Royal Entomological Society

Celebrating 50 years of Antenna

Volume 50(1) | 2026

Antenna

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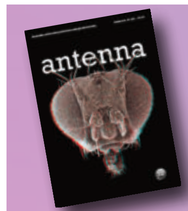

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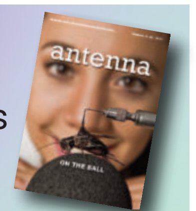

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Cover Picture: Golden Tortoise Beetle (*Charidotella sexpunctata*).
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Editorial

Antenna is 50 years old, and in this year's four issues we will celebrate that milestone in various ways, starting by reproducing the very first item in Volume 1 Issue 1, a letter from the President, J.D. Gillett. Volume 50 Issue 1 has a decidedly golden theme, including the cover, which shows this issue's 'Featured Insect', the spectacular American Golden Tortoise Beetle. Our Librarian has written about *The Aurelians* – the magnificent painting that hangs in the Council Room. 'Aurelians' is a term for insect (especially butterfly and moth) collectors and is derived from the golden colour of many chrysalids. Do you have any pictures of golden insects? If so, please send them in and we'll try to use them during the year.

The other items in this issue are also worth their weight in gold. We have a fascinating *Research Spotlight* on vibrational communication in insects, an article on how the law does and doesn't protect insects, an article on how insect conservation and apple production go hand-in-hand in South Africa, and an article on the work being done by our Conservation Science Team to help save the Large Blue butterfly in Denmark. We see the welcome return of *Embiopteran Tools*. The Embioptera are the webspinners, so you will soon see the relevance of the title. We also feature some of the pictures which won a gold star in the Society's photographic competition.

We have several new and wonderful staff members in the Society, so thought it time to provide a 'Who's Who' so you can put faces to names and roles. Hopefully, you will meet many of them in-person at our forthcoming events – there are reports on recent events herein to tempt you. Walter Leal is the subject of our Honorary Fellow Interview, and we celebrate the incredible entomological life of Ken Davey, who was also an Honorary Fellow.

Many thanks to all who have contributed to this issue – and to the past 50-years of *Antenna*!

Richard Harrington

Letter from the President

Welcome to *Antenna*'s 50th volume! Over the past half century, both the world and entomology have changed profoundly. Back then, insect science largely focused on pest control, reflecting societal priorities in agriculture, public health and a rapidly industrialising world. The discipline has since broadened and deepened, supported by transformational advances in technology and analytical tools. Today, there is a well-established appreciation of insects as vital contributors to ecosystems and as organisms worthy of conservation and restoration. And entomology is increasingly interdisciplinary.

The RES itself has also changed. This year, our headquarters will return to London, to a fabulous, modern, welcoming building for staff and members. We will continue to work to be more diverse and inclusive – when *Antenna* was first published, the RES had never had a female president, and now it's had five! And we will reaffirm our commitment to advancing insect science, and scientists, for generations to come. Congratulations and here's to the next 50 volumes of *Antenna*.

Jane Stout
President
Royal Entomological Society

Antenna

Bulletin of the Royal Entomological Society

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First letter from the President

The President at the time of the first *Antenna* was (John) David Gillett OBE, DSc, Hon FRES. He was on Council from 1964 to 1966, Treasurer from 1975 to 1977 and President from 1977 to 1979. His main interests involved blood-sucking insects, working at the London School of Hygiene and Tropical Medicine, Brunel University and in many countries where these insects spread diseases. He was also a world expert on airships! Here is the very first article to appear in *Antenna*.

Correspondence: From the President

It is difficult to understand the urge to travel to other planets in the hope of finding those little green men, when we have perfectly good candidates here on Earth, antennae and all. I refer, of course, to the insects, those strange beings so different from ourselves and our fellow vertebrates, that were already a going concern long before we intruded. The insects, with their external skeletons and complex mouthparts, their six legs, one or two pairs of wings and, above all, the unorthodox way in which many of them grow up, are far stranger than anything that could ever be thought up by man, even in his most imaginative flights of fancy.

These strange fellow inhabitants, green or not, are found almost everywhere: they inhabit the surface and burrow deep within the soil; they live both on and in fresh waters and, above all, they are present in the air, actively flying or drifting even over the oceans. Hardly a plant in the garden or field, scarcely a tree in the forest is without its associated insects. Human habitations too provide shelter and food for insects, some conspicuously flying round the light, others less conspicuously chewing away at our precious books or even the very structure of houses themselves. Yet others, with seeming consummate skill, push infinitely refined hypodermic needles into the very lumen of our capillaries and getting away with a drink of fresh warm blood.

Insects are everywhere from the high arctic to the tropics. J.B.S. Haldane once described the weevil as God's favourite animal, so many variations are there on the curculionid theme. But for sheer numbers of individuals and exploitation of every habitat, I often think that ants must be counted a close rival. Over much of the world it is almost impossible to touch any vegetation, whether the limb of an isolated tree in open savanna or a blade of grass at the edge of a tiny island, without a column of ants immediately invading one's arm.

Insects, then, are ubiquitous, with vast numbers of individuals in the cooler regions and vast numbers of species in the topics. Their strangeness has invited our curiosity and attention from earliest times. They are the ideal subjects for studies on behaviour, cytology, development, ecology, endocrinology, flight, genetics, growth, physiology, population dynamics, sociology ... and so on. But insects can be creatures of great beauty in themselves, both in form and function: butterflies are surely unsurpassed by anything in nature, not even among plants or birds; and what could be more fascinatingly beautiful than the movements of a dragonfly hawking over a summer pond?

Insects, however, have their dark side: they compete with us for our food. They bring about such gigantic losses of the crops we cultivate as to threaten our livelihood, not only during the growing period of these crops, but also during storage after harvesting. And these problems multiply as we intensify our effort. Insects, too, still bring disease and suffering to untold millions; it is sobering to reflect that, apart from starvation (also largely an entomological problem) malaria alone still ranks as the most important killer of mankind, destroying about one and a half million people every year, and bringing misery to countless others.

If the appalling economic and medical problems resulting from these rivals are somewhat daunting, let us not forget for a moment the benefits that insects also bring. These are not marginal; our very existence depends on them: flowering plants, or at least a very high proportion of them, would not be present today were it not for the activity of insects. Quite apart from its economic importance, this unlikely association between two such disparate groups of living creatures is a never ending source of wonder. It was to foster the study of these strange, sometimes beautiful, sometimes sinister but always interesting and often informative fellow beings that the Entomological Society of London was founded nearly 150 years ago. And it is to further these studies that the Society continues to flourish today. But the Society was also created to bring together those of us who share these interests, whether in our spare time or as paid professionals. Today, with an increased number of Fellows, many of whom live and work abroad, this aspect is even more important. *Antenna* seeks to fulfil this want.

Antenna replaces the former *Proceedings*; it is a bulletin aimed not only to cover the regular meetings of the Society, but also to bring matters of entomological interest to the attention of Fellows wherever they may be. It will serve as a link between Fellows, providing correspondence columns for those who wish to air their views or bring certain matters to the attention of others. It will also provide news of Fellows and act generally as a vehicle of communication and exchange of ideas. I congratulate the editor, Peter Hammond and his able assistants, Alan Stubbs and Dick Vane-Wright, and all who have had a share in the planning of this new venture, and wish *Antenna* the success it clearly deserves.

J.D. Gillett
President 1977 to 1979
Royal Entomological Society

Correspondence

Information sought

Can you help? In relation to climate change, I am looking for examples where a shift in the phenology (as can be caused by global warming) of a plant-feeding insect results in better or worse synchronisation with a critical stage in the phenology of its host plant.

Background

In my research career at Reading, I have been a lone entomologist among plant scientists. Their interests have often been the regulation of plant development, involving processes quite different from those that affect insects. I have identified three very different mechanisms that would result in plants responding less to global warming than insects.

It has proved easy to verify this prediction, since there are many records of dates in different years of events such as seedling emergence and first flowering of plants, as well as of insect events such as first sightings. It is clear that the number of days advanced per 1°C increase in temperature during the time period spanned by the data for each species is consistently greater for the insects.

Unfortunately, the records for plants and insects are not linked, they are independent. I have only found two examples where a difference in response of an insect species and its host plant to an increase in temperature has affected their synchronisation; both concern forest pests, and one of these results is from an experiment in controlled temperature rooms.

Hence this appeal for examples both from the literature or just anecdotal from anywhere around the world. If recording insect phenology or the effects of global warming on insects is your area of interest, I would be most grateful to hear from you.

Helmut van Emden
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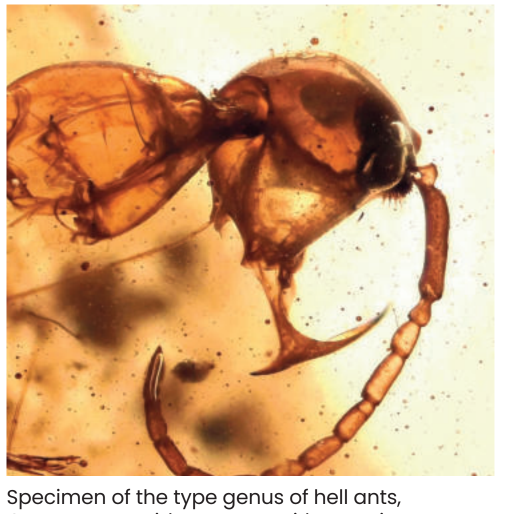
Opinion Piece 49(4)

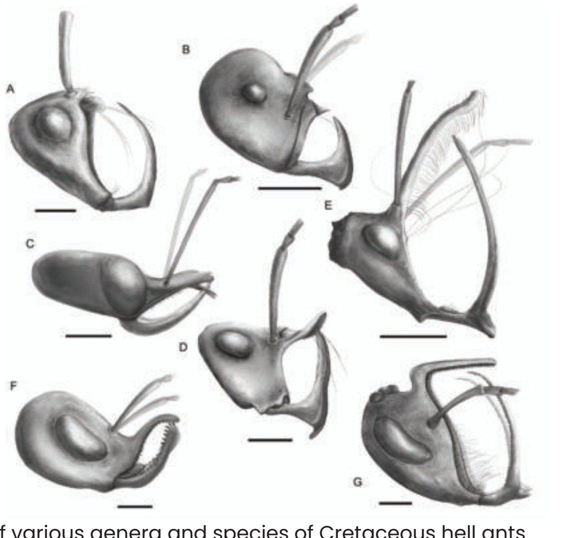
Dear Editors,
Regarding the Opinion Piece: *Artificial Intelligence and insect mouthparts: hallucinations begat a nightmare vision* (*Antenna* **49**(4), 182–185), fact can be stranger than fiction, see below.
Ed Jarzembowski

Magnusantenna wuae Du & Chen, an extinct coreid true bug (with a somewhat predictable name!). The inclusions are all from burmite (Burmese amber) from the mid-Cretaceous at 99Ma. Scale bar 5 mm. Creative Commons.

Don't worry, the fossil ant below is only 4.5 mm long and 2 mm across.



Specimen of the type genus of hell ants, Cretaceous Haidomyrmex, with open jaw (Courtesy of Nathan Hochrein).



Heads of various genera and species of Cretaceous hell ants (Haidomyrmecinae) from Vince Perrichot. Scale bar 0.5 mm.

RESEARCH SPOTLIGHT

The beat beneath my feet: vibrational communication in ants and other insects

I'm pickin' up good vibrations,
She's giving me excitations…
Good, good, good, good vibrations…

The Beach Boys, 1967

Stuart Reynolds
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and Milner Centre for Evolution,
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Listen to the music: ants

This *Research Spotlight* is about how ants and other insects detect vibrations in the solid materials beneath their feet, what these vibratory signals mean, and how the insects react to them. As we shall see, interfering with this sensory system may ultimately be useful in 'green' pest control.

Ants (Formicidae) were the first insects discovered to be insensitive to airborne sounds but nevertheless able to respond to vibrations in the solid substrate. As the twentieth century opened, it was already known (Janet, 1893; Wheeler, 1903) that many ant species produce airborne sounds by scraping one part of the cuticle over another, a behaviour known as 'stridulation'. An example of this is shown in Fig. 1; this shows a leaf-cutting ant, but the anatomy and the behaviour are quite similar in many other ants. It had been known since antiquity (Aristotle, 1970) that stridulation is a means of communication between the sexes of grasshoppers, crickets, cicadas, *etc*. Yet in the opening years of the 20th century, the significance of the stridulatory sounds made by ants was unknown, and since ants do not possess anything that looks like an ear, it was uncertain whether the insects that produced these sounds could even hear them.

In 1903, provoked by this apparent black hole of insect physiology, a Philadelphia medical doctor, Adele M. Fielde, and a Harvard undergraduate (later Professor), George H. Parker, converged on the Marine Biological Laboratory at Woods Hole in Massachusetts, then (as now) far from solely occupied with life in the sea. Fielde and Parker brought with them a collection of musical instruments; they planned to discover whether

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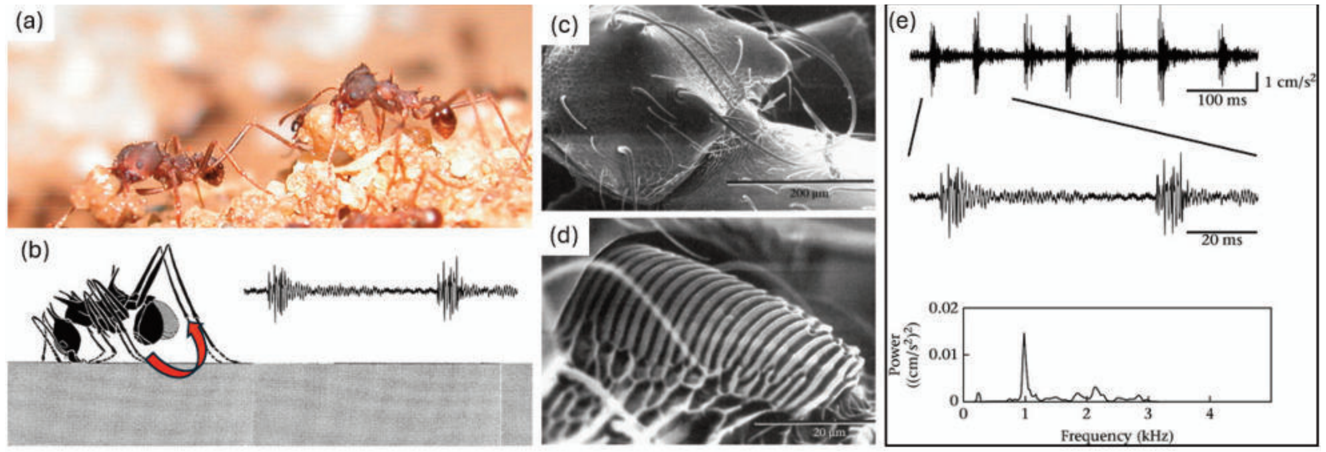

Figure 1. Digging behaviour and stridulation in leaf-cutting ants. **(a)** Workers of *Atta vollenweideri* carrying soil pellets during nest excavation. Photo: Oliver Geissler. **(b)** Gaster movements (indicated by arrow) produce stridulation signal. Drawing: Malu Obermeyer. **(c, d)** Stridulation organ of an *Atta cephalotes* worker (note scale bars). SEM images: Flavio Roces. (a)-(d) are reproduced (slightly modified) with permission from Sendova-Franks (2012). **(e)** Above: measured acceleration values over time. The calibration bar (acceleration in cm s^{-2}) is valid for both plots. Recordings were filtered below 500 Hz. Below: power spectrum of the signal illustrated above. Reproduced with permission from Pielstrom *et al.* (2012).

captive ants would react to the music with a change in their pattern of movement. This test of the insects' ability to hear was not in itself a novel idea; the world's most famous biologist, Charles Darwin himself, had performed similar experiments on earthworms (oligochaetes, not insects!) around 20 years previously. Typically, Darwin's experimental plan had been simple, effective and economically described (Darwin, 1881). It involved playing notes from all sorts of musical instruments, including a whistle, a bassoon and a piano, while watching a container of worms. When individual notes were played 'loudly' while close to the container in which the worms lived (but not touching it), the worms didn't move a muscle. But when the same musical instruments were physically connected to the container (*i.e.*, when placed on top of the piano), the worms quickly reacted by twitching. Darwin concluded "*Although [worms] are indifferent to undulations in the air audible by us, they are extremely sensitive to vibrations in any solid object*".

Fielde *et al.* (1907) now extended Darwin's musical approach to the Formicidae. Eight different species of ant were exposed to sounds and substrate vibrations produced by a piano, a violin and a Galton whistle (a 'dog whistle' producing high frequency sounds that cannot be heard by the human ear). The experimenters concluded that, like Darwin's worms, ants are unable to hear aerial sounds but are exquisitely sensitive to vibrations in the substrate (Fielde *et al.*, 1907). The new study went considerably further than Darwin's in testing which vibration frequencies are effective. Fielde and Parker found that different ant species reacted to different musical notes; all were very sensitive to very low frequencies, such as the lowest tone on their full-size piano keyboard (bottom A at 27 Hz). The ranges of vibrational frequencies causing a reaction were not only unexpectedly wide but also variable between species; while the top effective frequency in the myrmicine ant, *Cremastogaster lineolata,* was only one octave above middle C, or 522 Hz, a formicine ant, described by the authors as *Lasius umbratus* (but which was probably *Lasius aphidicola* - Schär *et al.,* 2018) was able to detect frequencies three octaves higher, top C at 4176 Hz (Fig. 2). Other ant species had narrower frequency ranges because they were less sensitive to the highest notes. These results were described by Fielde *et al.* (1907) without the benefit of statistical analysis; in those days the reader just had to take it on trust that sufficient replications of the experiment had been performed!

As far as I can tell, these musical studies constitute the first published evidence that any insect can perceive and react to substrate vibrations. Only later did Eggers (1928) suggest that the subgenual organs of insect legs (a type of chordotonal organ) have the specific function of detecting such substrate vibrations, an assertion that was experimentally confirmed for locusts by Autrum (1941). Meanwhile, the question of the significance of substrate vibrations in ant behaviour was shelved (Strauβ, 2021).

Good vibrations: social communication in ants

Of course, the realisation that ants can detect substrate vibrations with great sensitivity immediately begs the question of what those vibrational signals 'mean'. In other words, how does the insect benefit in fitness terms from being able to 'hear' them? Are the vibrations that are of interest to the ants produced by their own species, or other insects? Or do the ants benefit by detecting environmental sounds of an entirely different origin?

This supplementary question requires a different sort of experiment. We need to be able to listen in on the insects' vibrational world – now termed the 'vibroscape' (Šturm *et al.,* 2021). This is much less easy than the Darwinian piano-and-bassoon approach, because vibrations in the substrate are localised and carry only tiny quantities of energy. As a result, we humans can't actually hear what's going on underneath the insects' feet with our own ears. But once clever instrumental methods to detect and classify the vibrations have been devised, we can correlate the signals with behavioural reactions. This allows us to ask the

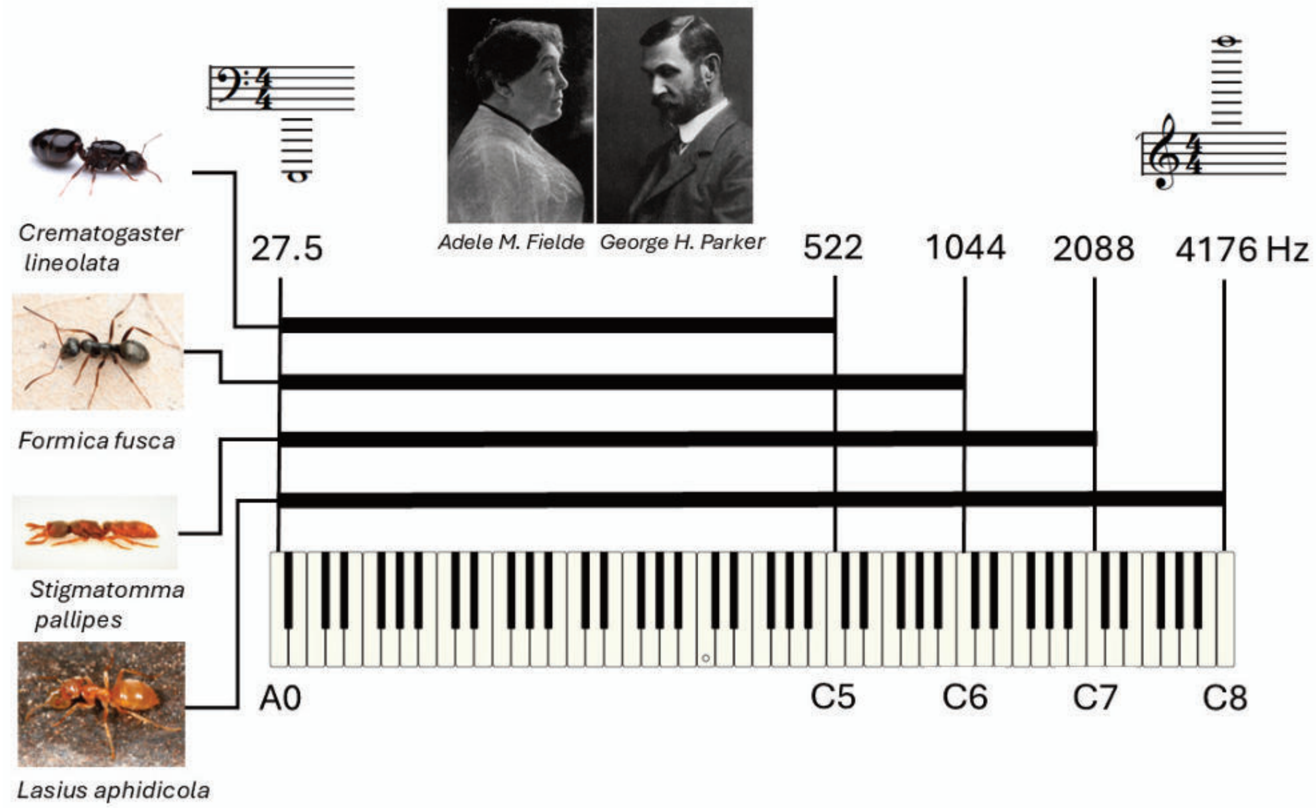

Figure 2. Fielde and Parker's musical experiment. Various species of ant (just four of those tested are shown here) were tested to determine their reactions to a range of substrate vibration frequencies (designated in Hz). The substrate vibrations were produced by striking the key of a piano (as shown here) by bowing a violin or blowing a whistle. The ants were contained in an experimental arena that was physically connected to the musical instrument. The range of frequencies that caused a behavioural reaction is shown for each species by a broad black horizontal line. The insects did not react at all to the same sounds if they were not physically connected to the instrument. Images: Fielde: public domain image from Stevens, 1918; Parker: public domain image from http://ihm.nlm.nih.gov/images/B20665; *Crematogaster lineolata*: image by Conor Cashman, CC BY; *Formica fusca*: image by Marie Lou Legrand, CC BY-NC; *Stigmatomma pallipes*: image by Nick Bédard, CC0 1.0 Universal; *Lasius aphidicola*: image by Tom Murray, CC BY-ND-NC.

insects themselves what the substrate vibrations 'mean' to them – in other words, to reveal their evolutionary adaptive significance.

Although the question of whether ants can detect substrate vibrations is still contested (Hickling *et al.,* 2000; 2001; Roces *et al.,* 2001), most entomologists are now convinced that aerial sounds are at best only a minor component of the ant sensory world. Moreover, although other forms of adaptive significance are not ruled out, it appears that the function of the vibrations is mainly that of intraspecific communication within the colony. Just as Fielde *et al.* (1907) had speculated, the vibrational signals detected by the ants are produced by the ants themselves.

The vibrations originate from a 'file-and-scraper' apparatus very like the Latin American percussive musical instrument called a *guiro*. Ants from a number of different families possess a stridulatory organ that is found between the petiole and the gaster, where the edge of the petiolar or postpetiolar scraper (the *plectrum*) is rubbed against a ridged surface (the *pars stridens*) (Hunt *et al.,* 2013) (Fig. 1). Phylogenetic analysis reveals that such structures are not ancestral within the Formicidae but have evolved on at least five occasions within the family (Golden *et al.,* 2016). Stridulation is extremely common among ants; in the two largest subfamilies, representing the majority of ant diversity, 95% of myrmicine species and 42% of ponerine species possess a stridulatory apparatus.

But this is where the scientific trail of early twentieth century work on ant vibrational communication goes cold. There was no proper follow-up to the prescient speculation of Fielde *et al.* (1907) about the importance of such signals in ants until the publication of a landmark paper (Markl, 1965) by Hubert Markl of Harvard University. This clearly demonstrated a social communication role in leaf-cutter ants for stridulatory vibrations conducted through the substrate (but not through the air).

We now know that in ants of many species, different types of stridulatory signal are generated according to the ecological and developmental circumstances of the ants that emit them. An almost certainly incomplete catalogue of associations between vibratory signals and behavioural context is given by Golden *et al.* (2016); ants have been noted to stridulate when excavating a new nest, foraging or retrieving food, feeding each other (trophallaxis) and manipulating brood, as well as during nest emigration and conflict with conspecific colonies. The signaller's caste may be communicated by vibrational signals, ant queens may stridulate to signal their non-receptivity to males, and worker ants may stridulate when attacked by a predator. Masoni *et al.* (2021) have shown that several of these behavioural associations are present in a single species, the Acrobat Ant (*Crematogaster scutellaris*) (Myrmicinae). This ant produces vibratory signals in the frequency range 250–4,000 Hz, which differ in their temporal organisation between castes and when the ants are in the presence of food or are physically restrained (Fig. 3).

Evolutionary innovations in interspecific interactions often shine a powerful light on the adaptive functions of particular traits within a single species

Temporal associations between signals and responses, of course, are insufficient to prove that signalling is selectively advantageous, but evolutionary innovations in *inter*specific interactions often shine a powerful light on the adaptive functions of particular traits *within* a single species. In this case, it turns out that the stridulatory signals of a host ant species can be dishonestly mimicked by myrmecophilic mutualists and social parasites to trick the host into accepting them as 'guests' in the nest. Larvae and pupae of riodinid and especially lycaenid butterflies, as well as a socially parasitic carabid beetle, *Paussus favieri,* all of which live in ant nests, emit signals that manipulate host workers to respond to the guests as they do to signals of the host queen, showing significantly higher levels of trophallaxis and guarding behaviour than are elicited by host worker ant calls (Schönrogge *et al.,* 2017). The existence of such deceit is perhaps the surest indication of the adaptive value to the victim of these vibrational signals in honest *intra*specific communication.

Not just ants

Even while little or no progress was being made to understand the phenomenon in ants, it was realised that substrate vibrations were important to mate-finding in other insects, especially in the order Hemiptera. A monograph by Ossiannilsson (1949) on the sexual vibratory signals produced by 79 different Swedish species of Auchenorrhyncha (planthoppers) is generally cited as the original source of the modern approach to insect vibrational communication. Ossiannilsson even made old-fashioned phonograph recordings of the 'sounds', but other insect sensory physiologists were evidently not yet ready for his suggestion that vibrations in the substrate represented a major new sensory modality in insects. A later paper by Moore (1961), which investigated the vibrational 'sounds' produced by 11 species from five families of Hemiptera and 13 species from four families of Auchenorrhyncha and Sternorrhyncha also deserves considerable credit for stimulating further research.

Conclusive evidence that, in these insects, communication between the sexes is achieved *via*

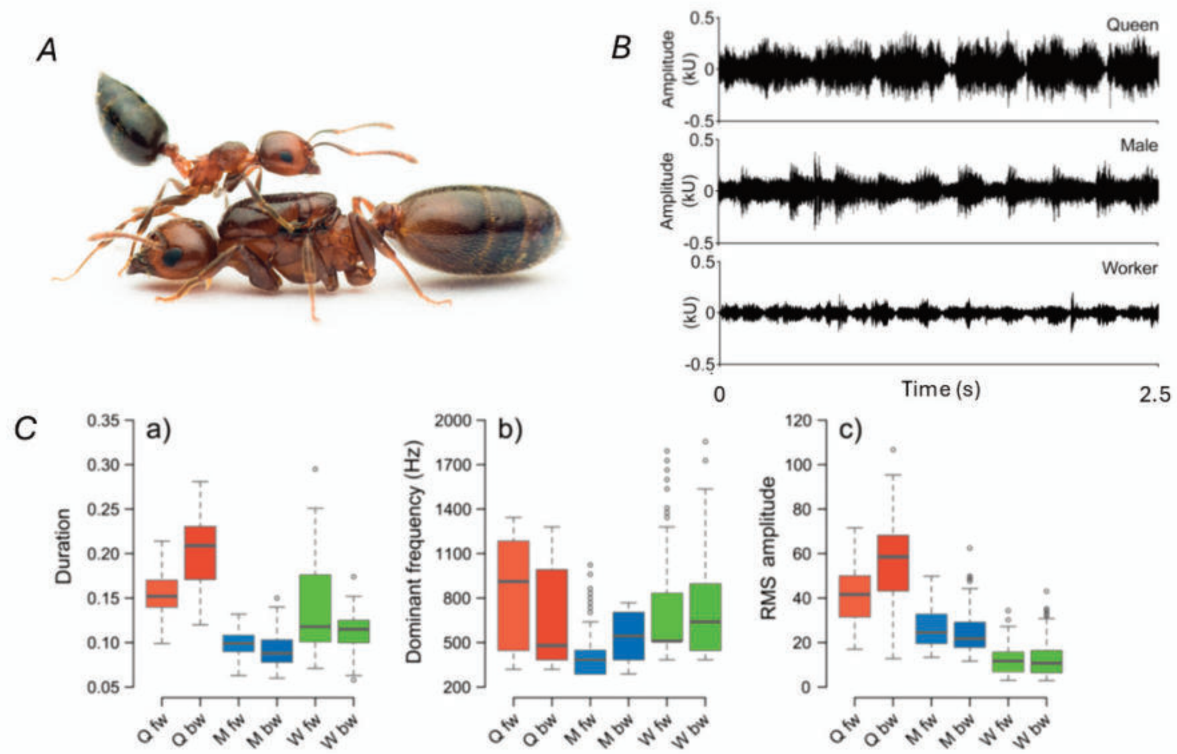

Figure 3. Caste-specific vibrational signalling in the ant *Crematogaster scutellaris*. **Panel A:** images of Worker and Queen. Photos by Michael Kukla, CC BY-SA 4.0. **Panel B:** Examples of oscillograms of substrate-borne vibratory signals during restraining experiments – note that different castes produce signals with distinct characteristics. **Panel C:** (a) chirp duration, (b) chirp dominant frequency (Hz), and (c) Root Mean Squared (RMS) amplitude of substrate-borne vibrations produced by stridulation. Qfw: queens' forward chirp; Qbw: queens' backward chirp; Mfw: males' forward chirp; Mbw: males' backward chirp; Wfw: workers' forward chirp; Wbw: workers' backward chirp. B and C are slightly modified from Masoni *et al.* (2021), CC BY 4.0.

substrate vibrations rather than as airborne sound had to wait for technological advances in recording vibrational 'sounds'. Eventually, it became possible to monitor substrate vibrations by using a record player cartridge; to make tape recordings of the signals; to analyse them in an oscilloscope; and to replay them to the insects through an amplifier and loudspeaker. Two important papers of this kind (there are others by the same authors) were those by Ichikawa *et al.* (1974) and Ichikawa (1976); in this work the planthopper *Nilaparvata lugens* was shown not only to be able to detect conspecific vibrational signals through substrate transmission, but also to respond with appropriate behavioural reactions.

Despite this mid-20th century rediscovery of vibrational signalling in insects, the reaction of the research community remained slow. Even a decade after Ichikawa's important contribution, the Royal Entomological Society's 12th Symposium volume *Insect Communication* (Lewis, 1984) still concentrated overwhelmingly on chemical signals, with only two chapters out of 16 chosen to discuss auditory communication, and coverage of vibrational signals being limited to less than one page of text and just 12 references.

Since then, however, there has been a remarkable turnaround, with a more than exponential rate of increase in publications on insect vibrational signalling. An exhaustive literature search by Turchen *et al.* (2022) found no fewer than 831 papers on insect vibrational communication. While insects from 17 Orders had been reported to use vibrational signalling for intraspecific communication, the list was dominated by Hemiptera (31.5% of cases), Hymenoptera (21.8%) and Coleoptera (13.5%).

Vibrational sexual signalling in psyllids

There are far too many scientific papers on insect vibratory signalling for me to mention them all, but I should say something about vibrational signalling in the Hemiptera, the insect order that is most strongly represented as communicating in this way. An impressive example is the use of substrate vibrations for sexual signalling in the superfamily Psylloidea.

Both sexes of psyllids have been known since the 1960s to produce 'buzzing' sounds, which are characteristic of the emitting species. In early work it was not so easy to characterise these signals. An attempt by Campbell (1964) to characterise psyllid sounds in musical notation (Fig. 4) deserves notice; perhaps this was a direct throwback to the original Darwinian approach. Today, however, it is much easier to record, display and analyse in detail the vibrational signals, and video recordings can be used to correlate the insects' behaviour with vibrations. While we almost certainly still have much to learn about vibrational signalling in these insects, it is clear that the most important function of psyllid vibrations is in sexual communication.

Adult male and female psyllids produce distinctive vibrational signals, using them to locate each other on their own host plant by 'duetting' (Liao *et al.*, 2022). The male signals his presence by emitting a species- and sex-specific signal, which advertises his own presence, and this solicits a reply from an available female that can hear him. The female's response is to emit a different but also species-specific vibrational signal that encourages the male to seek her out. Just as in music, the stereotyped timing and sequential relationship of the male and female calls defines the nature of the 'duet'. The vibratory signals are structurally complex, being made up of distinctive patterns of trills and chirps. The temporal structure of the calls within a species is rather constant compared to the more variable detail of vibration frequency and amplitude of the vibrations within these signal components (Fig. 4).

On the other hand, the sheer variety of vibratory signals found within the superfamily is very great. These calls have now been characterised from more than 100 species of psyllid. This is only a tiny fraction of the Psylloidea, a superfamily comprising eight constituent families, with 4,000 species in more than 200 genera worldwide, many of these being serious crop pests. It is evident from what has been done so far, that most if not all species within this superfamily use substrate vibrations as an essential part of their mate-finding behaviour.

The mechanism by which psyllids produce vibratory signals was until recently unknown, although it was suggested that they might arise from a stridulatory contact between the wings and the abdominal cuticle. Polajnar *et al.* (2024) have now shown, however, that in the Pear Psyllid (*Cacopsylla pyrisuga*), the vibrations are not stridulatory but are produced by oscillatory movements of the wings while they are held immobile at their bases. Physical contact of the wings with the underlying body wall appears not to be required. It seems likely that this is also true of other psyllid species. Presumably, the vibration produced by wing movements is transmitted to the rest of the body from the wing bases and only then to the substrate. This, then, is a similar phenomenon to the vibrations used by honey bees and bumble bees engaged in 'buzz pollination' (Vallejo-Marin, 2019).

Good vibrations: sexual and social signalling

What are the general principles of vibrational sexual and social signalling? Here are a few examples of recent research in this area. Vibrational signalling may be important in speciation: female mason bees from two geographically separate subspecies (*Osmia bicornis rufa* and *O. bicornis cornigera*) prefer to mate with males from their own subspecies, which use the correct vibrational signals during courtship (Conrad *et al.*, 2015; 2019).

Vibrational signalling is often competitive: in the cicadellid *Aphrodes makarovi*, both males and females participate in vibrational duetting, which assists males to locate females, but the females simply mate with the first male to arrive. When more than one male is present, males may adopt different calling strategies. Some males 'eavesdrop' a male–female duet maintained by a rival, exploiting the rival male's advertisement calls by silently approaching the female. To interfere with an ongoing male–female duet, males may also emit masking signals that overlap part

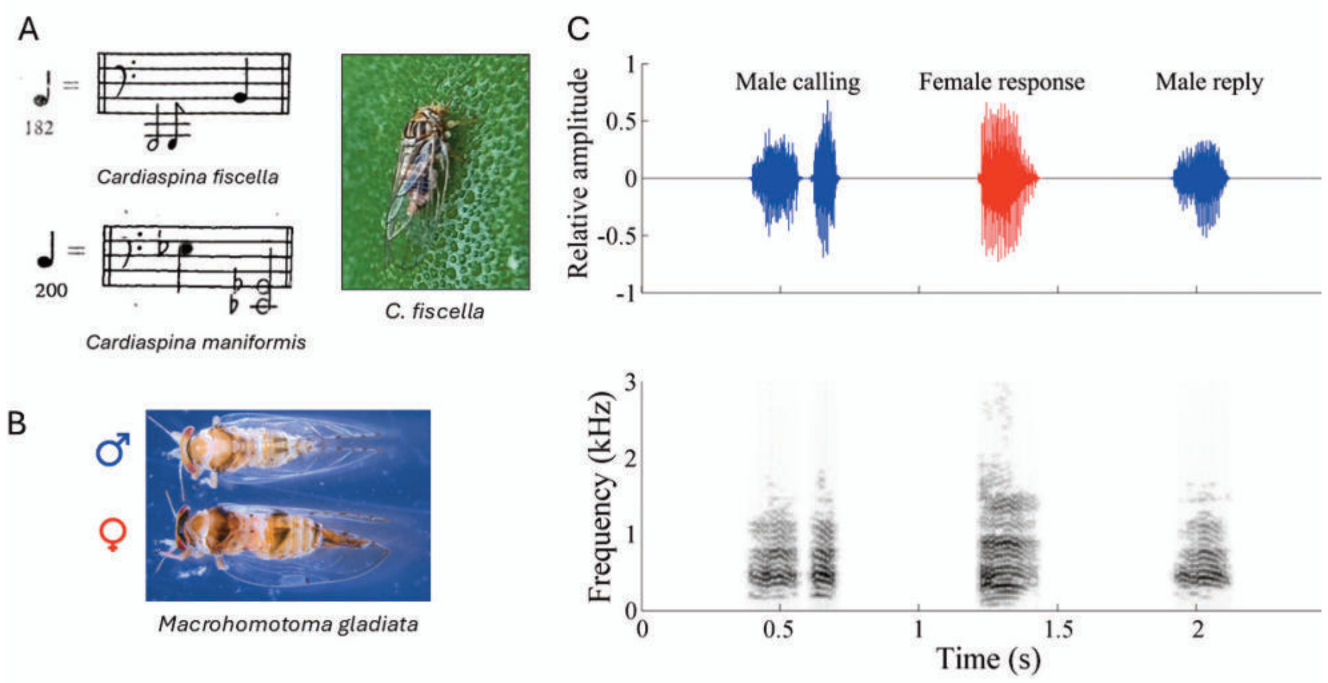

Figure 4. Vibrational duetting in psyllids. **Panel A:** An attempt by Campbell (1964) to characterise the vibrational signals of two species of psyllid from New Zealand, *Cardiaspina fiscella* and *C. maniformis*, using musical notation. *C. fiscella* is shown (image by Joseph Knight, CC NC-BY). **Panel B:** *Macrohomotoma gladiata*, male and female adults. Photo by Janis N. Matsunaga, Department of Agriculture, State of Hawaii, USA. **Panel C:** Vibrational signals in duetting *M. gladiata*. From Liao *et al.* (2019). CC BY 4.0."

of the female reply, thus delaying the rival's progress in reaching the female (Kuhelj *et al.*, 2017).

Vibrational signals can be 'jammed' by competitors: in the Neotropical Brown Stink Bug (*Euschistus heros*) on bean plants, females produce substrate vibrations that attract males to search for and approach the calling female. Duetting then leads to mutual emission of the courtship song and mating. These vibratory signals are readily disrupted when signals from 'rival' stinkbug species (*Chinavia ubica* and *Chinavia impicticornis*) are present in the environment (Dias *et al.*, 2021). The adaptive function of such trans-species interference is not immediately clear but may be an incidental consequence of intraspecific competition for mates.

Substrate vibrations may be integrated with airborne signals: crickets have been famous as the source of airborne sounds for more than 2,000 years, yet it is becoming increasingly evident that the well-known sexual advertisements and courtship signals emitted by males contain both airborne and substrate components, involving simultaneous wing stridulation, body tremulation, and leg drumming. In the House Cricket (*Acheta domesticus*) the relationship between these components of vibrational signal is complex and changes as the male approaches the female (Stritih-Peljhan *et al.*, 2024).

Vibrational sexual signalling may contribute to speciation. If this is so, then it would be expected that vibrational signals would be evolutionarily labile, and this appears to be the case in the Pacific Field Cricket (*Teleogryllus oceanicus*), in which foreleg drumming produces sexually-related vibrational signals and appears to be evolving rapidly (Wikle *et al.*, 2023).

Intraspecific communication using substrate vibrations is not only sexual in nature: vibrations can also be used to generate spatial order with a population. For example, newly hatched *Falcaria bilineata* (Lepidoptera: Drepanidae) caterpillars establish solitary leaf-tip territories (~10 mm wide) from which they exclude conspecifics, advertising their presence by producing multicomponent vibratory signals which increase in frequency when outsiders approach more closely (Matheson *et al.*, 2025).

On the other hand, producing substrate vibrations may also reduce the risk of predation: communally-living caterpillars (*Drepana arcuata*) use vibration signals to attract conspecifics to retreat from exposed feeding positions to form social gatherings, where they are less vulnerable to predation or parasitisation (Yadav *et al.*, 2017).

Bad vibrations: eavesdropping by predators and parasites

Substrate vibrations are not used only in sexually-related and social intraspecific communication, but also in eavesdropping by predators and parasites, which can 'tune in' to vibrations produced by their victims (Virant-Doberlet *et al.*, 2019). For example, pit building antlions *Euroleon nostras* are sit-and-wait predators that use vibrational signals from approaching insects to estimate both the distance and the direction of their prey (Martinez *et al.*, 2023). Some parasitoid wasps locate their insect prey by detecting substrate vibrations produced by the latter (Meyerhofer *et al.*, 1999; Broad *et al.*, 2000).

Substrate-transmitted vibrational signals mediate colony defence in many social insects, and it has been suggested that these vibrations deter predators (Masters *et al.*, 1979). Of course, this deterrence may be because the vibrations are directly confusing or damaging to the potential predator, or because they advertise the availability of other

Artificially generated substrate vibrations can be used to control insect pests of crops

defences such as distasteful or poisonous chemicals. Vibrational deterrence appears to be phylogenetically ancient among Blattodea. Sillam-Dussès *et al.* (2023) investigated 20 species of termite (Isoptera) as well as the wood roach, *Cryptocercus punctulatus*, and found that vibratory alarm signals arose at the base of the group, while chemical alarms have evolved independently in several cockroach groups and at least twice in termites. Vibroacoustic alarm signalling patterns are most complex in the relatively recently evolved Neoisoptera, where they are often combined with chemical defences. The ancient origin of vibratory defence signalling implies that the vibrations have at least some directly deterrent effect.

Substrate vibrations may also be used by potential victims to recognise the approach of a predator. This isn't strictly signalling, but more a case of a vulnerable individual assessing the suitability of its environment. An example is the recognition of the approach of hunting spiders by Meadow Spittlebugs (*Philaenus spumarius*) (Cercopoidea, Aphrophoridae); replaying a vibrational signal that mimics the predator provokes a 'freeze' response by the spittlebug in which movement ceases (Spadavecchia *et al.*, 2025).

Pest control using vibration

The use of vibrational sexual communication among insects leads quickly to the idea that it might be possible to interfere with these signals in order to reduce reproductive success. And indeed, it turns out that artificially generated substrate vibrations can be used to control insect pests of crops through Vibrational Mating Disruption (VMD). This looks like a terrific idea, since the great thing about vibrational signals is that they disappear straight away – no vibrational residues to cause trouble later on! Moreover, because the vibrational signals are species-specific, such interference could in principle be narrowly targeted. It has been estimated that as many as 195,000 insect species across all orders may be susceptible to such pest suppression techniques (Cocroft *et al.,* 2005), which offers plenty of opportunity to explore such control techniques.

The first reported attempt at this approach was that of Saxena *et al.* (1980), who yet again resorted to the good old Darwinian musical strategy. They used a harmonium (a portable reed organ) to generate complex aerial sounds with a low fundamental frequency, but also containing higher frequency harmonics, which they played to insects in the laboratory, while male insects were given the opportunity to approach and mate with females. Continuously playing the note G3 (~ 200 Hz) over a period of several minutes decreased the mating success of the Cotton Jassid (*Amrasca biguttula*) on cotton plants by 90%. Fundamental frequencies in the range 200–300 Hz were most effective for both this insect and also the Brown Planthopper (*Nilaparvata lugens*) on rice plants, but these treatments were more effective when the note contained higher overtones. To prevent mating over longer periods it was necessary to play these sounds continuously for long periods (up to several hours) at an intensity of 72–76 db (a sound pressure similar to a vacuum cleaner), the collateral noise pollution from which would almost certainly rule this out as a practical method of pest control. Although it's amusing to learn yet again of the utility of the 'musical instrument' approach to experimentation on insect vibrational signalling, I think that it's unlikely that anyone ever thought that playing live or recorded harmonium music to fields of crops would become commonplace.

Since this pioneering work, however, many refinements have been attempted and, in particular, it has been possible to apply artificially generated vibrational stimuli direct to plants without audible sound. Significant suppression of insect pests on a horticultural crop has been achieved for two different species of whitefly growing on tomatoes in protected environments. Males of the Greenhouse Whitefly (*Trialeurodes vaporariorum*) transmit vibrational signals to females at 250–375 Hz. In work by Berardo *et al.* (2022), artificial vibrations were generated by a computer-programmed mini-shaker attached to a vibroplate that was connected to the compost in which the tomato plants were growing; the shaking frequency distribution emphasised the fundamental frequencies of the insect's own vibrational signals and was applied continuously over several days to the host plant pots. Populations of adult and nymphal whiteflies on the shaken tomato plants grew significantly less quickly than controls and at 57 days, the number of whiteflies on the shaken plants was reduced by 30% compared to controls.

In a slightly different approach, Sekine *et al.* (2023) grew tomatoes on a metal frame that transmitted vibrations at 30 Hz and 300 Hz to the plants and any insects that were present on them. 300 Hz was effective in reducing *T. vaporariorum* population growth, while 30 Hz was not. Similarly, Yanagisawa *et al.* (2024) were able to control another whitefly species, *Bemisia tabaci,* on tomatoes; in this case, the vibrational signals were applied as 1 min of pulsed stimulation every 30 min. During the 1 min 'on', the 100 Hz vibratory signal was applied in a cycle of 1 s 'on' and 9 s 'off', following an interval of 29 min. This pattern, which had been devised specifically to avoid habituation to the applied signal, was highly effective, reducing *B. tabaci* nymphs by 40%.

There remain many 'known unknowns' in relation to the development of effective vibrational pest control; these include the extent to which the vibrational spectrum of the artificially applied vibrational noise must be tuned to match the insects' own vibrational signals (*e.g.,* Janža *et al.,* 2024); how often and for how long the vibrational signal should be applied (Polajnar *et al.,* 2016; Yanagisawa *et al.,* 2024); whether the artificial vibrations that are applied to the crop should be based on male or female mating signals (or both) (Dias *et al.,* 2021); the prospects for combining vibrational pest-suppressing treatments with other non-insecticidal methods of control *e.g.,* semiochemical disruption (Zapponi *et al.,* 2022); the best methods of delivering vibrational signals to pest insects under field conditions, including combining sticky traps with vibrational signals (*e.g.,* Jocson *et al.,* 2025); and the extent to which applied vibrational noise may exacerbate spatial dispersal of pests within the crop (Zaffaroni-Caorsi *et al.,* 2022).

Can vibrational techniques achieve effective pest management in the field? The question has been recently considered by Virant-Doberlet *et al.* (2023) and Yanagisawa *et al.* (2024). There are encouraging results in controlling the American Grapevine Leafhopper (*Scaphoideus titanus*) on outdoor grapes (Polajnar *et al.,* 2016), and other applications are being actively considered for vineyards (Thiery *et al.,* 2023). My own judgment is that there's probably a long way to go before vibrational pest control becomes common. Its high specificity means that there will be high R&D costs in developing it, and it's also likely to be expensive to deploy; this suggests it is likely to be used only on high value crops, perhaps especially those grown under protected conditions. But since the approach entirely avoids the use of toxic chemicals, it's worthwhile to explore its potential. Watch this space!

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Female Southern Damselfly (*Coenagrion mercuriale*).
Credit: Charles J. Sharp (CC BY-SA 4.0).

Insects and the law: exploring gaps in terrestrial invertebrate protection in Britain

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Introduction

Insects form the largest and most diverse component of Britain's biodiversity. They pollinate crops and wild plants, recycle nutrients, regulate populations of other organisms, and form the base of food webs that sustain birds, mammals, amphibians and reptiles. They also play a central role in cultural life, inspiring art, literature and public fascination. Yet despite their ecological and social importance, insects are largely absent from British law and policy.

While some species benefit from statutory protection, the overwhelming majority of invertebrates receive no explicit legal recognition. For many, their fate depends on proxy protections applied through habitats, general biodiversity duties, or indirect legislation such as pesticide controls. This article explores the current state of insect protection across England, Wales and Scotland, comparing how each jurisdiction addresses invertebrates in terrestrial ecological law. It assesses where meaningful safeguards exist, where gaps persist, and why insects, despite being excellent biological indicators, continue to fall through the cracks of environmental policy.

Insects as biological indicators

Biological indicators are organisms whose presence, absence or condition provide insight into ecosystem health. Insects are exceptionally well suited to this role. They occupy almost every terrestrial niche, respond quickly to environmental change, and interact with plants, soils and other animals in ways that reveal the state of ecosystems more reliably than single vertebrate species or vegetation types.

Butterflies, for example, are among the most widely used bioindicators of terrestrial ecosystems. Long-term monitoring schemes such as the UK Butterfly Monitoring Scheme demonstrate how species like the Speckled Wood (*Pararge aegeria*) expand in response to climate warming, while habitat specialists such as the Marsh Fritillary (*Euphydryas aurinia*) decline with grassland loss (Fox *et al.*, 2015). Freshwater insects provide equally powerful signals: the presence of pollution-sensitive mayflies (*Ephemeroptera*) and stoneflies (*Plecoptera*) is routinely used to assess river health.

Other groups offer subtler but equally critical insights. Ground beetles (*Carabidae*) are used in agri-environment research to measure soil health and tillage impacts. Hoverflies (*Syrphidae*) indicate the availability of flower resources and the condition of wetland margins. Ants reflect soil composition and disturbance regimes.

Despite this, the potential of insects as bioindicators is not embedded in most statutory frameworks. Ecological impact assessments often focus on birds, bats and vascular plants, even though insects may be more sensitive to disturbance. As a result, policies risk missing early warning signals of biodiversity decline.

Britain's legal landscape

The legal frameworks that govern biodiversity in Britain arise from a combination of domestic legislation and international commitments, including EU-derived measures and multilateral environmental agreements. While there are now clear differences in approach between England, Wales and Scotland, these largely reflect the effects of devolution and differing policy priorities rather than Brexit itself or the loss of EU funding. Nonetheless, all three countries continue to share a common legislative backbone rooted in long-standing domestic statutes and international obligations.
The following sections examine the main laws and policies relevant to terrestrial invertebrates, assessing their contributions and limitations.

The Wildlife and Countryside Act 1981

The *Wildlife and Countryside Act 1981 (c.69)* (WCA) remains the cornerstone of species protection in Britain. Schedule 5 of the Act lists species afforded full protection from killing, injury, disturbance and, in some cases, damage to their places of shelter. For invertebrates, the list is strikingly short — fewer than 80 species out of the tens of thousands present in Britain (JNCC, 2022).

Examples include the Fisher's Estuarine Moth (*Gortyna borelii lunata*), the Large Blue butterfly (*Phengaris arion*) and the Sussex Emerald moth (*Thalera fimbrialis*). These species benefit from strong safeguards: damaging their habitats or intentionally disturbing them can result in prosecution. However, the listing process is slow, heavily reliant on Red Data Book status, and infrequently updated. Many petitions for listing — such as for the Stag Beetle (*Lucanus cervus*) or the oil beetle (*Meloe proscarabaeus*) — have been rejected on the grounds that populations remain locally strong, even though declines are well documented.

As a result, Schedule 5 creates a two-tier system in which a tiny minority of insects receive direct protection, while the majority, including many declining pollinators and saproxylic beetles, are excluded.

Habitats Regulations

The *Conservation of Habitats and Species Regulations 2017 (SI 2017/1012)* in England and Wales, and the *Conservation (Natural Habitats, &c.) Regulations 1994* in Scotland (as amended), implement the EU Habitats Directive. These Regulations protect species listed on Annex II (requiring designation of Special Areas of Conservation) and Annex IV (requiring strict protection).

For insects, the list is again narrow. In Britain, Annex species include the Southern Damselfly (*Coenagrion mercuriale*) and the Large Blue butterfly. Legal obligations for these species are stronger than under the WCA: their breeding sites and resting places must not be damaged or destroyed, and deliberate capture or disturbance is prohibited.

Yet the Habitats Regulations are largely silent on the vast majority of invertebrates, despite their ecological roles. In practice, Special Areas of Conservation may safeguard insect-rich habitats incidentally, but insects are not the drivers of designation.

The Environment Act 2021

The *Environment Act 2021 (c.30)* represents a major reform in England, introducing Local Nature Recovery Strategies (LNRS) and a statutory requirement for 10% Biodiversity Net Gain (BNG) in new developments. While the Act's ambitions are significant, insects are not explicitly mentioned.

The biodiversity metric underpinning BNG focuses on habitat condition and distinctiveness, with little reference to invertebrate assemblages. Habitats critical to many insects, such as bare ground, early successional stages, and decaying wood, are

Figure 1. Shrill Carder Bee (*Bombus sylvarum*) foraging on Downy Burdock (*Arctium tomentosum*). Credit: Ivar Leidus (CC BY-SA 4.0).

undervalued in the metric. This creates a risk that developments will deliver net gains on paper while failing to support insect populations in practice.

Wales and Scotland have not introduced equivalent statutory BNG requirements, though similar principles are being explored through planning reforms and biodiversity duties.

The NERC Act 2006 and devolved biodiversity lists

The *Natural Environment and Rural Communities Act 2006 (c.16)* places a "biodiversity duty" on public authorities in England and Wales, requiring them to "have regard" to conserving biodiversity. The Act also established Section 41 (England) and Section 7 (Wales) lists of species of principal importance.

These lists include many insects, from the Shrill Carder Bee (*Bombus sylvarum*) (Fig. 1) to the Violet Click Beetle (*Limoniscus violaceus*). In theory, public bodies should consider these species when making decisions. In practice, the duty is weakly enforced. Reviews by the Environmental Audit Committee have described it as "toothless" (EAC, 2017), and many local authorities remain unaware of their obligations.

In Scotland, the *Nature Conservation (Scotland) Act 2004 (asp 6)* created the Scottish Biodiversity List (SBL), which also includes numerous insects. Scotland has taken biodiversity duty reporting more seriously, with statutory requirements for public bodies to report every three years. Nevertheless, there is little evidence that this has translated into meaningful gains for insects on the ground.

CITES and wildlife trade controls

The Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) regulates international trade in threatened species, including a small number of insects that are attractive to collectors or have commercial value. The United Kingdom remains a Party to CITES in its own right, and the convention is implemented domestically through the retained EU Wildlife Trade Regulations and the Control of Trade in Endangered Species Regulations 2018, which establish offences, permitting requirements and enforcement powers.

In practical terms, this means that import, export, re-export and certain forms of commercial use of listed insects are subject to a licensing system. For example, the Satanas Beetle (*Dynastes satanas*), a large rhinoceros beetle from Bolivia, is included in CITES Appendix II because of pressure from international collecting; any international trade in this species, including movements into or out of the UK, must comply with CITES documentation requirements and corresponding domestic permit controls. This framework can provide an important safeguard for a small number of highly collectible insect taxa by ensuring that trade is monitored, controlled and, in principle, kept within sustainable limits.

However, the scope of CITES is necessarily narrow. It applies only to species listed in its Appendices and is concerned with regulating international trade, rather than addressing broader drivers of insect decline such as habitat loss, pollution or pesticide use. As such, CITES operates as a complementary, trade-focused layer of protection that sits alongside domestic species protection, habitat conservation and environmental management laws, rather than as a comprehensive mechanism for conserving Britain's insect fauna.

Bee disease and pest orders

Bees receive unique attention under plant health and animal disease legislation. The *Bee Diseases and Pests Control (England) Order 2006 (SI 2006/342)*, and equivalents in Wales and Scotland, regulate the movement of honey bees and require notifiable disease reporting.

Scotland has gone further by designating the islands of Colonsay and Oronsay as a reserve for the native Dark European Honey Bee (*Apis mellifera mellifera*) (Fig. 2). Under the *Bee Keeping (Colonsay and Oronsay) Order 2013 (SSI 2013/279)*, only this subspecies may be kept there, protecting a genetically important population. This represents one of the few examples of legislation crafted specifically for insect conservation, rather than incidental protection.

Invasive Alien Species legislation

The *Invasive Alien Species (Enforcement and Permitting) Order 2019 (SI 2019/527)* implements EU Regulation 1143/2014 on invasive alien species. For insects, the Asian Hornet (*Vespa velutina*) (Fig. 3) is the most notable example, with restrictions on keeping, breeding and releasing. While this provides a framework for rapid eradication responses, it is reactive rather than proactive and covers only a small number of species.

Figure 2. Dark European Honey Bee (*Apis mellifera mellifera*) worker emerging from brood cell. Credit: Abalg (Public domain).

Figure 3. Asian Hornet (*Vespa velutina*). Credit: Charles J. Sharp (CC BY-SA 4.0).

Pesticide and chemical controls

The regulation of pesticides under the *Plant Protection Products Regulations 2011 (SI 2011/2131)* and related statutory instruments has profound indirect effects on insects. The restriction of neonicotinoid insecticides, following evidence of harm to pollinators, illustrates how agricultural law can shape insect populations. However, the framework prioritises human health and crop protection, with biodiversity often a secondary consideration. Emergency derogations granted for neonicotinoids on sugar beet in England in recent years highlight the fragility of these safeguards.

Environmental damage regulations

The *Environmental Damage (Prevention and Remediation) (England) Regulations 2015 (SI 2015/810)*, and equivalents in Wales and Scotland, transpose the EU Environmental Liability Directive. They cover "protected species and habitats" and impose duties to prevent and remediate environmental damage. In theory, this could apply to insects listed under the WCA or Habitats Regulations. In practice, thresholds for action are high, and the legislation has rarely been used to protect insects.

Where insects do benefit

Despite the gaps, there are positive stories. The Large Blue butterfly is a flagship example. After becoming extinct in Britain in 1979, it was reintroduced using populations from Sweden. Its listing under both the WCA and Habitats Regulations ensured targeted habitat management and research funding, leading to one of the most successful insect conservation programmes in Europe (Thomas *et al.*, 2009).

Another success is the legal protection of the native honey bee population on Colonsay, demonstrating how devolved powers can be used innovatively. Similarly, the inclusion of numerous insects on Section 41/7 and SBL lists has at least raised awareness and provided a basis for conservation funding.

Invasive species law has also mobilised public action against the Asian Hornet, with citizen science reporting networks established across Britain. These examples show that law can make a tangible difference when insects are explicitly recognised.

Where gaps remain

The gaps in legal protection for insects are nonetheless stark, and they fall into several recurring themes.

Coverage

The most fundamental shortcoming is that only a minute fraction of Britain's insect diversity is directly protected in law. Fewer than 80 species are listed on Schedule 5 of the *Wildlife and Countryside Act 1981*, out of an estimated 24,000 terrestrial insect species in the UK (JNCC, 2022). This represents less than 0.4% of the total fauna. Even when other instruments such as the Habitats Regulations are considered, the proportion barely rises. By comparison, almost all bat species, all cetaceans, and every native amphibian and reptile species enjoy statutory protection. This imbalance reflects a historical bias towards vertebrates as conservation 'flagships', leaving the majority of invertebrates invisible to statutory frameworks.

Duties

The biodiversity duties set out in the *Natural Environment and Rural Communities Act 2006* (England and Wales) and the *Nature Conservation (Scotland) Act 2004* are potentially powerful but weakly enforced. Public authorities are legally obliged to "have regard" to biodiversity, but the wording is vague and compliance is rarely monitored. Reports by the Environmental Audit Committee (2017) concluded that many local planning authorities are unaware of their duty or lack the resources to act on it. Consequently, insects listed as "priority species" under Section 41, Section 7, or the Scottish Biodiversity List often remain unsupported by practical measures.

Policy silence

Insects are largely absent from national policy frameworks and planning guidance. Documents such as the National Planning Policy Framework in England emphasise biodiversity more generally but make little or no mention of invertebrates. Guidance for ecological survey work often focuses on birds, bats, reptiles and Great Crested Newts – groups that have benefitted from strong statutory drivers. By contrast, few protocols exist for mandatory insect survey, even in high-value habitats such as ancient woodlands or heathlands. The silence at policy level cascades into silence in practice, with developers and consultants less likely to consider insect assemblages unless specifically required.

Survey requirements

A major practical gap is the absence of statutory survey triggers for most insects. Developers are routinely required to survey for bats or newts if habitats are suitable, but there is no equivalent legal hook for insects. Even species protected under the WCA or Habitats Regulations are rarely flagged unless specialist entomologists are engaged early. This results in under-recording, with populations potentially destroyed unknowingly during development. Without mandated surveys, the data deficit continues, reinforcing the perception that insects are rare or absent.

Metrics

The introduction of Biodiversity Net Gain (BNG) in England, under the *Environment Act 2021*, illustrates how insects can be sidelined by design. The statutory biodiversity metric assesses habitats based on "distinctiveness" and "condition", yet undervalues critical features for invertebrates such as ephemeral pools, exposed sandy soils, flower-rich brownfield sites and deadwood habitats. These habitats are often assigned low scores because they appear degraded or transitional, even though they are hotspots for invertebrate diversity. As a result, BNG may incentivise replacement of insect-rich sites with more 'tidy' but ecologically poorer habitats, perpetuating losses under the guise of net gain.

Together, these shortcomings perpetuate a cycle of neglect. Insects are overlooked in law, which leads to weak policy guidance, which in turn leads to limited survey effort and inadequate data. The resulting invisibility is then used to justify their exclusion from policy and legal mechanisms, locking in a downward spiral that is difficult to reverse.

Comparative perspectives

Across England, Wales and Scotland there is notable variation in the number and strength of insect-relevant terrestrial ecology laws. Scotland achieves slightly higher coverage, supported by proactive measures such as specific protections for distinct honey bee populations and more robust biodiversity duty reporting. England, despite the scale and sophistication of its policy framework, performs relatively poorly because of its heavy reliance on habitat-based approaches and weak enforcement of biodiversity duties. Wales sits between the two, with ambitious legislative frameworks but comparatively limited delivery on the ground. Taken together, these contrasts show how devolution can enable innovation, while also creating risks of fragmentation and inconsistency in the overall regulatory landscape.

Implications for practice

For ecologists, planners and conservationists, these legal gaps have real consequences. Insect surveys are rarely mandated, so practitioners must advocate for them proactively. Biodiversity Net Gain offers opportunities to promote insect-friendly habitats, but success depends on challenging the undervaluation of early successional habitats and deadwood.

Engagement with policy processes is essential. Consultations on LNRS guidance, BNG metrics, and pollinator strategies provide avenues for entomologists to press for greater insect recognition. Public engagement is also powerful: charismatic insects such as bees, butterflies and dragonflies can galvanise support for broader invertebrate conservation.

Conclusion

Insects are vital to Britain's ecosystems but remain marginal in its laws. The Wildlife and Countryside Act and Habitats Regulations protect only a few species. Biodiversity duties and Section 41/7/SBL lists include many more but lack enforceability. New mechanisms such as BNG and LNRS risk sidelining insects if metrics undervalue their habitats.

At the same time, the proposed Planning and Infrastructure Bill signals further change to the planning system in England. Although it is not yet on the statute book, its emphasis on streamlining decisions and accelerating housing and infrastructure delivery could either entrench the current marginalisation of insects, if assessment of individual projects is weakened and there is heavy reliance on broad habitat metrics, or create new opportunities where any related nature restoration mechanisms give clear priority to habitats that support rich invertebrate assemblages. Its final form will be critical in determining whether future planning law narrows or widens the gap between ambition for biodiversity and the protection of real insect communities on the ground.

Examples such as the Large Blue reintroduction and Colonsay honey bee protection show that law can be transformative when insects are recognised. To address biodiversity decline meaningfully, insects must be brought from the periphery to the centre of policy. That requires stronger duties, better integration into planning frameworks, and recognition of insects as essential bioindicators.

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Flowers, fruit and fynbos: how to conserve beneficial insects in a biosphere reserve

In the heart of South Africa's Cape Floristic Region (CFR) biodiversity hotspot (Fig. 1), lies the rugged fynbos-clad mountains (Fig. 2). Fynbos is a tough bushy, Mediterranean type of vegetation adapted to cool, wet winters and hot, dry summers. The region is famous not only for its exceptional biodiversity—one of the richest floras on Earth—but also for producing some of South Africa's finest apples in suitable terrain among the peaks. Yet, like so many other agricultural landscapes around the world, this region faces a growing challenge: how can it sustain both food production and biodiversity within the same space?

Across the globe, agricultural intensification has simplified landscapes and reduced insect diversity (Habel *et al.*, 2019; Batáry *et al.*, 2020). Pollinators and natural enemies alike have declined under increasing pesticide use and habitat loss (Biesmeijer *et al.*, 2006; Potts *et al.*, 2010; Knauer *et al.*, 2025). In the CFR, more than 30% of natural fynbos has already been transformed by agriculture and urbanisation (Cowling *et al.*, 2003). Apple production is important in this modified environment, being significant for the local agricultural economy (Fig. 3).

In recent years, we have worked with South African fruit growers to test whether it is possible to move from conventional agriculture to an agroecological approach by establishing wildflowers in the apple orchards. Our aim was to

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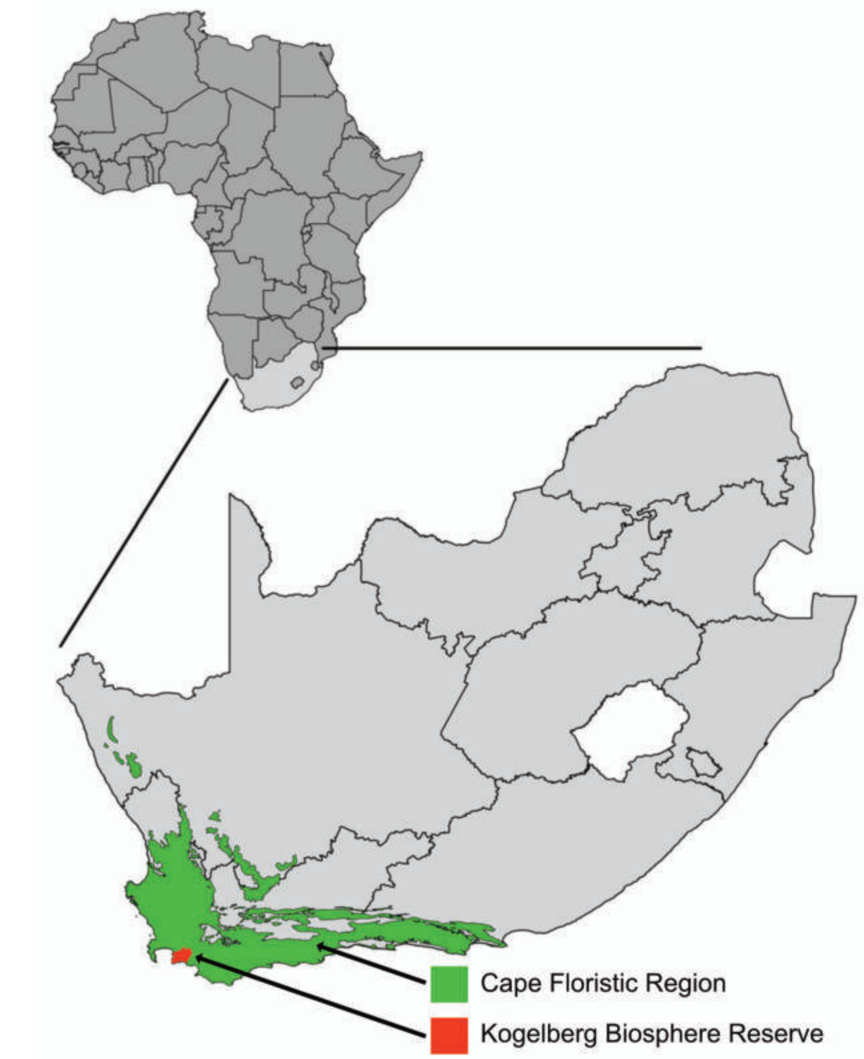

Figure 1. The Cape Floristic Region biodiversity hotspot at the southern tip of Africa with the position of the Kogelberg Biosphere Reserve arrowed. Map by Charl Deacon.

Figure 2. The rugged Kogelberg Biosphere Reserve, extremely rich in plant and insect diversity. Credit: Michael Samways.

Figure 3. An apple orchard with weedy interrow strips nestled among the mountains in the Kogelberg Biosphere Reserve. Credit: Peter Steward.

explore whether increasing floral resources could help restore beneficial insects like pollinators and parasitoids while improving apple production at the same time. As Biosphere Reserves are gaining so much significance (today 784 globally in 142 countries), our experiments took place within the Kogelberg Biosphere Reserve (KBR), a UNESCO Man and the Biosphere site in the southwestern Cape. The KBR includes a core conservation zone surrounded by buffer and transition zones where farming and biodiversity conservation coexist (Pool-Stanvliet *et al.*, 2018) (Figs 2 and 4). This geographical setting provided the perfect outdoor laboratory to test agroecological ideas in practice.

We researched 36 commercial apple orchards, each growing the Golden Delicious cultivar, to establish experimental floral resource strips between orchard rows. Each orchard contained three 40 m transects with floral plots planted in February 2018. One of the transects was sown with indigenous *Lobularia maritima* (Sweet Alyssum) (Fig. 5 top), another with a diverse mix of 11 flowering local species (Fig. 5 bottom), and a third left as an unmanipulated control dominated by grasses and weeds (Ratto *et al.*, 2021, 2025) (Fig. 3). The floral species were chosen for their extended flowering period and attractiveness to a wide range of insects. *Lobularia maritima* especially, has been shown to support both pollinators and parasitoids in various cropping systems (Begum *et al.*, 2004; Balzan & Wäckers, 2013). The apple orchards were embedded within landscapes that ranged from highly natural (>50% natural habitat) to low natural habitat (<20%) within a 500 m radius, allowing us to test how landscape complexity interacts with local floral management.

A tale of two services: pollination and pest control

Our research involved two complementary investigations. The first focused on pollinators (Fig. 6) and their impact on apple yield and fruit quality (Ratto *et al.*, 2021). The second looked at hymenopteran parasitoids, the tiny but vital insects that help control crop pests while also a major component of natural ecosystems (Ratto *et al.*, 2025). Both studies used standardised pan trapping and field

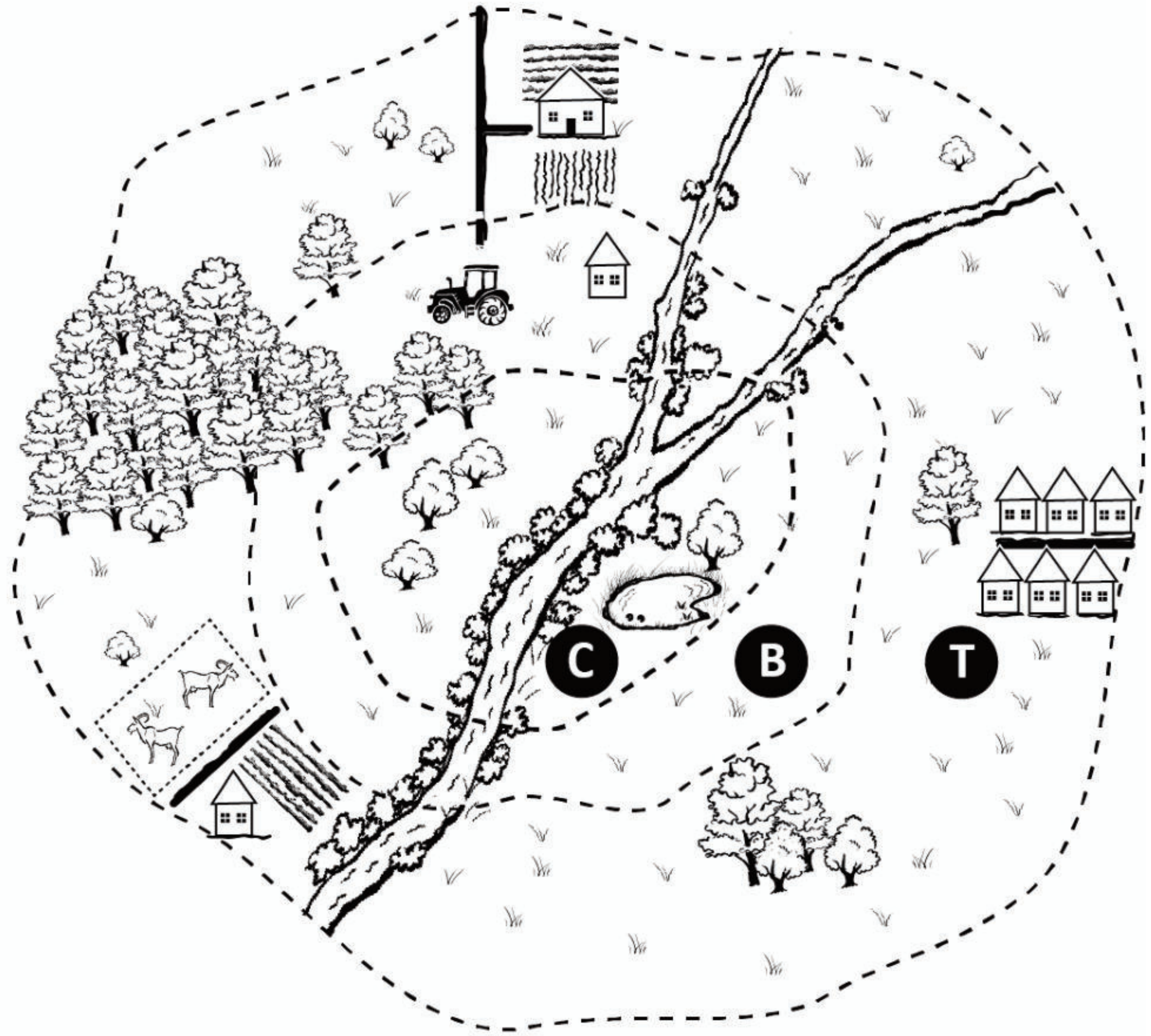

Figure 4. The Biosphere Reserve concept. The core zone (C) in the centre is a formally proclaimed protected area dedicated to biodiversity conservation and the maintenance of ecosystem processes. Around this zone is the buffer zone (B) with low-intensity human land use and employing agroecological principles. Outside the buffer zone is the transition zone (T), also employing agroecological principles, but slightly more extensively than in the buffer zone. In reality, these zones are much more convoluted than shown here (From Samways, 2020).

Figure 5. Experimental single flower strip (*Lobularia maritima*) (top) and a diverse flower strip (bottom). Credit: Peter Steward.

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observations, but each targeted different groups of beneficial insects (Fig. 7). For the pollination study, we also ran pollinator exclusion experiments to quantify the contribution of insects to fruit set, and to estimate the economic value of these services.

During the apple bloom, we recorded over 6,000 insect visitors across the experimental orchards. The endemic *Apis mellifera capensis* (Cape Honey Bee) was by far the most common visitor, accounting for 89% of all flower visits. Smaller wild bees, hoverflies, beetles and moths made up the rest of the assemblage. We found that floral strips significantly increased honey bee activity within orchards. For every additional square metre of floral cover, honey bee abundance increased by roughly 15%. Interestingly, while managed honey bees were relatively unaffected by the surrounding landscape, wild bees were more abundant in orchards surrounded by natural fynbos, confirming the importance of maintaining native vegetation near farms (Garibaldi *et al.*, 2011; Kennedy *et al.*, 2013).

Pollination experiments revealed that open-pollinated flowers set more and larger fruit than those excluded from insect visitors. Apples pollinated naturally were on average 8.6% heavier and 4.7% wider than those from insect-excluded branches, with significantly higher sugar content. Even a small-scale floral intervention translated into tangible economic benefits: orchards with floral strips produced apples worth R4,160 more per hectare (c. £165) compared with control plots. While the system remains heavily dependent on managed honey bees, these results suggest that modest increases in floral resources can improve both pollination and fruit quality, offering a win–win for growers and insects alike.

While pollinators steal the spotlight, the success of any orchard ecosystem also depends on its natural enemies, particularly parasitic wasps that help suppress pest populations. In a follow-up study on the same orchards, we investigated whether the same floral enhancements that benefited

Figure 6. An indigenous *Apis mellifera capensis* pollinator visiting apple flowers. Credit: Peter Steward.

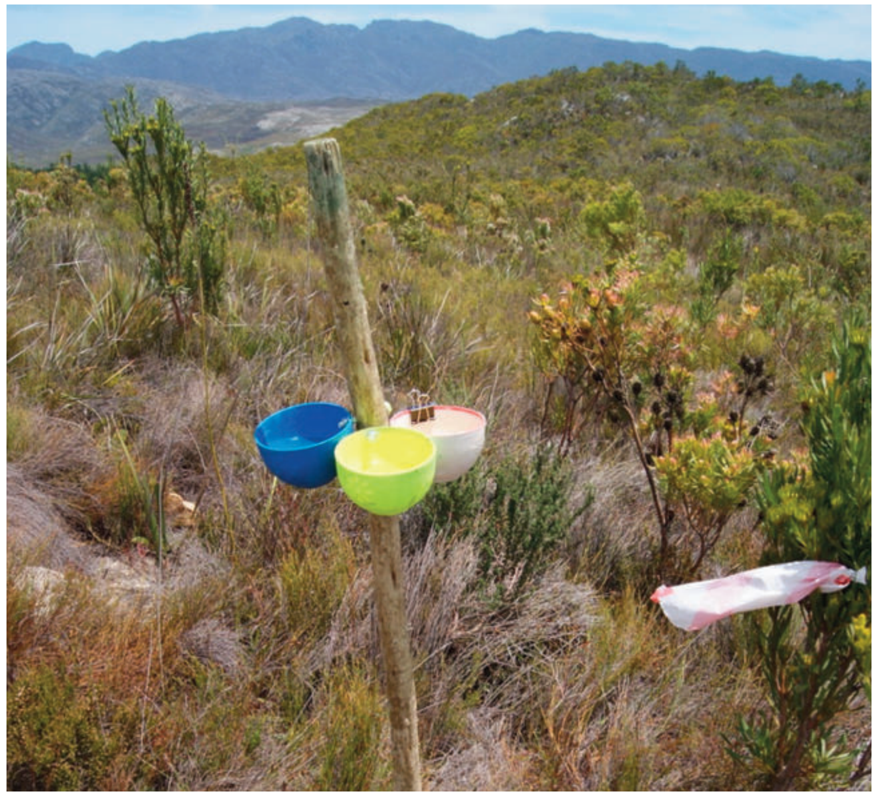

Figure 7. A pan-trap station. Credit: Peter Steward.

pollinators could also support these less-celebrated allies.

Across the 36 orchards, our pan-traps collected 4,278 parasitoid individuals, representing at least a dozen families, including Platygastroidea, Chalcidoidea, Aphelinidae and Ichneumonidae. Using a human-assisted molecular identification (HAMI) metabarcoding framework (Penel *et al.*, 2025), we were able to characterise species richness and assemblage composition. The results were encouraging. Parasitoid abundance increased significantly with floral area, demonstrating that even small, additive flower strips can boost beneficial insect numbers within orchards. However, we also found that non-crop habitats – the weedy margins and adjacent ruderal areas – supported even higher parasitoid richness, while natural sclerophyllous fynbos harboured the most diverse assemblages overall.

This gradient highlights an important principle of agroecology: local interventions such as floral strips work best when embedded within a complex, heterogeneous landscape. Although flower plantings boosted parasitoid abundance locally, landscape structure ultimately determined the diversity and composition of these assemblages, as also seen elsewhere (Tscharntke *et al.*, 2012).

Not all flowers are equal

An intriguing aspect of our findings was that simple floral plantings (*L. maritima* alone) supported higher parasitoid abundance than the more diverse seed mixes. While this may seem counterintuitive, it reflects the importance of flower traits such as colour, structure and nectar accessibility for attracting specific insect groups. *Lobularia maritima*'s open white flowers are particularly attractive to small parasitic wasps, which prefer easily accessible nectar sources (Begum *et al.*, 2004; Urbaneja-Bernat *et al.*, 2024). This result suggests that careful plant species selection may be more important than sheer floral diversity in optimising ecological benefits, supporting evidence that *L. maritima* provides a nutrient-rich food source, thus enhancing parasitoid fitness, longevity and fecundity compared to other plants (Balzan & Wäckers, 2013; Chen *et al.*, 2020; Theron *et al.*, 2020).

Connecting fynbos, farms and food security

The broader implication of both studies is clear: integrating floral diversity into production landscapes enhances multiple ecosystem services simultaneously. Flower strips do not merely decorate the orchard floor but, importantly, restore crucial ecological functions that intensive agriculture has eroded. Within the Biosphere Reserve framework, this work illustrates how transition zones can serve as testing grounds for more sustainable farming systems that balance productivity with conservation (Samways *et al.*, 2024). By promoting local biodiversity and maintaining functional connectivity across landscapes, floral enhancements contribute to the resilience of both natural and agricultural ecosystems.

Moreover, the synergy between pollination and pest control exemplifies the principle of *agroecological* intensification—producing more with less chemical input, while improving ecosystem health (Gaigher *et al.*, 2024). This aligns with global efforts to reimagine agriculture not as a driver of biodiversity loss, but as a partner in its restoration.

Despite the clear ecological and economic benefits, widespread adoption of floral enhancement remains limited. However, growers often worry that non-crop flowers will compete with their crop or harbour pests. Yet our data show the opposite: flower plantings increase beneficial insect activity without reducing pollination efficiency or yield (Ratto *et al.*, 2021). Another concern is cost. While establishment requires some investment, the potential returns—in fruit quality, pollination services and reduced pest management costs—more than justify the effort. Over time, these interventions may be complementary to the small cost of rented beehives (at 2 hives/ha) that use indigenous and wild *A. m. capensis* and which farmers overall prefer as a safety net for optimal apple production.

Ultimately, encouraging farmers to view biodiversity as an asset rather than a liability will be key. Disseminating local evidence, such as the findings from the biosphere here, can help build trust in these practices and inspire broader uptake across South Africa's fruit sector. The lessons from our work extend beyond apples and farther afield than South Africa. Around the world, similar experiments are showing that reintegrating wildflowers into farmland can deliver multiple benefits: sustaining pollinators, improving soil health, supporting natural enemies and stabilising yields (Albrecht *et al.*, 2020).

In biodiversity hotspots like the Cape Floristic Region, these gains carry added significance. By designing farms that work with nature rather than against it, we can conserve species found nowhere else on Earth while producing food sustainably.

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Featured Insect

Charidotella sexpunctata (Fabricius, 1781) – American Golden Tortoise Beetle

American Golden Tortoise Beetle (*Charidotella sexpunctata*). Credit: © Santiago Murillo Dasso, CC-BY-NC 4.0; reproduced from iNaturalist (inaturalist.org/photos/175752623).

Scientific name: *Charidotella sexpunctata* (Fabricius, 1781)

Order: Coleoptera

Family: Chrysomelidae

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At first glance, *Charidotella sexpunctata* looks less like an insect and more like a piece of jewellery due to its metallic golden colouration. This beetle belongs to the family Chrysomelidae and subfamily Cassidinae, which are known as the tortoise beetles. This name derives from their tortoise-like body shape which they utilise as a defence mechanism. A tortoise beetle is broadly characterised by enlarged elytra and pronotum which cover their head and legs. The specialised pads on their feet allow the beetle to hold firmly onto a leaf, making it challenging for predators to remove an individual from their host plant (Eisner & Aneshansley, 2000).

A dried specimen of *Charidotella sexpunctata*. Credit: Talay Namintraporn & Danaë Vassiliades / Natural History Museum, London.

The brilliant metallic colour of *C. sexpunctata* is not produced by pigment, but by fluid-filled microscopic 'nanotube' structures in its cuticle that manipulate light, an example of structural colouration (Biró & Vigneron, 2010). When the beetles dry out, they lose their golden colour. Experiments to maintain their colour in museum collections have involved placing specimens in tubes of oil to prevent desiccation. The Latin name of the species *C. sexpunctata* means 'six-spotted', referring to the six spots on the elytra which become more visible when the beetle loses its golden sheen.

Charidotella sexpunctata is a widely distributed American species, however, there are several beetle species which are known as 'golden tortoise beetles' due to their similar colouration. These include *Aspidomorpha sanctaecrucis* and other closely related species which occur across Asia (Borowiec & Świętojańska, 2008–2024).

Female *C. sexpunctata* lay their eggs on the underside of leaves of Convolvulaceae host plants, which include sweet potato and bindweed. Unlike some other tortoise beetles, this species does not exhibit parental care; once laid, the eggs are left to develop on their own. The larvae feed on the same host plants as adults and are often gregarious, feeding in groups. They are also known for exhibiting a unique defence mechanism: the 'faecal shield'. Larvae accumulate their own faeces and shed skins on a fork-like structure at the rear of their body and hold it over themselves like an umbrella. This shield deters predators such as ants and parasitic wasps (Barclay & Bouchard, 2023). Adult *C. sexpunctata* are about 5–7mm long and are characterised by their metallic gold appearance. When disturbed or stressed the beetle's colour changes from shiny gold to a red or brown colour. The mechanism for colour change in *C. sexpunctata* has not yet been studied. However, in the closely related species, *Charidotella egregia* (also known as the 'Golden Tortoise Beetle'), the mechanism for colour change is a physical 'expulsion' of the reflective fluid, which exposes the red pigment beneath (Vigneron *et al.*, 2007). It is also thought that the colouration and smooth reflective surface of the elytra may mimic water droplets on leaves, helping them blend into their environment (Barclay & Bouchard, 2023).

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Embiopteran Tools AI-powered species identification

Every year, millions of insects are collected, photographed and identified by entomologists around the world. Yet, with over one million known insect species and an estimated four to six million more awaiting discovery, even experienced entomologists can spend hours puzzling over a single specimen. The shortage of taxonomic experts compounds this challenge, creating the so-called 'taxonomic impediment' – a bottleneck that slows biodiversity research and conservation efforts worldwide.

This is where artificial intelligence (AI) comes in. Over the past decade, machine learning algorithms have been developed that can recognise patterns in images with remarkable precision. If these systems can distinguish between human faces or identify objects in photographs, researchers reasoned, perhaps they could learn to tell a beetle from a butterfly, or even distinguish between closely related species that look nearly identical to the untrained eye.

The core technology behind these systems is the convolutional neural network, a type of artificial intelligence that processes images in layers, gradually learning to recognise increasingly complex features. Much like a student learning entomology, the system starts by noticing basic shapes and colours, then progresses to more sophisticated features like wing venation patterns or the curve of an antenna. The crucial difference is speed: what might take a human months to learn, a computer can master in hours when given sufficient training data.

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So, how well does AI identify insects? For this article I've tested five readily available AI engines.

Obsidentify is a specialised insect identification application that uses AI to help users identify various insect species through photographs. The app allows users to take pictures of insects they encounter and receive identification suggestions, together with a percentage rating of the identification based on visual analysis.

Apple has integrated AI capabilities into iPhones that allow users to identify insects through the device's native assistant. By activating Siri's visual lookup feature, users can take or select photos of insects and receive identification information directly through Apple's ecosystem. This functionality is built into iOS devices, eliminating the need for separate app downloads.

Google Lens is Google's powerful visual search tool that can identify insects amongst countless other objects, plants and animals. Users can point their camera at an insect or upload an existing photo, and Google Lens will analyse the image and provide identification results along with relevant web information about the species.

iNaturalist Seek is an educational app designed to encourage exploration of the natural world, with strong capabilities for insect identification. Developed by the California Academy of Sciences and National Geographic, Seek uses image recognition technology to identify insects in real-time through the device's camera.

Figure 1. Images of live specimens used: a) *Glyphotaelius pellucidulus*; b) *Limnephilus flavicornis*; c) *Potamophylax latipennis*; d) *Limnephilus marmoratus*; e) *Rhyacophila dorsalis* ; f) *Limnephilus lunatus*; g) *Agrypnia varia*; h) *Limnephilus auricula*; i) *Polycentropous flavomaculatus*. Credit: Craig Macadam.

Insect.id is a dedicated identification app that focusses specifically on the world of insects, offering specialised AI-powered recognition for various insect orders and species. The app allows users to photograph insects and receive detailed identification results, often including information about the insect's taxonomy, distribution and ecological role.

I focused testing these apps on images of caddisflies (Trichoptera) collected while light trapping in central Scotland. I used images of both live and dead specimens (Figs 1 and 2) and compared the number of correct identifications at family, genus and species level. The results are shown in Table 1.

So how did they do? The clear leader was Obsidentify, achieving 94% accuracy at family level, 78% at genus level and 61% at species level in the overall assessment. At the opposite end of the spectrum, iNaturalist demonstrated weaker performance, correctly identifying only 22% of specimens at species level overall, though it managed 67% accuracy when restricted to family-level identification.

Insect.ID matched Obsidentify's species-level performance at 61% overall, whilst Apple Siri and Google Lens both achieved 28% accuracy at species level. However, these applications showed differing strengths at higher taxonomic levels, with Insect.ID reaching 83% at family level compared to 67% for both Siri and Google Lens.

The distinction between live and dead specimens proved important for most applications tested. Obsidentify and Insect.ID demonstrated the most dramatic decline in identification ability, dropping from 78% species-level accuracy with live specimens to 44% with dead ones. Conversely, iNaturalist maintained its modest 22% species-level accuracy regardless of specimen condition, suggesting either robustness to morphological changes or a consistently limited capability. Apple Siri and Google Lens showed relatively minor fluctuations between conditions, with Siri actually improving slightly from 22% to 33% at species level when identifying dead specimens.

The marked superiority of Obsidentify across nearly all categories suggests a fundamental difference in either training data quality, algorithmic sophistication or both. In contrast, the consistently poor performance of iNaturalist is puzzling, particularly given the platform's reputation and extensive community-generated database. One possible explanation lies in the distinction between the platform's community-driven identification process, which involves human experts reviewing submissions, and its automated computer vision component, which was tested in this trial.

One potential method of improving identification accuracy lies in the provision of location data as a constraining factor in the identification process. iNaturalist, Google Lens and Apple Siri all frequently suggested North American species in this trial despite the specimens being

Table 1. Results from each of the apps tested.

Live specimens

	Obsidentify	iNaturalist	Apple Siri	Google Lens	Insect.ID
Family	100%	67%	67%	78%	100%
Genus	89%	44%	56%	67%	89%
Species	78%	22%	22%	33%	78%

Dead specimens

	Obsidentify	iNaturalist	Apple Siri	Google Lens	Insect.ID
Family	89%	67%	67%	78%	67%
Genus	67%	22%	56%	44%	44%
Species	44%	22%	33%	22%	44%

Overall

	Obsidentify	iNaturalist	Apple Siri	Google Lens	Insect.ID
Family	94%	67%	67%	78%	83%
Genus	78%	33%	56%	56%	67%
Species	61%	22%	28%	28%	61%

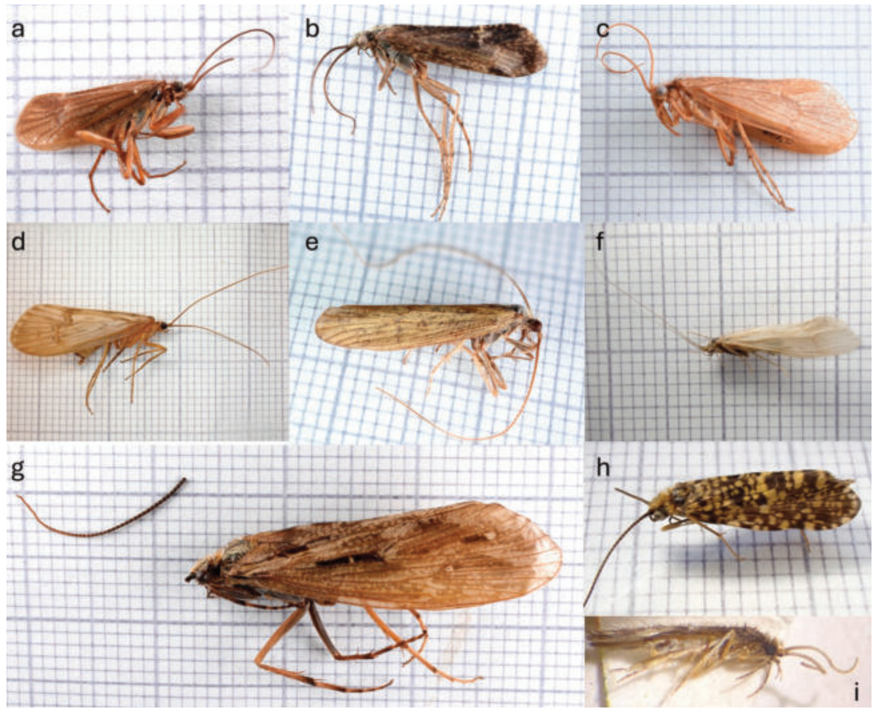


Figure 2. Images of dead specimens used: a) *Chaetopteryx villosa*; b) *Limnephilus sparsus*; c) *Micropterna lateralis*; d) *Halesus radiatus*; e) *Odontocerum albicorne*; f) *Oecetis ochracea*; g) *Phryganea bipunctata*; h) *Philopotamus montanus*; i) *Oxyethira flavicornis*. Credit: Colin Legg.

photographed in the UK. The simple addition of location details would most likely improve the results for these apps.

The practical implications of this trial are clear. For citizen scientists and amateur naturalists, Obsidentify and Insect.ID offer genuinely useful capabilities, correctly identifying approximately three in every five specimens to species level under typical conditions. However, this 60% accuracy rate, whilst impressive for automated systems, remains insufficient for scientific applications requiring definitive identification. Biodiversity surveys, invasive species monitoring and conservation assessments cannot rely solely on these tools without expert verification. Field naturalists photographing living organisms can expect the best results from most applications, whilst researchers working with museum collections, light trap surveys or malaise trap samples might want to stick to more traditional identification methods.

This is a small study covering only UK caddisflies. It is possible that with more samples or other insect groups, the relative performances of the different platforms would change. Despite the limitations revealed by this evaluation, there remains considerable cause for optimism regarding the future of AI-powered species identification. The technology has advanced remarkably in recent years, and applications like Obsidentify demonstrate that accuracy rates approaching genuinely useful levels are already achievable. As training datasets continue to expand and diversify, incorporating millions of verified specimens across broader taxonomic and geographical ranges, and as algorithms become more sophisticated in their ability to integrate morphological features with contextual information such as location, habitat and seasonality, we can expect substantial improvements in performance. The potential of these tools is profound: they offer the possibility of empowering countless citizen scientists, students and nature enthusiasts to engage more deeply with the biological diversity around them, transforming casual encounters with wildlife into opportunities for learning and contributing to scientific knowledge. Whilst AI identification will likely never entirely replace the nuanced expertise of trained taxonomists, it need not do so to be transformative. If these applications can reliably narrow identifications to a handful of candidate species, provide educational information about those possibilities and flag cases requiring expert verification, they will have succeeded in making the natural world more accessible and comprehensible to a generation eager to understand and protect it.

Acknowledgements
The author would like to thank Colin Legg for the images of dead specimens.

Insects in the News

October to December 2025

Richard Harrington
with the help of material from
Hugh Loxdale, Stuart Reynolds
and Dafydd Lewis

By the time you are reading this, Christmas will be a distant memory, but I'm writing on the seventh day thereof, and the swans are a-swimming. Did you have a Christmas tree? Well, you were lucky. "Festive spruces threatened by an evil weevil", a *Daily Telegraph* headline read, blaming a ban on insecticides. The "tiny bug" in question is, ironically, the Large Pine Weevil (*Hylobius abietis*). Saplings are vulnerable and the stripping of bark can be fatal. One forest manager said: "without active management, weevils can wipe out entire stocks".

A Christmastide staple is the World Dart's Championships, but this year's was interrupted numerous times by the 'Ally Pally Wasp'. As our very own Adam Hart explained to *The Daily Telegraph*, "when queens enter warm places, they potentially don't go into hibernation or they get revived and become active".

MI6 Chief ('C'), Blaise Metreweli, gave her first speech on 15th December. *The Daily Telegraph* devoted three paragraphs to her thoughts on Putin's invasion of Ukraine, and nine paragraphs to her large and colourful broach, a bee motif. There was speculation as to what hidden messages this conveyed and whether it contained any "high tech concealments", alongside a huge picture of Miss Moneypenny, wearing a remarkably similar broach in *Octopussy*.

The most widely reported entomological story of the quarter in the UK was the invasion of Harlequin Ladybirds (*Harmonia axyridis*) into homes in early October. Naming no names, but the stories ranged from the deranged ("bugs forced their way in when she opened a window to let the cat in") via the sensationalist ("petrified Brits say their houses are swarming with beetles") to wise words from our former president and ladybird queen.

Researchers from Florida have identified the DNA of 86 species of animal from blood sucked by 21 species of mosquito (*The Independent*). The prey included frogs, bald eagles, rattlesnakes, tortoises (you'd think they'd be protected), alligators, otters and deer. "No species is safe." "Mosquitos found in Iceland for first time as climate crisis warms country" (*The Guardian*). Watch out, you Arctic Foxes!

The National Trust's Wicken Fen nature reserve has reported its 10,000th species, the Six-belted Clearwing moth (*Bembecia ichneumoniformis*) (*The Daily Telegraph*). Congratulations on this amazing milestone. The NT reckons that Wicken Fen is the most biodiverse recorded reserve in the UK.

Limb repairs and replacements have increased the mobility of countless people. Now, a Monarch butterfly (*Danaus plexippus*) has been given a new lease of life with a wing transplant. I kid you not. According to *The Independent* and *CBS News*, a member of the public took an injured butterfly to the Sweet Briar Nature Centre in New York, where a wing from a dead butterfly was attached. The recipient apparently continued its migration towards Mexico. In return, insects can support surgery on humans. Researchers at Heriot-Watt University have suggested that the way in which the ovipositor of sawflies cuts into plants whilst avoiding their "key functions and tubing" (*The Daily Telegraph*) could have applications in surgery. They have scaled up the sawfly's cutting mechanism 400 times and tested it on a material that mimics human tissue. They found that it only cut into what was safe. "This could lead to methods by which surgeons no longer have to work in blood-soaked environments."

This is undoubtedly the first report I've included from *Colin Stuart's Astronomy Club*. Apparently, entomophagy has gone into space. In 2022, the European Space Agency (ESA) astronaut, Samantha Cristoforetti, took with her a blueberry cereal bar made with cricket flour. "Who knows?", says Colin, "the first colonists on Mars might dine on space-farmed insects". I'm sure Elon will be delighted!

Bumblebees can read Morse code to find food. Oh yes! As reported in *Earth.com*, researchers at Queen Mary University of London built a maze where bees encountered two flashing circles, one emitting short flashes, the other long flashes. Only one led to a sugar reward, whilst the other led to a substance distasteful to bees. The position of each circle was regularly changed so that the bees could not rely on location. Once the bees had learned the associations, the sugary reward was removed, and most bees went straight for the flash duration that once gave them sugar.

And finally, Pope Leo has seen the light. He has appointed the Right Reverend Richard Moth as the 12th Archbishop of Westminster and leader of Catholics in England and Wales. I'm sure that entomologists everywhere will wish Archbishop Moth well in his new role – just mind the candles.

Six-belted Clearwing (*Bembecia ichneumoniformis*) male (La Thuile, Aosta, Italy). Credit: Hectonichus, CC-SA 4.0; reproduced from https://en.wikipedia.org/wiki/File:Sesiidae_-_Bembecia_ichneumoniformis_(male)-001.JPG

News from Council

Council Meeting
Council met online on 26th November 2025. The President welcomed new trustees Heather Campbell, Liam Crowley and Anastasia Uglow, and new staff member Kay Oxley (Executive Coordinator).

CEO's Report
The interior design of 24 Wenlock Road is proceeding apace, and it is hoped that the move to our new head office will be completed by April 2026.

An application has been submitted to the National Archives for a consultant to support scoping for a future large-scale cataloguing grant application. An Expression of Interest has been submitted to the Natural England Species Recovery Programme for RES to be lead partner in a proposal working with Gloucester, Somerset and Wiltshire Wildlife Trusts, the National Trust and others on a multi-species recovery project from June 2026 to March 2029. An application has been made to the Elgol fund to support our Large Blue conservation work in Gloucestershire and Somerset.

Amongst many recent developments in relation to grants, partnerships and business development, BASF (UK) and UKCEH have joined the RES as gold-level organisational members. The partnership with Aardman's Lloyd of the Flies is continuing, with focus on the 50th anniversary celebrations of Aardman in 2026.

Journal submissions for the year are up 15% on last year. Wiley is aiming to provide a recommendation by the first week of February 2026 on the potential to flip *Insect Conservation and Diversity* to Open Access.

The meeting of the All-Party Parliamentary Group on Bees, Pollinators and Invertebrates at the House of Lords went very well. A report can be found in this issue of *Antenna.* Plans are proceeding for meetings in 2026. In September, RES was invited by Defra to take part in a Pollinator Action Plan Working Group session involving several of our Fellows and partners. The Society will join the Steering Group.

Matters for Discussion
The Management Accounts and Risk Register were presented and discussed.

Matters for Decision
Simon reported that a buyer for Mansion House has been found. Council agreed that the amount offered was appropriate and that the sale should proceed.

Presentations were made by Echospace and Andrew Pryke (ARP Chartered Surveyors), on the exciting interior design of 24 Wenlock Road. After much lively input of ideas from trustees, the costings were approved.

Wiley has offered an attractive package to take on our forthcoming new journal *Approaches in Entomology*. The publication arrangements were approved.

Subscriptions for the 2026/2027 membership year were approved.

Matters for Information
Minutes of the Science, Policy & Society Committee, EDI Committee, Publications Committee, Outreach Committee, Education Committee, Events Committee and Health and Safety Group were circulated but not discussed, as was a summary of recent press coverage.

Thanks
The President thanked trustees and staff and wished them a merry Christmas.

Who's Who at the Royal Entomological Society

Welcome to 'Who's Who' at the Royal Entomological Society
As Chief Executive Officer, I am delighted to introduce you to the talented team behind the Society's work. Our mission is to work with and support our membership in order to advance the science of entomology and promote its importance in addressing global challenges. This directory showcases the people who make that possible, professionals dedicated to research, publishing, education, policy and conservation.

Each member of our team plays a vital role in delivering impact: from shaping strategy and governance to managing publications, supporting members and driving outreach. Their expertise and commitment ensure the Society remains a trusted voice and an innovative leader in the field.

I feel incredibly privileged to work alongside such a passionate and skilled group of individuals. Every day, I see their dedication making a difference, not just within the scientific community, but in society at large. Whether you are a long-standing member or new to the Society, I hope this resource helps you connect with the people who make our work possible. Please don't hesitate to reach out; collaboration and conversation are at the heart of what we do.

Together, we can continue to champion entomology and its contribution to science, society, and the environment.

Simon Ward
Chief Executive Officer
Royal Entomological Society

Executive Office

Simon Ward Mem.RES
Position: Chief Executive Officer
Email: exec@royensoc.co.uk

Simon works strategically with the trustees to shape the Society's vision and long-term goals while ensuring effective governance. He oversees all operational aspects, driving efficiency and impact across programmes and initiatives. A significant part of his role involves engaging with members, stakeholders, and partners from academia, industry, policy and public engagement. Through these collaborations, Simon champions the advancement of entomology, positioning the Society as an influential voice and trusted partner.

Kay Oxley Mem.RES
Position: Executive Co-Ordinator
Email: exec@royensoc.co.uk

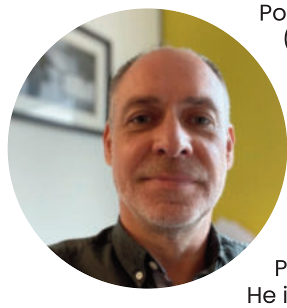
Kay provides executive and governance support to the CEO, Council and committees, ensuring smooth administration and communication across the organisation. Her role includes managing meetings, correspondence and official records, coordinating projects and events, and overseeing administration processes and information systems. Acting as a central contact point for staff, membership and partners, Kay ensures effective coordination and upholding of charity governance standards.

Publishing Department

Emilie Aimé Mem.RES
Position: Director of Publishing
Email: emilie@royensoc.co.uk

Emilie is responsible for overall success of the RES Publications portfolio, including our library, journals, handbooks and *Antenna*.

David Ross Mem.RES
Position: Director of Publishing (Interim)
Email: david.ross@royensoc.co.uk



David has been heavily involved in the transition to open access, being a founding board member of the Open Access Scholarly Publishing Association (OASPA). He is responsible for overall success of the RES Publications portfolio whilst Emilie is away.

Dr Jayne Whiffin Mem.RES
Position: Managing Editor
Email: jayne@royensoc.co.uk

Jayne works with our academic editors to ensure the journals' continued success in an ever-changing publishing landscape. This includes: working on the strategy for the portfolio as a whole; discussing how to develop an individual journal with its Editors-in-Chief; putting together board meetings; managing the relationship with our publisher and the tools they provide; project managing innovations on the journals; and ensuring the journals are promoted across various media and in person at conferences and meetings.

Rosemary Pearson Mem.RES
Position: Librarian & Archivist
Email: rose@royensoc.co.uk

Rose oversees the Society's unique entomological library and archive. Key responsibilities include assisting members with research queries, running the article supply and loans services, the acquisition of new print and electronic material and collections care. She also works to promote the collections and writes on rare books and libraries for *Antenna*.

Dr Jennifer Banfield-Zanin FRES
Position: Editorial Coordinator
Email: jen@royensoc.co.uk

Jen is responsible for the smooth and timely publication of *Antenna*, working with and supporting its editors to ensure it continues to deliver quality content. She also works with the Managing Editor and the Digital & Media Officer, helping to promote content published in the RES journals. She supports the delivery of other publications projects and the running of the RES Publications Committee, along with other administrative tasks.

Kate Watkiss Mem.RES
Position: Facilities Officer
Email: kate@royensoc.co.uk

Kate manages a wide range of operational needs including coordinating maintenance and remedial projects, monitoring building systems, ensuring regulatory compliance, organising staff training and implementing health and safety procedures, working closely with external suppliers to deliver reliable, cost-effective solutions to keep the Society's infrastructure operating at its best.

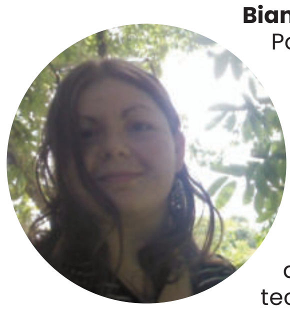
Policy, Communications and Membership Department

Tom Leeman Mem.RES
Position: Policy and Public Affairs Manager
Email: tom@royensoc.co.uk

Tom is responsible for furthering the Society's policy objectives by engaging with government departments and ministers, members of parliament, think tanks and other parliamentary stakeholders.

Rebecca Brueton Mem.RES
Position: Membership Manager
Email: rebecca.brueton@royensoc.co.uk

Rebecca is working to cultivate a strong, connected and growing community of UK, international and organisational members. She helps to shape events, initiatives and improvements that enable the community to grow and thrive.



Bianca Saccone Mem.RES
Position: Digital & Media Officer
Email: bianca@royensoc.co.uk

Bianca supports website management, content curation, digital marketing, social media and event promotion, while working across departments to meet a broad range of digital, technical, operational and reporting needs. Her focus is on strengthening the Society's online presence and raising awareness of its programmes, activities and impact.

Jemma Gannon Mem.RES
Position: Finance & Governance Administrator
Email: jemma@royensoc.co.uk

Jemma supports the finance and governance administration. She works closely with the accountants, ensuring they receive invoices and expenses for payment as well as informing them of the income the society receives. She is involved in the internal management of the awards and grants schemes..

Gulam Hussain Mem.RES
Position: Membership and Events Officer
Email: gulam@royensoc.co.uk

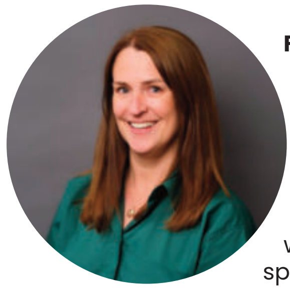
Gulam aids members with any membership queries, as well as supporting and assisting with the development of membership services. He puts together new Fellowship applications for the panel to assess, notifies applicants of the outcome, and checks and validates student memberships.

NEWS

Development and Projects Department

Anne Weinhold Mem.RES
Position: Head of Development and Projects
Email: anne@royensoc.co.uk

Anne works with colleagues on our events and conferences, outreach and education as well as our partnership project work on insect ethics and welfare. She manages our fundraising and business development activities and coordinates our Equality, Diversity and Inclusion Committee. She is also developing our commercial licencing portfolio.

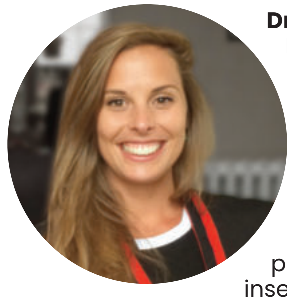


Fran Fleming Mem.RES
Position: Events Manager
Email: fran.fleming@royensoc.co.uk

Fran is responsible for organising our scientific events. This includes liaising with delegates, venues, sponsors and exhibitors, members of the Events Committee, Student Representatives and SIG Convenors.

Francisca Sconce FRES
Position: Senior Outreach & Learning Officer
Email: fran@royensoc.co.uk

Fran oversees RES outreach and education projects, such as Insect Week , exhibition stands at New Scientist Live, the education programme at the RES Garden, and an upcoming project on careers with insects. She coordinates the Outreach Committee and Education & Training Committee, which assess applications for awards and funds for outreach and teaching.



Dr Jessica Stokes FRES
Position: Project Officer
Email: jessica@royensoc.co.uk

Jess maintains extensive links across research communities, including ongoing supervision and support of students. She works across a broad portfolio of projects from the ethics of insects in research to insects as food and feed, supporting member needs and helping develop innovative services for newly evolving areas of entomology.

Conservation Science Project Team

David Simcox FRES
Position: Conservation Project Manager
Email: david@royensoc.co.uk

David leads work building on a 50-year programme of scientific research on the globally endangered Large Blue butterfly and associated species. The team works across several landscapes in the UK, including Gloucestershire where RES co-owns Daneway Banks nature reserve with the Gloucestershire Wildlife Trust, which supports a core Large Blue population. Together with Sarah, the work includes monitoring the impacts of climate change on wildlife, advising site managers from NGOs and helping colleagues in Denmark to save their last colony of Large Blues.

Sarah Meredith Mem.RES
Position: Conservation Project Officer
Email: sarah@royensoc.co.uk

Sarah conducts research to help inform the conservation work taking place at sites such as Daneway Banks. She engages in outreach activities to demonstrate the value of landscape scale conservation for insects.

A new EDI Committee Chair and actions

Anne Weinhold, Head of Development and Projects

The Equality, Diversity and Inclusion Committee is delighted to welcome Dr Allan Watt, President Elect and Science Area Lead at the Centre for Ecology and Hydrology in Edinburgh, as the new Chair of the Royal Entomological Society's EDI Committee. He is currently overseeing the committee's first EDI survey that seeks to determine both the committee members' confidence and present ability to speak to different EDI issues both at the Society and within the wider membership. Conducted by research agency Ragdoll Research, Bristol, the survey results will also recommend any training needs for the committee and a schedule for rolling out the survey to other RES committees in 2026.

The RES EDI action plan has been updated to ensure that our activities in 2026 consider appropriate measures and concerns for inclusion and diversity across the organisation. Actions for 2026 include the Publications Committee's commitment to increase the gender and geographic diversity of the journal editorial boards with targets set by journal Editors-in-Chief based on their respective submissions. The Outreach Committee has put forward its aim to review Insect Week activities in 2025 with recommendations for at least two activities in 2026 that ensure greater public engagement in entomological activity.

We will shortly open-up the 2026 round of our EDI grant, with further funds available for insect science projects that have equality, diversity and inclusion at the core of proposed activities. Please check our website for submission timelines, and for any queries or accessibility needs please contact anne@royensoc.co.uk.

Conservation Science

Danish Blues: applying our evidence-based science to help the declining Large Blue butterfly (*Phengaris arion*) to survive and prosper in Denmark

David Simcox and Sarah Meredith
Royal Entomological Society Conservation Science Team
david@royensoc.uk

On 31st March 2025, Sarah Meredith, Jeremy Thomas and I were met by Peer Ravn at Copenhagen airport and driven south in glorious sunshine to the beautiful Møn region where we were to spend the next five days. Peer, a highly successful and dynamic conservationist (www.ravn-nature.dk), first contacted me in 2019 to ask if we could help prevent the Large Blue butterfly (*Phengaris arion*) from becoming extinct in Denmark. He explained that although over 50 colonies existed in the 1920s there was now only one small colony surviving on a nature reserve (Fig. 1). Over the following years we helped Peer and his colleagues to apply for funding and in 2024 they were awarded the LIFE Orchids project centred on the restoration and creation of 'dry grasslands', crucial to the survival of many of Denmark's rarest orchids and their one remaining colony of the Large Blue.

Key targets for RES work

Early in 2025, the RES Conservation Science team began working on a four-year contract to carry out research in Denmark with the key aims to:

- Ensure the survival of the existing Large Blue population
- Identify potential nearby sites for future expansion
- Work with site managers to improve habitat quality for Large Blues
- Research, design and implement a reintroduction programme.

Our priorities during 2025 were to carry out baseline surveys to assess the habitat quality of the existing site at Høvblege, these included measuring the distribution and abundance of food plants, host ants and the Large Blue population. This chalk downland site is rich in biodiversity, supports a multi-age mosaic of Juniper (*Juniperus communis*) which is declining across Europe, and is regularly grazed by Galloway cattle (Fig. 2).

Ant surveys with positive results

We found that Large Blue food plants Thyme (*Thymus drucei*) and Marjoram (*Origanum vulgare*) are well distributed across the site in good numbers. We measured the percentage of both plants that lie within the foraging range of the Red Ant (*Myrmica sabuleti*) which Large Blues parasitise. Small piles of cake were placed next to the foodplants and checked one hour later. The species of ant was recorded, together with the

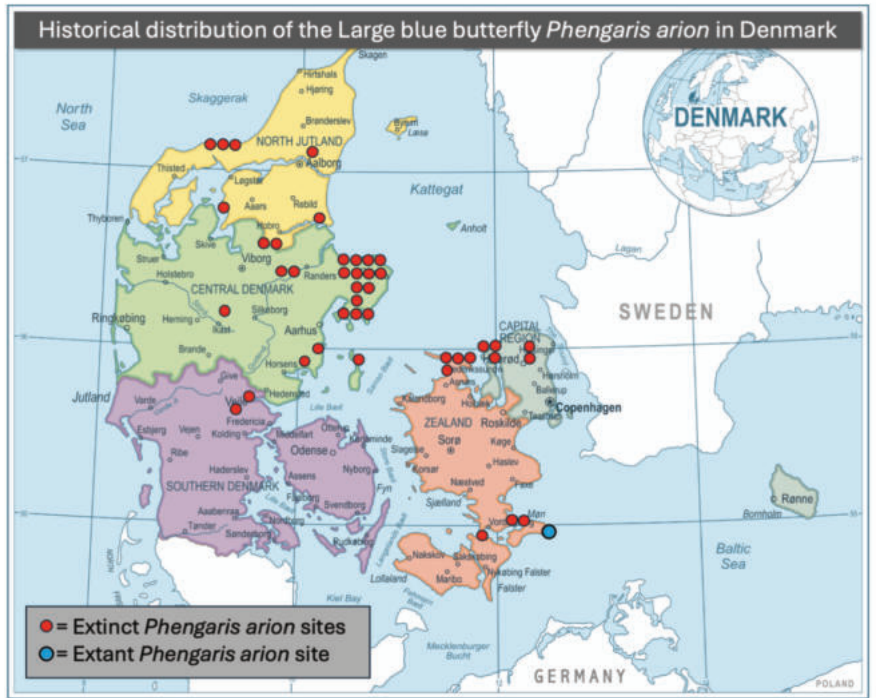


Figure 1. Former distribution of *Phengaris arion* in Denmark (red circles) and the one remaining colony at Høvblege, Mon (blue circle). Map Shutterstock 2170415671 with data supplied by Per Stadel Nielsen.

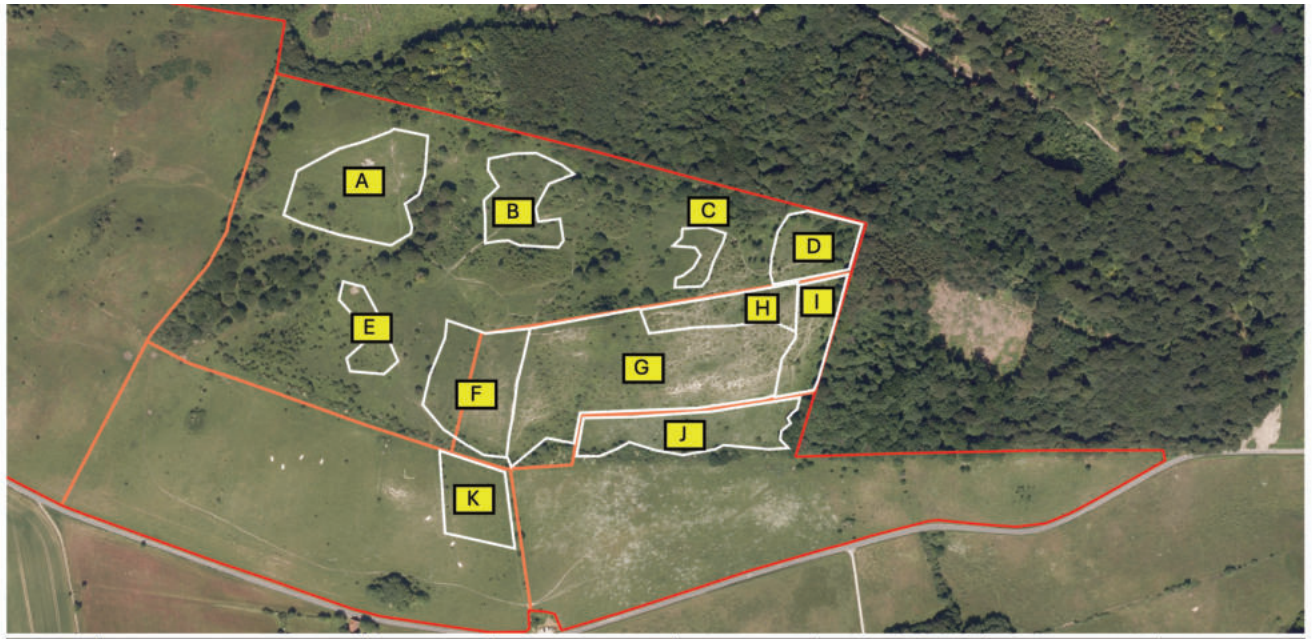
Figure 2. Galloway cattle extensively graze the flower-rich slopes at Høvblege throughout most of the year except during the Large Blue flight period in June and July. Credit: David Simcox.

number of ants and the average turf height. Our previous studies have shown that for a site to be able to support a colony of Large Blues this figure must exceed 68% (Thomas *et al.*, 2009). Encouragingly, most of the site surpassed this figure with the large south-facing slopes (F,G,H & I) averaging >90% (Fig. 3).

Measuring the Large Blue population

The first Large Blues emerged on Høvblege on 12th June and by watching egg-laying females we were soon able to confirm that both Thyme and Marjoram were being used. Regular timed counts (Fig. 4) of adult Large Blues confirmed that they were breeding right across the site and helped us to decide when to carry out egg surveys (Fig. 5).

The density of eggs laid on Thyme was measured in the field as the eggs are relatively easy to see. However, the dense flowers of Marjoram make this impractical, so samples of known numbers of Marjoram spikes were collected and kept in a temporary field laboratory. As the larvae reached their 4th and final instar, they dropped into plastic bowls, enabling us to measure the density of larvae per flower spike. The populations of Thyme and Marjoram across the site were measured using quadrats and when combined with their respective egg densities, we were able to calculate that the total Large Blue egg population for the whole site was approximately 166,000 – equivalent to circa 6,500 butterflies emerging over a five-week period. We have shown that in the UK, Large Blue populations can vary by 100-fold (Thomas *et al.*, 2025) and that the Høvblege population in 2025 ranks with



	Area Name - English	No. of baits	No. with *M.sabuleti*	% *M.sabuleti*	% baits >30 ants	Foodplant	X turf ht (cm)
A	Kings Hill	31	22	71	86	*Origanum*	5.3
B	Amphitheatre	44	38	86	71	*Origanum+Thymus*	6.1
C	North facing slope	12	10	83	34	*Origanum+Thymus*	4.5
D	North-east plateau	40	29	73	21	*Origanum+Thymus*	5.4
E	Slumber Valley	30	25	83	80	*Origanum*	5.3
F	Main slope west	31	30	97	33	*Origanum+Thymus*	3.8
G+H+I	Main slope centre	55	52	95	97	*Origanum+Thymus*	3.1
J	South-east arable reversion	77	48	62	43	*Origanum*	4.4
K	South arable reversion	28	6	21	33	*Origanum*	5.2
	Totals	**348**	**260**	**75**			

Figure 3. Detailed ant surveys reveal that Høvblege supports robust and numerous colonies of the Red Ant (*Myrmica sabuleti*) crucial to the survival of Large Blues. The cooler areas C & D will become important in the future under a warming climate. Aerial supplied by Danish Nature Agency.

Figure 4. Sarah undertaking timed counts of Large Blues (Credit: David Simcox). Like most Large Blues on Høvblege this female (inset; credit: Sarah Meredith) has few spots on the upperwings.

Figure 5. Sarah searching for Large Blue eggs laid on Thyme on Høvblege. The pale blue eggs are relatively easy to see in the field (inset). Credit: David Simcox.

Figure 6. Discussing management options with our Danish colleagues. From right: Carsten Horup, Alberte Margrethe Kofoed Larsen, Anna Ravn, David Simcox, Peer Ravn, Ditte Gammeltoft, Markus Raeder Konner, Helle Stuhr and Jens Ljungmann Pedersen. Credit: Sarah Meredith.

some of the largest ever measured.

Potential reintroduction sites

In addition to Høvblege, we also carried out detailed surveys on another Danish Nature Agency reserve at the nearby Jydelejet, where Large Blues became extinct in the late 1970s – about the same time as in the UK. The results of the surveys were very encouraging, with both food plants and *M. sabuleti* ants being extremely well distributed. We met regularly with Ditte Gammeltoft and Hele Stuhr who manage these sites and Carsten Horup from Vordingborg Kommune who oversees the whole Life Orchid project (Fig. 6). As part of this project, we have been delighted to be able to advise on management issues such as scrub control and grazing to improve the sites' potential to support Large Blues.

Plans for 2026

Our key priorities during 2026 will be to undertake detailed ant surveys at both Høvblege and Jydelejet to evaluate the impact of this winter's management and decide, together with our Danish colleagues, whether to carry out a trial reintroduction to Jydelejet in June and July. During our most recent visit in October we were shown the extensive unimproved calcareous grasslands belonging to the Klintholm Estate which lie between Høvblege and Jydelejet. The Estate is keen to follow our recommendations to increase the grazing which would ultimately enable the Large Blue to naturally colonise, creating a sustainable Large Blue metapopulation as in the UK (Simcox *et al.*, 2025).

This challenging project has enabled us to apply our extensive knowledge of Large Blue ecology to help conserve them in Denmark. To date, we have not noticed any significant differences in the species' ecological requirements but celebrate seeing it prosper on sites which support such rarities as Wart-biter Bush-crickets, Lady Orchids, Sand Lizards and Juniper.

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Thomas, J.A. *et al.* (2009) *Science* **325,** 80–83.
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Library and Publications

The Aurelians Painting 1908–09

Rose Pearson
RES Librarian and Archivist

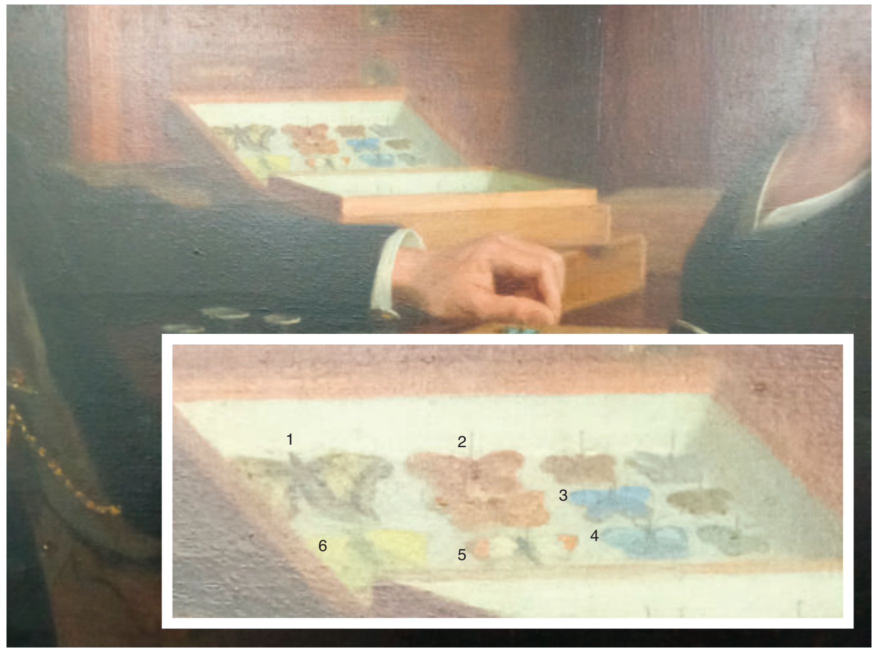
At nearly 2.5m wide and 1.5m high, the oil painting *The Aurelians* is a striking presence in the RES Council Room. Completed in 1909 by South African born portrait painter John Cooke (1866–1932), the painting features two enthusiastic lepidopterist friends, mounting specimens of the British butterflies they were both passionate about. A large entomological display cabinet is prominent in the background.

The two men met as undergraduates at Oxford in 1868, both sharing a love of art and natural history, and went on to have very different careers; on the left is George Blundell Longstaff (1849–1921) and on the right Selwyn Image (1849–1930).

Longstaff was born in 1849 to a physician father. His uncle, William Spence, was an economist and entomologist and President of the Society 1847–1848. While studying natural history at Oxford, an accident meant that he lost the sight in one eye, leaving him unable to do microscopic work. This did not stop him travelling to every continent to collect Lepidoptera, as detailed in his 1912 autobiography *Butterfly Hunting in Many Lands*, which was dedicated "To my old friend and fellow Aurelian, Selwyn Image".

Outside of natural history he studied, but never practiced, medicine, wrote on demographics and was elected as the Wandsworth representative for the first London County Council in 1889, serving a total of five three-year terms.

The Aurelians by John Cooke. Credit: Rose Pearson.



A collection of British butterflies including: Swallowtail (*Papilio machaon Britannicus*; inset 1), an unspecified fritillary species (inset 2), Adonis Blue (*Polyommatus bellargus*; inset 3), Chalk Hill Blue (*Polyommatus coridon*; inset 4), Orange tip (*Anthocharis cardamines*; inset 5), Brimstone (*Gonepteryx rhamni*; inset 6) and Holly Blue (*Celastrina argiolus*; not numbered). Credit: Rose Pearson.

He published widely on Lepidoptera, including a note on the Lepidoptera of Wandsworth in the first issue of *Entomologist's Monthly Magazine*. Longstaff joined the Society in 1904 and served as Vice President in 1909, 1915 and 1917, published in the Society's Transactions as well as donating £1,000 (around £55,000 in today's money) to the Society before his death. He was also a Fellow of the Linnean Society and the Geological Society and a keen supporter of the Hope Department of Entomology in Oxford.

When he passed away after a long illness, Image wrote his obituary in *Entomologist's Monthly Magazine*, lamenting: "*so passes the oldest and dearest of my friends*". Many Fellows of the Society attended his funeral.

Image was born in Sussex, where his father, John, was the local vicar, as well as being one of the original members of the Society. Initially following in his father's footsteps and becoming ordained as a priest, he began studying art in 1880 and left the clergy two years later.

After studying with A.H. Mackmurdo, who founded the Century Guild of Artists – part of the Arts and Crafts movement – he established workshops for the organisation. He was best known for his work in stained glass, designing windows for around 30 churches. He also designed embroidery, book bindings and furniture. In 1910 he became the Slade Professor of Art at Oxford University and wrote and lectured widely. One of his lectures was reviewed by Oscar Wilde.

Image enjoyed regular butterfly collecting trips in London and Essex, as detailed in his collecting notes, which are held in the RES archive, but his favourite collecting area was the New Forest. Image preferred the term *Aurelian* to *Entomologist* as he found it more elegant. He joined the Society in 1897, remaining a Fellow for the rest of his life, and served on Council 1909–1911. In 1912, he joined the Entomological Club, the oldest extant entomological society in the world. When the Society moved to new headquarters opposite the Natural History Museum in London in 1921, he wrote a poem to commemorate the occasion. He was also responsible for acquiring portraits of Fellows to be displayed on the wall, including a portrait of the recently deceased Longstaff.

He died in Holloway, London, at the age of 81 and is buried in Highgate Cemetery. In 1932, the painting was donated to the RES by his wife, Janet. It is planned for the painting to remain on display once the RES moves to its new London HQ.

If you would like to view the painting or other items from the RES Collections, please contact the Librarian on 01727 899387 or library@royensoc.co.uk to make an appointment.

Thank you to Sarah Meredith and David Simcox for the butterfly identifications.

The Terry Dillon book bequest

Rose Pearson
RES Librarian and Archivist

When RES Honorary Fellow Terry Dillon passed away last year, he left a unique collection of Lepidoptera books to the Society.

Dillon was elected to the RES in 2000 as a retired member, giving his interests as Lepidoptera and Bibliography, and became a Fellow in 2010, and an Honorary Fellow in 2017. Dillon was also a longtime member of the Amateur Entomologists' Society, the British Entomological and Natural History Society, The Society for the History of Natural History, and a Fellow of the Linnean Society. He contributed to several books on British Lepidoptera, and also to works on the history of entomology and entomological bibliography.

His collection, of exceptional quality, contains around 600 volumes dating from the early 17th to the late 19th century. Whilst the majority of the collection focuses on Lepidoptera, it also includes key works on general entomology and natural history. Some highlights of the collection include significant works by Eleazer Albin, author of the first English entomological book with colour illustrations, Maria Sibylla Merian, pioneer entomologist and artist, and J.O. Westwood, RES President 1852–1853.

Meetings

Food and Feed Special Interest Group

9th October 2025

Elm Grove Conference Centre, University of Roehampton, London

Convenors: Daniel R. Amor and Kieran David Robertson

Report by Daniel R. Amor

Discussions over an excellent (but non-insect) lunch. Credit: Fran Sconce (RES).

This hybrid event involved scientists, farmers, food technologists, industrialists, lawyers, chefs, students and more, from the UK and overseas. The programme was structured around four key pillars of entomophagy: ethics; food; feed and nutrition, with each session offering fresh insights into the growing role of insects in sustainable food systems.

Session 1: The Ethics of Insects as Food and Feed (Chair: Jessica Stokes, RES)

The opening keynote by Prof. Jonathan Birch (LSE) posed a thought-provoking question: *Do insects have sentience*? He examined research on insect learning, play and, critically, pain responses. If insects have sentience, is this grounds on which ethical and welfare considerations afforded to livestock should be extended to insect rearing and farming? A key takeaway message was the need to establish clear welfare standards where insect-focused farming is concerned, to ensure both ethics and productivity.

Corentin Biteau (National Observatory on Insect Farming) cautioned against overstating the benefits of insect farming on both economic and environmental grounds, sparking an interesting debate from delegates of both viewpoints. George Burton (UCL) delivered a talk on the global origins of entomophagy from traditional communities, the lessons learned from these, and how this could impact large-scale adoption of the practice.

Session 2: Insects as Food (Chair: Dr Daniel R. Amor, University of Bristol)

Dr Jo Gould (University of Nottingham) delivered a keynote on the inclusion of insects in foods, from a technological perspective. She discussed her work on understanding the functional properties of proteins extracted from a variety of insect species and demonstrated that harnessing this knowledge identifies key ingredients which insect proteins could replace, with a reduced environmental impact. High performance of insect protein ingredients was noted in emulsions, foams and snack products. Dr Oscar Sánchez-Velázquez (University of Leeds) stressed that not only is the insect source of protein important, but the methodology used to extract and isolate these proteins affects both techno-functional properties and nutritional content of products, which in turn affects their prospective application in food products. Dr Geoffrey Knott (Chair of the UK Edible Insect Association – UKEIA) gave an overview of sustainable cricket production at edibl® (The UK Insect Company Ltd) and the lessons he had learned from his experience taking the company from concept to reality, underscoring the real opportunity to develop a robust UK insect food pipeline.

Session 3: Insects as Feed (Chair: Kieran David Robertson, Queen's University Belfast)

Ben Brown (InsectBiotech) presented a keynote talk discussing his approach to farming and utilising Black Soldier Fly (BSF) as one of nature's most efficient bioconversion systems. InsectBiotech uses its current farms to convert waste residues from agriculture into protein, oil and fertiliser, all whilst using minimal water, energy and land, without creating any additional pollution. Kieran Robertson discussed his research, focusing on how insects offer a more sustainable alternative to soy-based diets for livestock, with much discussion of the distinct needs of ruminant and non-ruminant nutrition. Chris Onuoha (Nottingham Trent University) acknowledged the fibre content of insects and the need for industry and academia to distinguish between chitin and neutral detergent fibre, as both are nondigestible components which comprise most of the insect fibre. Chris also demonstrated how rearing parameters affected the nutritional content of BSF larvae.

Session 4: The Nutrition of Insects as Food and Feed (Chair: Prof. Lisa Methven, University of Reading)
Prof. Tim Parr (University of Nottingham) discussed the huge variety of factors which affect the nutrient composition of insects before they are incorporated into animal feeds or human food, and the various approaches towards controlling this. He highlighted that it is not only the feedstock which insects are reared on, but the environment in which they are farmed which influences the nutritional composition of insects as a food or feed ingredient. This was followed by a research proposal from Joyce Njenga (Jomo Kenyatta University of Agriculture Science and Technology) to investigate the prospect of enriching BSF larvae meals to increase the content of Omega-3 polyunsaturated fatty acids. James Rutherford (University of Surrey) showcased his research into the bioavailability of insect nutrients, dependent on the age of the consumer. This included preliminary work on the digestibility of insects compared to whey protein, using muffins as a carrier food.

Posters
The conference featured an impressive array of posters. These covered a wide range of subjects, from the utilisation of CT-scanning to map the distribution of nutrients within edible insects, to the application of *in-vitro* digestion models to understand the potential allergenicity risks associated with insect protein.

Closing Remarks
The convenors would like to extend special thanks to Michelmores for sponsoring the event, the Insect Welfare Research Society (IWRS) for support via a small meetings grant, and to our colleagues at the RES for their unwavering support throughout the entire process. A final thanks and well-done to all who presented at IAFF25.
The work continues… roll on IAFF26! Save the date: 18–19th November 2026, London, UK.

New Scientist Live 2025

Francisca Sconce

Royal Entomological Society

Beautiful insect illustrations from the book *Insectarium* featured in a stage show and stand at New Scientist Live at Excel London from 18th to 20th October 2025. The RES was a partner exhibitor at the event, which had more than 21,000 visitors over three days.

Dave Goulson, Professor of Biology at University of Sussex, and illustrator and designer Emily Carter took part in "The *Insectarium* Story" show on the Engage stage, highlighting how entomological research was translated into the RES and Big Picture Press partner-published book. Dave highlighted the insects that particularly inspired him and Emily explained the illustration process and negotiating feedback from RES entomologists. The session, chaired by Alison Flood from *New Scientist*, was then opened up to questions from the audience, which included "how many insects are there?", and "what was the hardest species to draw?".

On the show floor the RES stand featured *Insectarium* illustrations on the walls and visitors were able to pick up taster sheets of the *Activity Book* and view the recently published *Poster Book.* Elsewhere on the stand we showed off recent winners of the RES Photography Competition, had live insects for visitors to meet, displayed insects in resin under microscopes and promoted careers and pathways in entomology.

Thank you to the ten volunteers who supported our activities, Resources for Change who evaluated our activities, and Russell McLean from Bonnier Books for supplying book artwork. The RES is planning activities for October 2026; do get in touch with Fran Sconce (fran@royensoc.co.uk) to find out more.

Anne Weinhold talking to visitors on the RES stand. Credit: Fran Sconce/RES.

Leaf insect handling on the RES stand. Credit: Alistair Veryard/New Scientist Live.

A young person using microscopes on the RES stand. Credit: Alistair Veryard/New Scientist Live.

46th Orthoptera Special Interest Group

Natural History Museum, London

5th November 2025

Convenors: Darron Cullen and Judith Marshall

Report by Richard Harrington

A tube strike led to last year's meeting being online only, so it was good to meet in person again. Forty enthusiasts gathered at the Natural History Museum and another fourteen joined online. As always, Judith provided drinks and cakes whilst Darron had organised an excellent programme comprising a mix of hard science and natural history. Thanks to them both, and to Beulah Garner, Curator of Small Orders (what a splendid job title), our Museum host, Fran Fleming, RES Events Coordinator and Bianca Saccone, who ran the online service.

The first talk came from Louise Coates (University of Bath), who is studying how nematomorph parasites (known as horsehair worms, hairworms or Gordian worms) manipulate the House Cricket (*Acheta domesticus*). The adults need freshwater and manipulate their hosts to increase their chances of entering water. It is thought that they do this by inducing erratic behaviour, and Louise designed an assay to test this hypothesis. Five-minute video track analyses showed that crickets infected with *Paragordius varius* (Fig. 1) displayed more erratic movement, despite a reduction in overall activity levels, in comparison to uninfected crickets. Crickets entered water most frequently on the day of worm emergence and displayed increased erratic behaviour one to two days before worm emergence. Small RNA (sRNA) from immature *P. varius* secretions target molecular transport and development in the cricket, whilst sRNA from mature *P. varius* secretions target behaviour and reproduction and potentially explain increased erratic behaviour.

Figure 1. *Paragordius varius* emerging from *Acheta domesticus.* Credit: Louise Coates.

The 'ears' of bush crickets (katydids), located in their forelegs, are analogous in some ways to human ears, having paired tympani and a pinna-filled cavity, the morphology of which dictates resonance. Jack Waterfield (University of Lincoln) is investigating ontogenetic acoustic resonance in the pinnae of a Central American bush cricket, testing the hypothesis that the shape of the pinnate cavity shifts with age to bring the resonance closer to bat echolocation frequencies. Jack created 3D-printed models of the cavity at different stages of development to test this. First instars have no pinnae in the cavity but with age the size of the cavity and the number of pinnae increase, and the cuticle becomes thickened. There was a downward shift in peak resonance with age, such that in adults it closely matched the frequency of local bat echolocation calls. Predator detection needs to be optimised in adults because they are more easily heard and seen by bats than are nymphs.

This theme continued in the presentation by Md Niamul Islam (University of Lincoln). Bush crickets have a second auditory pathway via acoustic tracheae. Md wants to understand frequency tuning mechanisms, directional hearing and evolutionary adaptations with a view to developing bioinspired devices to aid human hearing. 3D models have advantages over biological specimens in being non-invasive, reusable, easier to handle and fossil compatible. They facilitate controlled, ethical, repeatable bioacoustics experiments. Laser Doppler Vibrometers were used on 15–20 times magnified 3D-printed pinnate cavities and associated tympanic membranes, as well as acoustic tracheae. Md hopes that it may be possible to redesign the pinnate cavity for modified gain at certain frequency ranges as a route to bioinspired mechanical sensors.

Desert Locusts (*Schistocerca gregaria*) must tolerate very hot conditions. Jake Dudderidge (University of Oxford) is studying changes in thermal tolerance as they age. His hypothesis is that the more mobile stages are less tolerant of thermal extremes because they are more active and can move to available cooler places. This is known as the Bogert Effect. Jake's experiments involved 1 hour of ramping the experimental arena up from 25°C to the treatment temperature, 2 hours at the treatment temperature, 1-hour post-treatment recovery and then survival assessment. All stages survived 45°C, above which adult survival declined. Juveniles all survived to 47.5°C. At 50°C all adults and most juveniles died. Jake has hence demonstrated the Bogert Effect and is planning studies on acclimation, sub-lethal effects, wild vs captive specimens, and eggs.

Mark Marcello is a veterinarian interested in insect productivity and welfare with respect to the food and feed industry. To aid this, together with another veterinarian, Benjamin Kennedy, he is developing an open-source histological atlas of the farmed crickets *Gryllodes sigillatus* (Fig. 2), *Gryllus assimilis*, *Gryllus bimaculatus* and, later, *Acheta domesticus*. He showed impressive, stained sections of various body parts, the idea being that the atlas will aid specialists, perhaps commercial agencies, in identifying pathologies. Discussion focussed on potential

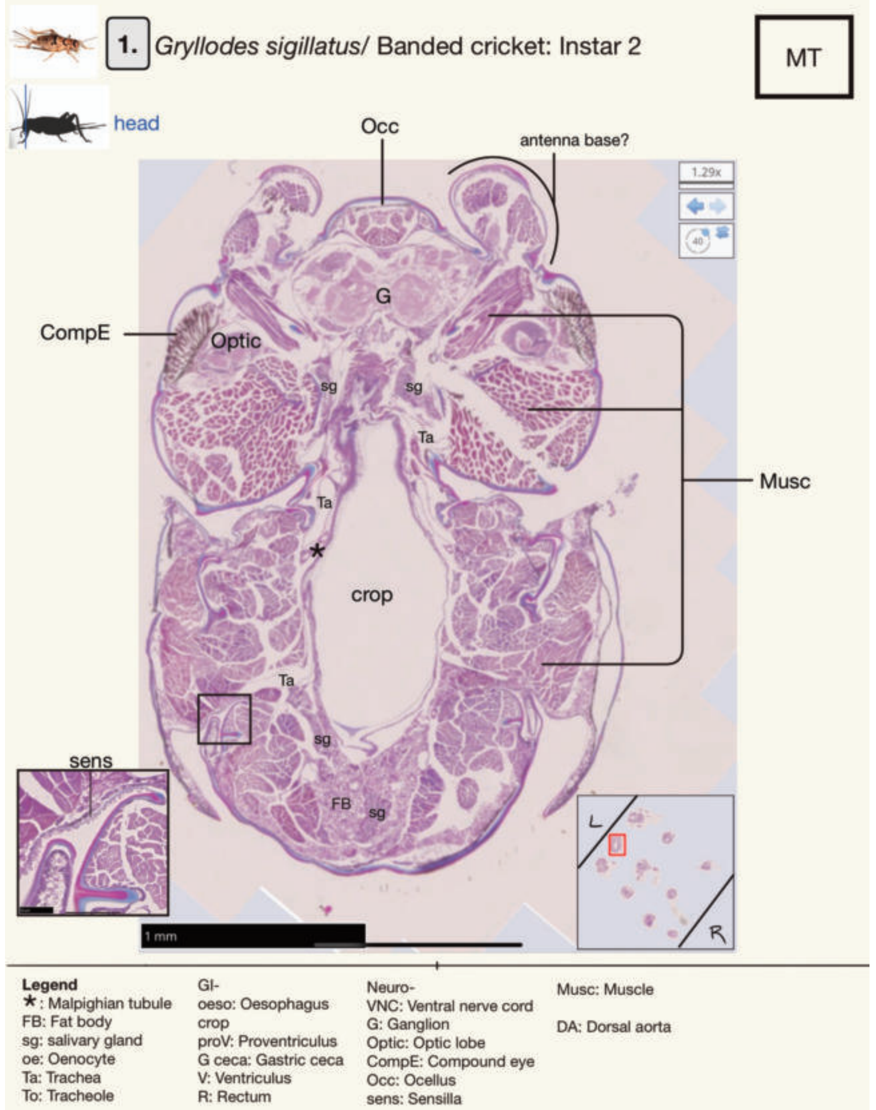


Figure 2. *Grylloides sigillatus* Instar 2. Credit: Mark Marcello.

imaging issues relating to dehydration of specimens in transit, the effect of fixing in 95% ethanol, and the detection of gregarine parasites. It was suggested that in some cases it might be easier and cheaper to assess pathologies chemically than histologically. Discussions also touched on lack of industry standards and necessities of robust key performance indicators for welfare and production measures.

Essex-based orthopterists are in luck. Ted Benton and Tim Gardiner have produced an excellent book, *The Grasshoppers of Essex* (published by the Essex Wildlife Trust, 2025). At a mere £10 it is incredibly good value, and the sales table was soon emptied. This has been a labour of love for Ted since the 1970s and Tim since the 1990s and builds on a 1997 book, *The Grasshoppers and Crickets of Essex (Orthoptera)*, by Alan Wake. The new book compares distributions with those described in the old book. Records are shown for 2 x 2 km squares. Since the first book, the native Grey Bush Cricket (*Platycleis albopunctata*) and Stripe-winged Grasshopper (*Stenobothrus lineatus*) have been found along with three non-native species. The book features Ted's excellent photos and describes the distribution, biology and ecology of each species. Ted describes visiting agricultural north-west Essex as "soul destroying", consoling himself in that you've discovered something if you have discovered that there's nothing there.

Roger Hawkins has been hunting Orthoptera in southern France on a farm which has been turned into a nature reserve where the owner, Jenny Boncey, allows naturalists to stay for free if they record their specialist species. Roger was looking particularly for species absent

Figure 3. *Uromenus rugosicollis*. Credit: Roger Hawkins.

from Britain and found some exciting bush crickets, including *Uromenus rugosicollis* (Fig. 3), but no exciting grasshoppers.

In 2002, the FAO asked Andrew Harvey to manage an emergency locust control programme in the northern provinces of Afghanistan following the fall of the Taliban. This is a mediterranean zone prone to prolonged drought. Locust (*Dociostaurus maroccanus*) plagues are a "last straw". After egg hatch, hoppers march away and the area covered expands by 10–15% per day, hence speed is critical for a successful control programme. Whilst various natural enemies are present and mechanical control has been attempted, chemical control is essential. Locals were paid to recruit teams of ten volunteers who were motivated to work because of the economic benefits gained through increased crop yields. Each was issued with a ULV hand-held sprayer, and the teams walked in chevron lines in the direction of the wind to spray out large areas. End-of-season egg surveys were conducted so that hoppers could be discovered and quickly controlled in spring. Benzoylureas (insect growth regulators that inhibit chitin synthesis and cause death at moulting) were used. As these chemicals must be ingested, they do not affect pollinators, but they only work against hoppers as adults don't moult. Deltamethrin was used to control adults. Andrew estimates that the programme saved growers up to £100 million. Once the funded programme ended, locals were equipped with the knowledge to continue the programme unaided.

At last, the definitive *Field Guide to the Grasshoppers and Allies of Great Britain and Ireland* (Fig. 4) by Peter Sutton and Björn Beckmann (former Orthoptera SIG Convenor) is due for publication on 26th February 2026. It is

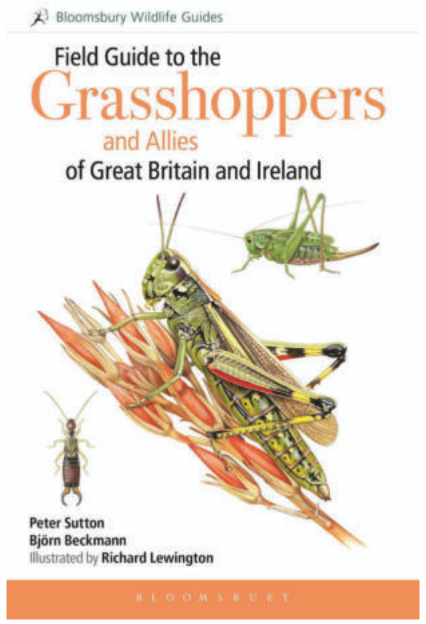


Figure 4. *Field Guide to the Grasshoppers and Allies of Great Britain and Ireland*. Credit: Peter Sutton.

illustrated by the amazing Richard Lewington and published by Bloomsbury Wildlife Guides. It is the culmination of six years of hard graft. Many species appeared for the first time during preparation of the book, but Peter believes it is as future proofed as possible. It covers the Dermaptera, Orthoptera, Blattodea, Mantodea and Phasmida. Yes, the European Praying Mantis (*Mantis religiosa*) (Fig. 5) appears to be established in the New Forest and the Isle of Wight, as is the Blue-winged Grasshopper (*Oedipoda caerulescens*) in Kent, and the Mediterranean Stick-insect (*Bacillus rossius*) is becoming ever more prevalent in the southern counties of England. The book includes regional guides, comparison tables, distribution maps, photos, and QR codes in the species accounts that allow mobile phones to play the songs of the 'singing' orthopterans!

Buglife's Karim Vahed has funding from the Natural England Species Recovery Programme to hunt and map the Scaly Cricket, otherwise known as the Atlantic Bush Cricket (*Pseudomogoplistes vicentae*), which is classified as 'vulnerable'. Threats include severe storms, sea-level rises ('coastal squeeze') and coastal development. It requires marine shingle beaches and is found mainly along the Atlantic coast. It is clothed in butterfly-like scales, the function of which is uncertain. It has a two-year life cycle with eggs, mid stage nymphs and, occasionally, adults overwintering. It is flightless, nocturnal, omnivorous, feeding on strandline debris, and oviposits on driftwood. There are strong populations on Branscombe Beach (Devon) and Chesil Beach (Dorset). Karim, with the aid of volunteers from the National Trust and Wildlife Trusts, has surveyed these in detail by pitfall trapping but has also searched other promising areas. No significant new populations have been found, although it's at the Abbotsbury end of Chesil Beach so is probably present all the way back to the sample sites at the Portland end. None has been found from Hampshire eastwards. Populations declined after major storms in 2013/14 and 2023/24 but gradually recovered, suggesting that the species is resilient to extreme storm events.

Collections can reveal a lot about diversity and distributions in times gone by. Luc Willemse introduced us to some of the world's Orthoptera collections and gave a plug for the multiauthor book *Grasshoppers, Locusts and Crickets of the World*, edited by Martin Husemann and Oliver Hawlitschek, which is due out next year. Luc gave a history of the Linnaeus Collection of Orthoptera, which the great man started in 1741. On his death in 1778, it was taken over by his son, Carl Linnaeus the younger. In 1784 the collection was sold to Sir J.E. Smith, who moved it to the UK. Between 1784 and 1828, Smith added his own material, moving it to the Linnaean Society, which bought the collection in 1828, and it remains at their headquarters in Burlington House, London. It comprises 9,000 specimens, 3,200 of them belonging to the original collection. Luc also described the history of the Naturalis Collection, in Leiden, The Netherlands, in which his grandfather played a major role. Luc lamented the lack of centralised information on Orthoptera collections and is planning to develop a Findable Repositories and Taxa website. In the meantime, The Global Biodiversity Information Facility (GBIF) holds detailed information on close to a million orthopteran specimens. Other sources include the Integrated Digitised Biocollections (iDigBio), Orthoptera Species File (OSF) and Barcode of Life Data Systems (BOLD) databases.

Finally, Stuart Green (*Citizen Zoo*) gave an update on efforts to bring the Large Marsh Grasshopper (*Stethophyma grossum*) back to East Anglia, as he has done on many other occasions at this forum. He reminded us that it is the largest (and most handsome) grasshopper in the UK, and one of the rarest, and how it has declined drastically over the past 80 years due to degradation and

Figure 5. European Praying Mantis (*Mantis religiosa*). Credit: Mark Telfer.

Figure 6. Stuart Green and Judith Marshall. Credit: Richard Harrington.

Figure 7. Judith's plaque. Credit: Stuart Green.

loss of wet habitats, the eggs being especially sensitive to desiccation. The New Forest remains the species' stronghold, but there are historic records from across East Anglia. Each summer, the project trains and equips a small army of 'citizen keepers' who home-rear two cohorts of grasshoppers from egg pods. Since 2018, a remarkable total of 8,283 individuals has been released at seven sites, which are subsequently monitored. Mark-release-recapture work has shown that at least one site is now self-sustaining and others are doing well. A highlight this summer was the first introduction at sites in Cambridgeshire.

Stuart kept the floor to lead a presentation to Judith, marking the fact that she has attended all 46 Orthoptera meetings and organised most of them. They began before the Society's SIGs had been invented and the Orthoptera SIG is hence the original – and, without a shadow of a doubt, the most regular.

Judith was presented with a beautiful bunch of flowers (Fig. 6) and a framed Portuguese hand-painted, art nouveau tile by Bordallo Pinheiro (Fig. 7). Stuart warned taxonomists not to look too closely. He thinks it is supposed to be *Tettigonia viridissima*, but it appears that it may have hybridised with a locust. A card made to Stuart's design was signed by all present. The meeting then adjourned to the legendary buffet, prepared as ever by, yes, you've guessed, Judith.

Outreach, Education & Culture Special Interest Group

National Museum of Scotland (NMS)

22nd November 2025

Convenor: Wendy Harris

Report by Wendy Harris

A buzz of enthusiasm greeted the entomologists who assembled for the first meeting of the re-named SIG. Following a welcome from RES Senior Outreach & Learning Officer, Fran Sconce, and Convenor, Wendy Harris, Sarah Beynon spoke about the achievements and challenges of a decade of The Bug Farm. Sarah's work embraces policy, conservation, public engagement, outreach and education. From developing the St David's Pollinator Trail, managing land for nature recovery, and re-introducing Marsh Fritillary to the St David's Peninsula, there was something everyone could be amazed and inspired by.

Our session talks highlighted the many innovative and valuable ways being employed to encourage community engagement, especially among children and young people, in entomology.

The ways in which entomology is helping to create community events, engage the public with ongoing science research, promote inclusivity and increase mental health are truly inspiring. Clara Montgomery (Queen Mary University of London) explained how students involved in the 'Biocapture' project make connections and improve mental health within their community and with each other through learning about their local nature and sharing this through their creation of videos and guides. Connor Butler embraces inclusivity with his bespoke walks and talks, particularly to engage with the LGBTQ+ community, and so helps to connect everyone to the weird and wonderful ecology of their local insects. Kumari Riya Pati (University of Edinburgh) shares her PhD research on *Nicrophorus vespilloides* (Common Sexton Beetle) with the community using brilliant hands-on research techniques in science festival workshops and citizen science projects. Rosy Christopher (Newcastle University) also uses community science methods to gather information on *Misumena vatia* (Flower Crab Spider), to understand how this species contributes to ecosystem services in verges.

The importance of engaging young people was a strong theme, from storytelling to education on invasive species. Yanet Sepúlveda (University of Sussex) highlighted the history and significance of storytelling as a fundamental way of sharing information that resonates with listeners. The Dear Earth project that Yanet founded includes stories that introduce insects to children and supports their understanding of ecological concepts and environmental challenges, while empowering them to take action to help the planet. Tomas Ditrich (University of South Bohemia) also believes in the power of children – this time to help to monitor the spread of the Asian Hornet (*Vespa velutina*). Tomas and his team trained schoolchildren to identify native and invasive species so that they would have the confidence to recognise and report the invasive species. This project was a great success, demonstrating the abilities of young people to learn quickly and contribute positively. Armando Rosario-Lebron (Swansea University) was also keen to educate young people on the consequences of invasive species – this time ants imported as pets. As there is limited control on the importing of non-native ant species, the risk associated with release of species that could cause environmental damage is high. Encouraging accountability, alongside education on invasive species, will support responsible ownership. Finally, Hayley Jones (Royal Horticultural Society) described the 'Incredible Insects' challenge badge for Girlguiding and other youth groups, created in partnership with the RES. This badge supports young people to explore nature, create art and homes for insects, and learn more about what insects are and the important roles they play.

Wild Wings of Hope taster workshop. Credit: Ashleigh Whiffin.

Coffee and lunch sessions were all gloriously noisy, with lots of introductions and lively chatting. It was a shame (and a challenge) to break up the discussions to move onto the next sessions! We had a dedicated poster session to ensure that there was time for everyone to appreciate the posters on display.

We were so lucky to have two motivating and interactive workshops. The first was a Wild Wings of Hope taster, led by Ashleigh Whiffin (NMS Curator of Entomology) and Ashley Mackenzie-White (NMS Engagement Manager). This session brought back the role of storytelling as a compelling means to share valuable information – in this case about the plight of migrating birds and insects and the messages of hope that they inspire. Ed Harrison, the project artist and lead, had created simple card papercuts that we were invited to put together and decorate to make convincing male and female Orange-tip butterflies, along with a message of hope. These will be transformed into a traditional 'pinned' insect display and exhibited in the NMS.

Our second workshop was led by Jessica Symons, creator of Giant Insect World, and supported us in creating new insect-based games via a walk through our past to remember the games we enjoyed most as children. We used these experiences to join like-minded participants in small groups and from there formulate new games, with insects as the main theme. We came up with a wonderful range of entomology-based games encompassing battling insects, developing skills to identify insects, and more strategic resource-based games where players are ants foraging for food and defending their nest.

Our final guest speaker, Nick Baker, captivated us with his solutions to ensuring insects are always the stars, despite their small size, and making them appeal to all the people who haven't yet discovered how amazing insects really are. Nick's passion and enthusiasm for insects truly epitomises everything we try to create in our outreach, and his stimulating talk was a superb way to wrap up the day.

Nick Baker and his Bug Safari kit. Credit: Ashleigh Whiffin.

Irish Entomologists' Meeting: Celebrating the little things that run the world

University College Dublin

1st December 2025

Convenors: Aisling Moffat and Dara Stanley

Report by Aisling Moffat

Credit: Georgina Mooney.

On a chilly December Monday, the campus of University College Dublin (UCD) was anything but quiet. The halls were abuzz with the enthusiastic chatter of 95 entomologists who had gathered for the highly anticipated Irish Entomologists' Meeting (IEM). Jointly organised by the Royal Entomological Society (RES) and the newly formed (2021) Student Entomological Society of Ireland (SESI), the one-day meeting proved to be a resounding success.

For organisers Dara Stanley (UCD) and Aisling Moffat (University of Galway), the timing could not have been better; having Professor Jane Stout (Trinity College Dublin) as the current RES President provided a perfect backdrop for the meeting. With her support, and that of the RES Irish Regional Representative, Louise McNamara (Teagasc), the event was signposted far and wide across entomological networks in Ireland. For its small size, Ireland hosts a large group of keen entomological researchers and enthusiasts, reflected by the registration list of nearly 100 delegates.

Presentations on the day were kept short to accommodate all of those looking to speak and disseminate their research. The day consisted of four sessions, and a total of 25 8-minute talks, and 14 poster presentations – a jam-packed schedule! The delegates came from a diverse array of backgrounds, representing over 20 institutions, organisations and universities from both the Republic of Ireland, Northern Ireland and Great Britain. These spanned from academia, state conservation bodies, museums, consultancies and Non-Governmental Organisations. This blending of sectors created a uniquely rich environment for discussion and collaboration, underscoring the fact that the study and conservation of insects is a truly multi-disciplinary challenge. Jane Stout reinforced this in her presentation, reminding us to "Stand Tall for the Small". Insects constitute one of the most diverse and numerous groups of organisms on the planet. Here in Ireland, the sheer scale of the invertebrate fauna is astounding, with over 12,000 recorded species of insect alone, and new additions continually being made to Irish species lists. This Irish gathering was a vital opportunity to celebrate these miniature marvels and discuss the profound roles they play in our lives.

Presentations spanned a variety of topics. Delegates heard updates from several different monitoring schemes going on across the Island of Ireland; from two schemes run by the National Biodiversity Data Centre; the Irish Pollinator Monitoring Scheme and the Farmer Moth Monitoring Scheme, to the Ash Sawfly (*Fraxinus excelsior*) survey of

The President, Jane Stout, holding forth. Credit: Sarah Keenan.

Ireland conducted by Agri-Food and Bioscience Institute (AFBI), and the ongoing monitoring of stonefly (*Plecoptera*) by the Environmental Protection Agency (EPA). We heard from Ryan Mitchell (Jennings O'Donovan & Partners Limited) on the mapping of Ireland's Diptera, which were largely under recorded until recent years, resulting in quite a few new additions to the list of known Irish fauna.

Hannah Fullerton (Buglife Northern Ireland) showcased current projects that are looking at increasing public engagement and citizen science around invertebrates. Buglife has also set up a volunteering group, Team Tiny Taxa, established to learn collaboratively about different invertebrate groups and survey techniques, and to get involved in outreach events. This linked up nicely with Jane Stout's call to action, made on behalf of the Royal Entomological Society, as to who is going to be Ireland's 2026 Insect Week Ambassador. It was certainly evident from this event that there are many well-equipped teams that could lead on this. Watch this space!

The meeting held a balanced vision of entomological research ongoing in Ireland, with topics such as pollination, pest control and invasive species being covered. In terms of pollinators, Dara Stanley gave an update on the Great Yellow Bumblebee (*Bombus distinguendus*), noting how confined its populations in Ireland have become. Now recorded primarily in remote west-coast locations, this decline mirrors its status on the European Red List of Bees.

From an agricultural perspective, aphids emerged as a primary concern for Irish cereal production. As vectors for the Barley Yellow Dwarf Virus (BYDV), these small insects represent a significant challenge for the crop production sector.

One very topical presentation was from Aidan O'Hanlon, Curator of Entomology at the National Museum of Ireland. Aidan reported on his involvement in the tracking and capturing of the Asian Hornet (*Vespa velutina*) in Ireland, August 2025. This really was a reminder of how quickly action is needed with invasive species, highlighting the important work of entomologists for Ireland's biosecurity. Luckily all nests detected were controlled before reproduction could occur, but work is still ongoing to provide more information on these first Irish colonies.

Overall, the Irish Entomologists' Meeting was more than just a series of talks and poster sessions; it was a powerful affirmation of the strength and commitment of Ireland's entomological community. It provided a crucial platform for knowledge exchange, career development for young researchers, and the forging of new collaborations necessary to tackle the complex conservation and agricultural challenges that lie ahead. The little things truly do run the world, and thanks to this dedicated and enthusiastic group, the future of these essential creatures in Ireland looks a little brighter.

Many thanks to all presenters and to the RES support team, especially Fran Fleming.

All-Party Parliamentary Group on Bees, Pollinators and Invertebrates

Sustainable Farming Incentives: where next?

25th November 2025

House of Lords

Report by Richard Harrington

Belonging to the Royal Entomological Society offers a rich tapestry of life experiences, as many members and guests discovered as they entered the upper house for a meeting of the All-Party Parliamentary Group on Bees, Pollinators and Invertebrates, for which the RES acts as secretariat.

This session examined the effectiveness of nature-friendly farming policies in relation to invertebrate diversity and associated ecosystem services. Excellent presentations by Emma Gardner and Michael Image (UKCEH) and Tom Breeze (University of Reading) explained succinctly the impacts so far of such policies and modelled their projected impacts to 2051 (using the Poll4pop model) in the face of land-use (but not climate)

Alistair Carmichael MP, Brian Gardiner MP, Tom Breeze. Credit: Fran Sconce / RES.

The panel. Credit: Simon Ward / RES.

The audience. Credit: Simon Ward / RES.

change. The policies examined were Development and Biodiversity Net Gain (BNG), Carbon-motivated Habitat Creation (CMH) and Environmental Land Management Schemes (ELMS), the latter including Countryside Stewardship Higher Tier (CSHT) and the Sustainable Farming Incentive (SFI).

The biggest and quickest gains in abundance have been seen for ELMS, with ground-nesting bees, for example, increasing by 16% nationally and many (but not all) other bees also responding positively. It should be noted that this scheme covers a far larger area than the others. Hoverflies are declining nationally but the impact of ELMS on them has not yet been assessed.

Following the presentations, Tom joined Claire Carvell (UKCEH), Jon Williams (BASF UK), Chris Hartfield (NFU) and Alistair Carmichael MP (Chair of the Environment, Food and Rural Affairs Committee) for a panel discussion chaired by Barry Gardiner MP. There was general agreement that the policies are producing good results but there were concerns, particularly over funding and the current pause to the existing programme. The SFI, for example, has 37,000 agreements but new applications are not being accepted. It is hoped that the scheme will resume in spring 2026.

At this point, the division bell sounded, and the parliamentarians trooped out to do their democratic thing. With a momentarily startled look, our CEO, Simon Ward, was invited to take the chair, which he did with aplomb. The following main points emerged during the remaining discussion.

- The budget to support consistent, sustainable farming initiatives over a wide area and long duration is needed.
- ELMS must work hand-in-hand with long-term economic benefits to farmers. Many farmers have realised that this is the case and are continuing the practices even though they are not currently funded.
- Options under SFI should be bundled, rather than being available in isolation, to achieve a holistic approach.
- Schemes and the science behind them must be communicated in such a way that they are easy for farmers to digest and implement.
- Monitoring systems must be in place to assess the success of the schemes. PoMS (Pollinator Monitoring Scheme) is one of many available.
- Most farmers care more about the soil than about pollinators, but good soil leads to more flowers, which lead to more pollinators.
- Unintended consequences must be noted, and schemes adjusted accordingly. For example, flower mixes should not be hosts to insects and diseases that could potentially infest/infect nearby crops. It is useful, though, if they are hosts to natural enemies of pests.
- There will inevitably be winners and losers amongst the invertebrates.
- There is a need to convince up-chain actors such as food companies to support such schemes.
- Excellent translational science is needed.

Other parliamentarians present were Lord Randall of Uxbridge (Conservative), Baroness Miller of Chilthorne Domer (Liberal Democrat), Terry Jermy MP (Labour) and John Slinger MP (Labour). They joined the guests for a convivial networking drinks reception.

Such discussions have the potential for real influence and are part of the Society's recent drive to have more of a voice in policy, primarily through the recently established Science, Policy & Society Committee.

Forest Invertebrate News

The interests of the *Forest Invertebrates Special Interest Group* extend beyond the forest, to include all tree-associated insects and their kin. We might instead be named the '*Trees, woodlands and forests invertebrates SIG*' (many of us are just as passionate about the trees as the arthropods alongside them!) but that would be rather cumbersome. This year, however, we're keen to celebrate our urban tree invertebrates, and would love to hear from anyone with a shared interest. Urban trees must withstand a wide variety of stresses such as poor soils, root compaction, drought and over-pruning. Another increasingly frequent and widespread pressure upon urban treescapes is non-native insects, which may arrive with imported plants, on traded goods or by hitchhiking. Illustrating this problem, Chris Berman describes here the detection of a newly invasive insect in central London.

Plane Lace Bug: the hitch-hiking hemipteran has arrived in London

Christopher Berman, advisory entomologist at Forest Research
christopher.berman@forestresearch.gov.uk

The Plane Lace Bug (*Corythucha ciliata*) (Fig. 1) is a small yet successful globetrotter. It is native to North America, and as the name suggests, feeds mainly on plane trees (*Platanus* species), including the London Plane (*Platanus x hispanica*) (Fig. 2). The insect was first recorded in Europe in 1964, in northern Italy, and has since spread across much of the continent, as well as parts of Asia and Australia.

Figure 1. Adult Plane Lace Bug, *Corythucha ciliata*. Credit: Forest Research.

Figure 2. Plane tree-lined street (*Platanus* x *hispanica*) in London. Credit: Forest Research.

An adult Plane Lace Bug (PLB) is only about 4 mm long, with delicate, lace-like wings, whilst the nymphs are shiny black and covered in tiny spines. Living on the underside of leaves, the lace bugs use their needle-like rostrum to pierce the leaf surface and suck sap from the cells inside. This feeding drains the chlorophyll from the leaf, leaving pale, speckled spots (known as stippling), that can merge into larger bronzed patches on the upper surface. The undersides of infested leaves often show telltale signs of PLB activity: tiny dark droplets of liquid frass, shed nymph skins, and the bugs themselves clustered together around the leaf veins (Fig. 4). Whilst damage is typically cosmetic, repeated heavy infestations can cause premature leaf drop, reduce canopy cover and make the trees more vulnerable to other stressors.

In the UK, PLB was first found in 2006 on imported plane saplings at a Bedfordshire nursery. The outbreak was swiftly treated, and the pest has shown no sign of persisting in the years since.

However, in summer 2024, the story took a new turn when an adult bug was spotted in Kensington in central London - quite literally hitching a ride on someone's backpack. Following a report on iNaturalist (Fig. 3) by Giuliana Sinclair, a staff member from the Natural History Museum, surveys by Forest Research,

Figure 3. Image posted to iNaturalist of PLB on rucksack. Credit: Giuliana Sinclair.

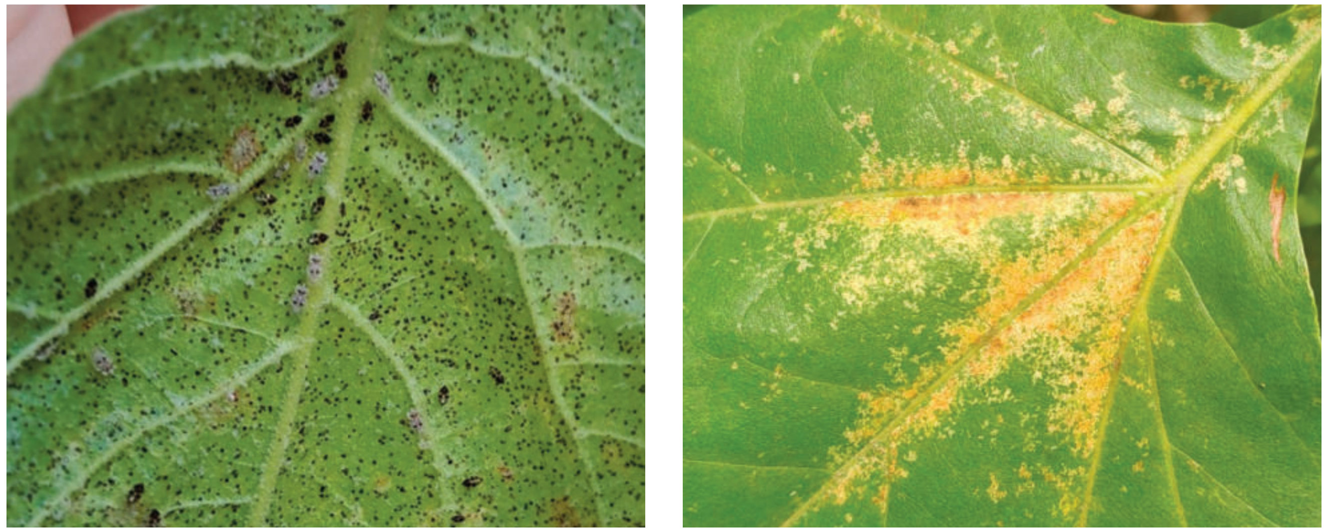


Figure 4. Underside of plane tree leaf covered in PLB adults, nymphs and frass droplets (left), and top surface of leaf showing stippling damage (right). Credit: Forest Research.

Forestry Commission and APHA quickly revealed that the insect had established in several parts of London, including Kensington, King's Cross and the South Bank. Over 1,600 plane trees were inspected across the city during the late summer of 2024, with observed PLB damage ranging from light spotting on leaves, to heavy bronzing and early leaf fall in some cases. On some heavily infested trees, adults were found tucked under bark flakes, indicating they were ready to enter a diapause to survive the cold months. Their survival was confirmed with new reports of PLB in spring 2025.

The 2024 detection appears to be unrelated to the earlier nursery find. Instead, the insects most likely arrived as 'hitchhikers', travelling unnoticed on luggage, vehicles or imported plant material. In London's tree-lined streets they have found a perfect home with thousands of suitable plane tree hosts, and a warm urban microclimate to help them multiply.

The London Plane, arguably the city's most iconic tree, is resilient and the damage remains largely aesthetic. Controlling the pest on large, mature street trees isn't practical or necessary at this stage, and chemical treatments would be costly and difficult to apply safely in urban areas. Instead, the focus is on monitoring and raising awareness.

Anyone who notices unusual leaf bronzing or tiny lace-winged insects on plane trees is encouraged to take clear photos and report it through TreeAlert (https://treealert.forestresearch.gov.uk/), the official Forest Research reporting system. This will help inform of any further spread of PLB populations.

A related species, the Oak Lace Bug (*Corythucha arcuata*), poses a similar threat to European oak trees. Also native to North America, it has spread rapidly across continental Europe. Like PLB, it causes leaf discolouration and premature browning, weakening oak trees during dry summers and raising concerns of increasing impact under a warming climate. With regular movement of plants and vehicles between mainland Europe and the UK, there is a significant risk that it may arrive here soon. Continuous vigilance is key!

The rediscovery of PLB in London is a clear reminder that urban areas are often the first places where new pests appear. It highlights how insect species can establish themselves and begin to spread before they are noticed, and how crucial public reporting and coordinated monitoring are in early detection. So, the next time you walk through a leafy London square or along a tree-lined avenue, take a closer look at the leaves. That delicate lacework of wings may signal one of London's newest residents, a small yet significant example of how the natural world continues to move with us.

What makes a good hitchhiking insect?

- Small and easily overlooked, allowing it to travel unseen on people, plants or goods.
- Hardy, able to survive long journeys, and able to tolerate a range of temperatures and new environments.
- Rapid reproduction, often with several generations per year and short life cycles that help populations build up fast.

TreeAlert logo, Forest Research official tree pest reporting line. Credit: Forest Research.

Entomological Society of America Conference Report

Jayne Whiffin
RES Managing Editor

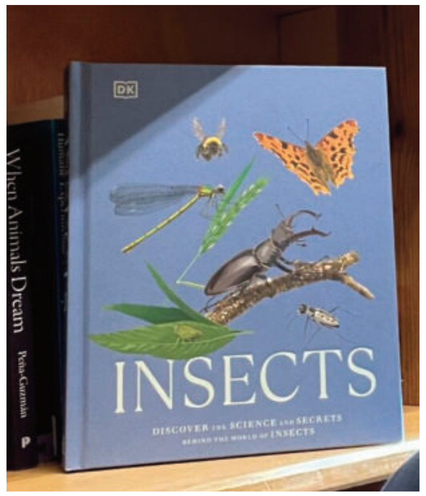
The Annual ESA meeting for 2025 took place in Portland, Oregon from 9th – 13th November. Over 3,000 delegates attended the Oregon Convention Centre, and we had excellent traffic at the RES booth. So many people had published or were planning to publish in the RES journals, with many Members and Fellows also stopping by. The Exhibition Hall was packed with over 50 exhibitors and a bustling Artisan Market. It was a super space to chat to entomologists from all around the world about the society, our outreach, our publications, and what we offer members across the world to benefit their research and spread the word about insect science.

Simon Ward (CEO) and Jayne Whiffin (Managing Editor) attended on behalf of the RES, and it was a fantastic opportunity for Simon to meet with the ESA and other key societies. Simon also presented a paper on behalf of Professor Lynn Dicks *et al.*, "Gathering the collective wisdom of professional societies to identify priorities for entomology", which outlined some of the key ideas behind the Grand Challenges concept.

Jayne spent much of her time at the booth but also found time to meet up with a number of journal Editors-In-Chief, Associate Editors and other board members. Our journals garnered lots of praise, but our books programme shone too: many people were keen to pick up a copy of *Insects* and were delighted by our children's books.

Portland is a very welcoming and friendly city, and we managed to enjoy the last of the "Fall" as well as some excellent coffee and a trip to the famous Powell's Bookshop – where we were excited to see a copy of *Insects* on the shelf!

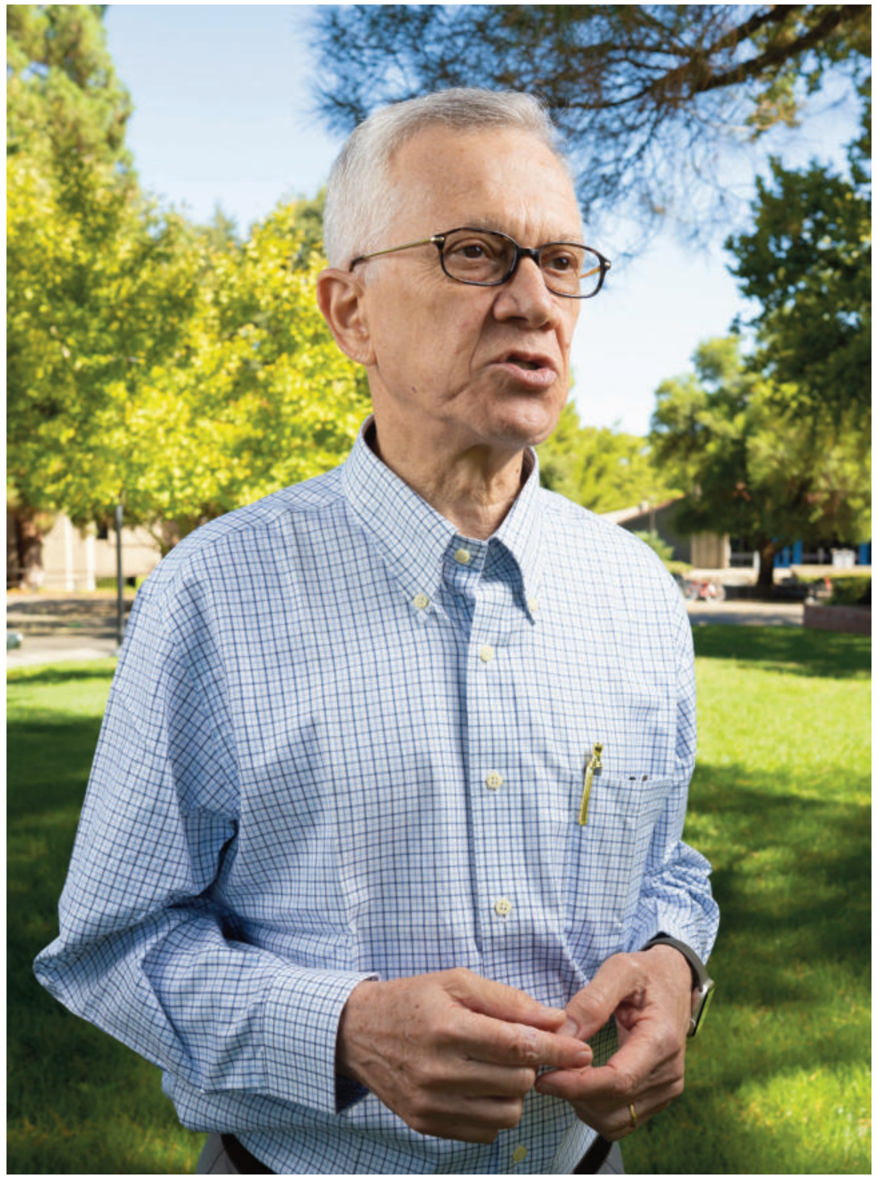
Simon Ward (CEO) and Jayne Whiffin (Managing Editor) at the RES stand. Credit: RES.



A copy of *Insects* on display at Powell's Bookshop. Credit: Simon Ward.

Multnomah Falls, just outside of Portland, Oregon. Credit: Jayne Whiffin; Inset: A Giant Maple leaf. Credit: Jayne Whiffin.

HONORARY FELLOW INTERVIEW



Walter at the UC Davis campus. Credit: TJ Ushing, UC Davis; provided courtesy of Walter Leal.

Walter Leal

Interviewed by Jozsef Vuts (Rothamsted Research)

Walter Leal is Professor of Biochemistry at the University of California Davies. An iconic and leading figure in insect chemical ecology, his research is unravelling the molecular mechanisms in the olfactory system of moths and mosquitoes, including odorant binding, release and transport, and pH-dependent conformational changes. Amongst many of his achievements, he was elected to the Brazilian Academy of Sciences in 2012. In that same year, he was awarded a Silver Medal from the International Society of Chemical Ecology, for which he had served as Councillor and President. He became an Honorary Fellow of the Royal Entomological Society in 2015. In 2024, he was elected to the National Academy of Sciences.

Professor Leal served as co-chair of the 2016 International Congress of Entomology, a gargantuan gathering of entomologists from all over the globe. I was lucky enough to be there, and it was truly at scale; I had to factor in the journey to get from one symposium to another in time within the same building. (Some participants were state-of-the-art enough to use electric scooters!) Another event with worldwide impact that he invented and organised was the 2021 *Insect Olfaction and Taste in 24 Hours Around the Globe*, which provided a platform for young scholars to highlight their recent work and interact with well-established scholars in the field. When I logged in at a very late hour, I could see and engage with a lot of bright-eyed, influential people in my own field of chemical ecology – a true 'Who's who' experience. It was thus a great honour to be asked by Richard Harrington to interview a scientist of such a calibre.

How has the field of chemical ecology changed since you started?

It has changed dramatically, because the foundation of chemical ecology was pheromones. People started discovering pheromones through the behaviour of insects and antennal electrophysiology and so forth. And then came the study of plant–insect interactions, later using molecular biology approaches. One issue in the field of chemical ecology is that we are not able to attract many people working with aquatic insects or the aquatic environment in general. Chemical communication in water is quite different and very exciting. We have people from time to time, but that's not a sector that is following the general trend of chemical ecology. We cannot define chemical ecology today in the same way as it was done before. The definition of the field is the same, but its scope is changing. I love that and want to see people attacking the same subject from different angles.

Have new techniques brought new areas into chemical ecology?

Definitely. For example, when we started, we had no idea about genomes and transcriptomes and things like that. These are now standard tools that help answer very important questions. The techniques are very important, but not the goal. For example, many years ago, we discovered a pheromone by just purifying it via behaviour-guided isolation. Then came GC-EAD as a shortcut to guide us and give us the active peak to start the behavioural studies.

Where do you think the best research ideas come from?

Sometimes when we are doing something, we find something else, so we abandon what we were initially doing because it's not that interesting in comparison. I like that we find something, and we follow the lead. We have to have an open mind and not be too focussed. We don't always have to have a plan, or we'll hopefully get something better than the original plan, and at the minimum, the original plan would be covered.

Does our research have to address an important problem, or can it be purely curiosity-driven?

I think both. For example, at the moment, I am working with the Asian Citrus Psyllid (*Diaphorina citri*). So that's focussed research, because it's a big problem in citrus cultures, and they want ways and means to reduce populations and, more importantly, reduce transmission of the bacterium that causes the disease. This is applied research. However, some other research can be curiosity-driven, because it allows a deeper understanding of the field. These are two different sectors of chemical ecology, and both are important in the advancement of the field.

Walter signing the equivalent of the RES's book of obligation at this Induction at the National Academy of Sciences (NAS). Credit: NAS; provided courtesy of Walter Leal.

Do you think it is justified to divide research into fundamental and applied?

It depends on, for example, where your funding is coming from. If I'm getting money from the growers to do some research, there are expectations that I'm going to have some deliverables for them. It may be that it fails, because research is not a given, it's an exploratory exercise. So, if it's for the growers, I say: "OK, maybe I'm going to give you this product at the end". But if it's a federal agency, for example, sometimes we have the flexibility to say that this and that would be important to explore, because it might open new directions. An example: a company has just called me to say that they are going to use a pheromone, that I discovered more than three decades ago, for mating disruption. This is not a case of basic research being applied; at that point, it was already applied research. We were looking for a pheromone to monitor the population of this insect, and now, thirty years or more later, a company says, "hey, we're going to use it for mating disruption, because you have done the preliminary experiments, which worked very well". It's very rewarding, because we didn't plan that. In the meantime, we do many things that are a failure. Like the American chemist Jerrold Meinwald once said: "we're allowed to make many failures as long as we generate some positive results". We all understand that we have failures, and we celebrate the accomplishments, because they are more important. I like thinking of this in terms of vectors: one is positive, and one is negative, but the absolute value of the positive results is much larger than that of the failures. Therefore, the field moves forward. To answer your

Walter preparing an insect antenna for a GC-EAD analysis. Credit: Sunny Ann, UC Davis; provided courtesy of Walter Leal.

question, it is also important to do research that we don't know of an application for. If we're looking at the insect brain and mapping the glomeruli to see what they respond to, we may not see the application immediately, but perhaps there is going to be one, or at least we'll have a better understanding of how biology works.

How big a part do you think luck plays in research, as opposed to well thought-through, logical research plans?

I gave a presentation last May about 130 years of my alma mater. I showed various segments of my research, and every single time I ended up saying: "I was lucky, because this thing happened, I was lucky because no one explored that", and they were making jokes after that about my luck. But that's the way of science: we have to be prepared, and we have to have an element of luck. Preparation we can get, but luck comes randomly. A combination of the two is important.

Who were your mentors and what lessons did you learn from them?

There was a teacher at high school who inspired me, Aloisio Sotero. His enthusiasm was contagious, and he brought to me an interest in chemical ecology. I had many mentors, including the professors supervising my master's and PhD projects. Later, when I spent a sabbatical at Cornell with Jerrold Meinwald for six months, we became friends, and I have learnt so much from him. He had so much influence in my career, and when I had a big decision to make, I would contact him to ask for advice.

If you can single out a paper of yours, which one would that be?

Heavens! That's one difficult question! There is a paper in the *Journal of Chemical Ecology* about scarab beetles that Alexander Nikonov, a post doc in my lab, wrote. Nikonov came to the lab, his English was not perfect at that time, so we had problems communicating, and every time I suggested something for Alex to do, he misunderstood me and did something better than I was asking! It was fantastic, because he had great ideas, and he is a brilliant sensory physiologist. That's one of the papers I like very much but which didn't get much attention. In a more recent paper in *PNAS*, we discovered that mosquito odorant receptors respond to the smell of old, degraded samples, but not to fresh ones. Why? It figures because old samples generate acetaldehyde, which triggers the most sensitive receptor we have ever found in all the species that we have studied. Then we asked the mosquito: "why do you like acetaldehyde?" Well, because it is an oviposition attractant. That paper is also not very well cited; however, it's a nice story, and the discovery was very exciting. Maybe the field doesn't yet need this information, but it's sitting there and will one day be available for researchers going in that direction. On the contrary, the paper where we discovered the receptor for DEET is one of the most highly cited papers.

INTERVIEW

What do you think the best way is to motivate people about insects or chemical ecology?

Insects are very easy, because people can relate to them. My friend Coby Schal is working with cockroaches, and cockroaches are not very attractive for the general public. But look at the scarab beetles that you and I work with! They are beautiful and it is very easy to show people how interesting they are. Also, if you convey a message about, for example, mosquitos that carry disease, people don't like mosquitos, but they like to know the story behind them. For the public, it is interesting that they live part of their life in water and another part outside as terrestrial insects, and only the female sucks blood. In chemical ecology, the easiest thing to talk about is sexual communication, right? Talk about pheromones and say: "you know, these insects don't see well in the dark and yet the females release this little compound, and the male can find the female using it wherever she is, and they mate". Or, if you say we can open the brain of the insect and can still record how they sense scents, some people get very fascinated by that, because this is such a tiny thing. If you convey that this information may be useful to understanding humans as well, they like the idea.

What unsolved questions in entomology and chemical ecology do you find most exciting or pressing today?

There is a species of scarab beetle here in California that I have worked on for many years, and I will not retire until I find its pheromone! I know for sure that the compound is there, but in amounts so small that I cannot take a mass spectrum of it. It doesn't undergo derivatisation, except once by accident, but that's the only information I know about the structure. I've already talked to one of the best chemists in the field, Stephan Schulz in Germany, and showed him what I had, and he even tried with his graduate student to synthesise some molecules to see if their mass spectra matched, but they didn't. So, to me this is a very important problem, but for everyone else it probably isn't. People sometimes ask me: "How long does it take to isolate a pheromone?" I tell them that sometimes it takes an afternoon, sometimes thirty years.

In what ways do you think chemical ecology can help halt insect decline?

That's a difficult question. Chemical ecologists usually get trained to get rid of this or that pest, then all of a sudden, the question comes up about what we can do about declining species. Mattias Larsson in Sweden is doing a good job in identifying pheromones that might be useful in conservation. That's a completely new area of chemical ecology that I didn't foresee when I started.

What advice would you give to scientists who are starting their career in entomology or chemical ecology?

It's vital to look at the literature and know what's already been done to avoid repetition. When we started, we had to go to the library and look at books, so it was very easy to miss something. Now we have everything at our fingertips. So, spending time first with learning what is already known is a very important thing. If, for example, you study scarab beetles, then we will see that *Costelytra zealandica* was the first to have its pheromone identified as phenol, then Jim Tumlinson identified the pheromone of the Japanese Beetle (*Popillia japonica*). We are sometimes required to do a review of the field, which I think is a good idea.

Well, with scarab chemical ecology, one should start with your review. It was certainly the first one for me!

That was the first time that I felt: "OK, now I am an entomologist", because when the *Annual Review of Entomology* invites people to write articles for them, you feel like you've made it. At that point, it took a long time, because back then again there was no search engine, so I had to figure it out. I wrote that article over several weekends. At the weekends, I only worked on that article, and I thought it was a good review of the field at that point. I am very glad that the *Annual Review of Entomology* asked me to write a review on olfaction, which became the most cited review paper in the field thirteen years ago. They have asked me to write yet another on insect olfaction, which will come out soon.

Finally: what interests do you have outside of research?

Well, writing papers! It is honestly one of the most rewarding parts of the research, but sometimes the most depressing, because you do your best and the reviewer comes back with a very negative report. However, the process of publishing is very rewarding. You see, now we have to write a story, we have to put it in a package that is going to be very convincing, then we submit it. And one day, it is published, and when it is published, we feel good. I don't have many hobbies; I spend most of my time working. You see, some people don't like their job; I love my job so much! Spending a Saturday or Sunday in the lab for me is nothing punitive, I feel good about that. Some people say they like swimming or riding, but I like reading the literature!

I remember when I started my MSc a long time ago, the very first paper that it was compulsory to read was Professor Leal's seminal review on the chemical ecology of scarab beetles. What made it really enjoyable were stories of my supervisor, Miklós Tóth, who visited Walter's lab in Japan, where many of the discoveries mentioned in the review were made – stories that transformed scientific research into a relatable, human experience.

RES Photography Competition grows in 2025

Francisca Sconce, Royal Entomological Society

The winning images in the Royal Entomological Society's Photography Competition 2025 have been announced. The annual competition showcases the very best amateur insect photography. Over 3,000 entries were received, our largest ever number, with photos taken in more than 110 different countries, from keen photographers of all ages. Photographers were able to submit up to three entries in the 'Under 18' category, or the '18 and Over' categories of insect portraits, insects in their environment, insect behaviour and smartphone images.

The 2025 overall winner in the '18 and Over' age group is Raghuram Annadana for the image *Parasitic Play* that depicts a wasp *Agiommatus* sp. parasitising eggs of the Banana Skipper butterfly (*Erionota thrax*). Speaking about the image, Raghuram, based in India, said: "On a walk earlier this year, I spotted Banana Skipper eggs on a banana leaf. But through the lens, the scene turned dramatic — a tiny parasitic wasp was sneaking its eggs into them. Each butterfly egg is just 1.8 mm, the wasp, even smaller."

The 'Under 18' category winner is Benji Cook for the image *Tyrant of the Dunes* that shows an antlion larva *Synclisis baetica* lying in wait in its pit. Benji, from the UK, said: "My sister unearthed this strange looking creature when she was building sandcastles on holiday. She called me over and we watched with curiosity as it vibrated its abdomen and retreated backwards into the sand, leaving just its head protruding, fearsome jaws outstretched."

The images were judged by zoologist, broadcaster and photographer Dr Tim Cockerill, conservationist Lucia Chmurova, and award-winning macro photographer Matt Doogue.

Tim said: "The standard was exceptionally high this year, which made picking winners a tricky prospect. The winner and runner-up really stood out though, as being wonderful examples of the way that insects interact with ecosystems, while also forming a significant part of the same."

Matt said: "The entries demonstrated incredible technical skill, field craft and patience, revealing behaviours that never cease to amaze me. As imaging technology evolves, particularly with AI, it reminds us how important authenticity is in documenting the natural world."

All images are available to view on the Insect Week website insectweek.org. The 2026 RES Photography Competition is now open for entries from all amateur insect photographers. The deadline for entries is 31st October 2026. Visit insectweek.org/art-and-photography/ for full details.

Over 18, Winner, Raghuram Annadana, India.
Parasitic Play. Banana Skipper butterfly (*Erionota thrax*) eggs being parasitized by a wasp *Agiommatus* sp.

Over 18, runner up. Dara Ojo, Canada.
Nature's Drama: A leafhopper overtaken by parasitic fungus. A leafhopper (Cicadellidae) in Costa Rica overtaken by vivid green parasitic fungus.

Under-18, Winner, Benji Cook, aged 12, UK.
Tyrant of the Dunes. Antlion larva *Synclisis baetica* ready to ambush an unsuspecting prey, photographed in France.

Under-18, runner up, Jack Brackley, aged 13, UK.
Green-eyed flower bee. A Green-eyed Flower Bee (*Anthophora quadrimaculata*) flying above flowers at Lackford Lakes in Suffolk.

Obituary

Kenneth George Davey

20th April 1932 – 12th November 2025

William M. Hominick
Emeritus Research Fellow and former Director, International Institute of Parasitology, CABI Bioscience Silwood Park, Ascot, Berkshire, UK SL5 7PY

Erwin Huebner
Professor Emeritus Biological Sciences, Former Head Department of Zoology, University of Manitoba, Winnipeg, Manitoba, Canada, R3T 2N2

Kenneth George Davey, a distinguished Canadian scientist and Professor Emeritus at York University, passed away peacefully on 12th November, 2025, at the age of 93. Born on 20th April, 1932, in Chatham, Ontario, Ken was driven by a passion for science and a fascination with the natural world.

He earned his BSc and MSc in zoology from the University of Western Ontario. These were followed by a PhD and a postdoctoral fellowship in insect physiology with Sir Vincent B. Wigglesworth, in the Zoology Department of Cambridge University. He embraced this environment, including pubs, and it fed his passion for science. Ken's remarkable career spanned decades, with notable roles as Director of the Institute of Parasitology at McGill University, and Chair of the Department of Biology, Dean of Science, and Vice-President of Academic Affairs at York University. After retiring, he was named a York University Distinguished Research Professor.

A Fellow of the Royal Society of Canada and an Honorary Fellow of the Royal Entomological Society, Ken's contributions to biology, entomology, endocrinology and physiology earned him three Queen Elizabeth II Jubilee Medals, an appointment as Officer of the Order of Canada, and honorary doctorates from Western, York and Dalhousie universities.

Beyond his scientific achievements, Ken was a devoted mentor, teacher and storyteller. He published over 200 peer-reviewed papers and was known for his quick wit and kindness. When visiting a lab, he wanted to meet the graduate students and post docs. The discussions included much banter and laughter. In a letter he wrote, "If I did anything, it was to create an environment where young people could realise their potential. I hope only that my students and post-docs were fearless and would reach beyond their grasp. Contemporary graduate 'training' is the ugliest description that I know of. It should be, but rarely is, an independent academic exercise free of interference from a 'supervisor'. Training and supervision occur in factories."

Ken was a prolific and erudite writer. He should have the last words, as he wrote in a letter about his time with graduate students and Post Docs. "They were special times and graduate students were special people and were an important part of the very privileged life that has been my fortune." Outside the lab, he found joy in gardening, cooking, and weaving.

We, Bill Hominick and Erwin Huebner, were fortunate to have worked in Ken's lab from 1969 to 1972 at the Institute of Parasitology, McGill University as a PhD student and PDF respectively. It was a very special time. His mentorship changed our lives and resulted in a lifetime friendship.

Kenneth Davey with Bill Hominick (left, credit: Erwin Huebner) and Erwin Huebner (right, credit: Bill Hominick) at Ken's 65th birthday celebration.

EVENTS

Details of the events programme can be viewed on the Society website (www.royensoc.co.uk/events) and include a registration form, which usually must be completed in advance.

Offers to convene events on an entomological topic are very welcome and can be discussed with the Chair of the Events Committee (richard@royensoc.co.uk).

March 2026

Mon 30 — 30–31 March
Student Forum
Newcastle University

April 2026

Thu 16 — 16–17 April
Infection, Immunity and Microbionts Special Interest Group (SIG)
University of Bath

May 2026

Wed 13 — 13 May (1 - 2 pm BST)
Insect Hour: Pesticides, dogs and insect declines (virtual event)
Prof. Dave Goulson, University of Sussex

June 2026

Wed 10 — 10 June (1 - 2 pm BST)
Insect Hour: The mosquito diaries (virtual event)
Prof. Janet Hemingway, Liverpool School of Tropical Medicine

Mon 22 — 22–28 June
Insect Week

Mon 29 — 29 June–3 July
XIII European Congress of Entomology (external event)
Tours, France

July 2026

Thu 2 — 2–8 July
5th Hemipteran-Plant Interactions Symposium (HPIS) (external event)
Institut Agro Montpellier, Montpellier, France

Wed 8 — 8 July (1 - 2 pm BST)
Insect Hour: Land management for beneficial insects and smallholder livelihoods (virtual event)
Prof. Deepa Senapathi, University of Reading

September 2026

Tue 8 — 8–10 September
Ento26
Cardiff University

October 2026

Thu 28 — 29 October
Hemiptera SIG - Advances in Hemipteran Research
Brussels, Belgium

November 2026

Wed 4 — 4 November
Orthoptera SIG
Natural History Museum, London

Thu 19 — 19–20 November
Insects as Food and Feed SIG
London (tbc)

For full details on all RES meetings please visit www.royensoc.co.uk/events