and Saudi Arabia. Several specimens of the ant species *Camponotus sericeus* (Fabricius, 1798) from Abha (Asir Province, Saudi Arabia) were sent to Dr Ellen Schluens and her supervisor Prof. Ross Crozier (School of Marine & Tropical Biology, James Cook University, Australia) for their molecular phylogenetic study of that

Figure 1. Profile of *Solenopis saudiensis* Sharaf & Aldawood n. sp. (in press)

species. Numerous specimens of the Egyptian ant genera *Solenopsis* and *Monomorium* were sent to Dr Rachelle Adams and her supervisor Dr Ted Schulz (Smithsonian Institute, Washington) to be used in their phylogenetic project of the Solenopsidini tribe. Additionally, many specimens of the *Monomorium exiguum* and *M. salomonis* were sent to Dr Henri Cagniant (Paris).

An important outcome is the discovery of a new ant species, *Solenopsis saudiensis* Sharaf & Aldawood sp. n. (Figs 1 and 2) from Saudi Arabia. A few individuals were collected under a palm tree in Riyadh, another large colony was found nesting in a wild area near Riyadh and coexisting with the ant species *Tapinoma simrothi*, both tending an interesting species of mealybugs. This is the first *Solenopsis* record for Saudi Arabia. Discussions with Dr Taylor and Barry Bolton enabled me to gain a good understanding of the taxonomic status of this new species. The grant was used in sending series of paratype specimens to the British Museum of Natural History and to the World Museum (Liverpool). A third series was sent to Dr. Kiko Gomez (Barcelona, Spain) to be photographed by the automontage.

Solenopsis saudiensis was found coexisting with many ant species including *Tetramorium caldarium*, *Paratrechina jaegerskioeldi*, *Monomorium exiguum*, *M. mayri*, *Pheidole minuscula* (or the species denoted as *P. miniscula* by Collingwood, 1985), *Hypoponera abeillei*, *Tapinoma simrothi*, *Cardiocondyla mauritanica* and *C. emeryi*. A formal description has been submitted to the *Journal of Arid Environments*.

Figure 2. Full-face view of *Solenopsis saudiensis* Sharaf & Aldawood n. sp. (in press)

I would like to express my deep thanks to the RES for supporting me with this grant and for the great role it plays for the advance of entomology and I hope this great support can continue to me and to all workers in the future.

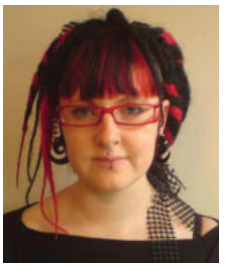
Acknowledgements

Special thanks go to Dr Brian Taylor and Prof Jim Hardie for reviewing the article language.

Student Essay Competition 2009

Once again it was a difficult task for the judges, sorting through the entries to select the winning three. In fact this year they have agreed to publish five of the submitted essays the three winners plus two runners up which deserved to be acknowledged. Thank you to all those who entered, better luck next year. We hope to have another bumper batch of fascinating articles submitted for this year's competition which the judges look forward to reading.

Peter Smithers



1st Prize

Insects: The incidental investigators

Louise Cuttiford, Imperial College

Picture the scene if you will: 13th Century China. A man is stabbed to death near a paddy field. The following day Sung Tzu, a local death investigator, orders the workers in the nearby field to lay down their sickles for inspection. Within a brief period of time, blow flies begin to land and feed on a single sickle. These flies are attracted by tiny traces of blood still present on the sickle and Tzu knows this. He questions the owner of the sickle who quickly confesses to the murder.

This ancient case, detailed in Tzu's book "The Washing Away of Wrongs", is in fact the first documented case of Forensic Entomology. Over the centuries since then, many investigators, doctors, anatomists and even artists and sculptors have observed and depicted the role of insects, particularly maggots, in the decomposition of human remains and more recently, television shows and films have bought Forensic Entomology into the public eye. The Forensic Entomologist must approach situations which most others would reel away from, but if you are able to suspend your initial apprehension about the topic, I'd like to tell you why Forensic Entomology is so fascinating.

When a body begins to decay it becomes rather more like an ecosystem. All the internal organs and other parts made up of tissues, bones and various fluids can be thought of in more general terms as a series of micro-habitats, providing shelter and nutrition for insect visitors. The nutritional content of decaying flesh also changes over time meaning that different families of insects arrive at particular stages of decay and they do so in a very predictable manner. In fact some insects arrive in such a highly predictable manner as to be an extremely accurate indicator of the time passed since the body died or at least was exposed to possible insect visitors. This is known as Post Mortem Interval (PMI) and it is the job of the Forensic Entomologist to accurately predict the PMI using their knowledge of the particular insects that they find.

Probably the most well known visitors and almost always the first, known to arrive within half an hour of death are the lowly blow-flies, known to most as the Blue Bottles and Green Bottles. These are the most forensically important group of insects as they have the most predictable development patterns, based largely on temperature. Blow-flies will feed on rotten flesh and lay their eggs there too, so they are also easy to collect and if necessary can be reared to adult for proper identification. Although the most common visitors, blow-flies may not be able to visit a body which is sealed off, say in a flat with closed windows. In these cases it is often another species which becomes the centre of investigation. These can be beetles, mites, spiders or even other families of flies, such as scuttle flies which are able to squeeze through the tiniest of holes. Certainly it would be rare to find a decomposing body without some sort of insect or arachnid presiding on it, even if it is only one or two individuals.

There are many instances where an investigation is not as straightforward as this. For example, what if a body has been in two different places? Perhaps a victim has been wrapped in plastic and stored in a freezer whilst the perpetrator chooses a burial site. And it is cases like this where it gets really interesting. Because we know at what points during decay particular groups of insects will arrive, we can also make a good estimation as to when a body was exposed to possible insect visitors. So if our body in the bag in a freezer was moved outside, we should be able to tell you roughly when it was moved, and it is information like this that can prove pivotal in an investigation. And of course insects aren't just homicide investigators; they can also tell us about other crimes including abuse and neglect, drug crime and wildlife crime. Insects can be found in almost every environment on the planet so it's not too difficult to believe that they can find their way into pretty much everything!

Although this discipline has been practised for such a long time, it is only within the past few decades that we have embarked on trying to create useful standardised data concerning the most forensically important species. Developmental studies and DNA profiling are being undertaken all the time to produce more resources for entomologists in the field that will be both useful and accurate. If more young Entomologists take an interest, the

2nd Prize

Carmine: The Colour of Desire?

Borame Dickens,
Imperial College

As a nation which has become increasingly concerned with the consumption of artificial E-number colourants, food companies have searched far and wide to find more natural sources to use as food dye. In 2006, Nestle proudly announced that their Smarties™ were completely free from any artificial colouring. At the end of 2008, Tony Bilsborough proudly stated that Cadbury had listened to their consumers and replaced all their colourings. Tesco, Sainsbury's, The Co-op and many more supermarkets have slowly stamped their foot down and started to ban range of colouring agents demanding that more natural alternatives be used. Strangely, few consumers question; What is being used instead?

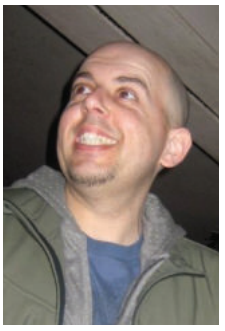
Whilst the answer to this question horrified some, many recognised the insect derived "carmine" from the cochineal scale insect as a traditional dye which had been used by the Aztecs and Mayan people of Central and North America. It was a highly prized commodity, comparable with gold. The robes of Roman Catholic Cardinals and the jackets of the British military were tinted with this dye and it was regularly traded across European countries. In 1868, the Canary Islands exported approximately three million kilos of the processed product, representing a significant economic source of revenue. Whilst demand fell with the synthesis of artificial colours in laboratories, carmine has recently become commercially viable to farm again especially since many consumers are unaware of the source on 'natural colouring E120' on the label. In fact, the brilliant rich reds and pinks of cakes, cookies, jams, glazed cherries, cough drops and lipsticks to name a few, owe their vibrancy to this insect. Oddly, some brands of sausages, pies and cider contain this colourant too.

Native to Central and South America, the cochineal scale insect (*Dactlopius coccus*) within the suborder of Sternorrhyncha (containing aphids and whiteflies) is considered to be a sessile parasite of nopal or opunti cacti. They are soft-bodied, oval shaped and flat. Sucking up the cactus juices with their mouthparts, their bodies are purple from the red liquids they've extracted from the plant. Extraordinarily, it takes 70,000 dried insects to produce 0.5kg of dye with an acre of cacti yielding approximately 130kgs of insects. They are usually killed by hot water immersion or heat exposure, producing carminic acid which is changed into two forms of dye; cochineal extract [E120(ii)] from the raw, dried and pulverised bodies and carmine [E120(i)] from a more concentrated liquid form. Neither are toxic or carcinogenic but they can induce an anaphylactic shock reaction in a very small number of people. As with many other food products, this is largely due to contamination during preparation.

Consequently, the FDA (Food and Drug Administration) has decided that consumers have the right to know whether insects are present in their food or cosmetics. The 'correct terminology' conflict has begun again with phrases such as "artificial colour" and "colour added" being banned with "cochineal extract" and "carmine" replacing them in 2011. Vegans, vegetarians and those consuming kosher and halal are expected to steer clear of these products, provided they know what both these terms actually mean. Perhaps it would be more transparent to write "crushed red beetles" instead but this would obviously deter a significant number of people and hit supermarket sales. Companies use this dye because it makes food look more ripe and healthy to consumers. Is it perhaps the shallowness of the consumer which is the problem here and not whether proteinaceous insect material is used in a nation of numerous carnivores? Society seems to show few concerns about eating the limbs of a dead mammal, so why are insects so alien?

Carmine is not the only insect dye. Kermes (*Kermes vermillio*), a parasite of dryland oak shrubs in the Mediterranean region also produces a bright red dye. The shells of immobile female insects were crushed and made into paint, often referred to as a 'King's red' for its beautiful lustre. Shellac, a resin which is secreted by the female lac bug (*Tachardia lacca*) when it forms a cocoon on trees in Thai and Indian forests, has been used throughout history too. It has a range of purposes and was used as a brush on colorant, food glaze and a wood finish. When it was applied with a drop of linseed oil on a rag, shellac could bring out a brilliant gloss on Swiss music boxes and historical pianos, currently known as a "French polish".

It seems strange that the public which lobby so vehemently against the use of artificial additives in food would also condemn a natural source simply because it seems a bit 'icky', especially since insects have been used to make favourable products for hundreds of years. It's ultimately up to you, the consumer – Is eating creepy crawlies better than ingesting petroleum based concoctions made in a laboratory? I'm not sure.



3rd Prize

Wanted:
The Ant Mugger of Central America or what a spider must do to keep its reputation...

Chris Ayre,
University of Plymouth

Spiders! Wooo... made you jump already haven't I? The very word sends a shiver down quite a few people's (and other animals) spines/exoskeletons. From the tarantula to the house spider, these chaps sit atop of the public enemy number one lists even if, for the most part, they don't deserve it. But with all those legs going, the ever watching eyes and just even the very idea of those fearsome fangs, these guys don't mess about. It's a cut-throat natural world out there, there are hungers to satisfy, children to feed and these attributes serve them very well. So after 400 million years of evolution and with 35,000 species known and counting, *that* reputation is more than established. Until now. The spider world is rocking, news has come in which could dent that well earned rep. A vegetarian spider. As millions of spiders rub their (many) eyes in disbelief, a nectar feeding spider has been found by scientists in Central America. But fear not my arachnid friends, all is not as it seems. And those of you spider-fearing folk who relaxed a little at the thought of a veggie spider, you may need to get back on that chair…

In some quiet corners of south eastern Mexico and north western Costa Rica, a partnership has been developing and is thriving. A species of ant known as *Pseudomyrmex* have formed a mutually beneficial relationship with a certain species of Acacia plant known as *Vachellia*. This partnership really is a wonder of nature. The Acacia offers the ants protection and nutrients and the ants defend the acacia from herbivores and keep competing plants nearby at bay. Up to two or three trees can be occupied at a time, their large hollow thorns providing perfect sanctuaries for the ant colonies. The nutrition that the acacia offers its defenders comes in the form of Beltian bodies, specialised leaf tips that are harvested by the ants. It is these 'fruits' that *Bagheera* has its eye(s) on and here's the rub. *Pseudomyrmex* are highly aggressive ants that defend their territory ferociously, attacking anything that comes near. Soldier ants are capable of repelling snakes, birds and mammals using bites and spitting formic acid. So this is no simple walk to Sainsbury's for *Bagheera* to get it's five a day, it's a grocery trip fraught with danger. So how do they do it?

Bagheera kiplingi is a member of the Salticidae family, or Jumping Spiders and membership of this gang means you're equipped with some pretty special skills. These guys have advanced colour-vision for recognising prey, are superbly agile with lightning reflexes and have superior cognitive skills. That's problem solving to you and me, they are very bright indeed. To get his food, *Bagheera* has been observed the very tips of the Acacia's, keeping well out of the way from the larger bodies of soldier ants that patrol the trees. It's from here that *Bagheera* does his stuff and proves his spider credentials. Taking advantage of the fact that their appearance mimics the ants body shape and that they are also thought to use the ants own chemical scent to mask themselves (clever, remember), *Bagheera* uses its superlative athleticism and agility to either grab a Beltian Body from the leaf tips or they mug a poor, unsuspecting worker ant, robbing it of a fruit or two. If he is spotted by the soldier ants, *Bagheera* simply turns tail and jumps from leaf to twig to leaf, leaving his pursuers eating his dust. The soldier ants simply cannot keep up. Vegetarian spider 1, Big, Angry Ants 0.

So there you have it. A Vegetarian spider. And with reputation restored I'll think you'll find. None of this spinning a web and waiting for your dinner to fly into it, no, a daring heist filled with adventure and danger. With big, angry ants too. To get fruit. All you spiders choking on their flies, demanding this fraud hand in his spider membership card, I think *Bagheera kiplingii* has earned his place in the club. And to all you humans thinking about stepping down from your chair and going for a banana, well, you've been warned...

Runner Up

Demon Ants in the Devils Backgarden

Aaron Gallimore,
University of Plymouth

The Amazon rainforest is home to a multitude of plants and animals, each with different natural histories and life strategies. This high diversity of life has come about by the evolution of certain species (sp.) to certain niches within said ecosystem. Within the Amazon there are unusual clearings that look to have been cultivated.

These clearings are the product of a clever and industrious Ant sp. (Formicidae, *Myrmelachista schumanni*). This sp. lives in and feeds on a single sp. of tree (*Duroia hirsuta*.) that are found as large stands in these clearings. *M. shumanni* protect the tree stands by killing off the competition. This extraordinary feat of mutualism results in what are termed 'Devils Gardens'. These 'gardens' were given their name by locals who came across the stands and made the inference that evil spirits live there.

The stands of *D. hirsuta* are achieved by *M. shumanni* actively seeking out seedlings of any other plant sp. in the localised area, biting an opening in the leaf tissue, inserting the tip of its abdomen into the tissue and releasing formic acid inside. This then turns the tissue necrotic and the plant accordingly dies. So, in effect, *M. shumanni* are gardeners.

This unique behaviour seems to have evolved because the benefit outweighs the cost scenario. In other words, the benefit of *M. shumanni* living in *D. hirsuta* outweighs the cost of feeding them. This benefit of mutualism is a long lasting one; nests have been recorded to have survived in a particular stand for eight hundred and seven years.

M. shumanni primarily nests in the hollow stems of *D. hirsuta* in the old growth. These hollows are called domatia. *M. shumanni* tends the domatia, keeping the nest site disease free. This then provides perfect conditions to raise their larvae, thus ensuring a nest site for generations to come.

Now, you may be thinking 'how do *M. shumanni* or ants in general communicate?' As, for this level of organisation certain thought processes are needed. However, communication is achieved by using chemical signals, called pheromones. Chemical receptors on the antennae pick-up these signals, although it is not that simple. The ants themselves are covered in a coat of pheromones, these 'coats' help to determine what that particular ants' behaviour is. Examples of behaviour in *M. shumanni* can include foraging for food items or excavating the nest.

The pheromone make-up of these coats has been documented to change and, subsequently, the ants' behaviour changes. This has been noted to have occurred because of several reasons that need to be researched further to gain a fuller understanding. It appears that changing light intensities do have an impact upon this process, as does social 'grooming'. Ants' have a 'group mind', or, they have the ability to work together to achieve a goal that they would struggle to achieve individually.

To conclude, *M. shumanni* are a fascinating and thought provoking species. However, they are just one of the myriad of ant species on the planet. Each one has a unique behaviour; a slight difference in how they live and each one is waiting for you to discover them…

Runner Up

Jewels of India

C. J. Thorpe-Dixon,
University of Plymouth

We stopped to watch the white tailed sea eagle fly along the bund that separated our little island from the Indian Ocean. Its' underside illuminated by the reflected light glancing back off the azure blue sea as brightly as its top was by the sun itself. As it disappeared over the palm tops we turned into the island onto a dusty path bounded on one side by fisherman's shacks, roofed from plaited palm fronds that looked as if they would not keep an English shower off let alone the monsoon rains already on the horizon, the other fringed in broom like shrubs. The dust clouded over our feet dusting them in beige talcum.

Our track passed a patch of dark green water fringed in coconut palms giving view to a vista of lush green paddy. Our companions on the look out for reptiles had left us behind as we had stopped for the eagle and now we hurried to catch them. Only fifty meters down the track though my eyes were struck by something bright and jewel-like in the bush. It was obvious as we started to look that it was a dragonfly (Green marsh hawk, female,

Orthtrum Sabina), brightly coloured with its' wings stuck out like a glider. There was something odd about the shape though. Worried that we would scare it into flight we readied cameras at a distance and approached slowly. We need not have worried though it was intent on a very large meal. It had caught and decapitated another dragonfly (Coral-tailed cloud wing, male, *Tholymis tillarga*) even larger than itself and was intent on consuming what for us would have been a late breakfast. Even our macro lenses half a meter from its' great all encompassing compound eyes and the whirr of our motor winds could not disturb its' reverie. They do say there is nothing like a good breakfast to set you up for the day!

Sure in the knowledge we had captured the moment we moved on. The rest of our party were not too far ahead watching the wash being done in a rather muddy pond in a deep depression in the sand. As we watched, a few dragonflies (Pied paddy skimmers, male and female, *Neurothemis tullia*) on the wing flashed by leaving a coloured trail in our eyes like a sparkler on bonfire night. Some settled on the ground or shrubs long enough to be photographed but none had a visible feast in its grasp. In all we counted four species in this one location and it turned out to be the only place on the island that we encountered them.

The days passed dragonfly-less and the time came to return home. Thinking nothing more of our jewels in the bushes we set about editing the vast number of images that digital technology seems to encourage you to take. Until one day whilst showing off some photographs of the stunning scenery and the wildlife we had seen I by chance put on the screen one of the images of an Indian breakfast. The viewer, an invertebrate expert and enthusiast. Our chance sighting was perhaps unusual and may be worth reporting but first we should find out a bit more.

There started the paper chase that has almost turned into an obsession. Starting with a member of staff at my university then the local Dragonfly Society we were directed from one organisation to another and from one continent to another. There were people in India interested because of the location, there was a student in South Africa who was studying the phenomenon. The literature was far from conclusive; yes dragonflies sometimes ate others but usually as larvae. Several species of anisoptera predate on the smaller damselflies, zygoptera, but always the definitive answer to our chance encounter question remained elusive.

So as I write this I am putting together a nature note to be sent off for consideration for publication and this lowly amateur entomologist may yet be published. If this happens or not is now beside the point. This chance observation has re-ignited a childhood fascination for entomology and the Odonata in particular?

Meeting Reports

ENTO '09

Miss Emma N. I. Weeks

RES National Meeting including Postgraduate Writing and Publishing day and the symposium on Insect Infection and Immunity: Evolution, Ecology and Mechanisms

14th -17th July 2009

Postgraduate Writing and Publishing Day

The postgraduate writing and publishing day at Sheffield University was organised by Rhiannon Pursall, a RES postgraduate representative based at Sheffield. The workshop preceded ENTO '09 and attracted many postgraduate students (60 delegates), many of which were also attending the following conference.

Alex Dumbrell (University of York) gave a talk entitled 'A basic introduction to scientific writing', in which he covered many of the issues of submitting a manuscript that all scientists have to struggle with the first time they decide to publish their data. I submitted a manuscript myself a week prior to the course, and this lecture would have been priceless to me as I struggled with submitting my figures online! He covered everything from where to publish, to how to prepare your manuscript for submission. Following the authors perspective from Alex, Chris Haines (University of Greenwich) gave an editor's view. Chris's presentation concentrated on how to avoid rejection and keep the editor of the journal you are submitting to 'happy', with the major take home message being "read the author guidelines". 'Publishing for early career scientists' was then tackled by Debbie Wright from Wiley-Blackwell Publishing, giving more information from a publisher point of view and on the steps that occur post-submission.

Prior to the reviewing workshop Jane Hill, the editor of the RES journal Ecological Entomology, gave valuable information about the reviewing process. As a scientist in the first stages of my career these points were extremely valuable, both to understand what happens after you submit a paper, and what to do if, or when, you are asked to review a paper. For the reviewing workshop the invited speakers were joined by Keith Walters (Food and Environment Research Agency) and Lin Field, president of RES (Rothamsted Research). Both Keith and Lin are editors of RES publications, Agricultural and Forest Entomology and Insect Molecular Biology, respectively. We had a choice of three papers to read and then we were grouped by journal to discuss our thoughts on the paper with its author. We also had the opportunity to hear the reviewer comments and the comments from the author to the reviewer, giving an insight into what sort of communication to expect during this stage of the process.

Few PhD students have any idea how the submission process works prior to attempting to submit their first paper and a course such as this would be invaluable. As a postgraduate student I can vouch for the fact that the course was extremely worthwhile and I intend to recommend a similar course be organised for students at our institute. For information, a complimentary workshop will be run in February 2010 at the Postgraduate Symposium which is being hosted by Sheffield University. This course will cover the same areas but in more depth so it will be beneficial to both students who did and did not attend the Postgraduate Writing and Publishing Day.

Insect Infection and Immunity: Evolution, Ecology and Mechanisms

When, Hans G. Boman demonstrated that the response of Drosophila to bacterial pathogens led to the production of antimicrobial peptides in 1972, many people still believed that insects were devoid of immune responses (Boman, Nilsson et al. 1972). Since this time there has been a great deal of interest in the pathways that lead to the production of these peptides, specifically, and insect immunity in general. Traditionally there are two separate approaches to investigations into insect immunity, molecular or ecological studies.

Every second year there is a symposium held in conjunction with the RES National Meeting and this year Stuart Reynolds from the University of Bath and Jens Rolff from the University of Sheffield hosted a symposium on Insect Infection and Immunity. This symposium and the corresponding book attempts to combine the two fields, bringing researchers together from both areas, to enhance knowledge and understanding of the insect immune system.

The symposium was held over three days and together with the national meeting attracted approximately 200 delegates from universities and institutes worldwide. Presentations for the symposium took place in the mornings and the national meeting followed on in the afternoons. All the invited speakers of the symposium contributed to the book 'Insect Infection and Immunity: Evolution Ecology and Mechanisms', edited by the meeting conveyers Stuart and Jens, which is now available through Oxford University Press.

The symposium was opened on the 15th of July with an introduction by Jens and Stuart with a forward by Sir David Read, Biological Secretary and Vice president Elect of the Royal Society and emeritus professor at the University of Sheffield. The first

session, chaired by Fotis Kafatos (Imperial College) and Brian Lazzaro (Cornell University), got off to a flying start with an overview of ecological immunity by Paul Schmid-Hempel (ETH Zurich) 'Ecological Immunity: then, now and next'. Followed by Brian Lazzaro 'Population genetics of insect immune responses', and Michael Kanost (Colorado State University) 'Serine proteases in *Manduca sexta*', both of which gave fantastic presentations on advances in insect immunology research, bringing non-immunologists and experts in the field quickly up to date. In addition, I felt they both gave a lot of thought towards ideas for future studies and questions that need to be answered giving me the indication that we will soon be back out of date in this field! Fotis Kafatos then gave a talk entitled 'Mosquito/*Plasmodium* interactions: immune responses of mosquitoes and malaria transmission'. The advances made in this area by Fotis' laboratory are groundbreaking. In particular, the degree of understanding we now have about *Anopheles gambiae* refractoriness to the human malaria parasite, *Plasmodium falciparum* and the differences between this system and the model system with mouse malaria, *Plasmodium berghei* is vitally important for future research in potential control methods targeted at the mosquito vectors of malaria (Mendes, Schlegelmilch et al. 2008).

The second session, which was chaired by Shelley Adamo (Dalhousie University) and Michael Kanost, was opened by two seminars on immunity in *Drosophila*. The first by Alex Kraaijeveld (University of Southampton) with a talk describing the costs of preparing for and having an immune response to a parasite or pathogen and continuing with Jean-Luc Imler (Université Louis Pasteur) who spoke about antiviral innate immunity. Jean-Michel Drezen (University of Tours) moved on to discuss the mutualistic association between wasps and bracovirus, in particular 'the quest for the ancestor virus'. This was followed by Bruno Lemaitre (Global Health Institute, EPFL) who unravelled the complexities of immune responses to pathogen invasion within the gut. Bruno described how the insect first destroys the pathogen using reactive oxygen species (ROS) and then repairs the side damage caused by ROS on the gut by an increase of epithelial renewal mediated by activation of stem cells by the JAKSTAT pathway (Buchon, Broderick et al. 2009). Finally Greg Hurst (University of Liverpool) discussed the role of symbiotic bacteria in insect immunity, with a talk entitled 'The inherited microbiota of arthropods and their relative importance in understanding resistance and immunity'. Greg described the importance of symbiotic relationships with relation to the most studied examples, *Drosophila/Wolbachia* and *Glossina/Wigglesworthia*. He stressed the fact that for insects to survive they must both kill the invading pathogen, whilst protecting their symbiotic microbiota. In the case of *Glossina* species, for example, particular amidases prevent the activation of the innate immune system and so protect the *Wigglesworthia* (Wang, Wu et al. 2009). He concluded by discussing the role of symbiotic relationships in vector insects, head lice for example have strong immune responses against Candidatus Riesia species the endosymbiotic bacteria found in body lice, *Pediculus humanus* (Allen, Reed et al. 2007). Body lice are efficient vectors of both epidemic typhus and louse-borne relapsing fever both of which are caused by bacteria, head lice on the other hand are not known to be vectors of any pathogens. Leaving us with the question, 'is the vector capacity of the body louse caused by tolerance to its symbiotic organisms?'

Paul Schmid-Hempel chaired the final session of the symposium. The first talk was given by David Schneider (Stanford University), who managed to wake up the audience from its post conference dinner lethargy with an amusing animation on the tools needed for resistance and tolerance to pathogens in insects (Fig. 1). The talk entitled 'Studying resistance and tolerance in a model system', gave an insight into the complexities of the response to pathogens and the trade-offs between resistance and tolerance that occur after infection. This was followed by Shelley Adamo and her talk on the impact of physiological state on immune function in insects. Shelley discussed how stressing crickets through exercise (or injection of the stress hormone) lead to a shift in resources from the immune system to metabolism via apoLp-111, an apolipoprotein which has the dual purpose of immune surveillance and lipid transport (Adamo, Roberts et al. 2008). As a consequence, stressed crickets are less resistant to opportunistic bacteria and show slower recovery rates. The final talk of the symposium, 'Mosquito immune defence to human pathogens' was presented by George Dimopoulos (John Hopkins Malaria Institute). George used examples of mosquito immune responses to protozoa, viruses and filarial worms to discuss the latest advances in this field. In addition, the induction of resistance through gene silencing was demonstrated with reference to different mosquito-pathogen systems.

The study of insect immunity is vitally important, not only to understand more about the relationships between insects and

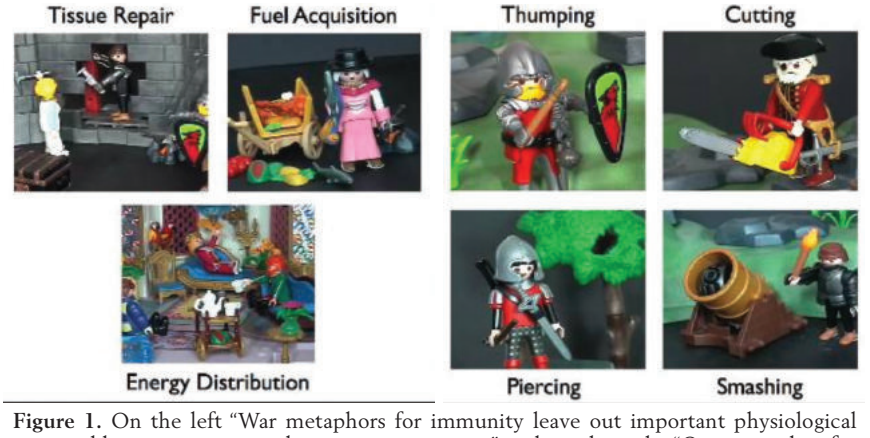


Figure 1. On the left "War metaphors for immunity leave out important physiological process like tissue repair and energy management" and on the right "One metaphor for immunity is to consider it to be a war and the effectors to be weapons". Two slides from the animated presentation 'Studying resistance and tolerance in a model system' given by David Schneider (Stanford University).

Figure 2. The bed bugs, the team that worked so hard to make the conference run smoothly.

their microbial pathogens or parasites, but also to aid studies in other areas such as insect evolution and genetics. The symposium highlighted recent discoveries in the field of insect immunology, with emphasis on future work and questions that need to be answered. The invited speakers were all experts in the field who gave fantastic seminars which were both suitable for all levels of knowledge and full with cutting edge results.

RES National Science Meeting

The annual National Science Meeting was organised by Klaus Reinhardt, Roger Butlin and Mike Siva-Jothy, from the University of Sheffield. The meeting comprised of oral and poster presentations in the following subjects: general entomology, range expansion, chemoreception and chemical ecology, predation, comparative genomics and immunity. To accommodate this wide range of subjects there were two sets of presentations running in parallel on each day, however, the meeting ran very smoothly, mostly due to the efforts of Klaus and his team of bed bugs, who ensured that everyone was in the right place at the right time (Figure 2)!

On the first day of the meeting there were talks on general entomology, chemoreception and chemical ecology and range expansion.

In the general entomology session, chaired by Mike Siva-Jothy there were four talks, the first two talks were Sam Heads (University of Portsmouth) and James Jepson (University of Manchester) were on the identification of fossilised insects. These were followed by two very different talks, the first by Richard Gill (University of Hull) on worker policing of queens in the ant *Leptothorax acervorum* in which he showed us some fascinating video evidence. Richard highlighted the differences between strains from the UK and from Spain, the Spanish population has multiple queen colonies and Richard has observed worker aggression that regulates fecundity in subordinate queens. Richard was followed by Matthew Tinsley (Stirling University) who found that in the absence of pathogens females with knocked down immune pathways had a slower rate of ageing.

In the range expansion session a talk by Jane Hill presented evidence for evolutionary change in butterflies during range expansion in the UK. In her talk, Rosa Menendez (Lancaster Environmental Centre) discussed the impacts of climate change on the range distribution of dung beetles in Spain, revisiting many sites for which there were reliable records from past entomological surveys. Followed by Jane DeGabriel (University of Aberdeen), who examined factors determining the distribution of midges in Scotland, with a view to assess their potential as vectors of blue tongue virus. Glenda Orledge (University of Bath) discussed the historical spread of a fungivorous beetle in the British Isles, since its likely introduction from New Zealand. Finally, in a study comparing life-history and immune function of damsel flies collected at different latitudes, Ine Swillen (Laboratory of Aquatic Ecology, Leuven, Belgium) showed lower immune function in more rapidly developing species from southern Europe, trends which were largely, but not totally independent of rearing temperature.

The first speaker in the chemoreception and chemical ecology session, which was chaired by Stephen Martin (University of Sheffield), was RES president, Lin Field. Lin discussed the work being done within her group at Rothamsted Research on the role of odorant binding proteins (OBPs) in insect olfaction. In particular, recent work on aphid species using a motif search algorithm to identify putative OBPs. Lin was followed by Rena Boothe (Canterbury Christ Church University) and Ki Jung Nam (Imperial College London). Rena's talk described her behavioural studies with the biological control agent, C*hilocorus nigritus* in response to volatiles from its prey, *Aspidotus nerii*. 'Host-plant acceptance and the initiation of reproduction in an aphid' was presented by Ki Jung, in this study an electrical penetration graph coupled to a video camera was used to observe host plant probing prior to parturition.

The evening plenary talks preceded the presidents' wine reception and poster presentations. There were two invited speakers; the first was Hannah Rowland from the University of Liverpool. Hannah was the winner of the Alfred Wallace Award 2009, an award given annually to an outstanding student for a PhD which is judged to be a major contribution to the science of entomology. Hannah's talk entitled 'Behavioural traits to avoid detection: Investigati ng the phototactic behaviour of countershaded caterpillars.' Hannah found that these cryptic caterpillars orientated themselves to complement their pattern and facilitate self shadow concealment. Hannah is currently a NERC funded postdoctoral scientist at the University of Liverpool working on signal mimicry and its consequences for evolutionary defence. The second plenary talk was given by recently elected honorary fellow of the RES, Niels Kristensen, on morphology and insect systematic in a molecular era. Niels is currently professor of systematic entomology at the Natural History Museum of Denmark (University of Copenhagen) where he has established an

Figure 3. Presidents wine reception and poster presentations.

Figure 4. Sarah Dewhirst (Rothamsted Research) describing her poster 'Prospects for the development of odour baits to control the Palpalis group species of tsetse flies, vectors of Human African Trypanosomiasis, in West Africa' to an interested group including George Dimopoulos, an invited speaker from the Infection and Immunity symposium.

Figure 5. Janis Antonovics, who chaired the range expansion session at ENTO '09, from the University of Virginia talking to Amy Pedersen (University of Edinburgh).

internationally renowned research group. His talk discusses the importance of comparative insect morphology in phylogeny reconstruction. Whilst Niels accepts the increasingly prominent role of molecular tools in this field, he encourages us not to forget that morphological data often have a more immediate bearing on explaining the function of evolved structures. Following on from the plenary talks the presidents wine reception was well attended with a wide variety of poster presentations in subjects from range expansion and predation to genomics and immunity (Figure 3 - 5).

On the second day of the meeting there were talks on predation, comparative genomics, general entomology and immunity.

The predation session, which was chaired by Dirk Mikolajewski (University of Sheffield), started with invited speakers Johanna Mappes (University of Jyväskylä) on the function and evolution of warning colouration and Robby Stoks on lethal and sublethal effects of predators on their prey. Robby's talk was based on a very thorough study of the effect of the presence of predators on odonate prey. With interesting results on the effect of predation risk on resistance to toxins, odonates were found to be increasingly susceptible to pesticide poisoning, when already stressed by the presence of a predator. This talk was followed by Oliver Otti (University of Sheffield) who show increased predation risk as a cost of immunity and Triinu Remmel (University of Tartu) who described determinants of predation risk in insect larvae. Triinu's talk sparked a lot of interest in the audience, mainly due to her dedication in painting thousands of artificial caterpillars in order to test her theory! Triinu found that whilst predation was positively size dependent, in both cryptic and aposematic prey, the effect being stronger in prey with warning colouration.

The second general entomology session contained three very varied talks from Suzanne Lommen (Institute of Biology Leiden), Miranda Whitten (University of Swansea) and Leeann Reaney (University of London). All three talks were similar only in the fact that they described unusual yet extremely interesting phenomena; wingless ladybird beetles that are unattractive to the opposite

that are unattractive to the opposite sex, evidence of alterations post mating in the reproductive system of female mosquitoes and flies that produce bigger sexual ornaments as a consequence of immune challenge as larvae, respectively.

The comparative genomics session, chaired by Casey Bergman (University of Manchester) started with a talk from invited speaker Dave Shuker (University of St Andrews) on the genome project of *Nasonia vitripennis*, a parasitoid wasp. This talk sparked a lot of interest, as whilst obviously being being beneficial to those working on *Nasonia* genetics it is also relevant to groups working on other insects, due to an increase in the number of genomes available for comparative studies. This talk was followed by three consecutive talks on comparative genomics of *Drosophila*, Casey Bergman discussed transposable elements followed by Darren Obbard (IEB) on immune related genes and Alex Kalinka (MPI) talking about genes which are important for embryogenesis.

The first of two immunity sessions, both of which were chaired by Petros Ligoxygakis (University of Oxford), began with Andreas Vilcinskas and his talk 'Comparative analysis of immune-inducible genes in phylogenetially distinct insects'. Zakaria Kambris (University of Oxford) discussed *Wolbachia* induced immune upregulation in mosquitoes and Aurore Dubuffet (University of Leeds) finished the session with her talk on the variation of virulence of the parasitoid *Leptipilina boulardi* in *Drosophila* hosts.

The evening plenary talk was given by Naomi Pearce, a professor of biology and curator of Lepidoptera at Harvard University. The talk entitled 'Nabokov meets Darwin: origin and evolution of blue butterflies' was enchanting. Naomi's seminar in particular the section on the symbiotic relationships between ants and Lycaenidae and her theories on the evolution of this trait was very interesting. The work in Naomi's laboratory on Lycaenids is very varied and this was clearly presented in her talk, she discussed everything from chemical ecology and behaviour to genetics and phylogeny. In addition her concise biography of Vladimir Nabokov, the entomologist and author, from his days as a butterfly catcher to his life as the museum curator was fascinating. Especially when coupled with the news that his theories surrounding the invasion of Lycaenids into the Americas have been proven by the latest research in her laboratory.

The setting for the conference dinner at the Western Park Museum was very appropriate given the latest exhibition 'The Big Bug Show' was in full swing (Fig. 6 - 8). We were rather spoilt in our insect themed surroundings however some of us did have to eat our dinner next to a tank of giant millipedes! President of RES, Lin Field presented several awards during her after dinner speech including the Alfred Wallace Award to Hannah Rowland and an honorary fellowship to Niels Kristensen (Fig. 9 & 10). In addition, David Lonsdale was presented with the Marsh Award for insect conservation (Fig. 11). David has had a lifelong interest in entomology, in particular insect conservation. He is an active member of the Amateur Entomologists Society, serving on the council and being responsible for their move into insect conservation. Following this, the awards for poster presentations were given out, Sarah Short (Cornell University) took first prize for her poster 'Understanding resistance: The effects of mating on pathogen defence in *Drosophila melanogaster*'. Second prize went to Nikos Karatolos (Rothamsted Research/University of Exeter), for his poster presentation of resistance against neonicotinoid insecticides in the greenhouse whitefly. A close runner up was Ben Longdon (University of Edinburgh), in third place with his poster 'The phylogeny and co-evolution of the Sigma virus and *Drosophila* species'. Music was provided by 'Jazz Impromptu' a group of Jazz musicians from around Liverpool (Fig. 11). The band was invited specifically by the organisers as it includes eminent evolutionary biologist and entomologist, Geoff Parker FRS (Fig. 12). Geoff had more than one reason to be present at the conference, he was also there to congratulate his former collaborator Niels Kristensen on his honorary fellowship and his previous PhD student Hannah Rowland on her award. The band were fantastic, the only complaint being that they just finished as we were about to get up and dance!

The next morning, the final day of the meeting, included talks on general entomology, immunity and chemoreception and chemical ecology.

The general entomology session chaired by Klaus Reinhardt started with a talk from Paul Buckland entitled 'Insects, Archaeology and the Quaternary'. Paul reminded us of the different insect faunas of the last 40,000 years and that extinctions are irreversible. It continued with two talks discussing the effects of air pollution on insects. Adam Walsh (University of Newcastle), as a third year undergraduate student almost certainly the youngest presenter at ENTO '09, trained hawkmoths to assess the effect of ozone pollution on pollinator foraging efficiency and Scott Johnson (Scottish Crop Research Institute) described the dramatic effects of elevated CO_2 on root feeding insects.

The invited speaker in the chemoreception and chemical ecology session, chaired by Stephen Martin was Stefano Turillazzi (University of Florence). Stefano's investigations into the chemical ecology of *Polistes* wasps are particularly focused on nest-mate recognition and colony defence but also revealed the presence of an aggregation semiochemicals for hibernating wasps. This talk was complemented during the last talk of the session by Heike Feldhaar (University of Osnabrueck) who studied the behaviour, chemical ecology and genetics of the yellow crazy ant *Anoploepis gracilipes*. There were two other talks in this session one by myself (Emma Weeks), on bed bug chemical ecology with particular reference to aggregation pheromones and the other by Anastasia Gardiner (John Innes Centre), entitled 'Comparative study of chemosensory gene repertoires in *Drosophila* species'.

The final immunology session was a diverse session incorporating presentations in the investigations of selective pressures on the arms race between an insect and its virus resulting in changes in the genetic variation of both the pathogen and its host by Lena Wilfert and the unusual antimicrobial treatment of mouse carcasses by burying beetles by Sheena Cotter (both University of Cambridge). Then Will Wood (University of Bath) used *Drosophila* embryos as a model system, to give us live demonstrations of bacterial infections in real time.

Figure 6 (left). RES president Lin Field enjoying dinner with future president Stuart Reynolds, new general secretary Archie Murchie, RES treasurer and ex-president Jim Hardie, and Debbie Wright from Wiley-Blackwell publishing to her left, as well as registrar Bill Blakemore and Elena on her right. **Figure 7 (right).** Inside the 'Big Bug Show' exhibition Brian Lazzaro and David Schneider enjoy a discussion whilst George Dimopoulos and first prize poster winner Sarah Short (far right) smile for the photographer.

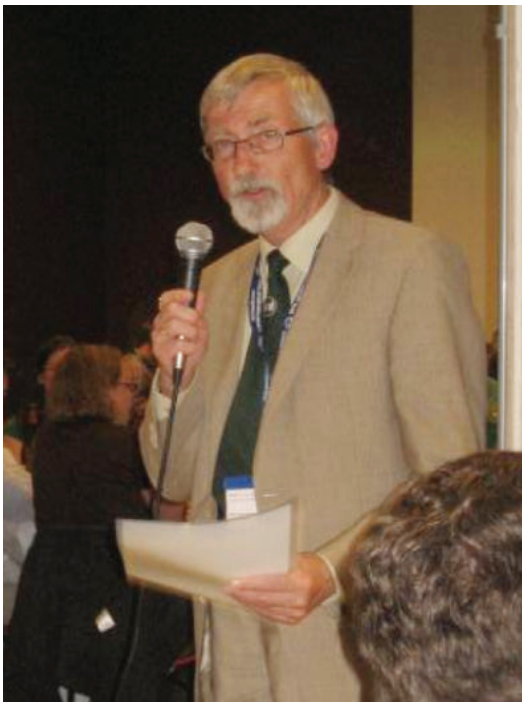


Figure 8 (left). Two little bugs, Freia Bladon (Forest Research, left) and Elizabeth Jones (Imperial College) enjoying the conference dinner. **Figure 9 (middle).** RES president Lin Field presenting the Alfred Wallace award to this year's winner Hannah Rowland. **Figure 10 (right).** Newly elected honorary fellow Niels Kristensen giving a speech after receiving his fellowship from the president.

Figure 11 (left). Jazz Impromptu, a group of jazz musicians from the North West playing in an unusual setting. **Figure 12 (right).** Eminent entomologist, Geoff Parker FRS in a different role: on the saxophone for the conference dinner of ENTO '09.

Finally, at the close of the conference, the prizes were given out for the oral presentations. The prizes were presented by Stuart Reynolds, future president of the RES and symposium conveyor. The first prize went to me (Emma Weeks, Rothamsted Research/London School of Hygiene and Tropical Medicine), for my talk on behavioural and electrophysiological techniques for identification of semiochemicals in the common bed bug. Second prize went to Suzanne Lommen (Institute of Biology Leiden), for her talk on mating behaviour in a wing dimorphic ladybird beetles and the evolution of winglessness. A special mention went to Jeremy Herren (École Polytechnique Fédérale des Lausanne), who narrowly missed out on a prize for his talk in the immunology session 'Haemocytes embedded in the *Drosophila* gut'.

The national meeting this year was a huge success, more than half of the delegates had remained until the final session which I believe to be testament to the quality of this meeting. The oral and poster presentations were extremely diverse and all of a very high standard of science. The meeting and symposium attracted scientists from a wide background, including immunologists, molecular biologists, ecologists, evolutionary biologists, parasitologists, epidemiologists, chemical ecologists, and geneticists and I doubt anyone went home disappointed.

The next national meeting, ENTO '10 will be held at the University of Swansea (Monday 26th – Wednesday 28th July 2010). The meeting conveyors include Miranda Whitten, a specialist in host-parasite interactions in insect vectors of disease, and Tariq Butt, an expert in the fungal control of insect pests. At ENTO '09 Miranda presented her findings on the ultrastructural changes in the atrium (a bursa copulatrix-like organ) in female *Anopheles gambiae* mosquitoes after mating. Miranda currently works on the mosquito/malaria and triatomine/ Chagas disease systems with the ultimate goal to develop novel disease transmission blocking strategies and pest control applications. Tariq and Miranda both have a strong interest in the uses of natural products for biological control and medicine. ENTO '10 promises to cover a wide range of topics with emphasis on applications and challenges for the 21st century, including; exploitation of beneficial insects, problems with medically important insects and their control and the effect of climate change on insect populations. Swansea is a fantastic location for the national meeting, the campus has a beautiful park on one side and the Swansea bay on the other, with the Gower peninsula (Britain's 1st Area of Outstanding Natural Beauty) just 15 minutes away. During the three day meeting there will hopefully be a delegate trip to the National Botanic Garden of Wales, the first national botanic garden to be created in the new millennium (www.gardenofwales.org.uk). Miranda, Tariq and the Royal Entomological Society look forward to welcoming you to Swansea next July.

Acknowledgements

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Southern Connections and the RES

Peter S. Cranston

Entomology, University of California, Davis, CA, USA

Presenters at the 'Austral insect patterns' symposium at Southern Connections meeting, Bariloche, Argentina, February 2010, from left to right: Lyn Cook, Steve Trewick, Nate Hardy, Dalton Amorim, Takumasa (Demian) Kondo, Pete Cranston, Eduardo Almeida, Guilherme Ribeiro, Pablo Pessacq and Carlos Molineri (photograph Penny Gullan).

Some 20 years ago, recognising that southern hemisphere biologists had shared interests but lacked a venue or organisation to cater for them, a group of ecologists, palaeontologists, plant scientists, climate reconstructionists, biogeographers and an entomologist met in Hawaii to found 'Southern Connections'. For the entomologist, Ebbe Nielsen from the Australian National Insect Collection in Canberra, this was but one of the many collaborative initiatives he initiated and helped bring into being. The inaugural meeting, held in Hobart, Tasmania, in January 1993, brought together austral biologists from New Zealand, South Africa and the 'Cono Sur' of South America, as well as northern hemisphere-based students of austral biological issues. From the outset, insects featured, not only as shared pests of southern forests, but also in relation to the growing importance of biodiversity and phylogenetic studies. And of course, insects always featured prominently in the development of our understanding of austral biogeography through the works of Erichson, Hennig, Edmunds, Illies and Brundin amongst others.

When the second meeting was held (in Chile in January 1997), organisers Mary Arroyo and Antonio Lara reported that the 'response … far exceeded our expectations …. with a program fuller than expected'. From my well-thumbed and pisco sour-damaged notes I see that at least half-a-dozen entomologists presented their studies in Valdivia. In subsequent meetings, hosted in Christchurch (New Zealand), Cape Town (South Africa) and Adelaide (Australia) the momentum built, despite the untimely death of founding member and driving force Ebbe Nielsen. Each meeting saw increased representation from our discipline, especially by students undertaking biodiversity and environmental monitoring studies in uniquely austral ecosystems. More generally, systematists working on evolution and biogeography of austral taxa became more prominent, but not always to the liking of some ecologists who objected to being told that their stories needed a phylogeny!

When our Argentine colleagues accepted the invitation to host the VI meeting, in Bariloche in February 2010, it was timely to bring together entomologists working on evolutionary studies of the austral radiations of several groups of insects. Since this important topic has been covered by papers in recent issues of *Systematic Entomology*, drawing up a list of prospective participants was straightforward. Thus, our symposium, entitled '*Austral insect patterns: phylogenetics and biogeography of austral insects*' with nine presentations and multiple co-authors was proposed, and accepted. A problem always with southern hemisphere meetings is the high cost of registration for international meetings for locals, and of air travel (its always easier and cheaper to fly north-south than circum-austral). Thanks to RES registrar Bill Blakemore, I was able to leverage my 2009 editorial allowance (*Systematic Entomology*) for matching funds from the Royal Entomological Society. This society sponsorship covered registration costs for three austral-based 'overseas' participants and six South Americans, without which our session would not have been possible.

So on the first afternoon of the meeting (15th February) a large audience attended the following program of talks:

Better the weta you know: biogeography of southern Orthoptera
Steven Trewick and colleagues from Massey University and Canterbury Museum, New Zealand.

Gondwanan and post-Gondwanan elements, but always vicariance: disjunction of old and new circumantarctic elements in the Bibionomorpha (Diptera)
Dalton de Souza Amorim (Universidade de São Paulo, Brazil)

Southern connected craneflies: diversity and endemicity; grades and clades (Diptera: Tipulomorpha)
Guilherme Cunha Ribeiro (Universidade Federal do ABC, Brazil)

Biogeography of South American Ephemeroptera
Carlos Molineri and colleagues (CONICET, San Miguel de Tucumán, Argentina)

Odonata from Patagonia: distributional patterns, relationships with other dragonflies and a comparison with other taxa
Pablo Pessacq (Universidad Nacional de la Patagonia, San Juan Bosco, Esquel, Argentina)

Brundin's midges
Peter Cranston (UC Davis, California, USA) and *Nate Hardy* (QPI&F, Queensland, Australia)

Biogeography and diversification of colletid bees: Emerging patterns from the southern end of world
Eduardo Almeida (Universidade Federal do ABC) and colleagues from Brazil and USA.

The scale insect fauna of Nothofagus forests: the Australasia-South America links
Takumasa (Demian) Kondo (CORPOICA, Palmira, Colombia) and colleagues *Penny Gullan*, *Nate Hardy & Lyn Cook* (UC Davis and Australia).

Biogeography of Austral insects: a comparative molecular phylogenetics approach
Nate Hardy, Lyn Cook (Queensland, Australia) and *Steve Trewick* (Massey University, New Zealand)

If the session can be summarised succinctly, seemingly the phenomenon of related taxa spread across the Gondwanan landmasses, taken to indicate deep history as implied by geological history, is under sustained attack. This undermining comes mainly from still-developing techniques for dating nodes on the growing number of molecular phylogenies. Reinterpretation particularly involves younger New Zealand and New Caledonian biotas than vicariance-dating would suggest. Furthermore, older (>100 million year) proposals for southern African connected taxa are rarely reconstructed as appropriately ancient. However trans-Antarctic connections (excepting New Zealand) more often are in the right time zone. Much of the wide-ranging discussion after the session, concerned the reliability of fossil insects, both in their capacity to provide realistic calibration dates for molecular phylogenies, and in our ability to place the fossils with accuracy on phylogenetic trees derived from DNA data. Such discussions continued into the evening in bars and grills, and into subsequent sessions in which results relied on similar data derived for plants, mammals and birds.

I'd like to thank all the participants in the insect biogeography session for a stimulating afternoon's presentations, and particularly Andrea Premoli (Team Leader) and Gabriela Pirk (Congress Secretary) and their Organizing Committee for hosting such a successful meeting in beautiful Bariloche. If your entomological studies connect in any way to austral issues, whether applied or theoretical, do consider visiting New Zealand in 2013 for Southern Connections Congress VII.

Society News

Council Matters October 2009

The October Council meeting was chaired by the President, Professor Field. Following from the initial administrative matters, the first substantive item on the agenda was the Review of Council Strategy. Dr Gordon Port outlined the need and rationale behind such a review and, to address these matters, it was decided to set up a working group consisting of the President, Dr Port, the Honorary Secretary and the Registrar.

The Honorary Secretary reported on Ento' 09, which had been of the highest calibre in terms of both organisation and the presentations. It was particularly encouraging to see a number of our American colleagues attending. The Registrar circulated a financial summary from Ento' 09 and it was noted that, as with all Symposiums, the Society heavily subsidised these events. Given the quality and impact of the meeting, the Council endorsed this expenditure as good value in delivering the aims of the Society. The Symposium volume "Insect infection and immunity: evolution, ecology, and mechanisms" was published in advance of the meeting and was thus available to delegates. Whilst this was commended, Council agreed that all future volumes be processed via the Publications Committee.

The Registrar reported on Ento' 10, which is being held at the University of Swansea, 26-28 July 2010. All necessary facilities for the meeting had been booked and the contract signed. The Registrar expressed his satisfaction with progress to date and the initial programme presented by the convenors. Flyers advertising Ento'10 were circulated and have been included with previous issues of *Antenna*.

The Council considered the workload of National Insect Week coordination. This is a large and high–profile task. To bolster the excellent work of the coordinator, Professor Haines, Council hoped to find a person to assist with organising NIW. Two changes to the Regional Honorary Secretaries were put to Council. A new South East Secretary was suggested to reflect the large population in that region. Mr Badmin, who has much experience as the former Honorary Secretary, was proposed for this role. Dr Johnson was proposed for the Scottish Honorary Secretary role, taking over from Mr MacAdam who is now Buglife's Scottish Conservation Officer.

Dr Port reviewed the Insect Festival which had taken place in July at York Museum Gardens. Upwards of 800 people attended the festival which had some 30 educational and commercial stands, along with public lectures, face painting, competitions and poetry readings. Council expressed their congratulation and thanks to the convenors - Dr Port, Mrs North and Mr Tilley.

Council Matters December 2009

The President, Professor Field, welcomed Professor Paul Eggleston (Keele University) to his first Council meeting.

The Registrar confirmed the changes in Regional Honorary Secretaries, as had been approved at the October Council. The responsibilities are as follows: Dr G. Masters – East region; Mr J. Badmin – South East region; Mr S. Johnson – Scotland region. The Registrar also confirmed that Dr Stewart as Chair of the Conservation Committee was seeking new members and they were planning to meet in the near future.

Dr Port reported that the working group set up to Review Council strategy had met. Specific items had been identified for attention, including revision of the Bye-Laws and synchronising the AGM with the Annual National Meeting. The first document from this group was published in *Antenna* (34, 1), which sets out the current strategic direction of the Society and invites comments.

The Honorary Treasurer, Professor Hardie, gave an overview of the Society's finances and transactions for the past year. Details of the accounts for Ento'09 and financial projections for Ento'10 were presented and approved by Council. The purchase of the Royal National Rose Society's gardens was confirmed completed. Digitisation of the Society's rarer volumes was approved and the possibility of using the images commercially had been discussed and agreed at Finance, the Registrar having been asked to manage any such opportunities. As expected, in the current economic climate, overall income had declined due to low interest rates.

In the absence of the Honorary Editorial Officer, the Registrar presented the Publications Committee's report. All seems on track with the journals with no Editor reporting any major problems. Submission rates and turn-around times are broadly the same as last year, and in some cases improving.

The Handbook Series, in the new style and format, is developing strongly with several forthcoming issues in the pipeline. One area of concern though is the continual shortage of copy for *Antenna* and this is posing a major headache for the Editors. The Council therefore appeal to the Fellowship/Membership to provide articles, photographs and letters for publication in *Antenna*.

The Honorary Secretary, Dr Murchie, reported on the recent Meeting's Committee. The number of joint meetings, regional meetings and special meetings (e.g. Darwin and Wallace Celebratory Meeting) was testament to the activity of the Society. The arrangements for Ento'10 were well in hand with, in addition to the scientific programme, a visit to the National Botanic Garden of Wales and an innovative academia/industry networking session. Initial arrangements and meetings had taken place regarding Ento'11, which will be held at Natural Resources Institute/University of Greenwich, Chatham with the Symposium topic of "Chemical Ecology".

Dr Johnson briefed Council on the possibility of the Society hosting the European Congress of Entomology in 2014. There are a number of obligations required of the host society and Dr Johnson circulated the guidelines. In principal, Council agreed to put forward a proposal to host the 2014 European Congress of Entomology. An organising group was drawn up from Council members.

SCHEDULE OF NEW FELLOWS AND MEMBERS

as at 2nd June 2010

New Fellows (1st Announcement)
Dr Naveen Samuel Singh

Upgrade To Fellowship (1st Announcement)
None

New Fellows (2nd Announcement And Election)
None

Upgrade To Fellowship (2nd Announcement And Election)
Professor Hideharu Numata

New Members Admitted
Dr Peter Kofi Kwapong
Mr David Egerton Cary

New Student Members Admitted
Mr Jamie Buchanan

Re-Instatements To Fellowship
None

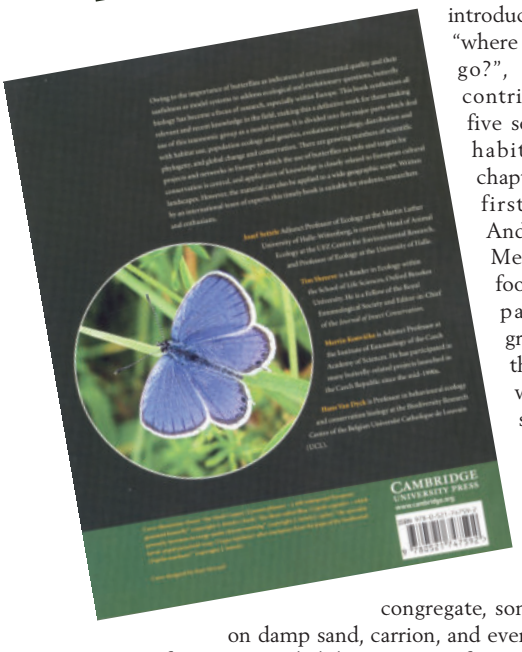
Deaths
None

Book Reviews

Ecology of Butterflies in Europe

Josef Settele, Tim Shreeve, Martin Konvi ka & Hans Van Dyck (eds). 2009. Cambridge University Press, Cambridge, UK, xii + 513 pp. Cost Hardback (ISBN: 978-0-521-76697-5) £90.00; Paperback (ISBN: 978-0-521-74759-2) £45.00. Additional resources on-line at www.cambridge.org/9780521766975.

With 43 authors and co-authors, 23 chapters occupying 370 double-column pages, 24 colour plates, 100 pages accommodating over 2800 citations, and two indices with approximately 2000 entries, *Ecology of Butterflies in Europe* represents a major contribution to our knowledge of western Palaearctic Rhopalocera – and butterfly biology in general. The full list of contents, contributors, index and even the text of Chapter 1 are all available on-line (Cambridge Catalogue, 2009).



Following Roger Dennis's insightful introductory essay (Chapter 1) on "where are we now and where to go?", the remaining 22 contributions are divided into five sections. Part I, devoted to habitat use, comprises six chapters. Of these, I found the first (Chapter 2), in which Andreas Erhardt and Jovanne Mevi-Schütz discuss "Adult food resources in butterflies", particularly interesting. I grew up foolishly imagining that nectaring by butterflies was almost incidental, something that was done to provide a little extra energy for flight perhaps, but little else it seemed. But then there was the seemingly mysterious business of why males congregate, sometimes in huge numbers, on damp sand, carrion, and even excrement, the attraction of many Nymphalidae to rotting fruit, and danaine butterflies to a variety of seemingly unrelated plants, even when damaged, dying or uprooted. Do all these phenomena have anything in common?

Broadly speaking, as discussed by Erhardt and Mevi-Schütz, the link seems to be that gathering additional resources as adults is very significant for the longevity, function (including mating success) and fecundity of many butterflies. A Monarch could never get from the Great Lakes to Mexico without the energy derived from nectar. For their very active lifestyle, many butterflies (and perhaps especially males) need additional sodium and potassium. Adult milkweed and glasswing butterflies (Danainae) use the potentially poisonous pyrrolizidine alkaloids they obtain from particular plants as a substrate from which to make sex pheromones, but the males can also pass unaltered alkaloids to the females within their spermatophores, and the females are able to incorporate these chemical into their eggs in order to protect them.

This seems to represent a key to so much that is now being discovered about adult feeding in butterflies: the ability of females to mobilise nutrients and other materials received from their males via the spermatophores not only, as in the case of the danaines, to enhance the chemical defences of their eggs, but more generally to improve the number and quality of their eggs – in other words, to increase their fecundity. Thus, far from just loving and leaving them, both sexes of many butterflies – as might reasonably be expected – make huge parental investments.

One of the most interesting aspects of this concerns the degree of exploitation, mutualism or even co-evolution between butterflies and flowers. Nectar containing amino acids may be at a premium for some butterflies – if they can metabolise these protein building blocks directly or indirectly (via the spermatophores) to increase fecundity. If specific plants are to increase the quantity or quality of amino acids in their nectar, what would be their selective advantage in doing so? The most obvious answer would be pollination. It is known that, for example, that *Dianthus deltoides*, which has amino acid rich nectar, is essentially butterfly pollinated (Jennersten, 1988). At a time when declines in bee populations and even extinction are seen as such great threats to plant diversity and human agriculture, the role of other insects as pollinators comes into focus. For which plants are butterflies actual or potentially significant pollinators?

In addition to pointing to the previously underestimated importance of nectar amino acids, Erhardt and Mevi-Schütz also show that butterfly foraging involves learning, and that the demonstrable tendency to flower constancy by individual butterflies may be due to memory constraints. This is likely to provide the conditions for true co-evolution if, as a result and as the authors suggest, butterflies may indeed be efficient pollinators. A further twist comes in relation to the possibility that, if adult flight time coincides with larval host flowering period, there may "strong advantages for adults to exploit the nectar of their host plants" – including, of course, that "adult feeding ensures the reproduction of the larval host plants". In this way we can begin to envisage that butterflies and flowering plants may have a much more mutualistic association rather than the simply exploitative one that has generally been assumed. This fits well with the growing realisation that ecosystems and evolution are just as much if not more about mutualism and synergy as about competition (Corning, 2005).

More pragmatically, there are clear consequences for butterfly conservation – or should I say *ecosystem* conservation. However, from an academic perspective, one of the best things about this chapter is that it suggests so many practical but also significant investigations into the role of adult feeding in butterflies, and in particular the relationships between particular butterflies and

particular plants in particular ecosystems – enough to make the mind of any red-blooded butterfly fanatic almost overheat at the prospect of managing dozens of PhD students in those best-of-all studies that embrace real fieldwork and direct empirical observation in equal measure with cerebration and theory. This is the sort of paper that makes you wish you could start afresh, and live your love affair with butterflies all over again!

Among the other valuable contributions to Part I, Chapter 7, by Boris Schröder, Barbara Strauss, Robert Biedermann, Birgit Binzenhöffer & Josef Settele, "Predictive species distribution modelling in butterflies" looks to be a particularly significant contribution to the planning and allocation of conservation resources, including area selection and the issues surrounding the impacts of climate change on species occurrence and persistence.

Part II consists of four chapters grouped as "Population Biology: population structure, dynamics and genetics". Among these I consider Chapter 11, "Parasitoids of European butterflies" by Mark R. Shaw, Constantí Stefanescu & Saskya van Nouhuys, to be particularly welcome. Knowledge of butterfly parasitoids and hyperparasitoids and their impact remains sketchy at best, even rudimentary. However, if we are to have any real grasp of butterfly population dynamics, this situation must be addressed. Parasitoids (notably numerous species of Diptera: Tachinidae and various families of Hymenoptera) plausibly have the greatest impact of all flesh-eating organisms on the vast majority, and possibly all butterfly populations.

The chapter starts by offering an explanation of the factors responsible for our poor knowledge, including the ever-present problems of misidentification. The authors point out that one of the key qualities of a parasitoid is its degree of host specificity – which can change geographically, with habitat and generation (in multivoltine species), and in response to the pool of potential hosts with which it is confronted. To get any quantitative idea of host range thus represents a potentially Herculean task – one, moreover, that needs to be repeated for every butterfly and every parasitoid species, and in all distinct ecosystems and across the geographical range too.

These cautionary thoughts are followed by a succinct overview of general parasitoid biology. I was particularly fascinated to learn that, perhaps in much the same way as adult butterflies, adult parasitoids also need food resources which, in the case of certain Hymenoptera, extends to the use of their ovipositors or biting mouthparts to wound hosts, and sometimes other insects, in order to feed on haemolymph. Apparently this so-called *host-feeding* can cause significant mortality. Plate 8b shows a "facultative pseudohyperparasitoid" *Itoplectis aterrima* (Ichneumonidae: Pimplinae) feeding from the pupa of campoplegine ichneumonid that it has wounded for this purpose.

This general biology is followed by a useful and extensive taxonomic review, and then a series of case studies covering examples from each of the five main butterfly families in Europe where there is sufficient knowledge to draw some conclusions or see a pattern: *Iphiclides podalirius* (Papilionidae), *Pieris brassicae* and *P. rapae* (Pieridae), *Maculinea rebeli* (Lycaenidae – now more correctly included in *Phengaris*: Fric *et al.*, 2007), *Aglais urticae* and *Melitaea cinxia* (Nymphalidae), and *Thymelicus lineola* (Hesperiidae). In the overview to these studies it was sobering to note that O. W. Richards (1940) pioneering study, attempting to measure density dependence of parasitoid attack on *Pieris*, remains just that – "few studies have run for long enough to examine this." Is this a product of our short-term focus that results from a lack of willingness to fund anything much beyond three-years at a time, as the late Arthur Cain often lamented? Is this the real reason for the very slow growth in our knowledge of these systems?

Among their concluding remarks, Shaw et al. note the work of Jack Dempster, who found that application of DDT in an attempt to control *Pieris rapae* on brassica crops resulted in increased loss, due to what militarists might call "collateral damage" to *Cotesia* parasitoids. They also cite collateral damage to the native *Pieris virginienesis* of North America following release of *Cotesia* in attempts to control introduced *P. rapae*. Nothing could illustrate more succinctly the poverty of treating organisms to linear cause-and-effect logic rather than systems thinking. The lessons to be learnt from the study of tritrophic systems such as plants, butterflies and moths and their parasitoids are reason enough to study these organisms in the depth called for by this excellent paper.

Part III, "Evolutionary Biology", comprises Chapters 12–15, including papers on gradients, fecundity, and wing morphology variation. Chapter 12, on "Adaptation and plasticity in butterflies: the interplay of genes and environment" by Hans van Dyck and Jack J. Windig tackles a particularly crucial issue. The paper is developed around the notion that "natural selection *generates* adaptation" and is "the *motor* of evolutionary change" (emphases added). The authors include behaviour as just one of several traits responsible for this process. In my view, it is "the capacity of individual organisms, as mediated by their behaviour, [that] is fundamental to setting the evolutionary trajectory of the species to which they belong" (Vane-Wright, 2009). This view, which goes back to James Baldwin and the organic selection movement, later picked up by Ernst Mayr, G.G. Simpson and C.H. Waddington, has most recently been emphasised by, among others, Peter Corning (e.g. 2005), Patrick Bateson and Mary Jane West-Eberhard. To quote just the last two: "The decision-making and adaptability of the organism is … an important driver of evolution and is increasingly seen as an alternative to … gene-focused views" (Bateson, 2005: 31), and "Adaptive evolution is a two-step process: first the generation of variation by development, then the screening of that variation by selection" (West-Eberhard, 2003: 139). I was surprised to find no reference to West-Eberhard's major synthesis on developmental plasticity in this chapter.

Part IV, "Species in time and space: distribution and phenology" groups another four chapters, commencing with the marvellously titled "Bad species" by Henri Descimon and Jim Mallet. Picking up on the taxonomists' tag of 'bon. sp.' or 'good species', the authors consider the logical necessity that this implies: the existence of 'bad species'. These the authors define, with disarming simplicity, as "a taxonomic unit that does not conform to criteria used to delimit species". How much of a problem is this in the European fauna? They conclude (p. 222) that "around 16% of the 440 butterfly species are known to hybridize with at least one other species in the wild. Of these perhaps half or more are fertile, and show evidence of backcrossing in nature."

After a rather challenging introduction (even for someone who likes to imagine that they have remained *au fait* with debates about species concepts), Descimon and Mallet provide an incredibly valuable overview of the many European butterflies that have presented (such as '*Erebia serotina*', now known to be a species hybrid) or continue to present (such as *Melitaea athalia*) taxonomic difficulties. A long table summarises these, followed by about ten case studies – only some of which offer resolution (such as confirmation that *Leptidea sinapis* and *L. reali* really are bon. spp!). Following a general discussion and some delightful conclusions ("a significant number of rakish taxa will probably always fail to conform to this species morality"), the authors finish with a very useful and stimulating appendix on "Tools for taxonomic practice at species level in butterflies" – something I am sure I will go back to on many occasions in future.

The existence of differing species concepts, including such 'bad species', has surely much to do with the unending differences of opinion surrounding the number of butterfly species recognised in Europe – which, as pointed out by John Tennent some years ago, can vary by a factor of two – from as few as *ca* 350 to as many as 700. While these extremes are not in evidence in this book, it is notable that Sway et al. quote a figure of 576 species in Chapter 21, whereas Descimon & Mallet settle on 440 in this section, Chapter 16.

Part V brings together the last four chapters, on "Global change and conservation". All four need to be read by those concerned with putting theory into practice with respect to the conservation

of Europe's declining butterflies – perhaps, in particular, chapters 20 ("Climate warming and distribution changes in butterflies", by Jane Hill, Ralf Ohlemüller, Richard Fox and Chris Thomas), and 23 ("Butterflies of European ecosystems: impact of land use and options for conservation management", by Josef Settele, John Dover, Matthias Dolek and Martin Konvi ka).

Overall, this is an outstanding volume that represents a major overview and synthesis of ideas and information relevant to understanding the biology of European butterflies and endeavouring to conserve them. Almost inevitably there is a scattering of minor typographical errors and inconsistencies (such as referring to the Heath Fritillary as *Melitaea athalia* throughout the cursive text, but listing it as *Mellicta athalia* in Table 16.1A – which caused me a little confusion), and one can cavil at some inclusions and exclusions. But in general terms the current awareness and presentation of this work are consistently excellent, and the editors must be heartily congratulated not only for formulating such a volume, but also for completing and executing it with such style. With respect to the pressing need to appreciate, monitor and conserve butterflies, Roger Dennis states that (Chapter 1) "The present book (EBIE) is another, important milestone along the path to understanding them." I could not agree more.

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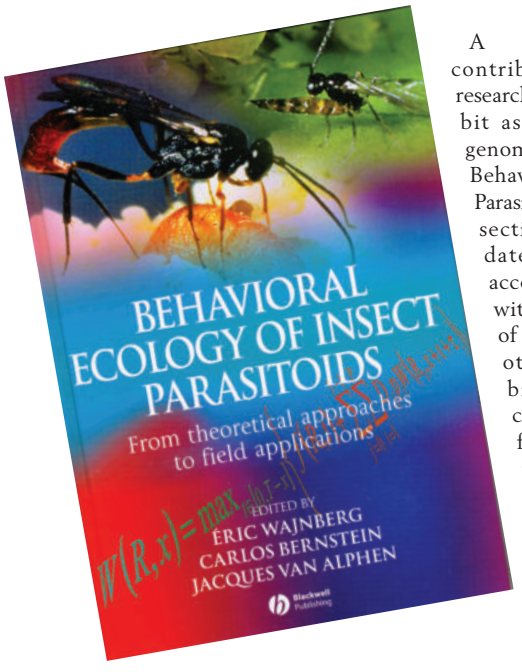
R.I. Vane-Wright

Behavioural Ecology of Insect Parasitoids: From theoretical approaches to field applications

Edited by Éric Wajnberg, Carlos Bernstein and Jacques Van Alphen.
Published by Blackwell Publishing
£55.00
ISBN 978-1-4051-6347-7



A major and timely contribution to an area of research rich in history, but every bit as relevant in an age of genomes and global warming, Behavioural Ecology of Insect Parasitoids is divided into three sections, covering an up to date and comprehensive account of current research within the field, extensions of behavioural ecology into other areas of parasitoid biology, and presenting cutting edge methodology for practitioners in the field.

Each chapter is written by leading international experts in specific aspects of parasitoid behavioural ecology. Extensive use of case studies guides the reader through topics ranging from detailed mechanistic research into the role of chemical cues and defences on parasitoid physiology and foraging activity, scaling up from individual behaviour to population responses through the use of population dynamic models, and expanding into ecosystems, placing parasitoids in their proper context within complex communities.

Reflecting current priorities, this book begins by firmly establishing the role of parasitoids as agents of biological control strategies and the applied theme is maintained throughout. Behavioural Ecology of Insect Parasitoids will appeal to advanced students of ecology, as well as active researchers in the fields of behaviour and entomology.

James Bull, University of Warwick

Diary

Assistant Editor: Craig Macadam (e-mail: craig.macadam@bradan-aquasurveys.co.uk)

Abbreviations

AAB	Association of Applied Biologists
AES	Amateur Entomologists' Society
BAS	British Arachnological Society
BC	Butterfly Conservation
BENHS	British Entomological and Natural History Society
BENHS (WS)	BENHS workshops held at Dinton Pastures Country Park, Davis Street, Hurst, Reading RG10 0GH. Grid reference SU 784 718. I: Ian McLean, 109 Miller Way, Brampton, Huntingdon, Cambridgeshire PE18 8TZ.
BES	British Ecological Society
BISG	Bloomsbury Insect Science Group meetings held at Birkbeck College, Department of Biology, Malet Street, London, Room 232.
BMIG	British Myriapod and Isopod Group. I: www.bmig.org.uk
DaNES	Derbyshire and Nottinghamshire Entomological Society
ECSS	Ecology and Conservation Studies Society. Meetings start at 6:30pm and are held in Room B29, Senate House, Malet Street. London WC1E.
EEC	Edinburgh Entomological Club
ESA	Entomological Society of America
FBA	Freshwater Biological Association I: www.fba.org.uk
FSC	Field Studies Council. I: www.field-studies-council.org
KFC	Kent Field Club
KMBRC	Kent and Medway Biological Records Centre
LCES	Lancashire and Cheshire Entomological Society
LNHS	London Natural History Society
LSL	The Linnean Society of London, Burlington House, Piccadilly, London W1V 0LQ.
NFBR	National Federation for Biological Recording
NHM	The Natural History Museum, Cromwell Road, London SW7.
RES	Royal Entomological Society
RS (CHT)	The Royal Society, 6 Carlton House Terrace, London SW1Y 5AG.
SHNH	Society for the History of Natural History (Hon. Sec.) c/o NHM.
YNU	Yorkshire Naturalists' Union. I: http://www.ynu.org.uk
ZSL	The Zoological Society of London, Regent's Park, London NW1 4RY.
I:	Information from:

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

Meetings of the Society

Recently, Special Interest Group (SIG) meetings have been held at Rothamsted, Harpenden and usually begin with registration and refreshments at 10am for a 10.30am start. Details of the day's programme can be downloaded from the RES website (www.royensoc.co.uk) and include a registration form, which has to be completed in advance so that refreshments can be organised. All meetings finish by 5pm.

Some SIG or monthly meetings may begin after lunch and be held at a different location, so it is best to consult the diary or the RES website for full details. Regional meetings, by definition, will be held locally.

2010

June 2 **Annual General Meeting and President's Address**

Professor Lin Field - Insecticide Resistance, the Battle against the Pests

Venue: Rothamsted Research, Harpenden.

With the world population predicted to double by the end of the 21st Century, there is a clear need for crop production to be increased and this includes the need for pest control strategies. Since this will, for the foreseeable future, include the use of chemical insecticides, the problems of resistance to these compounds are an important factor in food production. In addition there is a need to control insect vectors of human disease and this too is threatened by the development of resistance to many of the available compounds. In this presentation I will discuss how an understanding of the molecular basis of insecticide resistance can lead to better use of currently available insecticides and offer potential for the design of new compounds which overcome resistance, or are more selective for pest species.

June 21-27 **National Insect Week 2010**

June 22 **Infection and Immunity Special Interest Group**

Venue: The Daubeny Laboratory of Magdalen College, Oxford University

Time: 10.30 am for registration, 11.00 start

Confirmed speakers:

Jacob Koella (Imperial College)
Nick Waterfield (Bath)
Steven Sinkins(Oxford)

Additional speakers will be selected from submitted abstracts. The deadline for submission of abstracts will be the 18th April 2010. Those who would like to be considered for a short talk should send an abstract (around 200-250 words) to the convenor (as below).

Convenor: Dr Petros Ligoxygakis (petros.ligoxygakis@bioch.ox.ac.uk)

June 30 **Scottish Regional Meeting - Insect-plant biology: from genome to the landscape**

Venue: Scottish Crop Research Institute, Dundee

Keynote speaker Prof. Sue Hartley

Speakers include Dr Adam Vanbergen (CEH-Edinburgh), Emily Clark (University of Dundee, SCRI), Professor Pat Wilmer (University of St. Andrews) and Dr Brian Fenton (SCRI)

Convenor: Dr Scott Johnson (scott.johnson@scri.ac.uk)

July 26-28 **Ento 10 RES Annual National meeting**

Venue: Swansea University

Ento '10 will be held at Swansea University from the morning of Monday 26th to the afternoon of Wednesday 28th July 2010. The registration desk will be open from 2pm on Sunday the 25th.

Online registration is now open.

Our theme is "21st Century Challenges and Applications" and the undercurrent in our wide-ranging sessions will be the applied aspects of entomology - be they new strategies for pest control or conservation, exploitation of beneficial species, or even insects in space!

Convenors: Dr Miranda Whitten (m.m.a.whitten@swansea.ac.uk or ento10swan@googlemail.com)
Prof. Tariq Butt (t.butt@swansea.ac.uk)
Dr Ed Dudley (e.dudley@swansea.ac.uk)
Dr Alyson Bexfield (a.bexfield@swansea.ac.uk)
Prof. Norman Ratcliffe (n.a.ratcliffe@swansea.ac.uk)

We encourage delegates to participate in a new academia-industry "1-2-1" networking workshop that will run during the meeting.

Ento 1-2-1 enquiries: Phil Eadon (phil.eadon@allancia.com)

Aug 22-27 **9th European Congress of Entomology**

Venue: Budapest, Hungary.

RES sponsor the keynote speaker (Prof Stefan Scheu) at a symposium on 'Soil Entomology - an ecosystem perspective'

For information visit the website www.ece2010.org or contact the RES representative: Dr Scott Johnson (scott.johnson@scri.ac.uk)

Sept 7-9 **South-West Regional Meeting joint with Soil Ecology Society – "Soil Entomology & Ecology"**

Venue: University of Plymouth

Convenors: Dr Peter Smithers (psmithers@plymouth.ac.uk)
Prof. Rod Blackshaw (rblackshaw@plymouth.ac.uk)

Sept 22 **Aphid Special Interest Group**
Venue: Syngenta at Jealott's Hill International Research Centre, Berkshire
Offers of talks and posters are welcome in all areas of aphidology, from molecular to population studies.
Convenor: Dr Rob Lind (rob.lind@syngenta.com)

Oct. 2 **Insects and the changing scene: commemorating the life and work of Peter Skidmore PhD FRES**
Venue: Doncaster Museum
This symposium celebrates the life and work of Peter Skidmore, a notable entomologist, conservationist and illustrator. Peter was Keeper of Natural Sciences at Doncaster Museum for almost 30 years.
Convenors: Mr Martin Limbert (martin.limbert@doncaster.gov.uk)
Mrs Valerie Holt (v.holt1@ntlworld.com)

Oct. 27 **Climate Change Special Interest Group**
Venue: The Food and Environment Research Agency (FERA), York
Convenors: Dr Howard Bell (howard.bell@fera.gsi.gov.uk)
Dr Richard Harrington (richard.harrington@bbsrc.ac.uk)

Nov. 3 **Orthopterists' Special Interest Group**
Venue: Natural History Museum, London.
Convenors: Dr David Robinson (D.J.Robinson@open.ac.uk)
Mrs Judith Marshall (j.marshall@nhm.ac.uk)

Nov. 19 **South-West Regional Meeting joint with Peninsular Invertebrate Forum – "Applied Entomology"**
Venue: University of Plymouth
Convenor: Dr Peter Smithers (psmithers@plymouth.ac.uk)

Nov. 26 **Insect Parasitoid Special Interest Group**
Venue: Biology Department, University of York
Convenor: Dr Peter Mayhew (pjm19@york.ac.uk)

Dec. **Aquatic Insects Special Interest Group**
Date: To be confirmed
enue: Glasgow
Convenor: Mr Craig Macadam (craig.macadam@buglife.org.uk)

2011

Feb. **Postgraduate Forum**

March 2 **Verrall lecture**
Venue: Natural History Museum

April **Joint meeting with the Botanical Society of the British Isles on 'Pollination'**
Venue: Rothamsted
Convenors: Dr Ian Denholm and Prof. Jane Memmott (RES Pollination SIG)

May **Conservation SIG**
Venue: Rothamsted
Convenor: Dr Alan Stewart

Diary of other Meetings

2010

June
4-8 **14th International Sawfly Workshop**
Venue: Kindrogan Field Studies Centre, Pitlochry.
I: Andrew Liston - Email: andrew.liston@senckenberg.de
Address: Senckenberg Deutsches Entomologisches Institut, Eberswalder Str. 90, 15374 Müncheberg, Germany. Tel: ++49 (0)33432 736983734
Guy Knight - Email: guy.knight@liverpoolmuseums.org.uk
Address: World Museum Liverpool, Zoology Department, William Brown Street, Liverpool, L3 8EN.
Tel.: 0044 (0)151 478 4369

12-19 Dipterists Forum Summer Field Meeting
Venue: Stackpole, Pembrokeshire.
I: Roger Morris. 7 Vine Street, Stamford, Lincolnshire PE9 1QE. Email: roger.morris@dsl.pipex.com

13 BENHS Open Day
Venue: Dinton Pastures, Reading
I: www.benhs.org.uk

25-27 Scottish Entomomologists' Gathering
Venue: Claonaig, Kintyre
I: Tom Prescott (tprescott@butterflyconservation.org) or Craig Macadam (craig.macadam@buglife.org.uk)

28 – 2 13th International Auchenorrhyncha Congress and 7th International Workshop on Leafhoppers and Planthoppers of Economic Significance
Venue: Vaison-la-Romaine, France
I: www.mnhn.fr/colloque/iac13/

July
11 BENHS Open Day
Venue: Dinton Pastures, Reading
I: www.benhs.org.uk

22-25 Dipterists Forum Short Summer Field Meeting
Venue: Somerset Levels and Mendips - based at Wells Cathedral School.
I: Roger Morris. 7 Vine Street, Stamford, Lincolnshire PE9 1QE. Email: roger.morris@dsl.pipex.com

August
20-23 Identification of Hoverflies
Venue: Preston Montford Field Studies Centre, Shrewsbury
I: http://www.field-studies-council.org/professional/2010/courseinfo.aspx?id=401

September
19-24 Aphidophaga: the 11th meeting on the Ecology of Aphidophagous Insects
Venue: Perugia, Italy
I: Email jpmi@ksu.edu with "Aphidophaga" in the subject line if you would like to be added to the electronic mailing list for further details.

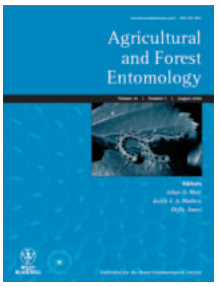
October
12-15 4th International Simuliidae Symposium
Venue: Hotel Sun Zeynep, Belek, Antalia, Turkey
I: www.simuliid10.hacettepe.edu.tr or www.blackfly.org.uk

25 Northern Coleopterists' Meeting
Venue: The Manchester Museum, Oxford Road, Manchester
Time: 10am to 4:30pm
This meeting is open to anybody interested in beetles and it is aimed at both novice and more experienced Coleopterists, in order to meet and discuss ideas and records. There will be a series of presentations (e.g., by Darren Mann on UK Scarabaeoidea, by Mike Denton on his local patch, Blackmoorfoot Reservoir, etc.), as well as a chance to view and explore the Manchester Museum's extensive collections of beetles. Everyone is welcome!
I: Tom Hubbal (vc63dragonfly@blueyonder.co.uk or 01535 678334) or Dmitri Logunov (dmitri.v.logunov@manchester.ac.uk or 0161 275 2666).

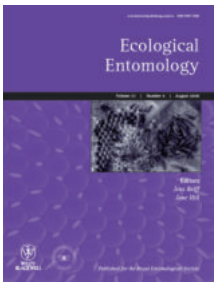
November
27 Dipterists' Forum Annual Conference and AGM
Venue: To be confirmed
I: www.dipteristsforum.org.uk

2011

April
25-30 7th International Symposium on Phlebotomine Sandflies (ISOPS7)
Venue: Kusadasi, Turkey.
I: www.isops7.org

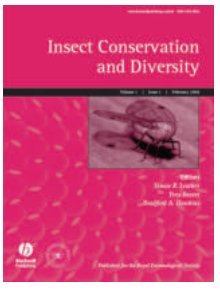


Publications of the Royal Entomological Society



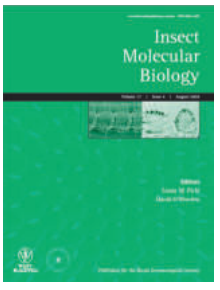
Agricultural and Forest Entomology provides a multi-disciplinary and international forum in which researchers can present their work on all aspects of agricultural and forest entomology to other researchers, policy makers and professionals.
2011 print or online prices: UK £590, Euroland €751, USA $1,091, Rest of World $1,272
2011 print and online prices: UK £679, Euroland € 864, USA $1,255, Rest of World $1,463

Ecological Entomology publishes top-quality original research on the ecology of terrestrial and aquatic insects and related invertebrate taxa. Our aim is to publish papers that will be of considerable interest to the wide community of ecologists.
2011 print or online prices: (with Insect Conservation and Diversity) UK £973, Euroland € 1,236, USA $1,800, Rest of World $2,099
2011 print and online prices: UK £1,119, Euroland € 1,422, USA $2,070, Rest of World $2,414



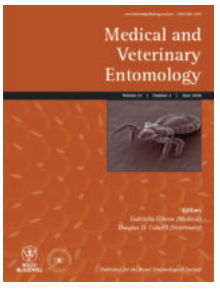
Insect Conservation and Diversity explicitly associates the two concepts of insect diversity and insect conservation for the benefit of invertebrate conservation. The journal places an emphasis on wild arthropods and specific relations between arthropod conservation and diversity.
2011 print or online prices: UK £590, Euroland €751, USA $1,091, Rest of World $1,272
2011 print and online prices: UK £679, Euroland € 864, USA $1,255, Rest of World $1,463

Insect Molecular Biology has been dedicated to providing researchers with the opportunity to publish high quality original research on topics broadly related to insect molecular biology since 1992. *IMB* is particularly interested in publishing research in insect genomics/genes and proteomics/proteins.
2011 print or online prices: UK £984, Euroland € 1,249, USA $1,818, Rest of World $2,120
2011 print and online prices: UK £1,131, Euroland € 1,437, USA $2,091, Rest of World $2,438



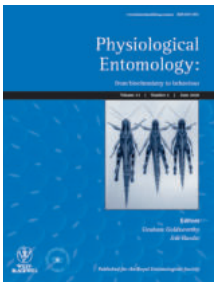
Medical and Veterinary Entomology is the leading periodical in its field. The Journal covers all aspects of the biology and control of insects, ticks, mites and other artropods of medical and veterinary importance.
2011 print or online prices: UK £566, Euroland €721, USA $1,048, Rest of World $1,223
2011 print and online prices: UK £651, Euroland € 830, USA $1,206, Rest of World $1,407

Physiological Entomology is designed primarily to serve the interests of experimentalists who work on the behaviour of insects and other arthropods. It thus has a bias towards physiological and experimental approaches, but retains the Royal Entomological Society's traditional interest in the general physiology of arthropods.
2011 print or online prices: UK £522, Euroland €664, USA $965, Rest of World $1,126
2011 print and online prices: UK £600, Euroland € 764, USA $1,110, Rest of World $1,295

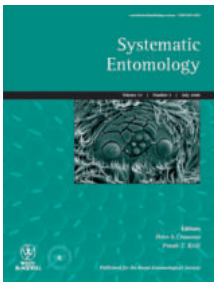


Systematic Entomology encourages the submission of taxonomic papers that contain information of interest to a wider audience, e.g. papers bearing on the theoretical, genetic, agricultural, medical and biodiversity issues. Emphasis is also placed on the selection of comprehensive, revisionary or integrated systematics studies of broader biological or zoogeographical relevance.
2011 print or online prices: UK £940, Euroland € 1,195, USA $1,739, Rest of World $2,029
2011 print and online prices: UK £1,081, Euroland € 1,375, USA $2,000, Rest of World $2,334

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



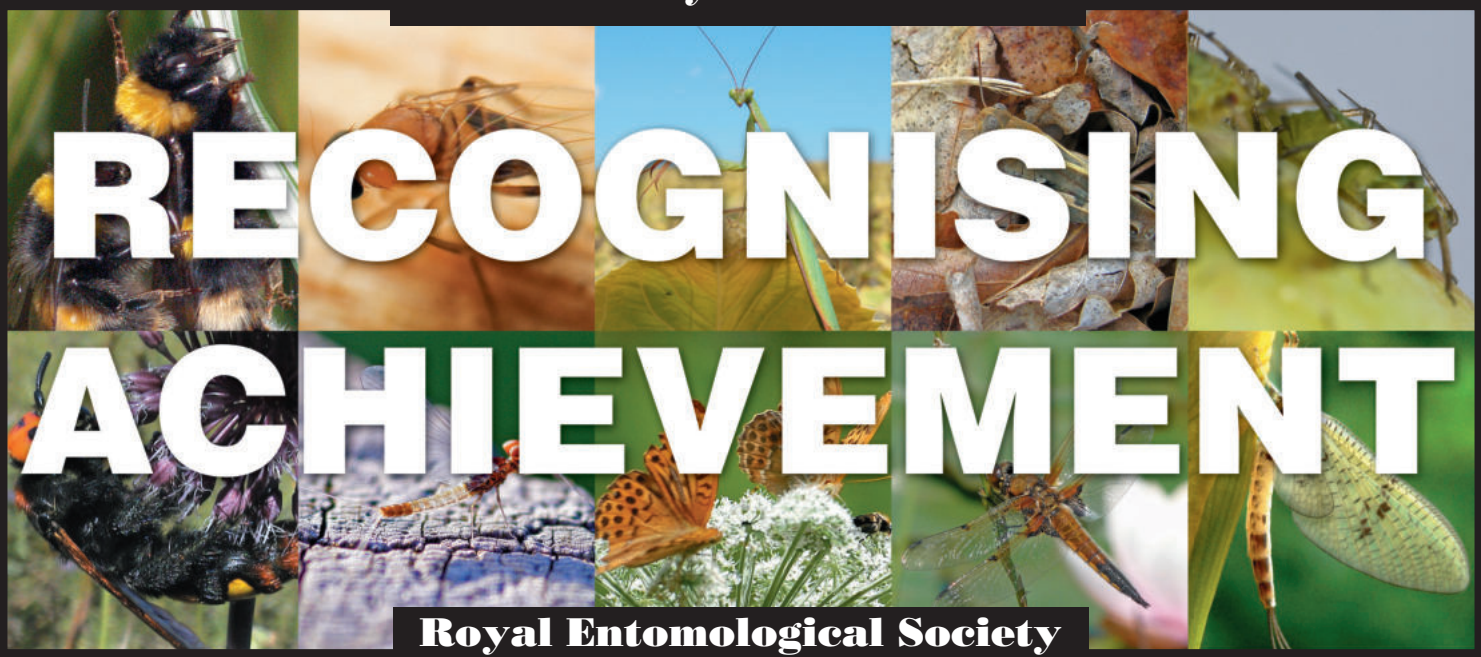
Antenna (Bulletin of the Society). Free to Members/Fellows. Published quarterly at an annual subscription rate of £40 (Europe), £42 (outside Europe), $70 (United States). This journal contains entomological news, comments, reports, reviews and notice of forthcoming meetings and other events. While emphasising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



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

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

www.royensoc.co.uk



RECOGNISING ACHIEVEMENT

Royal Entomological Society – Society Awards –

THE ROYAL ENTOMOLOGICAL SOCIETY STUDENT AWARDS

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

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

RES JOURNAL AWARDS SCHEME

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

Prize: £500 and Certificate for each participating Journal.

THE LJ GOODMAN AWARD FOR INSECT BIOLOGY

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

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

THE MARSH AWARD FOR INSECT CONSERVATION

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

Prize: £1000 and Certificate.

POSTGRADUATE AWARD: THE ALFRED RUSSEL WALLACE AWARD

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

Prize: £750 plus Certificate, plus one year's free Membership. The winner will also be invited to present their work at a Society Meeting.

JO WESTWOOD MEDAL – AWARD FOR INSECT TAXONOMY

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

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

THE WIGGLESWORTH MEMORIAL LECTURE AND AWARD

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

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

BOOK PURCHASE SCHEME FOR FELLOWS AND MEMBERS IN DEVELOPING COUNTRIES

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

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

OUTREACH AND CONFERENCE PARTICIPATION FUNDS

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

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

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

ROYAL ENTOMOLOGICAL SOCIETY · FOUNDED 1833

Royal Entomological Society
www.royensoc.co.uk

The Mansion House, Chiswell Green Lane, St. Albans, Herts AL2 3NS, UK
Tel: +44 (0)1727 899387 • Fax: +44 (0)1727 894797
E-mail: info@royensoc.co.uk