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Tuesday 9 September

- Innovation & Technology 1

Auditorium A | Chair: James Windmill, University of Strathclyde

10:45 – Holly Bassett, Nottingham Trent University
Novel, non-invasive monitoring of the nesting behaviours of the leafcutter bee *Megachile centuncularis* using continuous vibrational measurements

In-nest behaviours, particularly pollen provisioning, are difficult to observe for solitary bees such as the leafcutter bee, as their cavity nests are carefully wrapped in leaves. The complete process and sequence of behaviours these bees exhibit during nesting have therefore not been carefully monitored.

By attaching highly sensitive (1V/g) accelerometers directly to three experimental cavity nests placed in natural environments, we captured the unique and highly specific vibrations produced during different leafcutter bee nesting activities. We continuously collected vibrational signals alongside video for over a year. These data span the complete lifecycle of a solitary bee nest, from construction of nest cells in spring 2024 to the emergence of the adult bees in late spring 2025.

Using machine learning applied to video footage and accelerometer data, we assessed bee residency within the nest. We also used machine learning on accelerometer signals alone, discriminating between five different nesting activities (verified using video) including successfully discriminating 94% of bee arrivals from departures. Using this information, we determined the 24/7 nesting activity of a solitary bee across the complete nesting season with unmatched specificity; this can be explored alongside environmental information to understand how solitary bees respond to change.

Other authors: Martin Bencsik, Nottingham Trent University

11:00 – Fatima Zahrae El Arroud, University Mohammed VI Polytechnic (ONLINE)
Microwave Imaging for Red Palm weevil (Rhynchophorus ferrugineus) Detection

The red palm weevil (*Rhynchophorus ferrugineus*) (Coleoptera: *Curculionidae*), also known as the Asian palm weevil, is a highly invasive pest that infests various palm species globally. It has been designated as a Category 1 pest by the Food and Agriculture Organization (FAO) in the Middle East and North Africa (MENA) region due to its severe impact on date palm cultivation. Early and accurate detection of RPW is critical for effective pest management and control. This study explores the application of microwave imaging techniques for the non-invasive detection of RPW infestation within palm trunks, utilizing the MERIT toolbox for signal processing and reconstruction. The results demonstrate the effectiveness of the Delay Multiply and Sum (DMAS) algorithm in identifying the presence of RPW larvae, as evidenced by both numerical simulations and experimental validations.

Key words: Microwave imaging, pest detection, *Rhynchophorus ferrugineus*, RPW infestation

Other authors: Karim Elfakhouri (AgroBioSciences Program, College of Agriculture and Environmental Science, Mohammed VI Polytechnic University), Muhammad Zubair (DSchool of Engineering, University of Leicester, Leicester, UK.), Qammerhabbasi (James Watt School of Engineering, University of Glasgow, UK), Youness Zaarour (Microwave Energy Sensing (MES), DICE- University of Mohammed VI Polytechnic),

Chaimae Ramdani (AgroBioSciences Program, College of Agriculture and Environmental Science, Mohammed VI Polytechnic University), Mustapha Elbouhssini (AgroBioSciences Program, College of Agriculture and Environmental Science, Mohammed VI Polytechnic University) and Hafid Griguer (Microwave Energy Sensing (MES), DICE- University of Mohammed VI Polytechnic).

11:15 – James Bell, Centre for Applied Entomology, Parasites and Pathogens, Keele University
Tackling one of the hardest problems in entomology: estimating small insect migration distances

I will show high speed videos of aphids in flight, a proxy group for all insects that can take off and move through the atmosphere but cannot oppose the upwardly or downwardly moving aerodynamic forces. Instead, they just have to go with the airflow. This group is an informal collection of small insects (1-4 mm/mg) and include insects that flap their wings slowly (<200 Hz) to generate lift and thus fly. These small insects cannot glide or 'row' through the air, the latter being an extreme adaptation used by gall midges, fairyflies and ptiliid beetles amongst others.

I'll show how we can capture those wing movements and talk about some of the science that has helped us understand what they are doing in the upper atmosphere, outlining the monumental challenge of estimating distances below and above the flight boundary layer (approximately 10 m above the ground). Here, these insects engage in local, appetitive flight and long-distance migration, respectively. Distances range from a few metres to remarkable distances exceeding 1000s of kilometres.

11:30 – Elva Robinson, University of York
The role of wood ant translocations in promoting woodland biodiversity

Species translocations are increasingly used to restore biodiversity in habitats that are inaccessible for natural colonisation. Priority candidates for translocations are species that play key roles in ecosystem function and are poor dispersers, such as the wood ants *Formica lugubris* and *Formica rufa*. We used existing data on the occurrence of wood ants across England to develop species-specific habitat suitability models incorporating climate variables, topography, and forest structure using new LiDAR data. The model outputs identify areas of woodland that are suitable for each wood ant species and whether they could be naturally colonised. Almost half of the woodlands are suitable for wood ants, but only c16% are currently occupied and almost all of these unoccupied woodlands are unlikely to be naturally colonised.

We provide an online interactive tool to explore habitat suitability for wood ants in England and present a case study of how this tool has been used to guide a wood ant translocation within the Wilder Ennerdale project. We present the insights gained into best practice from this real-world application of the model's predictions. We provide recommendations for future translocation projects restoring woodland insect communities, including the protection of donor populations, and identifying key knowledge gaps.

Other authors: Joris Wiethase, University of Helsinki. Calum Maclure, James Hutton Institute. Jenni Stockan, James Hutton Institute. Colin Beale, University of York. Kevin Watts, Forest Research.

11:45 – Christopher Noroozi, University of Sheffield
Probabilistic Tracking of Bumblebee Flight Paths

Critical to conservation is understanding how animals use landscapes. Current landscape-scale flying insect tracking methods are either too expensive, too heavy and/or struggle to operate in cluttered environments - meaning the effects of landscape differences on behaviour are difficult to observe. Being able to

monitor the activity of flying insects across different landscapes could provide insights into how to better manage land, and understand their decision-making processes.

We are developing a novel method for landscape-scale insect tracking using rotating Bluetooth transmitters with ~500m range placed across a landscape and <40mg tags attached to foraging bees. The tag infrequently receives noisy & uncertain data due to power constraints, so a Gaussian Process models the individual's flight path based on assumptions made about the stereotyped movement of insect foragers. Doubly stochastic variational inference is used to perform 'probabilistic triangulation' to infer the probable flight path the tagged bee took.

Field trials have successfully proven the system's ability to track the low-power, lightweight tags moving through a complex environment and infer the position of a tagged *Bombus terrestris*. Further work plans to use the system to survey *Bombus terrestris* nesting sites and gather biologging sensor data using the tags.

Other authors: Michael T Smith, University of Sheffield.

12:00 – Vilde Leipart, Norwegian University of Life Sciences (ECR Prize Winner)
Resolving the zinc binding capacity of honey bee vitellogenin and locating its putative binding sites

We use an interdisciplinary approach to reveal a new outlook on how a protein works—vitellogenin (Vg), which is essential for honey bee health and behaviour. Vg is honey bees' primary zinc (Zn) carrying protein, necessary for biological reactions and normal lifecycles. Vg can be traced back 700 million years to the beginning of multicellular animal life, with descendants in animals today. A range of multifunctionality has been described for Vg in egg-laying animals over the years, including roles in reproduction, disease defense, lifespan regulation, and nutrition, but its molecular mechanisms remain poorly understood. Here, we combine structural predictions from artificial intelligence, sequence analysis, and experimental data to investigate honey bee Vg's function at the molecular level. We present the first direct evidence for Zn to Vg binding ratio, which can explain how Vg plays a central role in immunological and DNA-related processes (regulation of genes) where Zn is typically involved. The findings suggest that Zn may bind to or detach from Vg, indicating that Vg could release Zn during stress to support immune cell activity. Our findings provide a mechanistic explanation for Vg's multifunctionality and offer a new understanding of its central role in honey bee biology and beyond.

Other authors: Øyvind Enger, Norwegian University of Life Sciences. Diana Cornelia Turcu, University of Bergen. Olena Dobrovolska, University of Bergen. Finn Drabløs, Norwegian University of Science and Technology. Øyvind Halskau, University of Bergen. Gro V. Amdam, Norwegian University of Life Sciences and Arizona State University.

- Conservation and Mangement of Forest Insects

Auditorium B | Chair: Max Tercel, University of Montpellier / CIBIO-InBIO

RES Journals: Agriculture and Forest Entomology & Insect Conservation and Diversity

10:45 – Dianne Joy Aguilon, University of the Philippines Los Baños

Influence of Reforestation Age on Insect Community Structure, Diversity and Abundance in a Tropical Rainforest

Forest succession plays a crucial role in shaping species richness and habitat complexity, particularly within tropical ecosystems. This study aims to evaluate how different reforestation ages affect structure, diversity, and abundance of insect communities in Mt. Makiling Forest Reserve, Philippines. A total of 2,733 individual insects were recorded, covering 9 orders, 36 families, and 94 species. Our findings showed that species richness was highest in the 20-year-old, followed by the 10-year and 15-year-old stands.

Omnivorous insects, especially ants, were the most common across all stands, while the number of herbivores and detritivores increased with the age of reforestation, indicating a trend towards functional diversification. *Solenopsis geminata* was recognized as key indicator species linked to the 20-year-old reforestation stand, with a high indicator value of 0.977. Ordination analysis revealed distinct differences based on age group, suggesting that each stand supports a unique group of insect assemblages. Our results showed that species richness and diversity were not significantly affected by age, but insect abundance.

Our findings emphasize that longer reforestation periods correlate with higher insect richness, functional diversity, and ecological stability. The observed patterns highlight the ecological importance of older reforestation stands in restoring insect communities and boosting biodiversity in reforested areas.

Other authors: Melody Gipanao, Department of Forest Biological Sciences, University of the Philippines Los Baños (UPLB). Lerma Maldia, Department of Forest Biological Sciences, University of the Philippines Los Baños (UPLB).

11:00 – Jay Wilson, Queen Mary University of London & Royal Botanic Gardens Kew

Assessing Coleoptera and Lepidoptera Responses to a Land Use Gradient in Northwest Zambia

Insect diversity is declining in response to changing anthropogenic land use; however, studies dealing with the effect of different land use types are limited, especially in African countries such as Zambia. Here, we investigated the effect of land use type (agriculture, forest edge, and forest) on Coleoptera and Lepidoptera richness and abundance in Zambia. Surprisingly, our preliminary results show that richness (30 and 45 morphospecies of Coleoptera and Lepidoptera, respectively), and abundance (80 Coleopteran and 108 Lepidopteran individuals) is similar or slightly higher for both Orders in agricultural areas, followed by forest (29 and 33 morphospecies of Coleoptera and Lepidoptera, respectively), and abundance (80 Coleopteran and 85 Lepidopteran individuals).

Simpson's Index of Diversity was lowest in forest edges (Lepidoptera = 0.10, Coleoptera = 0.33) and highest in forests (Coleoptera = 0.61, Lepidoptera = 0.25) for both Orders. Sorensen's similarity index was lower for Lepidoptera than for Coleoptera across all land use types, indicating the uniqueness of Lepidoptera species in each land type. Our results address the differential response in diversity to land use type of two insect orders and highlight the importance of conducting research in different areas of the world.

Other authors: Dodly Prosper1,2, Anna Evans-Woolf1,2, Adam Devenish2, Kalsum Yusah1,2, and Carlos Martel2 (1Queen Mary University of London), 2Royal Botanic Gardens Kew)

11:15 – Alex Dittrich, Nottingham Trent University
Insect Translocations to Restore Habitats, Study Communities, and Engage People: A Case Study Using Hairy Wood Ants

This talk presents a case study from the Natural Capital Laboratory [NCL] in Scotland a 100 acre site, near Loch ness, a unique living laboratory with multiple partnerships across organisations set up to better understand ecological restoration and rewilding.

In May 2024, we translocated a population of hairy wood ants (*Formica lugubris*) into a patch of recently cleared Sitka spruce plantation on the NCL, introducing a missing keystone species. The ants were moved from an established plantation near Loch Ness, where the population was under threat from forestry operations.

Hairy wood ants were selected due to their strong establishment success post-translocation, vulnerability to habitat fragmentation, and important ecological roles in woodland systems. The primary aim was to assess ant establishment, interactions with the wider insect community, and opportunities for public engagement.

Within five months, the original colony expanded rapidly, budding into 12 satellite nests across the restored site. Having survived their first winter, the colonies show promising establishment. We discuss early observations of impacts on the broader arthropod community and outline how the project used these charismatic insects to engage local communities with invertebrate conservation — a group often overlooked in restoration.

11:30 – Katrina Dainton, Forest Research
On the rise: the impact of insect pests on British forests, their drivers and management

This talk summarises findings from a review paper that evaluated the impact and management of insect pests in British forests since the early 1900's. Sixty insect pests were identified as threats to British trees and forests. Pest detections slowly increased throughout the first half of the 19th century, before accelerating moderately to the 1990's and then sharply since the start of the 21st century. Global trade, forest management practices, climate change and tree stress were identified as factors driving forest pest arrival, abundance and damage.

Three species (*Hylobius abietis, Dendroctonus micans*, and *Ips typographus*) were classed as current significant pests, causing regular or severe damage and requiring intensive management. Three more pests were classed as actively managed, whereas a form of conservation biocontrol, usually natural enemies, was responsible for suppressing several other species. Monitoring and preventative methods were in place for many forest pests, however no management activities were identified for others. Insect pests critically impact forests and the economic and ecosystem services, such as timber production, carbon sequestration and biodiversity enrichment, that they provide.

This review highlights the need to implement forest management practices that prevent new pest establishments, mitigate climate change effects, reduce tree stress and increase resilience.

Other authors: Max Blake, Forest Research. Gail Jackson, The School of GeoSciences, University of Edinburgh. Henry Creissen, Institute for Agronomy and Agriculture, University of the Highlands and Islands. Fiona Burnett, Scotland's Rural College (SRUC). Mariella Marzano, Forest Research.

11:45 – Jozsef Vuts, Rothamsted Research
Responses of *Ips typographus* to Sitka and Norway spruce

Ips typographus (Coleoptera: *Scolytinae*) has established localized breeding populations in Britain for the first time, where Sitka spruce is a critical component of plantation forestry. The interactions between Norway spruce and *I. typographus* are well understood, but relatively little is known about the susceptibility of Sitka spruce to the beetle. This study aimed to determine whether *I. typographus* would select Sitka, compared to Norway spruce, as a host for breeding, and to investigate the chemical ecology underlying these host preferences.

Overall, colonization and breeding success were found to be similar in cut Sitka and Norway spruce material in both lab and field experiments. Volatiles of aged wood from the two species were equally attractive, and fresh Sitka was more attractive than fresh Norway spruce. The beetles did not differentiate between synthetic blends of Norway or Sitka spruce volatiles.

These findings suggest *I. typographus* will select and colonize cut Sitka as readily as cut Norway spruce, with implications for its establishment risk in Sitka-growing regions. Whilst the susceptibility of live Sitka trees remains unclear, the study advances the understanding of the role of both host-emitted volatiles in primary host location and induced host preference in host selection by *I. typographus*.

Other authors: Daegan Inward, Forest Research. Gareth Thomas, DEFRA. Kerry Barnard, Forest Research. John Caulfield, Rothamsted Research. Stephen Powers, Stats Powers Ltd. Ana Uglow, Forest Research. Katy Reed, Forest Research.

12:00 – Alice Walker, Forest Research
The Forest Trapping Network: An early detection strategy for quarantine forestry pests in GB

The management of quarantine forestry pests can cost affected countries millions annually. Early detection of insect pests is paramount for increasing the success and reducing the cost of subsequent containment and control measures. The Forest Trapping Network (FTN) was established in 2022, following two years of preliminary trials, to address requirements to survey for a broader range of quarantine and priority Coleopteran forestry pest species (*Cerambycidae, Molytinae* and *Scolytinae*) identified in the 2020 amendment to Phytosanitary Plant Health Regulations.

Different woodland types within 60 forest sites across GB between 2020-2024 were surveyed, targeting a broad range of forestry pests. The first two years showed that general lures (ethanol & alpha-pinene) performed well at attracting a broad range of woodboring beetles. Nearly 60,000 beetles were trapped over the 5-years from 80 species of *Cerambycidae, Molytinae* and *Scolytinae* and other woodboring families.

The data highlighted variation in beetle communities across GB, and fortnightly abundance data revealed trends in beetle flight patterns. Whilst no quarantine species aside from *Ips typographus* were detected, we trapped high numbers of native/established species analogous to those targeted on the quarantine list, suggesting the FTN would be effective in the early-detection of quarantine forestry pests, if present.

Other authors: Thomas Kendall, Forest Research. Sarah Facey, Forest Research. Anna Platoni, Forest Research. Max Blake, Forest Research.

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Auditorium A | Chair: Doreen Siria, University of Glasgow

14:15 – Rafael Henrique da Rosa, Western Parana State University (ONLINE)
Automating Aedes aegypti Surveillance in Brazil: A Low-Cost, Scalable, and Plug-and-Play Tool for Continental-Scale Monitoring

The vast continental dimensions of Brazil present a significant operational and financial challenge in monitoring mosquito populations, particularly for species like Aedes aegypti, the primary vector of dengue, Zika, and chikungunya. Current surveillance relies heavily on ovitraps, which detect mosquitoes indirectly through egg counts. While widely adopted, this method is slow, labor-intensive, and prone to inaccuracies, limiting its responsiveness to arbovirus outbreaks.

We introduce OviSense, a low-cost and plug-and-play device designed to automate ovitrap monitoring by integrating an optical sensor and machine learning to detect and capture target species in real-time. The embedded machine learning classifier was developed using an insect signals dataset collected over the years in various countries, comprising recordings from more than 20 species, resulting in over one million labelled signals.

Our sensor converts the signals into acoustic features, achieving 87% accuracy in distinguishing *Ae. aegypti* from other species. Additionally, the device includes a selective suction mechanism that physically captures targeted mosquitoes. Capture efficiency was experimentally validated under controlled laboratory conditions using an entomological cage, where groups of five mosquitoes were released per trial across ten replicates, resulting in a 94% capture rate. OviSense offers a scalable, faster, and more reliable alternative to traditional ovitrap-based mosquito surveillance.

Other authors: Barbara Lepretti de Nadai, Western Parana State University. Renato Bobsin Machado, Western Parana State University. Gustavo Batista, University of New South Wales. Andre Maletzke, Western Parana State University.

14:30 – Jess Lister, Edinburgh Napier University
BEATBOX: Developing accessible methods for studying insect vibrational signals with insights from stonefly drumming

Many insect taxa use acoustic signals for communication. Stoneflies (Order: *Plecoptera*) are an ancient lineage of aquatic insects whose terrestrial adult stage communicates using substrate-borne vibrational signals. These complex, species-specific duets—initiated by male "drumming" and followed by female reply—are critical to mate attraction and selection. However, the high cost and technical complexity of current methods remains a significant barrier for accurately recording vibratory signals. Currently no standardised, accessible protocols exist for capturing stonefly drumming, limiting broader research on this mode of communication.

This presentation details the development of a standardised and cost-efficient method for recording stonefly drumming, designed to overcome key challenges: their short seasonal adult lifespan, the need for an acoustically isolated arena for recording, and the limitations of current technologies. The first recordings of male and female drumming will also be presented for all three British endemic stonefly species, exploring how male call structure and female response vary with factors including age, time of day, temperature, and body size.

This work addresses priority challenges in entomology by using technology to advance methods in insect bioacoustics, enabling wider investigations into acoustic communication, sexual behaviour, and how they can be disrupted by human activities.

14:45 – João Pedro Ortega, Western Parana State University (ONLINE)
Towards Accurate Mosquito Surveillance: Why Proper Machine Learning Task Selection Matters

Mosquito surveillance plays an important role in understanding the composition, density, and phenology of mosquito species within their natural habitats. This information is essential for guiding public health strategies aimed at controlling arbovirus transmission and preventing outbreaks.

The automatic determination of mosquito population density has long been a sought-after goal in entomological surveillance. Automating this process can significantly enhance efficiency and scalability. Machine learning emerges as a powerful tool to support this task.

Recent advances enable the automated identification of mosquito species and the estimation of population density from image-based data. However, selecting the appropriate machine learning task is a critical decision to ensure a robust and reliable method. In this work, we emphasize the importance of using quantification, a specific machine learning task that focuses on directly estimating class prevalence rather than relying on individual analysis.

To address this issue, we collect mosquito images from both laboratory trials and literature records, building a dataset of 15,000 images across 12 species. We use Convolutional Neural Networks for species identification, followed by quantification methods to estimate population distributions. Our results show a 34.2% improvement in accuracy compared to standard methods, demonstrating the potential of quantification for mosquito population surveillance.

Other authors: Anny Dellani, Western Parana State University. Barbara Lepretti de Nadai, Western Parana State University. Andre Maletzke, Western Parana State University.

15:00 – Ewan Parry, University of Glasgow
Visualizing the lifecycle of a Plasmodium-blocking microsporidian in Anopheles mosquitoes

Microsporidia MB (MB) is a single celled microsporidian (fungi) that colonizes *Anopheles* mosquitoes, and was recently found to block Plasmodium falciparum transmission in challenge experiments. This blocking effect, combined with its ability to stably persist in mosquitoes with minimal effect on host fitness means that MB has potential for development into a malaria control strategy.

Several different microscopy approaches were used to reveal details of the MB lifecycle in a lab colony of *Anopheles coluzzii* from western Burkina Faso. An optimized protocol for producing serial formaldehyde fixed paraffin embedded sections of multiple mosquitoes has been used extensively to correlate H&E staining with FISH labelling and confocal microscopy. High resolution 3D imaging using Airyscan, revealed important details of an infectious, sporulating stage of the MB lifecycle for the first time. Characteristic details of microsporidian spores were then confirmed using transmission electron microscopy. Light sheet microscopy and microCT scans are now being used to visualize MB in dissected tissues and whole abdomens, giving the full context of the surrounding tissue.

Utilizing the unique advantages of each microscopy technique has revealed a detailed picture of the MB lifecycle that will inform experimental design and investigation through the next stages of the project.

Other authors: Ewan R. S. Parry, Roland Pevsner, Beth C. Poulton, Deepak-Kumar Purusothaman, Abdelhakeem I. Adam, Sare Issiaka, Thomas H. Ant, Stephanie M. Rainey, Etienne Bilgo, Abdoulaye Diabaté, Steven P. Sinkins

15:15 – Deepak Kumar Purusothaman, University of Glasgow
Colourimetric LAMP Assay for Mosquito Release Programs and Infection Monitoring

Aedes aegypti and *Anopheles gambiae* are key mosquito vectors of various viruses and malaria, each contributing significantly to global mortality. Our lab is involved in Wolbachia-based mosquito release programs in Malaysia and Burkina Faso. With recent funding from Open Philanthropy, we are also investigating the Microsporidia MB symbiont, which is known to block malaria transmission in *Anopheles* mosquitoes.

Effective control programs require accurate identification of mosquito species, symbionts, and pathogens. To address this need, we developed a rapid and straightforward colourimetric LAMP assay that targets unique, conserved genomic regions to identify mosquito species, symbionts, and pathogens. The assay is highly-specific and sensitive, demonstrating detection capabilities comparable to qPCR/TaqMan assays. It can detect both symbionts and species across various life stages, including individual mosquito eggs collected directly from ovitraps without the need for laboratory hatching.

We have also developed a homemade LAMP mix that reduces reaction costs to one-fifth of those of commercially available kits, while maintaining high sensitivity for both DNA and RNA targets (RT-LAMP). This fast, low-cost LAMP assay has the potential to replace high-throughput mosquito sample screening in the field, eliminating the need for advanced diagnostic laboratory services.

15:30 – Stewart Rosell, University of Aberdeen & Agri-food and Biosciences Institute
Challenges and opportunities for environmental DNA sampling for non-native invertebrates in horticultural habitats

A wide range of non-native invertebrates can be introduced via horticultural trade. Biosecurity inspections and surveillance are important measures to prevent the spread of these species. The taxonomic breadth of non-native invertebrates, need for non-destructive sampling methods for valuable horticultural products and difficulty detecting many species makes effective surveillance challenging and time consuming. Novel techniques such as environmental DNA (eDNA) based detection may overcome some of these challenges but validation of methods for a wide range of taxa and environments is a barrier to real-world applications of eDNA.

This research investigates the potential to harness eDNA to detect non-native invertebrates in plant trade and horticulture. This includes experiments to design detection methods for New Zealand Flatworm *(Arthurdendyus triangulatus)* in growing media and Light Brown Apple Moth (*Epiphyas postvittana*) in a range of foliage environments. These experiments reflect important introduction pathways for pests and invasive species in Europe.

The findings and methods highlight differing challenges for detecting non-native invertebrate taxa which may be introduced and spread via different habitat niches and inform environmental DNA research developing methods suitable for application in biosecurity and plant health.

Other authors: Dr. John Baird, University of Aberdeen. Dr. Archie Murchie, Agri-Food and Biosciences Institute (AFBI). Dr. Neil Warnock, AFBI. Dr. Nikol Kmentova, Hasselt University. Prof. Maarten Vanhove, Hasselt University.

- Pollinators 1

Auditorium B | Chair: Fiona Highet, SASA (Science & Advice for Scottish Agriculture)

14:15 – Seirian Sumner, University College London
Pollinator Potential of Aculeate Wasps

Ecosystems, natural and farmed, depend on insects for pollination. Bees, hoverflies, butterflies and moths are all valued – rightly so - for their pollination services. Other insects – like wasps – are less well understood. Aculeate wasps (solitary and social) are primarily predators: females hunt prey to feed to raise carnivorous brood. However, adult wasps are largely herbivorous, feeding on plant-sugars such as nectar and tree sap. Despite this, the contribution of wasps as pollinators has been little studied.

We explore the pollinator potential of aculeate wasps by compiling a database of almost 4000 flower visitation records for over 600 wasp species, expanding on previous wasp-flower visitation datasets by over 170%. We explore this database through interaction networks and determine the degree to which wasp interactions with flowers are generalist or specialist in nature; we review how plants have evolved adaptations to manipulate and exploit wasps for pollination; and to what extent behavioural, morphological and life-history traits of wasps might be used to indicate their potential as vectors of pollen. We identify key wasp subfamilies for future study and provide compelling evidence for wasps to take up residence on the pollinator map, alongside their more popular cousins.

Other authors: Enzo Sanchez Van Doorslaer(1), Idris Adams(1), Cintia Oi(1,2), Gavin Broad(2), Seirian Sumner(1)* ((1) Centre for Biodiversity and Environment Research, Dept of Genetics, Evolution and Environment, Gower Street, University College London. (2) Natural History Museum, Cromwell Road, London)

14:30 – Safinatu Ameen, Natural Resources Institute, University of Greenwich
Hoverfly use for the pollination of commercial soft fruits

Pollination of many high-value fruit crops requires supplementation with managed pollinators, often a single bumblebee species. However, increasing evidence suggests that species-rich pollinator assemblages provide better services, resulting in improved fruit quality. Hoverflies have potential as components of multi-species pollination systems, while their larvae provide natural pest regulation. Since managed pollinators are expensive, growers expect maximum performance, including high motivation to forage on target crops. Forage-focus may be improved using semiochemical lures to attract hoverflies where services are needed.

We developed semiochemical lures based on floral volatiles from 14 wildflower species. Our aim was to identify wildflower clusters with similar volatile profiles for synthetic lure development and assess their potential to attract pollinators. Volatiles were identified using gas chromatography-mass spectrometry. Cluster analysis grouped floral volatiles into five distinct odour profiles, forming the basis of five synthetic floral blends.

These blends are being evaluated using lure-baited sticky traps in commercial soft fruit crops. Trapped

insects are being identified to assess diversity and abundance of hoverflies and non-target pollinators attracted to each blend. Laboratory bioassays are also conducted to test hoverfly responses to the blend.

We aim to produce semiochemical lures deployable in commercial soft fruit production to enhance pollination services.

Other authors: Dylan Hodgkiss, Pollinator and Orchard Management Ltd T/A Olombria, United Kingdom. Tashia Tucker, Pollinator and Orchard Management Ltd T/A Olombria, United Kingdom. Daniel Bray, Natural Resources Institute, University of Greenwich, United Kingdom. Sarah Arnold, NIAB East Malling, Kent, United Kingdom. Mandela Fernández-Grandon, Natural Resources Institute, University of Greenwich, United Kingdom. Steven Harte, Natural Resources Institute, University of Greenwich, United Kingdom.

14:45 – Gael Kergoat, INRAE - Centre de Biologie pour la Gestion des Populations (CBGP)
Diverse but overlooked: weevils as specialized brood-site pollinators of tropical flora

Weevils (Coleoptera: *Curculionoidea*) constitute a hyperdiverse group of phytophagous insects, mostly known for their detrimental interactions with plants, especially because they encompass many pest species. However, a growing body of ecological and evolutionary studies fuelled by recent field expeditions are progressively highlighting that numerous weevil lineages actually play a significant role as pollinators in the tropics, and in particular as specialized brood-site pollinators. In these brood site pollination mutualistic systems (BSPM), floral structures are providing brood sites for the larval development of the weevil, while adults act as specialist pollinators of their host.

This presentation will provide an overview of the scale of these mutualistic interactions, which involve hundreds of weevil species and plants from dozens of distinct families. I will present common traits and evolutionary trends that have been unraveled recently for these specialized weevil lineages, as well as an excerpt of recent discovery and advances made by our team, thanks to a combination of fieldwork, taxonomic, ecological and macroevolutionary studies.

Other authors: Rémi Allio, INRAE – CBGP. Benjamin Zelvelder, University of Montpellier – CBGP. Laure Benoit, CIRAD, CBGP. Anne Loiseau, INRAE – CBGP. Julien Haran, CIRAD – CBGP.

15:00 – Yoorana Peyre, University of Stirling
Impact of short and long exposure to abnormal temperatures in bumblebees' (Bombus terrestris ssp. audax) cognitive abilities

Despite being responsible for 75% of crop pollination and essential for ecosystem maintenance, insect pollinators are declining worldwide. Among other threats, climate change is known to have direct (physiology, morphology...) and indirect (plant/pollinator phenology) effects on this decline. However, whether climate change impacts pollinators' cognition remains sparsely studied. Learning associations between a flower and a reward and remembering nest and resources' location are cognitive abilities that pollinators require to forage efficiently and ensure the colony's fitness.

In two studies, we aim to assess how these abilities might be impacted by temperatures associated with climate change. Specifically, we examined whether exposing 108 bees for 2-4 hours (Experiment 1) and 60 bees for a range of 1-3 weeks (Experiment 2) to temperatures of 14°C (cold), 25°C (neutral) or 32°C (hot) impacted their abilities to learn a colour-reward association and to remember where a reward was experienced. In both experiments, we found that hot temperatures negatively impacted bees' learning and spatial memory abilities. Interestingly, the results also showed a lower participation rate for bees exposed to 32°C than those exposed to 14°C and 25°C.

These results suggest that both short and long exposures to high temperatures can lead to a cognitive impairment in abilities that are critical for bees' pollination and survival.

Other authors: Gema Martin-Ordas, University of Stirling, Division of Psychology

15:15 – Charlie Woodrow, Uppsala University
Periodic buzzing enhances pollen release by bees and micro-robots

Bees are key pollinators mediating the reproductive success of diverse plant species through the collection and transportation of pollen. For 20,000 plant species, including crops such as tomato and potato, pollen release occurs exclusively through a process called buzz-pollination, whereby bees generate vibrations with the flight muscles of their thorax to release pollen. The properties of these vibrations affect the rate of pollen release. However, pollen release should also depend on the way vibrations are transmitted, and the temporal structure of buzzes. Previously, we revealed that buzz transmission occurs through a periodic biting behaviour. When biting, the bees deliver higher amplitude vibrations to flowers, increasing pollen release. But does the periodic structure of the vibration itself also increase pollen release? To address this question, we deployed novel micro-robots in which the temporal structure of buzzes can be manipulated. We demonstrate that several short buzzes release more pollen than a single buzz of equivalent total duration. This indicates that periodicity could be a strategy to maximise pollen release for a given buzzing effort. Further study of the transmission and temporal structure of vibrations across bee and plant species could offer insights into pollen collection strategies, with applications in artificial pollination.

Other authors: Yuchen Kang, University of Massachusetts Lowell. Xiaowen Chen, University of Massachusetts Lowell. Noah Jafferis, University of Massachusetts Lowell. Mario Vallejo-Marin, Uppsala University.

15:30 – Emma Plant, University of Glasgow
Seasonal changes in native and non-native plants drive changes in flower visitor networks in gardens and allotments

Private gardens and allotments likely differ in their value for pollinator diversity due to variation in their environmental conditions associated with their different land uses. Previous studies on pollinator diversity in green spaces often only consider environmental variables in isolation and rarely compare different green space types.

We investigated seasonal patterns in how environmental variables influenced plant-flower visitor interactions and the network structure in private gardens and allotments. We collected plant-flower visitor data in nine private gardens and eight allotments, simultaneously recording floral abundance and richness, plant origin, garden size, land use diversity, and green space surrounding sites.

Native plant abundance declined from April until September, resulting in fewer visits to native plants at the end of the season. Simultaneously, non-native floral abundance increased with increasing floral visits to non-native plants in September. Differences in floral visits between native and non-native plants across the season resulted in plant-flower visitor networks becoming less specialised from April until September.

Overall, higher floral abundances increased flower visits and mitigated effects on network structure, independently of the surrounding landscape or garden type. Our findings can help to guide management practices within green spaces and inform urban planning of the importance of pollinator conservation.

Other authors: Ria Dunkley, University of Glasgow. Dominic McCafferty, University of Glasgow. Davide Dominoni, University of Glasgow.

- Evolution, Genomics & Endosymbionts

Auditorium A | Chair: Laura Martinez, Harper Adams University
RES Journal: Insect Molecular Biology

16:15 – Erin Foley, University of Leicester
Larval diapause slows adult epigenetic ageing in an insect model, *Nasonia vitripennis*

Epigenetic clocks based on DNA methylation provide robust biomarkers of biological age, yet the mechanistic basis and functional significance of slowing these clocks remain unclear. Progress is limited by the lack of short-lived, genetically tractable model organisms with functional DNA methylation systems. The jewel wasp, *Nasonia vitripennis*, offers a unique solution. It combines a functional DNA methylation system with a short lifespan and tools for experimental manipulation. We previously developed an epigenetic clock in *Nasonia*, but whether this clock reflects plastic, environmentally driven ageing processes was unknown.

By inducing larval diapause, we have tested this directly. Larval diapause extends median adult lifespan by 36% and significantly slows the rate of epigenetic ageing. Using whole-genome bisulfite sequencing across multiple adult timepoints, we show that while adults from diapaused larvae emerge epigenetically older, their subsequent epigenetic ageing proceeds 29% slower than adults who did not undergo diapause.

Clock CpGs were enriched for gene ontology terms related to conserved nutrient-sensing and developmental pathways, supporting the established mechanistic link between development and epigenetic ageing. These findings demonstrate that epigenetic ageing is plastic and can be experimentally modulated by early-life environment, establishing *Nasonia* as a tractable system for dissecting the causal mechanisms of epigenetic ageing.

Other authors: Christian Thomas, University of Leicester. Eamonn B. Mallon, University of Leicester. Charalambos P. Kyriacou, University of Leicester.

16:30 – Antonella Bacigalupo, University of Glasgow
Comparative genomics of reduviids: on the origins of blood feeding in the assassin bugs

The evolution of haematophagy in the hemipteran family *Reduviidae* has been a controversial topic. The haematophagous subfamily *Triatominae* has been proposed to be monophyletic, polyphyletic, and paraphyletic, implying that haematophagy arose once or several times. All the other reduviid subfamilies are entomophagous.

In this work, we construct the *Triatomine* phylogeny and explore the adaptations to haematophagy by comparing *triatomine* genomes with non-triatomine reduviids. Using mitogenomes and whole genomes, we obtain phylogenetic and phylogenomic trees that concur in showing *Triatominae* as a monophyletic clade. Comparative genomics show that the reduviids analysed present similar number of gene families annotated with functions that can be associated with haematophagy, related to environmental sensing, circadian rhythm, heat homeostasis, digestion, detoxification and immunity, but some were specific to triatomines. Among shared reduviid gene families, some presented rapid expansions and/or contractions in triatomines. Many single copy orthologs analysed showed positive selection in *Triatominae*.

In summary, the emergence of haematophagy involved the emergence of new genes, expansion and contractions of existing gene families, and increased rate of non-synonymous versus synonymous mutations

of some coding sequences. These changes underpin the myriad adaptations that enable triatomines to feed on vertebrate blood.

Other authors: Kathryn R. Elmer, School of Biodiversity, One Health and Veterinary Medicine, University of Glasgow. Martin S. Llewellyn, School of Biodiversity, One Health and Veterinary Medicine, University of Glasgow.

16:45 – Idris Adams, University College London
Evolution of prey type and life history traits in solitary aculeate wasps

Ecological specificity describes the extent to which an organism is adapted to only a subset of all possible environments or resources. Trophic specialists, organisms with narrow dietary breadths, are typically theorised to evolve from generalist ancestors. Wasps, being the most abundant insect in the order Hymenoptera, provide many opportunities to address major questions in ecology and evolution. Solitary aculeate wasps in the families *Crabronidae* and *Sphecidae* exhibit considerable diversity in prey type and associated life history traits, including nesting habitat, nest structure, and mode of prey carriage. However, empirical research on these families is lacking in comparison to non-aculeate parasitoid wasps. Using phylogenetic comparative methods, we reconstruct the ancestral prey type of the *Crabronidae* and *Sphecidae* and use prey specificity metrics to measure trophic specificity across the two families.

Our results show that while extant specialists tend to evolve from more generalist ancestors, there is diversity across families in the direction of transitions, and entire clades have evolved to be more generalist than their ancestors. We show how historical data from natural history papers can be synthesised and used to test longstanding hypotheses, and highlight gaps in sequencing data that can limit the inference of results from phylogenetic comparative analyses.

Other authors: Seirian Sumner, University College London

17:00 – Saam Hasan, University of Plymouth
A Genus-Wide Comparison of the Nature and Incidence of Positive Selection in Bumblebees

Whilst decline is evident across the entire bumblebee phylogeny, the subgenus *Pyrobombus* is over-represented among stable or range-expanding species. This suggests that these population trends are driven, at least partly, by adaptations resulting from genomic variation unique to the group.

To investigate this, the first step is to identify the number and nature of genes exhibiting evidence of adaptive variation. This was detected using measures of positive selection. Evidence for positive selection was assessed in 24 bumblebee species representing all 15 subgenera using two types of maximum-likelihood methods. A branch model identified genes and a site model identified individual protein sites undergoing positive selection. The analysis was conducted on the complete universal single-copy ortholog set of 3,471 genes. In total, 161 genes from the branch model and over 7,000 protein sites from the site model exhibited positive selection within *Pyrobombus*. The majority of these genes also showed evidence of purifying selection in other subgenera.

The gene list was enriched for processes such as cell signalling and developmental process. These genes represent potential candidates for further research evaluating the specific impact of their variation on the success of the *Pyrobombus* group compared to others.

17:15 – Daniel Leybourne, The University of Liverpool
Aphids, endosymbionts, and plant viruses: How does vector-virus diversity influence virus-vector-host interactions?

Cereals are important crops that are attacked by a range of aphid species that vector barley yellow dwarf virus, a devastating virus of cereal crops. The transmission efficiency of yellow dwarf virus can differ between vector populations, with intra-species diversity (genetic variation, endosymbionts) a key determinant of vector competency. Transmission efficiency and disease severity can also be influenced by the virus variant. However, the extent to which diversity at both levels in the vector-virus system influences virus transmission efficiency, virus spread, and disease risk is unclear.

Using two populations of the bird cherry-oat aphid with contrasting endosymbiont profiles and two virus variants we examine the influence vector-virus diversity has on virus-vector-host interactions. Our results identify differences in transmission efficiency between aphid populations and virus variant, with aphids harbouring an endosymbiont less efficient virus vectors. Assessment of aphid feeding patterns shows that aphid feeding behaviour is influenced by the endosymbiont and the virus, potentially contributing towards observed variation in transmission efficiency. In ongoing work, we are monitoring the consequences vector-virus diversity has on vector dispersal and virus spread. These results represent an advancement in our understanding of the relationship between vector diversity, virus diversity, vector behaviour, and virus transmission efficiency.

Other authors: Elinor Baird, The University of Liverpool

17:30 – Simon Segar, Harper Adams University
Distribution and diversity of potential cytoplasmic incompatibility agents (Wolbachia prophage WO) within an entire fig wasp genus (*Agaonidae: Pleistodontes)*

Cytoplasmic incompatibility (CI) induced by non-compatible killer and rescue genes (cifB and cifA) contained within WO prophage of Wolbachia bacteria has potentially important consequences for incipient species. Pollinating fig wasps (*Agaonidae*) often radiate as sister species across their hosts. Sister species often eclose and come into contact within figs, with wide potential for gene flow.

What maintains species boundaries in this system? Here we examine the potential for CI causing genes to impose barriers to gene flow across sympatric and allopatric wasps, building on predictions from “contact contingency” and “adaptive decay” hypotheses outlined in previous work. Fundamentally, that Wolbachia may be adaptively acquired by hosts, and is not only a ‘master manipulator’.

Whole genome sequencing of Wolbachia across 43 species of wasp determined that while Wolbachia instances are high (29/43 species, 1.6 strains per species), instances of full and functional cifB (17) and cifA (29) genes is lower. Phage DNA is found in 31 wasp species (mean phage strain number: 1.6). Thus, Wolbachia appear to have persisted despite gradual purging of cif genes (cifB typically lost before cifA). We discuss nested distributions and functionality of prophage genes, highlighting non-random distributions through several instances of CI in sympatry.

Other authors: Sotiria Boutsi, Agriculture and Environment Department, Harper Adams University, Newport, United Kingdom. Clive T. Darwell, Independent Researcher. Sabine Nidelet, CBGP, INRAE, CIRAD, IRD, Montpellier SupAgro, Univ Montpellier, Montpellier, France. Astrid Cruaud, CBGP, INRAE, CIRAD, IRD, Montpellier SupAgro, Univ Montpellier, Montpellier, France. Jean-Yves Rasplus, CBGP, INRAE, CIRAD, IRD, Montpellier SupAgro, Univ Montpellier, Montpellier, France. Ed Harris, Agriculture and Environment Department, Harper Adams University, Newport, United Kingdom.

- Pollinators 2

Auditorium B | Chair: Gail Jackson, University of Edinburgh
RES Journal: Ecological Entomology

16:15 – Jamie Smith, University of Hull
Lasting Impacts of Sublethal Pre-pupal Heatwaves on the Fertility of the Solitary Bee, *Osmia bicornis*

Climate change is increasing the frequency and intensity of heatwaves and extreme weather events, threatening global biodiversity. Understanding how these climatic stressors disrupt species' reproductive mechanisms is crucial, particularly for ectothermic insects with often complex life cycles.

Osmia bicornis, a vital pollinator, develops in nesting cavities during early summer, rendering larvae susceptible to heat stress during early development. We subjected *O. bicornis* larvae in the pre-pupal phase to a simulated 3-day fluctuating heatwave of <40°C and assessed fertility in the resulting adults just before emergence. Males subjected to a heatwave suffered a 44% drop in sperm numbers, a 17% reduction to sperm length and a 53% drop in sperm motility compared to controls developing without a heatwave in otherwise identical conditions. Females suffered a 16% reduction to oocyte counts and a 19% reduction to oocyte volume.

These findings show that extreme weather events during development can have lasting effects that carry across months later into overwintered adults, severely compromising fertility of this important pollinator and potentially impacting key crop pollination.

Other authors: Elizabeth J. Duncan, University of Leeds. James D. J. Gilbert, University of Hull.

16:30 – Fairo Dzekashu Foryu, University of Lethbridge
Pollination in a changing climate: Warming and water scarcity distorts floral traits, plant-pollinator interactions and seed yield of canola plants

Insect-mediated pollination is an important ecosystem service with valuable contributions to the fertilisation of crops. However, environmental threats such as heat waves and drought threaten this mutualistic interaction and thus global food security. We examined the influence of heat and water stress on flower phenology, nectar volume, concentration and flower size, and how variations in these cues drive pollinator visitation rates and seed yield in three canola varieties.

We set up two temperature treatments, in two greenhouse bays (n= 4 bays total), and two irrigation treatments within each bay. The temperature conditions were: Ambient, 26°C:11°C, mimicking the average temperatures for the past 10 years, and Hot: 31°C:13°C, representing projected mean max and min temperatures for the year 2055 in the study region. The irrigation treatments were well-watered: 64% water holding capacity (WHC) and reduced-watered 21% WHC, mimicking ambient and drought conditions. We found an advancement in flowering onset, with plants reaching peak flowering earlier in hot treatments. Plants under ambient conditions were more attractive to pollinators as they produced broader flowers with larger volumes of less concentrated nectar. Plants in well-watered treatments produced significantly higher yields and pollinator visitation had direct positive effects on seed yields.

In conclusion, our study elucidates the importance of climate-mediated influences on plant phenology and flowering rewards which limits plant-pollinator interactions and the ecosystem services they provide.

Other authors: Shelley E. Hoover, University of Lethbridge

16:45 – Matthew Chambers, The University of Hull
Do mother bees provisioning young tailor their pollen provisions to the nesting environment?

Wild bee species are involved in pollinating 42% of leading crops. Populations are declining, threatening crop production. Osmia bicornis, like many wild solitary bees, rely on parental provisioning to develop into adult stages. Studies on other species suggest that the nutritional requirements of a developing Osmia are likely environmentally dependent. However, after provisioning young with pollen, nesting females have limited involvement, leaving developing offspring at the mercy of their environment. We know little about how or whether mothers tailor pollen provisions to the needs of young.

In the field, free-foraging *Osmia* females chose between nesting sites experimentally heated to differing temperatures. Subsequent maternal nesting preferences, provisioning levels and composition, and larval development and emergence were recorded.

We are using Conditional Process Analysis to model theoretical effect paths (including; nest temperature, provisioning level and nutritional abundance), allowing comparative analysis of potential action pathways on development.

While simple correlations indicate that increased nest temperatures result in increased laying, reduced provisioning and increased rates of eclosion, path analysis suggests that factors affecting development may vary by developmental stage.

Understanding the ability of wild bees to navigate environmental fluctuations, informs predictions of their developmental resilience, bespoke conservation efforts and precision interventions to promote pollinators.

Other authors: Gomes E, University of Hull. Miller E, University of Hull. Smith J, University of Hull. Niven J, University of Sussex. Nicholls E, University of Sussex. Gilbert JDJ, University of Hull.

17:00 – Krzysztof Miler, Institute of Systematics & Evolution of Animals, Polish Academy of Sciences (ONLINE)
The evolutionary ecology and behavioral relevance of ethanol in honeybees

Ethanol is a microbial fermentation product commonly found in sugar-rich substrates like floral nectar, yet its role in pollinator ecology remains understudied. We investigated how honeybees (*Apis mellifera*) respond to low, ecologically relevant doses of ethanol, combining behavioral, physiological, and parasitological approaches. Acute and chronic ethanol exposure had no measurable effect on odor discrimination or cognitive judgment bias, and only modestly elevated mortality in older individuals. Elevated hemolymph trehalose suggested metabolic adjustment rather than toxicity. Ethanol was also detected in the crop contents of naturally foraging bees, confirming environmental exposure. Strikingly, bees infected with the gut parasite *Nosema ceranae* showed a stronger preference for ethanol-spiked sucrose than uninfected controls, despite ethanol offering no reduction in parasite load. This infection-linked shift in dietary choice was accompanied by slightly improved survival in infected bees receiving ethanol, pointing to a potential buffering effect under physiological stress.

Together, these results suggest that honeybees are not only tolerant of ethanol but may actively regulate their intake in context-dependent ways. Ethanol should be recognized as a biologically relevant factor shaping pollinator behavior, with implications for understanding plant–pollinator–microbe interactions and the evolution of substance-mediated foraging decisions.

Other authors: Weronika Antol, Institute of Systematics and Evolution of Animals, Polish Academy of Sciences. Monika Ostap-Chec, Institute of Systematics and Evolution of Animals, Polish Academy of Sciences. Marta Golanska, Faculty of Psychology, University of Warsaw.

17:15 – Ashley Darst, Michigan State University (ONLINE, ECR Prize Winner)
Salty floral rewards affect floral visitation and pollination rate

Sodium is limiting in many parts of the world. This creates a challenge for the plant-eating animals that live there, as animals require sodium while plants do not. It is hypothesized that plants exploit pollinators' need for sodium by transporting sodium into their floral rewards. However, it is unknown whether many plants can transport sodium into their floral rewards, whether pollinators prefer sodium-enriched rewards, and whether this affects plant fitness. In one study, we used plot-level sodium additions in a restored prairie to investigate whether flowers grown in sodium-enriched soil attract more floral visitors. In a second study, we used black-eyed Susans (*Rudbeckia hirta*) to investigate whether sodium-enriched floral rewards increase seed set through increased pollination. Sodium-addition plots and black-eyed Susans had elevated sodium in the soil, leaves, and floral rewards. In the plots, sodium treatment did not predict overall floral visitor abundance and group richness. However, the abundance of honeybees and lepidopterans was greater in sodium-addition plots, while the abundance of wasps was lower. Sodium-enriched black-eyed Susans had a higher pollination rate, but only in prairies with low diversity.

Together, these results suggest that the preference for—or detection of—sodium-enriched floral rewards is more complex in natural systems.

Other authors: Bonnie Johnson, Michigan State University. Megan Lamm, Warren Wilson College. Nick Haddad, Michigan State University.

17:30 – Tegan Gaetano, University of Aberdeen
(Sea) Salt of the Earth: Structural Plant-pollinator Communities Mediated by Micronutrient Reward in Scottish Machair Ecosystems

One of the rarest habitats in Europe, machair is a flower-dense ecosystem distinct to the north- and west-facing coasts of Scotland and Ireland. Machair uniquely supports several species of endangered pollinators, including the great yellow bumblebee (*Bombus distinguendus*). Once found throughout Great Britain, this species is now restricted to the machair of north Scotland and its islands.

Previous investigations into what makes this habitat suitable for these rare bees have focused on food plant abundance and diversity. But the underlying nutritional landscape of the machair has gone unexplored. This research combines plant physiology and bumblebee foraging ecology approaches to explore the ‘salty nectar hypothesis’, which describes a mechanism of pollinator attraction mediated by sodium (Na+) reward. We measure plant uptake of environmental Na+ and other mineral salts (Ca+, K+, Mg+) in tissues, pollen and nectar as well as selection for these elements through analysis of bee forage and behaviour. Preliminary findings suggest machair plants maximize low quantity elements beneficial to their growth and development (i.e., K+), while restricting uptake of Ca+ and Mg+. But they retain environmental levels of Na+, a non-essential nutrient for most plants that can stunt growth in large quantities. This finding supports the ‘salty nectar hypothesis’.

Other authors: Fabio Manfredini, University of Milan; Lesley Lancaster, University of Aberdeen; Paul Williams, Queen’s University Belfast; Robin Pakeman, James Hutton Institute; Richard Comont, Bumblebee Conservation Trust

Wednesday 10 September

- Insects & Society

Auditorium A | Chair: Mauro Pazmiño Betancourth, University of Glasgow
RES Journal: Medical and Veterinary Entomology

11:00 – Michael Bonsall, University of Oxford
Variation in the mating interactions between Aedes aegypti and Aedes albopictus impacts control programmes

The mosquitoes, *Aedes aegypti* and *Ae. albopictus* are important disease vectors and have a long history of invasion. Their contemporary ranges continue to expand and overlap.

Heterospecific matings between these species have been observed in both the laboratory and field. Importantly, the outcomes of these mating vary by combination. Female *Ae. aegypti* that mate with Ae. *albopictus* are unreceptive to further rematings, while female *Ae. albopictus* that mate *with Ae. aegypti* continue to be receptive. Critically, the mechanisms underlying variation in heterospecific and conspecific insemination rates are poorly understood. To investigate this, we documented interactions between multiple sympatric and allopatric *Ae. aegypti* and *Ae. albopictus* populations.

We expected that female *Ae. aegypti* in sympatry with *Ae. albopictus* would exhibit lower interspecific insemination rates compared to those which had never been exposed to *Ae. albopictus*. Surprisingly, we found that sympatric, allopatric or lab-adapted *Ae. aegypti* populations showed very limited levels of heterospecific insemination by *Ae. albopictus*. Our behavioural observations revealed that male rather than female behaviour explained these lower insemination rates. Importantly, there was wide variation in the interspecific interactions between mosquitoes across different populations. We discuss the implications of our findings for the control of these mosquito vectors.

Other authors: Dr Laura Cator (Imperial College). Dr Maisie Vollens (University of Oxford).

11:15 – Emma Reid, Liverpool School of Tropical Medicine
Evaluating Insecticide Exposure: Surface Availability Compared to Total Content in LLINs

The WHO recommends both chemical content and bioavailability analysis when qualifying insecticide-treated bets (ITNs). Current chemical content assessments use high-performance liquid chromatography (HPLC) to quantify active ingredients (AIs) remaining within the net, including Ais embedded within the fibres. However, mosquitoes primarily interact with the surface AI. This study investigates whether surface AI content better predicts mosquito mortality than total AI content, with the aim of evaluating surface analysis as a simpler proxy for net efficacy.

PermaNet 3.0 nets were collected during a 3-year durability trial in Sud-Ubangi, DRC. Surface and total deltamethrin and piperonyl butoxide (PBO) were quantified by HPLC and cone bioassays were performed using resistant laboratory mosquitoes.

Strong correlations were observed between surface deltamethrin and surface PBO, and between total deltamethrin and total PBO. However, only moderate correlations were found between surface and total

Ais. As net age increased, both surface and total AI concentrations declined, accompanied by in mosquito knockdown and mortality in bioassays.

These findings suggest that while surface and total AI content are related, they are not interchangeable. Surface AI may offer a more biologically relevant measure of bioavailability and, if validated further, could simplify routine ITN monitoring.

Other authors: David Weetman – LSTM. Frank Mechan – LSTM.

11:30 – Ivan Casas Gomez-Uribarri, University of Glasgow
Plasmodium falciparum affects mosquito lifespan in a species-specific and temperature dependent way

Mosquito lifespan and the incubation period of *P. falciparum* are of similar length, and long-lived mosquitoes are thought to be responsible for most transmission events. Evolutionary theory predicts that, under such circumstances, the parasite is likely to extend its vector's lifespan. However, the physiological challenge of being exposed to a parasite usually has a fitness cost to the host, potentially reducing its lifespan. Here, we investigate how exposure to the deadliest parasite on Earth affects the survival of two of its major African vectors: *An. gambiae* and *An. coluzzii*.

We analysed the survival of 6852 mosquitoes that were either exposed or not to Plasmodium. Data was collected across 9 replicates with long follow-up periods, and mosquitoes were reared under different temperatures, with or without daily oscillations: 21±0ºC, 21±6ºC, 27±0ºC, and 27±6ºC. We developed a novel survival analysis framework that is free of parametric and proportional hazards assumptions to analyse these data.

We show effects of exposure to *P. falciparum* on mosquito survival that are both species-specific and temperature-dependent, highlighting the complexity of the system and the need for explicit integration of fine temperature and mosquito species data into models of malaria transmission.

Other authors: Mauro Pazmiño Betancourth. Simon Babayan. Fredros Okumu. Francesco Baldini.

11:45 – Diego Cruz Fagua, University of Salamanca
Deciphering the Probiotic Potential of Gut Bacteriome of Edible Crickets and Locusts: A Study of Wild and Farmed Populations for Enhanced In-sect Farming

Edible Orthoptera are projected to create a market worth USD 3.5 billion by 2029. Currently, successful cricket production depends primarily on chicken feed, which significantly drives up production costs. While agri-food side streams present a potential solution to decrease feed costs, experiments have shown reduced insect performance due to high fiber and low protein content.

This study hypothesizes that previous failures to integrate plant-fiber-rich side streams into orthopteran diets may be attributed to the absence of gut microbiota capable of degrading these polymers, a consequence of laboratory rearing. To address this challenge, we investigated the gut bacteriome through 16S rRNA gene amplicon sequencing and culturable bacteria isolation from wild and farmed populations of *Gryllus bimaculatus, Gryllus assimilis*, and *Locusta migratoria*, testing the probiotic effects of bacterial isolates with capabilities for plant polymer degradation, nitrogen waste recycling, and nitrogen fixation.

Results revealed that Firmicutes, Proteobacteria, and Bacteroidota were the dominant phyla across all species. Alpha and beta diversity analyses demonstrated significant differences in gut bacteriomes be-

tween wild and farmed insects. We obtained 477 bacterial strains. Wild insects showed higher percentages of bacteria capable of degrading cellulose and xylan, fixing nitrogen, and recycling uric acid, potentially conferring advantages in utilizing nutrient-poor diets. Conversely, farmed insects exhibited higher percentages of urea-degrading bacteria.

In probiotic evaluation studies, a novel bacterial species tested in *G. assimilis* showed significant negative effects with high-fiber experimental diets. However, in *G. bimaculatus*, a Pantoea strain showed promising results when combined with high-fiber, cost-effective experimental diets, producing crickets with growth parameters comparable to control diets.

Other authors: Zaki Santamaria, Microbiology and Genetics Department, University of Salamanca, Salamanca, Spain. Luisa Achury-Arrubla, Microbiology and Genetics Department, University of Salamanca, Salamanca, Spain. Giovanny Fagua, Department of Biology, Pontificia Universidad Javeriana, Bogotá D.C., Colombia. Amanda Varela, Department of Biology, Pontificia Universidad Javeriana, Bogotá D.C., Colombia Paula Garcia-Fraile, Microbiology and Genetics Department, University of Salamanca, Salamanca, Spain, Institute for Agribiotechnology Research (CIALE), University of Salamanca, Salamanca, Spain, Associated Research Unit of Plant-Microorganism Interaction, Universidad de Salamanca-IRNASA-CSIC, Salamanca, Spain.

12:00 – Georgia Gorbould, Newcastle University

The implications of Different Agricultural Management Approaches on the Assemblage and Hierarchy of Coprophagous Beetle Communities in North Northumberland

As an essential component of agricultural ecosystems, the activities of dung beetles directly contribute to the maintenance of ecologically and economically beneficial environmental processes and ecosystem services. The implications of differing agricultural approaches are therefore of great importance in the understanding of *Scarabaeidae* behaviour, abundance and community organisation. To examine this, a study was conducted across two agricultural locales, situated in near proximity. Although similar in features and arrangement, the locations chosen differed fundamentally, as one was managed farmland (New Bewick) and the other a site of natural pasture (Chillingham Wild Cattle Park). The primary aim was to investigate the community composition of independent dung beetle populations through pitfall sampling and to subsequently evaluate the impacts of biotic and abiotic factors upon localised population dynamics. While initial results highlighted that both field sites were dominated by *Aphodius* species, a stronger difference in community assemblage was apparent at New Bewick, with a significantly greater presence of paracoprid beetles and one additional species accounting for almost fifty percent of the total beetle records. Preliminary analysis did not demonstrate any significant effects of abiotic factors on these communities, instead suggesting that divergent aspects of agricultural practices could significantly influence community composition and hierarchy.

12:15 – Meshach Lee, University of Glasgow

Assessing variation in mosquito abundance and diversity across a rural-urban gradient in Scotland

Vector-borne diseases (VBDs) are an emerging threat in northern Europe, and monitoring mosquito populations is essential to assess disease risk in temperate regions. In Scotland, where mosquitoes remain understudied, it is essential to understand how mosquito exposure and potential VBD transmission may vary across urban and rural environments. This study represents the first longitudinal assessment of mosquito exposure risk to humans and birds along an urban–rural gradient in West Scotland.

Mosquito sampling was conducted at four sites: two urban (Kelvingrove Park [KG], Kilmardinny Loch [KM]) and two rural (Mugdock [MG], SCENE [SC]). Adult mosquitoes were trapped during weeks one and three

of each month between July and September 2023 and April and September 2024 using BG-Pro traps baited with CO_2 and BG-lure.

A total of 119 mosquitoes were collected in 2023 and 246 in 2024, from eight species. Urban sites, particularly KM, had the highest abundance and species richness. *Culex pipiens* was the dominant species (78%) and emerged earlier at urban sites.

These results suggest greater mosquito activity and potentially higher VBD risk in urban areas, highlighting the importance of targeted surveillance and public health planning in Scottish urban environments.

Other authors: Georgia Kirby, Davide Dominoni, Francesco Baldini and Heather Ferguson

12:30 – Doreen Josen Siria, University of Glasgow

Assessing the accuracy and precision of age-grading Anopheles malaria mosquitoes based on ovarian morphology

Measuring the age of mosquito populations is critical for malaria surveillance, as only older female Anopheles mosquitoes can transmit the disease. Traditional age-grading methods based on morphological assessment of the ovaries to determine gonotrophic state (known as *Detinova* and *Polovodova*) are widely used, but lack rigorous evaluation of their performance. This study assessed the accuracy and precision of the *Polovodova* method in two mosquito species, *Anopheles arabiensis* and *An. funestus*. Over 3,600 mosquitoes were reared in the laboratory until the completion of 4 gonotrophic cycles. A blind validation experiment was conducted with three researchers (R1–R3) independently assessing mosquito samples without access to age information, while the fourth researcher (R0) provided the reference data. Pairwise comparisons among R1–R3 were conducted to measure precision.

Results showed 100% accuracy for nulliparous and 90–96% accuracy for parous mosquitoes across species. Precision was high, with agreement ranging from 86% to 99% across parity states (nulliparous, parous, gravid), and inter-rater reliability ($\kappa > 0.80$). However, precision declined when estimating gonotrophic cycles: while agreement remained high for nulliparous mosquitoes (83–89%), it dropped to 59–70% for cycles 1–3 ($\kappa = 0.61–0.69$).

In conclusion, the *Polovodova* method is highly accurate and precise for basic parity classification; however, it is less reliable for determining specific gonotrophic cycles. Optimizing training is essential for maximizing its utility in vector surveillance programs.

Other authors: Halfan Ngowo, Ifakara Health Institute. Fredros Okumu, Ifakara Health Institute and University of Glasgow. Heather Ferguson, University of Glasgow. Francesco Baldini, University of Glasgow.

- SYMPOSIUM: Insect Decline & Population Change

Auditorium B | Chair: Helen Roy, Centre for Ecology and Hydrology
RES Journal: Insect Conservation & Diversity

11:00 – Shannon Murphy, University of Denver
Indirect effects of global environmental changes on insect herbivores through top-down and bottom-up forces – a meta-analysis

Global environmental change is driving declines in insect populations worldwide, yet mechanisms underlying these patterns remain poorly understood, particularly when mediated by trophic interactions. Many studies test global change stressors (e.g., climate variability) on insect herbivores mediated via their host plants (bottom-up) and natural enemies (top-down), but we lack a comprehensive understanding of overall effects. We tested how 18 distinct globe change stressors impact insect herbivores via trophic interactions by employing a meta-analysis of 246 experimental papers. We found variable and often opposing impacts of global change stressors on insect herbivores through bottom-up effects, whereas top-down effects showed only a negative effect of warming on insect herbivores. Notably, generalists exhibited greater vulnerability to global change than specialists, challenging long-held ecological assumptions that dietary generalists should be more resilient. Insect herbivores tested in agricultural systems were more prone to be positively affected by global change, whereas closed experimental systems amplified negative outcomes.

Our results underscore the importance of considering trophic interactions and context-specific dynamics in predicting ecological responses to environmental change. By integrating bottom-up and top-down mechanisms, our study advances a more nuanced understanding of how global change influences insect herbivores, offering critical insights for biodiversity conservation in the *Anthropocene*.

Other authors: Mayra Vidal - University of Massachusetts, Boston. Matteau Comerford - University of Massachusetts, Boston. Billie Maguire - University of Massachusetts, Boston.

11:15 – Lindsey Kemmerling, University of Minnesota (ECR Prize Winner)
Geographic range-size explains butterfly tolerance to heavy metals more than coevolutionary history with toxic plant defense chemicals for 26 common species

Heavy metals are toxic pollutants common in urban areas, and why species vary in their tolerance to such pollutants remains an open question. The toxin coevolution hypothesis posits that an evolutionary history with natural toxins preadapts species to deal with novel toxins; the range-size-tolerance hypothesis posits that a larger geographic range selects for broader tolerance to stressors. Butterflies are useful to investigate these hypotheses because they coevolved with plants that vary in defensive compounds. We collected 26 species of butterflies across a gradient of pollution in Minneapolis, USA, and measured their heavy metal concentrations, their wing area and number of eggs. We also built a dataset of plant mutagenicity that we coupled with butterfly host records, to estimate evolutionary history with mutagens. We found that butterfly species with larger ranges tolerated greater concentrations of lead, arsenic, and cadmium. Species that coevolved with more mutagenic host plants tolerated greater maximum lead concentrations. There was a negative correlation between sublethal lead concentrations and butterfly wing size across all species. We provide additional support for the observation that small-ranged species are more vulnerable to environmental change, in this case, metal pollution, and an evolutionary history with mutagenic host plants may provide additional resilience.

Other authors: Ashley Darst, Michigan State University. Emilie Snell-Rood, University of Minnesota.

11:30 – Reyard Mutamiswa, Rhodes University (ONLINE, ECR Prize Winner)
Thermal stress exposure of pupal oriental fruit fly has strong and trait-specific consequences in adult flies

Global climate change is projected to increase the incidence of heat waves, their magnitude and duration resulting in insects experiencing increasing environmental stress. While studies on insect thermal tolerance are rapidly increasing, variation across developmental or juvenile stress cross-stage effects within generations remain unexplored. We investigated the effects of pupal mild heat stress on the performance of laboratory-reared adult *Bactrocera dorsalis* measured as longevity, critical thermal maximum (CTmax), critical thermal minima (CTmin), heat knockdown time (HKDT) and chill coma recovery time (CCRT). Pupal heat stress impaired longevity and heat tolerance (CTmax and HKDT) in both sexes with improved and compromised cold tolerance (CTmin and CCRT) in females and males, respectively.

These findings highlight the role of juvenile stages in mediating stress responses at adult stages. For *B. dorsalis,* pupal heat stress compromised thermal tolerance implying that the species has limited potential to shift its geographic range in heat prone areas. Significant benefits in cold tolerance in females may help in improving survival in the cold in the short-term despite restricted activity to the same traits in males. This study suggests that basal heat tolerance and not short-term thermal plasticity may have aided the recent invasion of *B. dorsalis* in Africa.

Other authors: Vimbai Lisa Tarusikirwa, Botswana International University of Science and Technology. Casper Nyamukondiwa, Botswana International University of Science and Technology. Ross Cuthbert, Queen's University. Frank Chidawanyika, International Centre of Insect Physiology and Ecology.

11:45 – Sean Rands, University of Bristol
Behavioural responses to rainfall in the pond skater *Gerris lacustris*

Characterising how organisms respond to environmental changes is key to mitigating the effects of climate change, especially given the increasing stochasticity of weather systems. Changes to global and local precipitation patterns have the potential to alter the behaviour and ecology of many organisms across multiple habitat-types. Raindrops present a significant threat to small-bodied organisms and a range of behavioural and physiological responses to these threats have been documented. Simulating rainfall in the lab is one way we can demonstrate the behavioural effects of precipitation and, using *Gerris lacustris* as an example species, we demonstrate how an experimental set-up can be adapted to study the effect rainfall has upon invertebrate behaviour.

Our results show that rainfall affects movement behaviours and spatial use. Individuals travelled further during and after rainfall, with movement events occurring more frequently and at higher velocities post-rain than pre-rain. Shelter-seeking behaviours were also commonly observed. Spatial analysis revealed that individuals occupied smaller areas during rainfall, with consistent dissimilarities in space use between rain and non-rain conditions. Adopting the methodologies proposed here would help better our understanding of the effects of rainfall upon behaviour, helping to predict and mitigate the effects of climate change across ecosystems.

Other authors: Oscar Hazell, University of Bristol

12:00 – Peter M. J. Brown, Anglia Ruskin University

Ladybird community changes and the dominance of the invasive harlequin ladybird Harmonia axyridis in long-term field studies in East Anglia, England

Long-term field studies of insect populations are relatively rare. However, when combined with species distribution data they can inform the changing status of species in a region. Ladybirds (Coleoptera: *Coccinellidae*) are important insects for pest control. Here I present results from a 19-year study examining ladybird community changes in East Anglia, England. Field data on adult and larval ladybirds were recorded from standardised sampling at four sites comprising two habitat types: nettlebeds and lime trees.

Overall, 13,801 ladybirds were recorded in 378 surveys conducted from 2006-2024. Seventeen of the UK's 26 macro ladybird species were recorded in total (ten at each nettlebed site; fourteen at each lime tree site). Eleven species had larval records.

Results show substantial inter-year variation. The invasive harlequin ladybird *Harmonia axyridis* arrived in year two of the study and rapidly increased in number: it was the most abundant species in all but year one and accounted for 57.8% of all ladybirds across 19 years. Whilst *H. axyridis* dominated both lime tree sites, the native 7-spot ladybird *Coccinella septempunctata* was most abundant at both nettlebed sites. Changes in populations of some of the native ladybird species were likely driven partly by negative interactions with *H. axyridis*. Better understanding of insect population trends can help inform appropriate conservation actions and policy.

12:15 – Lucy Holland, University College London

Assessing Long-Term Trends in Tropical Bee Occupancy in Response to Climate Change

Climate variability is expected to drive shifts in the occupancy patterns of pollinators, with significant consequences for ecosystem functioning and food security. These dynamics are especially concerning in tropical regions, where many species live near their thermal limits and critical data gaps restrict our ability to assess climate impacts. In this study, we investigate long-term occupancy trends of apid bees in South America over the past 50 years (1970–2020). We model changes in occupancy using effort-corrected occurrence records from the Global Biodiversity Information Facility (GBIF) as a proxy for species presence.

We hypothesise that tropical bees, due to their narrower thermal tolerances, will exhibit steeper occupancy declines in response to pronounced warming than their temperate counterparts. By integrating robust statistical approaches with large-scale occurrence data, this work aims to provide methodological insights and inform best practices for evaluating pollinator responses to climate change in data-poor regions.

Other authors: Dr Tim Newbold, University College London. Dr Charlie Outhwaite, Zoological Society of London.

12:30 – Denise Wawman, Edward Grey Institute, Department of Biology, University of Oxford (ONLINE, ECR Prize Winner)

Mapping the UK's Flat flies – a citizen science project

The *Hippoboscidae* are a family of *haematophagous* ectoparasites of birds (known as flat flies, or louse flies) and mammals (keds) that share some important aspects of their biology with the related Tsetse flies. Some species are competent vectors of *Haemoproteus spp.* and *trypanosomes*. They can harbour a range of pathogens, including some which are zoonotic. The last study of these species' United Kingdom ranges took place in the early 1960's.

The Mapping the UK's Flat Fly Project started with a small pilot study in 2020. British Trust for Ornithology licensed bird ringers were asked to collect flat flies. It grew to include over 250 individual bird ringers, bird ringing groups, bird observatories, entomologists and members of the public. The project received over 4300 flies that were identified to species level based on their morphology. Three species that had previously been considered vagrants were found breeding in the United Kingdom, including two on migrant birds. Two of the five commonest species had undergone significant range shifts since the 1960's and there has been an increase in host-parasite interactions. Further research will be required to determine the potential implications of these changes for animal and possibly human health.

Other authors: Ben Sheldon, Edward Grey Institute, Department of Biology, University of Oxford
Adrian Smith, Department of Biology, University of Oxford

- Natural History & Taxonomy

Auditorium A | Chair: Gael Kergoat, INRAE
RES Journal: Systematic Entomology

15:45 – Robin Hutchinson, UK Centre for Ecology & Hydrology & University of Exeter
Adding Diptera to the UK Checklist: how can we support the discovery of new species?

A core issue in quantifying gaps in insect monitoring to inform trends analysis and conservation is the existence of unknown unknowns – we do not know how many species are present but have never been recorded. Entomologists add 29 new species to the UK Diptera Checklist every year. Many of these are the result of taxonomic splits or investigating historic collections, but an average of 12 species per year are discovered through field surveys. These "overlooked" species are less likely to be collected through direct observation than previously discovered species.

Describing how new species are found for the first time allows us to understand how entomologists approach the discovery of species. We sourced sampling information (method, location and funding) for new Diptera species sampled between 1999 and 2024. We used this information within a multivariate analysis to explore the correlation between species level factors (such as survey type) and family level factors (including whether the taxa are included within a national recording scheme). We considered the limiting factors within each survey type, and how we could most effectively support an increase in detection of overlooked species.

Other authors: Helen Roy, UK Centre for Ecology & Hydrology and the University of Exeter. Dave Hodgson, University of Exeter. Martin Harvey, UK Centre for Ecology & Hydrology.

16:00 – Pritha Dey, National Centre for Biological Sciences, Bangalore (ECR Prize Winner)
From traits to tactics: How moth traits influence survival against adaptive bat predators

We explore how moth traits and seasonal availability influence their vulnerability to predation by the lesser false vampire bat (*Megaderma spasma*), a flexible predator found in India's Western Ghats biodiversity hotspot. Rather than focusing on individual prey–predator species pairs, we used a trait-based approach to assess vulnerability at the level of the entire moth community. Over three years, we analyzed

moth remains discarded at bat roosts and compared them with moths collected via seasonal light-trapping.

We measured key traits affecting predation risk—primarily body size and flight manoeuvrability. We found that predation patterns shift with the seasons: moths from the *Hepialidae* family were most frequently consumed during the wet season. Larger moths with poorer flight escape capabilities were more likely to be preyed upon. In particular, *Sphingidae* (hawk moths) and *Hepialidae* (ghost moths) were dominant in the bat's diet due to their size and low agility.

The findings highlight that morphological traits and seasonal availability together shape predation risk. This trait-based framework offers a powerful lens for understanding predator–prey dynamics in complex tropical ecosystems and opens new avenues for studying interactions in less-studied Paleotropical communities.

Other authors: Rohini Balakrishnan, Indian Institute of Science, Bangalore, India

16:15 – Beulah Garner, Natural History Museum, London

Counting on all species: one last look at the beetle tree of life

Coleoptera amount to over 400,000 described species globally. This staggering diversity, illuminated by taxonomic efforts over three centuries, requires a global synthesis. We introduce the result of combining genomes, mitogenomes and barcodes into the most comprehensive Coleoptera phylogenetic tree to date, of 100,000 species. This innovation in taxonomy still only covers a third of the known diversity, though includes many undescribed species. Our knowledge of historically described species provides a baseline dataset to monitor current diversity and distributions through global mechanical collecting methods, but it is high throughput DNA barcoding and metagenomics for lineages that remain phylogenetically unknown and incomplete, which form the basis for populating the global Coleoptera phylogenetic tree. We argue are these efforts enough at describing species and understating their distributions and evolutionary lineages to inform contemporary studies. Many species, especially from the diverse tropics may not be discovered again, and if they are, their recognition requires access to digital resources and more comprehensive species description.

We cannot answer the relevant questions with descriptive taxonomy alone. The tree of 100,000 species is of an unprecedented scale and requires innovative approaches to the tree search discussed herein. The resulting mega-tree allows us not only to count species but to make species count, by understanding global patterns of diversity in space and time and ultimately shedding light on global change and species loss.

16:30 – Agata Kowalik, Natural History Museum of Geneva & University of Geneva

Target-capture museomics and biogeography of arboreal Therates tiger beetles (Coleoptera, *Cicindelidae*)

Arboreal tiger beetles of the genus *Therates* occur in forests from the Indo-Australian Archipelago to continental Southeast Asia with many island endemic species. This group therefore represents an interesting new model to revisit the biogeography of this geologically intricate region. The genus currently comprises 124 described species, but their phylogenetic relationships remain unknown. In this study we use a museomics approach to sequence specimens of *Therates* and closely related genera from private and institutional museum collections to generate the first robust phylogenomic tree for the genus. We leverage the power of historical DNA extractions, and target capture to produce genomic-scale data for 94 specimens,

representing 41 described species and covering most recognized morphological species-groups in the genus *Therates*.

Our new phylogenomic reveals an unexpected placement of *Therates* within the family Cicindelidae with both systematic and evolutionary implications. Divergence time and ancestral range estimations allow us to reconstruct the evolutionary history of the genus across Southeast Asia and the Indo-Australian Archipelago, suggesting an origin east of Lydekker's Line with subsequent westward colonization of the region showcasing a dynamic evolutionary pattern.

Other authors: Hélène Mottaz, Natural History Museum of Geneva; Julia Bilat, Natural History Museum of Geneva, ; Cody Cardenas, Natural History Museum of Geneva; Jérémy Gauthier, Natural History Museum of Geneva, Naturéum –Cantonal Museum of Zoology; Jürgen Wiesner, 3Am Zellberg 6, D-38527 Meine, Germany; Emmanuel F.A. Toussaint, Natural History of Geneva

16:45 – Cody Raul Cardenas, Natural History Museum of Geneva

HyRAD-X phylogeography of the Balkan mountain endemic and flightless Calosoma (Callisthenes) pentheri

Reduced gene flow has been suggested as a major driver of diversification in insects. The flightless Calosoma (*Callisthenes*) *pentheri Apfelbeck*, 1918 is known from mountainous regions of North Macedonia, Albania, and Montenegro. This taxon is represented by two subspecies, *C. (C.) p. pentheri* and *C. (C.) p. relictum Apfelbeck*, 1918 with little morphological variation but presumed disjunct geographic distributions. The status of both lineages as subspecies or distinct species have been debated in the past and the current evidence supporting either of these hypotheses remains tenuous. We report the first phylogeographic examination of this species in the Balkans using 63 contemporary and historical specimens representing both lineages, as well as a new high-fidelity genome of *C. (C.) p. pentheri* generated using long-read sequencing. Genomic data are generated using hybridization capture of RAD-derived probes obtained from a reduced exome template and high-throughput sequencing.

We recovered nearly 12,926 single nucleotide polymorphisms and 2,278 loci for phylogenetic analysis. Phylogeographic and population genomics analyses show a clear delineation between the two lineages along western Balkan mountain ranges. Our analyses suggest that the taxonomic status of these two lineages be revised to better represent the evolutionary history of the group.

Other authors: Jérémy Gauthier, Natural History Museum of Geneva & Naturéum - Cantonal Museum of Natural Sciences; Hélène Moataz, Natural History Museum of Geneva; Julia Bilat, Natural History Museum of Geneva; Slavčo Hristovski, Institute of Biology, Faculty of Natural Sciences and Mathematics Ss. Cyril and Methodius University; Emmanuel FA Toussaint, Natural History Museum of Geneva

17:00 – Víctor Noguerales, University of La Laguna - Department of Animal Biology, Soil Science and Geology (ONLINE, ECR Prize Winner)

Microgeographic speciation within mountains: Insights from a species complex of grasshoppers (Orthoptera: *Gomphocerinae*)

Mountains contribute disproportionately to global insect biodiversity, yet the ecological and evolutionary processes that make them important centers of speciation remain poorly understood. Here, we use a species complex of *Gomphocerinae* grasshoppers distributed across the Pyrenees (Spain and France) as an insect model system to investigate the process of speciation in mountain regions. Genomic clustering

analyses revealed a marked genetic fragmentation of populations and divergence time estimates indicated that all lineages split during the Pleistocene (<0.9 Ma). Although all taxa currently exhibit allopatric distributions, fine-scale temporal distribution modelling suggested that their ranges likely overlapped across extensive areas during glacial periods. Despite ample opportunities for historical hybridization, introgression tests indicated that limited gene flow was exclusively restricted to peripheral populations, with only one of them exhibiting a high degree of genetic co-ancestry from a closely related species. Accordingly, our inferences revealed abrupt genetic discontinuities corresponding to the current distributional boundaries of each taxon.

Although taxa have probably not achieved complete reproductive isolation, semi-permeable species boundaries do not appear to have blurred their taxonomic and evolutionary cohesion. These results pose taxonomic implications for this grasshopper species complex, while shedding light on the proximate processes promoting microgeographic speciation in topographically complex landscapes.

Other authors: Joaquín Ortego, Estación Biológica de Doñana - Department of Ecology and Evolution

- Integrated Pest Management (IPM) 1

Auditorium B | Chair: Daniel Leybourne, The University of Liverpool
RES Journals: Ecological Entomology & Physiological Entomology

15:45 – Neelendra Joshi, University of Arkansas
Integrated Pest and Pollinator Management: A Framework to Safeguard Pollinator Health

Bees play a critical role in pollination, supporting both wild plant reproduction and crop production, and thereby contributing to biodiversity and agricultural sustainability. However, widespread declines in bee populations threaten global food security, underscoring the need to address key stressors such as pathogens, pests, habitat loss, poor nutrition, and pesticide exposure. One emerging strategy to mitigate these threats is Integrated Pest and Pollinator Management (IPPM), which broadens traditional pest management to explicitly include pollinator health. This talk highlights key strategies within the IPPM framework aimed at promoting both crop protection and pollinator conservation.

Other authors: Olivia Kline, University of Arkansas, Fayetteville, AR. Ngoc Phan, University of Arkansas, Fayetteville, AR. David Biddinger, Pennsylvania State University, University Park, PA.

16:00 – Rosie Knapp, ADAS
What doesn't kill you makes you weaker: Lethal and sub-lethal impacts of insecticides on agriculturally important natural enemies

In agriculture, natural enemies provide effective control of insect pests and are a cornerstone of Integrated Pest Management (IPM). Natural enemy populations are supported through provision of habitat, resources, and minimising off-target insecticide impacts. However, the toxicity of insecticides towards natural enemies has not always been thoroughly investigated, with knowledge gaps for newer 'selective' chemistries, sub-lethal impacts and non-commercially reared species.

In Australia, a shortage of clear, publicly available information on the toxicity of common insecticides towards natural enemies is also cited as a barrier to informed insecticide use by farmers. To address this, acute mortality assessments were conducted for 15 natural enemy species and 20 insecticide products

used by the Australian grains industry following International Organisation for Biological Control (IOBC) laboratory methods.

The results provide a broad comparative overview with useful applications for industry, demonstrating key inter-specific differences in insecticide toxicity profiles and highlighting the risks of generalising within natural enemy groups and insecticidal classes. For certain species, further investigations of behaviour, reproduction and population demography emphasised the importance of also considering long-term and sub-lethal impacts of insecticides. These findings are considered in the context of their applications to wider IPM programmes globally, taking a broad overview of the role of selective insecticides within IPM.

Other authors: Robert McDougall, Cesar Australia. Kathy Overton, Cesar Australia. Luis Mata, Cesar Australia. Ary Hoffmann, University of Melbourne. Paul Umina, University of Melbourne, Cesar Australia. Mark Ramsden, ADAS.

16:15 – Antoine Pichon, Teagasc

Insecticide resistance in *Bruchus rufimanus* in Ireland: Evidence for metabolic resistance to λ-Cyhalothrin

The broad bean beetle *Bruchus rufimanus* is a major pest of faba bean (Vicia faba), significantly impacting grain quality. European Market thresholds are strict: less than 3% seed damage is tolerated for human consumption, and up to 10% for animal feed. In Western Europe, including the UK and Ireland, control of *B. rufimanus* relies mainly on pyrethroids. Spraying is recommended at the start of pod setting when maximum daily temperatures exceed 20 °C for two consecutive days and adult beetles are present. However, field control is often suboptimal.

To investigate whether insecticide resistance could explain this reduced efficacy, we evaluated the susceptibility of an Irish *B. rufimanus* population to λ-cyhalothrin, one of the two authorized pyrethroids in the British Isles. The bioassay revealed a strong resistance (LD_{50} =120% of the recommended field rate). Biochemical assays suggested enhanced metabolic detoxification as a resistance mechanism. The screening for the L1014F mutation did not detect the presence of this mutation.

These results indicate that metabolic resistance is present in Irish populations of *B. rufimanus* and may compromise the efficacy of current control practices. Our findings underline the urgent need for routine resistance monitoring and the development of integrated pest management strategies.

16:30 – Chandana C. R, ICAR-National Bureau of Agricultural Insect Resources, Bengaluru (ONLINE)

Transcriptomic and functional genomics insights into insecticide resistance in *Maruca vitrata F.* (Lepidoptera: *Crambidae*)

The legume pod borer, *Maruca vitrata F.,* is a pantropical insect pest causing substantial yield losses in legume crops like cowpea, beans and pigeonpea in India. As because of intensive and indiscriminate use of insecticides, field control failures owing to development of insecticide resistance mechanisms. ABC (ATP-binding cassette) transporters and UGT (UDP-glycosyltransferase) genes, are suspected to play key roles in detoxification and resistance. However, their involvement in resistance to lambdacyhalothrin in *M. vitrata* have rarely been studied in detail. This study investigated insecticide resistance in five field-collected populations from South Indian. ABC and UGT genes were mined and characterized using draft genome/transcriptome assemblies.

Further, their role in insecticide resistance was deciphered. The phylogenetic relationship was established between different ABC and UGT subfamilies. Reference genes were identified and validated qRT-PCR normalization, and their expression stability was assessed. The quantitative gene expression studies revealed overexpression and under expression of key detoxification genes in resistant population over susceptible laboratory population. The findings provide a new insight into the molecular mechanism associated with insecticide resistance in *M. vitrata*, emphasizing the functional roles of ABC transporters and UGTs, and contribute to the development of resistance management strategies.

Other authors: M Mohan, Division of Genomic Resources, ICAR-National Bureau of Agricultural Insect Resources, Bangalore-560024, India. Sushila Nadagouda, Department of Entomology, College of Agriculture, University of Agricultural Sciences, Raichur- 584104, India.

16:45 – Rakesh V, ICAR-Indian Agricultural Research Institute (IARI), New Delhi

Sprayable RNA solutions: A sustainable alternative for managing insect vectors of plant viruses

Insect vectors such as thrips and whiteflies transmit devastating plant viruses (e.g., *tospoviruses*, *begomoviruses*), causing annual crop losses of 17.5%–23.3% (USD 36 billion) in India, prompting heavy reliance on chemical pesticides. RNA interference (RNAi)-based biopesticides offer a sustainable alternative, using sequence-specific double-stranded RNA (dsRNA) to silence essential genes in pests while sparing non-target organisms. Here, we demonstrate that foliar-applied dsRNA targeting the V-ATPase-B gene in thrips (Thrips palmi) significantly reduced survival (58.33% suppression) and reproductive fitness (67% decline), with effects lasting up to 10 days post-treatment. The dsRNA remained stable on cucumber plants, inducing a 5-fold downregulation of V-ATPase-B mRNA in thrips sap feeding on it. Similarly, silencing the peptidoglycan recognition protein (PGRP) gene in whiteflies (*Bemisia tabaci*) disrupted chilli leaf curl virus acquisition and transmission while impairing vector fitness. These findings validate RNAi's potential for targeted pest suppression and viral disease management. Unlike broad-spectrum insecticides, dsRNA sprays provide species-specific control without harming beneficial organisms, offering an eco-friendly strategy to reduce pesticide dependency.

Our results highlight the practicality of customizable RNAi biopesticides for sustainable agriculture, minimising environmental impact while effectively managing insect vectors and associated plant viruses.

Other authors: Dr Amalendu Ghosh, Senior Scientist (Entomology), Advanced Centre for Plant Virology, Division of Plant Pathology, ICAR-Indian Agricultural Research Institute, New Delhi-110012, India.

17:00 – Elizabeth Tettey, University of Ghana, Legon & CSIR Oil Palm Research Institute, Ghana (ONLINE)

Spatiotemporal Dynamics of *Oryctes monoceros Olivier* (Coleoptera: *Scarabaeidae)*, in Ghana: Seasonal and Agro-Ecological Drivers of Population Peaks

Cocos nucifera L. (coconut) is a globally important perennial crop with increasing demand. The crop is under increasing threat from the rhinoceros beetle (*Oryctes monoceros*, Coleoptera*: Scarabaeidae*), which can inflict up to 40% damage in affected tropical-Africa regions. To guide sustainable pest management, this study monitored seasonal beetle abundance across four agro-ecological zones in Ghana: Coastal Savannah, Deciduous, Rain Forest, and Transition.

Monthly field surveys revealed that *O. monoceros* exhibits a multi-voltine life cycle, with adult populations emerging during the major rainy season and reaching peak abundance in the minor rainy season. Numbers declined notably during the dry season. Results revealed that the abundance of *O. monocerus*

was significantly different (P < 0.001) among the various ecological zones and seasons, respectively. Similarly, there was a significant interaction between the zones and seasons (P < 0.001). Rain Forest, Coastal Savannah zones and Deciduous recorded significantly higher abundance of *O. monocerus* relative to the Transitional.

These findings support that both temporal (seasons) and spatial (zones) factors must be considered for effective pest control planning. By pinpointing times and locations of peak beetle abundance, this study provides critical insights to inform targeted, ecologically sound management strategies for *O. monoceros* in Ghanaian coconut systems.

Other authors: Prof. Ken O. Fening - University of Ghana. Dr. Sylvester Dery - Council for Scientific and Industrial Research, Oil Palm Research Institute. Prof. Kwame Afreh- Nuamah - University of Ghana. Prof. Alfried Voglar - Imperial College, London.

Thursday 11 September

- Invasive Species & Community Ecology

Auditorium A | Chair: Robert Wilson, Museo Nacional de Ciencias Naturales
RES Journal: Ecological Entomology

09:45 – Graham Stone, University of Edinburgh
Top-down and bottom-up effects structure parasitoid assemblages attacking cynipid galls in the forests of Sichuan, China

What structures host-parasitoid interactions remains a key question in insect community ecology. Are herbivore and parasitoid assemblages structured by the 'bottom-up' effects of herbivore food plant associations? If so, both plant-herbivore and plant-parasitoid interactions should be strongly predicted by plant identity. Or does 'top-down' selection from parasitoids result in structuring by herbivore defences that are decoupled from food plant associations? If so, we expect plant identity to be a much poorer predictor of plant-parasitoid interactions than of plant-herbivore interactions. We assessed support for these alternative models by generating interaction networks for previously unstudied communities of forest trees, herbivorous cynipid gallwasps and associated parasitoids in Sichuan, China.

Samples of 42,620 cynipid galls of 176 morphotypes from 23 host plant species yielded over 4500 specimens of 64 parasitoid morphospecies. Almost all of the cynipid and parasitoid taxa are new to Science. Gallwasp-plant interaction networks were significantly more modular than parasitoid-plant association networks, and gallwasps were significantly more specialised to host plants (i.e. had higher mean d' values) than parasitoids. Parasitoid assemblages nevertheless showed significant plant-associated beta diversity, suggesting that herbivore-parasitoid interactions are structured by a combination of 'bottom-up' and 'top-down' effects. We discuss our findings in light of the processes thought to structure tritrophic interactions centred on endophytic insect herbivores.

Other authors: ZhiQiang Fang (Sichuan Provincial Academy of Natural Resources Sciences, China), Chang-Ti Tang (University of Edinburgh), Frazer Sinclair (Tropical Biology Association), György Csóka (Sopron University, Hungary), Jack Hearn (Scotland's Rural College), Koorosh McCormack (University of Edinburgh), George Melika (Hungarian Plant Health Diagnostic National Reference Laboratory), Katarzyna Mikolajczak (Grantham Research Institute on Climate Change and the Environment), James A Nicholls (Royal Botanical

Gardens Edinburgh), José-Luis Nieves-Aldrey (Museo Nacional de Ciencias Naturales, Spain), David G Notton, Sara Radosevic (University of Edinburgh), Richard I Bailey (University of Lodz, Poland), Alexander Reiss (University of Edinburgh), Yuanmeng M Zhang (University of Edinburgh), Ying Zhu (Southwest Minzu University, China), Shengguo Fang (Zhejiang University, China), Karsten Schönrogge (CEH Wallingford).

10:00 – Ainoa Pravia, Forest Research
Arthropod communities as indicators of peatland restoration trajectories

The restoration of afforested peatlands starts with tree removal and rewetting to raise the water table and open the habitat. Standard monitoring often focuses on water, vegetation, and peat condition but tends to overlook the restoration trajectory of arthropod communities. In the restoration of a Scottish raised bog, several arthropod taxa were sampled and identified to species in pristine and under restoration treatments; and their microhabitat characterised (temperature, soil and vegetation species). Ordination showed differences in communities according to treatment, with diversity metrics in restoration showing greater species richness and more even community structures across all arthropods (*Carabidae, Araneae, Collembola* and *Acari*).

Functional diversity analysis revealed the importance of a multitaxon approach in the understanding of arthropod restoration as *Carabidae* and *Araneae* were mainly shaped by abiotic factors, while Acari and Collembola were more influenced by biotic interactions. Collembola may act as early indicators of peatland restoration progress, Acari may indicate long-term habitat stability, whilst *Carabidae* and *Araneae* reflect habitat complexity. Additionally, indicator species for both treatments were identified, providing valuable insights for long-term monitoring. Differences in community composition suggest restoration progress, but full recovery has yet to be achieved pending re-establishment of bog-like microhabitats.

Other authors: Thomas Ashton, Katty Baird, Verity Brosnan, Gavin Mackie (all Forest Research)

10:15 – Peter Convey, British Antarctic Survey
Despite its isolation, Antarctica's unique terrestrial ecosystems are increasingly threatened by invading insect 'ecosystem engineers'

Until the advent of human contact over the last three centuries, Antarctic and sub-Antarctic terrestrial ecosystems had evolved in isolation for multi-million year periods, protected by their isolation and challenging environments. Of the ~250 known sub-Antarctic establishment events since the islands' discovery, only two represent putative natural colonisation events, while all of the ~18 known for the maritime Antarctic are anthropogenically-assisted. A large proportion of these introductions are insects and other invertebrates. Detailed studies and ongoing monitoring of the impacts of these non-charismatic organisms on native ecosystems and their often endemic biota are generally lacking. However, it is already clear that some of these species are well pre-adapted to the environmental challenges of Antarctic ecosystems, introducing new trophic and other functions with resulting step changes in ecosystem processes.

These range from intense predation by invading carabid beetles, the introduction of pollinating flies with the potential for synergy with already-introduced but pollinator-requiring non-native flowering plants, order-of magnitude increases in currently rate-limiting decomposition and nutrient release processes by detritivorous flies, and apparent replacement of native by invading springtail species in certain habitats. Individually and together, these invading insects highlight the biosecurity and conservation threats resulting from human-assisted introduction of such 'ecosystem engineers'.

10:30 – Gwenaëlle Deconninck, Lund University (ECR Prize Winner)

Ornamental plants and mistletoe as catalysts of spring populations of *Drosophila suzukii*

Winter is a critical bottleneck for many insects and for pests in particular; not only they have to cope with harsh environmental conditions but they also need to find alternative resources as cultivated fruit are lacking. In this study, we questioned if fruit of ornamental and wild plants could sustain the populations of the pest *Drosophila suzukii* during end of winter/early spring. We measured fly infestations in commonly occurring ornamental plants and in *Viscum album* between January and July 2022 in northern France.

Most plant species allowed the emergence of the fly and the fruiting succession provided a resource continuum. Climatic factors (e.g. cumulative precipitation, number of frost hours), landscape composition (e.g. grassland, shrubland and water cover) and local variables (e.g. resource abundance, vegetation architecture) influenced infestations with effects varying between host plants. Interestingly, while *D. suzukii* cooccurred with *D. subobscura* in *V. album*, no competitors were found in ornamental plants. With infestations up to 60% in some species, our study indicated that non-crop plants could catalyse *D. suzukii* populations early in the season, before commercial fruit become available (e.g. strawberries, cherries), and should be considered in integrative pest management strategies.

Other authors: Méghan Boulembert, EDYSAN UMR7058 CNRS, Université de Picardie Jules Verne. Patrice Eslin, EDYSAN UMR7058 CNRS, Université de Picardie Jules Verne. Aude Couty, EDYSAN UMR7058 CNRS, Université de Picardie Jules Verne. Françoise Dubois, EDYSAN UMR7058 CNRS, Université de Picardie Jules Verne. Emilie Gallet-Moron, EDYSAN UMR7058 CNRS, Université de Picardie Jules Verne. Sylvain Pincebourde, IRBI UMR7261 CNRS, Université de Tours. Olivier Chabrerie, EDYSAN UMR7058 CNRS, Université de Picardie Jules Verne.

10:45 – Helen Roy, UK Centre for Ecology & Hydrology; University of Exeter
Predicting and tracking invasive insects on the horizon

Invasive non-native species (INNS) are a major and growing threat to people and nature. Target 6 of the Global Biodiversity Framework (GBF) commits nations to reduce the introduction of INNS by 50 percent and minimize their impact. Effective biosecurity, and specifically preventing the arrival of INNS, is critical to achieving Target 6. Collaborative horizon scanning studies, combining impact assessments and expert elicitation, are used to inform biosecurity by predicting which species might be the most likely to arrive and impact biodiversity and ecosystems. We have applied this approach to inform prioritisation of preventative actions for INNS in Britain and across the UK Overseas Territories.

Here we provide an overview of the invasive non-native insects that are considered to be amongst the high-risk species. Additionally, using the yellow-legged hornet, *Vespa velutina*, as an example, we highlight the importance of early warning and rapid response for mitigating the impacts of INNS. We call on everyone to contribute information about non-native species to the GB Non-Native Species Information Portal. Such information is used in many different ways including informing horizon scanning and our understanding of progress towards Target 6 of the GBF. Curbing the threat of INNS, including insects, is urgent but achievable.

Other authors: Helen E. Roy, UK Centre for Ecology & Hydrology and University of Exeter
Stephanie L. Rorke, UK Centre for Ecology & Hydrology

11:00 – Simeon Wilton, UK Centre for Ecology and Hydrology
Has the arrival of Harlequin Ladybird, *Harmonia axyridis*, contributed to the declines in the distribution of UK Hoverfly species?

Harmonia axyridis, harlequin ladybird, is an invasive non-native species first recorded in the UK in 2004. It spread rapidly across Great Britain and is the most recorded ladybird species in many places. *H. axyridis* has displaced some native ladybird species through competition and predation (Roy et al., 2012). However, little is known about the impacts of these shifts in ladybird assemblages to ecosystem function and resilience. *Harmonia axyridis* is an intra-guild predator, that is it feeds both on aphids and other insects that also feed on aphids, which includes other species of ladybird but also hoverfly species. Hoverflies are crucial pollinators and many species also consume aphids. I have been assessing the impacts of *H. axyridis* on aphid-feeding and other hoverfly species.

I use spatial-temporal occupancy models, to assess whether the presence of *H. axyridis* is correlated with changes in the distribution of hoverfly species. I predict that hoverfly species with highest niche (habitat and food) overlap with *H. axyridis* will be the most affected. Shifts in the community composition of aphidophagous insects may lead to cascading effects throughout the wider network of interacting species with consequences on ecosystem function and resilience.

Other authors: Louise Barwell, UK Centre for Ecology and Hydrology. Dan Chapman, University of Stirling. Beth Purse, UK Centre for Ecology and Hydrology. Olaf Booy, GB NNSS. Helen Roy, UK Centre for Ecology and Hydrology.

- Integrated Pest Management (IPM) 2

Auditorium B | Chair: Ali Karley, The James Hutton Institute
RES Journal: Agricultural and Forest Entomology

09:45 – Christopher Wiliams, Liverpool John Moores University
The natural enemies of snail-killing flies (Diptera: *Sciomyzidae*), their position in the fly/mollusc ecosystem, and implications for use of *sciomyzids* in biological control

This study provides the first comprehensive analysis of natural enemies affecting *Sciomyzidae* (snail-killing flies), focusing on insect parasitoids and predators. A total of 218 records were compiled, covering 97 species and morphospecies of natural enemies across 44 genera in 27 families and 7 insect orders. These insect enemies were found attacking 64 species of *Sciomyzidae*, mainly in North America and Western Europe. Parasitoid Hymenoptera are highlighted as the primary enemies, with 67 species across 25 genera reared from 24 fly species.

Emphasis is placed on the specificity and ecological roles of these parasitoids—particularly those in the families *Braconidae, Chalcididae, Diapriidae, Ichneumonidae, Pteromalidae*, and *Trichogrammatidae* - describing their host range, phenology, and habitats. I also evaluate how these natural enemies influence the potential of *Sciomyzidae* as biocontrol agents against harmful snails and slugs. The aim is to inform both general insect ecology and targeted biocontrol efforts by encouraging further collection and study of these parasitoid and other natural enemy species.

10:00 – Laura Marcela Martinez Chavez, Harper Adams University
The efficacy of commercial populations of parasitic wasps against different populations of the potato aphid (*Macrosiphum euphorbiae*)

The potato aphid (*Macrosiphum euphorbiae*) is an economically important pest of strawberry crops for which the current management relies on biological control. However, recent reports of poor control of M.

euphorbiae using releases of parasitoid wasps could indicate a reduction in the efficacy of biological control. Most of the research on this topic has been done to understand the effect of aphid variation on parasitism success, which oversimplifies the complexity of the interaction by ignoring the role of the variation in biological control agents' populations on parasitism outcomes. Here, we aim to understand how the intraspecific variation of parasitic wasps can affect their efficacy against different populations of their aphid host. To achieve this, we evaluated the genetic diversity of five commercially available populations of *A. ervi* and test for their efficacy against multiple clonal lines of potato aphid. We found high variability in the genetic diversity of commercially reared *A. ervi*, and a low number of mitochondrial lineages.

Parasitism assays indicated lower efficacy of *A. ervi* populations associated with lower genetic diversity when encountering less susceptible potato aphid clonal lines. However, parasitoid efficacy reached similar levels when encountering susceptible populations. This result indicates the importance of considering genetic diversity in the production of biological control agents for commercial biological control programs.

Other authors: Alison J. Karley (The James Hutton Institute), Francis Wamonje (NIAB), Joe Roberts (Harper Adams University), Tom W. Pope (Harper Adams University)

10:15 – Simon Elliot, Universidade Federal de Viçosa
Entomopathogenic (and endophytic) fungi as ecosystem service providers and as major contributors to the bioinput revolution in Brazil

Entomopathogenic fungi of the order Hypocreales (Metarhizium, Beauveria, Cordyceps etc) have long been of interest for biological control of pests, yet have remained a niche option. With over 55% of Brazilian farmers adopting biocontrol (versus 23% in the EU or 14% globally), biocontrol is now mainstream. Entomopathogenic fungi are the principal agents used and many of these provide benefits beyond pathogenicity, acting within plants as endophytes or in the rhizosphere, increasing plant resistance to stresses. Entomopathogenic fungi that occur naturally in soils may also be providing a little recognized ecosystem service in pest control, especially in agroforestry, organic and regenerative production systems.

After a brief overview of these topics, I will show some recent results on the potential of these fungi against pests of coffee (e.g. coffee leaf miner) and in forestry (against leaf-cutting ants). I will conclude by asking to what degree this transformation could contribute to arresting the decline in insect biodiversity and emphasize the importance of preserving native forests (especially the Atlantic Forest) as a source of new isolates and molecules with potential.

10:30 – Wim van Herk, Agassiz Research and Development Centre, Agassiz, British Columbia
The pest wireworm complex in Canada: developing new tools for identification and management

Wireworms—the soil-dwelling larval stage of click beetles (Elateridae)—are notable pests of potatoes, cereals, maize, and field vegetables worldwide. Recent surveys have identified approximately 20 pest species in Canada, of which 3 are native to Europe (where they are also pests). The distribution of these 20 species varies per agricultural region, and sometimes per field. We present a summary of research conducted in recent years, including the identification of sex pheromones of native species, development of molecular tools for identification, and identification, development, and registration of chemical and non-chemical tools for management.

Other authors: Wim van Herk1, Terisha Bailey1, Kathleen Furtado1, Simran Cheema1, Regine Gries2, Gerhard Gries2, Bob Vernon1,3

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10:45 – Moshe Zaguri, Agricultural Research Organization - Volcani Institute
Plant induced defenses promote transgenerational effects including intraclutch cannibalism in Colorado potato beetle

One mechanism by which parents can increase their progeny's fitness is through transgenerational effects, the non-genetic transmission of traits from parents to offspring. Parental nutrition is a significant driver of transgenerational effects, impacting multiple offspring traits. Therefore, plant quality alterations due to the induction of anti-herbivory defenses can affect both the herbivorous insects and their progeny. We explored whether defense-induced plant quality changes trigger adaptive transgenerational effects in Colorado potato beetles (*Leptinotarsa decemlineata*). First, we examined how induced defenses affect adult reproductive success and whether they promote parental provisioning via intraclutch cannibalism. We then used a reciprocal design to assess whether offspring benefit from environmental matching across generations and how cannibalism influences larval development.

Induced defenses reduced adult oviposition and larval growth but also triggered transgenerational effects. Offspring of parents fed on defended plants showed higher intraclutch cannibalism, improving larval growth, particularly on induced plants. Larvae also performed better when reared on the same plant type experienced by their parents, pointing to additional transgenerational adaptations.

Focusing on plant-induced defenses, our study broadens the environmental factors influencing transgenerational effects. The transmission of phenotypic traits across generations adds to the diverse strategies insect herbivores use in their coevolutionary arms race with plants.

Other authors: Jennifer Thaler, Cornell University

11:00 – Nasamu Musa, RSK ADAS LTD
Is it time to rethink aphid treatment thresholds in potato production?

Peach potato aphid (Myzus persicae) significantly reduces potato yields through virus transmission and direct feeding. Current treatment thresholds, set at five aphids per compound leaf during tuber bulking, are based on research conducted 60 years ago and may not be applicable to today's cultivars. This study re-evaluated the relevance of this threshold through three pot experiments conducted over two years at two sites. Aphids were inoculated at low (current threshold), medium (3× threshold), and high (9× threshold) densities at two crop growth stages: leaf development (early) and tuber initiation (late).
Potato data, including tuber yield, were collected nine weeks after inoculation. High aphid densities during early development reduced tuber yield by 28.2% compared to aphid-free controls. Medium and low early densities resulted in 15.5% and 6.5% losses, respectively. In contrast, late-season inoculation produced yields comparable to controls, with slight (up to 4%) increases observed.

These findings suggest that early aphid infestations, particularly before tuber initiation, can be substantially more damaging to potatoes. They highlight the need for the industry to consider revising the current aphid treatment threshold by prioritising early-season aphid monitoring for modern varieties. This will support reduced pesticide use and promotes sustainable aphid management in potato production.

Other authors: Daniel Leybourne, University of Liverpool. Diana Pooley, RSK ADAS LTD. Duncan Coston, RSK ADAS LTD. Sacha White, AHDB (previously with RSK ADAS LTD).

- Poster presentations

Conservation and Management of Forest Insects

P1 - Erfan Bari, Concordia University
The Effect of Temperature on Spruce budworm Performance

We examined interactions between insects and three coniferous tree species—White Spruce (Picea glauca), Black Spruce (*Picea mariana*), and Balsam Fir (*Abies balsamea*)—under two temperature conditions: Normal and Warm (Normal +3°C). Using 30 years of climate data from the Begtoville station, we simulated historical temperature trends and controlled temperature precisely in growth chambers while maintaining natural photoperiods. Our primary goal was to assess the impact of warming on Spruce Budworm (SBW) performance and behavior across these tree species.

Given rising global temperatures, understanding SBW's adaptive responses is essential for forest conservation. We evaluated SBW consumption rates, weight gain, and frass production, alongside chemical analyses to explore host tree interactions under different temperature regimes. This integrated approach enhances our understanding of climate-driven changes in insect behavior and contributes to predictive models for forest pest management.

Other authors: Emma Despland (Concordia University)

P2 - Kyle Miller, Forest Research
Using a population genomics approach to track the spread of an invasive lepidopteran

Oak processionary moth (OPM – *Thaumetopoea processionea*) is an invasive forestry pest in Great Britain (GB) that threatens forestry practises and native biodiversity through urticating hairs that cause an immune response in humans and through numerical dominance of oak trees. OPM established in GB in 2006 forming an established area around London however, two satellite populations, which are of unknown origin and occur further than thought possible through natural dispersal, have occurred in recent years which are of concern.

This presents two hypothesise either; border biosecurity is inadequate and has allowed further incursions of OPM, or internal controls are inadequate and have allowed for human mediated movement. Tracking the spread of invasive species presents a unique challenge particularly in a forestry context where incorrect findings can result in legal challenges.

Here we show the use of a population genomic approach to uncover the relationship between two populations of OPM in GB. We extract single nucleotide polymorphisms from mitochondrial genomes which are then visualised using NMDS analysis to compare similarity across samples and elucidate relationships between populations. Analysing invasive species populations in this way should allow for the identification of vulnerabilities in biosecurity practices ultimately aiding local and nation plant health strategies.

Other authors: Anna Platoni, Sarah Facey - Forest Research. James Kitson - Fera Science Ltd.

P3 - Norina Vicente, Porto University

Exploring the Unknown: Ant food webs and Morphologies in Equatorial Guinea's Forest Stronghold

Approximately 83% of the primary forest in Western Africa has been lost, leaving fragmented patches within a landscape dominated by agroforestry and urban land use. Equatorial Guinea—especially Bioko Island and the newly protected Reserva de La Paz—retains some of the region's last primary forests and supports high levels of endemism. Yet, these ecosystems remain poorly studied, particularly in the canopy. Forest canopies form vertically stratified habitats that support diverse organisms, but the processes by which ground-dwelling ants colonize these arboreal spaces are largely unknown.

This project investigates ant diversity and ecology in tree canopies in a stronghold of Western African primary forest. We will combine morphometrics and DNA barcoding for species identification and apply X-ray micro-computed tomography to analyse morphological traits associated with arboreal life.

To understand trophic interactions, we will use DNA metabarcoding to analyze ant diets and apply food web analysis to assess food partitioning and dietary niche breadth. We will also explore how food availability and environmental pressures shape colonization patterns. This research will help fill major knowledge gaps in tropical forest ecology and ant biodiversity in one of Africa's most unique bioregions.

Other authors: Luke Powell, Porto University. Maximillian Tercel, Porto University & Monpellier University. Roberto Keller, Museu Nacional de História Natural e da Ciência & Centre for Ecology, Evolution and Environmental Changes.

P4 - Anna Platoni, Forest Research

Plantanus Lace Bug, *Corythucha ciliata* (Say) (Hemiptera: *Tingidae*) – a newly reported pest in Central London

Platanus lace bug, *Corythucha ciliata* (Say) (Hempitera: *Tingidae*), was first described in the UK in 2006. Following treatment of this early establishment with pesticide however, no evidence of its continuing presence in the UK has been found in the years since. In the summer of 2024, an iNaturalist report was made by a member of the public travelling on a bus in central London, showing a *Corythucha ciliata* adult crawling over a rucksack. Follow-up surveillance across the capital has revealed at least three known core areas of infestation, all in very populated and well-touristed areas.

This presentation will introduce the pest including its diagnostic features and symptoms, describe the surveillance which took place in London in the summer of 2024, update on its current known distribution and will discuss its potential management in a UK context.

Other authors: Anna Platoni(1), Sarah Facey(1), Chris Malumphy(2)
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P5 - Florentine Spaans, Agri-food and Biosciences Institute

Ash sawfly (*Tomostethus nigritus*) in Ireland

Ash sawfly (*Tomstethus nigritus F.)* is typically a sporadic pest of European ash (*Fraxinus excelsior L.)*
It is a defoliator of ash in the larval stage, with the potential to cause significant damage. It is found across

Europe, including Great Britain (GB), and in some areas of Europe it has completely defoliated established stands of ash. However, in GB the damage has been limited to urban environments.

Ash sawfly was first recorded on the island of Ireland in Belfast, Northern Ireland, in 2016. In the Belfast area, there has been consistent defoliation of ash trees in parkland, hedgerows and riparian habitats, with the sawfly gradually extending its range, with in some cases evidence of inadvertent carriage on motor vehicles. In 2021, ash sawfly was found in counties Kildare and Dublin in the Republic of Ireland. The consistent defoliation of ash trees each year is not typical of ash sawfly outbreaks elsewhere, which normally subside after a few years.

This work assesses the spread of ash sawfly around Belfast, the phenology of the pest and the impact of annual ash sawfly defoliation on ash tree growth. It also investigates the interaction of ash sawfly with ash dieback (*Hymenoscyphus fraxineus*).

Other authors: S. Clawson1†, C. Hall1†, Weir, R., C. Isaac, P. Williams, A. Murchie1
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P6 - Charlotte Cooke, Swansea University
Wood Ants as Ecosystem Engineers

Wood ants are vital ecosystem engineers and contribute significantly to ecosystem services. They are important for nutrient cycling, pest control, biodiversity, and host a wide variety of *myrmecophiles* within their nests. Despite their important roles, they are not legally protected within the UK, and while much research has been undertaken in England, we have no current assessment for the population within Wales. This project aims to start bridging this information gap by assessing the current population of red wood ant *Formica rufa* in South Wales, establishing baselines for future monitoring, and collaborating with a wider European monitoring programme.

Sites will be identified using previous records, assessments, and public sources (NBN Atlas) to establish likely locations, and each site surveyed for Formica rufa nests. Once nests are located, detailed information will be recorded on their condition and surrounding habitat following the Monitant protocol, linking the project to the wider European initiative.

This study will help us understand habitat suitability in Wales, which will support future reintroduction programmes and contribute to our limited understanding. Given their role as ecosystem engineers in woodland environments, this work also aligns with the Woodlands for Wales Strategy by promoting healthy, resilient ecosystems.

Other authors: Dr Wendy Harris

P7 - Katherine Lester, Forest Research
Field evaluation of a 'Lure & Infect' Device using Beauveria bassiana for sustainable management of the large pine weevil, *Hylobius abietis*

The large pine weevil, *Hylobius abietis*, remains the most significant pest threatening conifer restocking efforts in the UK and Europe, with current management heavily reliant on repeated pesticide applications. This dependence is increasingly unsustainable due to regulatory restrictions and diminishing chemical options, highlighting the urgent need for effective alternative control strategies. Entomopathogenic fungi (EPF), particularly *Beauveria bassiana*, have demonstrated promising efficacy against *H. abietis* in

laboratory settings, but their field performance remains underexplored. This study aims to evaluate the effectiveness of a 'lure & infect' device containing *B. bassiana* as a biological control agent (BCA) for adult *H. abietis* under operational field conditions.

The trial will monitor weevil infection and mortality rates, confirm fungal infection through laboratory analysis and provide an initial assessment of non-target impacts on invertebrate biodiversity. We will present preliminary results on the device's effectiveness in infecting weevils and its potential influence on their population. This research seeks to inform the development of sustainable, cost-effective pest management solutions for forestry practitioners.

Other authors: Katy Dainton (Forest Research), Sonja Steinke (Forest Research), Molly Davidson (Forest Research) and Roger Moore (Forest Research)

P8 - Oliver O'Doherty, Newcastle University

Development of Invertebrate Communities in Young Broadleaved Woodlands in the UK

As insect populations decline worldwide, the loss of biodiversity driven primarily by habitat loss is a major concern. Woodlands form an essential habitat for insects but in the UK, they account for only 13.5% of the land cover. Efforts to increase woodland cover and biodiversity have seen extensive planting in recent decades with over 50% of British broadleaved woodlands aged 40 years or younger.

Understanding how these woodlands are developing over time is important for informing future woodland creation but despite this research is scant. We therefore aimed to explore how invertebrate diversity is establishing in these young woodlands and what role different tree species play in this.

In this study, we employed a paired design of 7 young (20-30 years old) and 7 established (at least 150 years old) broadleaved woodlands in Northwest England. Sampling took place in the spring of 2023 with invertebrates collected from the branches and foliage of Oak (*Quercus spp.)* and Birch (*Betula spp.)* trees. This has resulted in a dataset of over 7000 invertebrates identified to order.

Analyses are currently being undertaken to reveal the invertebrate abundance, diversity and community composition in the young and established sites and any interacting effect of tree species.

Other authors: Darren Evans (Supervisor at Newcastle University). Julie Smith (Supervisor at Newcastle University). Evelyn Jensen (Supervisor at Newcastle University).

P9 - Maximillian PTG Tercel, University of Montpellier & CIBIO-InBIO

The key to the queendom: driver ants as keystone species for rainforests across Africa

Driver ants (*Dorylus (Anomma*)) form some of the largest known animal colonies and are iconic predators in African rainforests. These nomadic ants conduct expansive daily raids that consume a wide range of arthropod prey, yet their ecological role remains surprisingly understudied. Much of what we know is extrapolated from research on Neotropical army ants, but emerging evidence suggests African driver ants have distinct and powerful ecological effects. As part of the KEYANTS project, we are investigating how driver ant raids influence forest floor arthropod communities. We collected thousands of diet samples from two species—*Dorylus wilverthi* and *Dorylus sjostedti*—paired with intensive leaf-litter arthropod sampling conducted immediately after raids, and again two and seven days later to assess community recovery.

Preliminary results indicate that both species are generalist predators, but *D. sjostedti* consumes other ants at notably higher rates. Some prey taxa are consumed disproportionately, suggesting preferences and avoidance. We hypothesise that driver ants impose spatiotemporally dynamic predation pressure that suppresses dominant taxa and enhances beta diversity.

Ongoing analysis of leaf-litter samples will help test this hypothesis. This presentation will share our first results and outline future directions for the KEYANTS project, which is shedding new light on the ecological role of Africa's most formidable social insect.

Other authors: Patricia Rodrigues, CIBIO-InBIO and Louisiana State University. Norina Vicente, University of Porto and CIBIO-InBIO. Eliza D. Stein, Louisana State University. Ibon Malaxetxebarria, University of the Basque Country. Panagiotis Nikolaou, University of Porto and CIBIO-InBIO. Celedonia Okomo Mba Obono, INDEFOR-AP and Bioko Biodiversity Protection Program. Coloma Sonsoles Nzang Micha Zabea, Universidad Nacional de Guinea Equatorial. Luke L. Powell, CIBIO-InBIO.

Pollinators

P10 - James Gilbert, University of Hull
How do wild bees manage nutrition in a changing world?

In a world where climate change threatens food security, bees provide ecosystem services of near-incalculable value. But bees' own nutritional requirements are complex and poorly understood. Adult bees meet their own needs by foraging for nectar, but must also supply those of dependent young with pollen. By metabarcoding bumblebee pollen loads, we found that adults forage using different networks for themselves (for nectar) versus offspring (for pollen).

Young bees themselves have limited food choices, with pollen provided by adults. We also investigated nutrition in growing mason bees (Osmia bicornis). Females seal each egg with pollen inside a cell. By replacing provisions with artificial diets, we showed that carbohydrate, not protein, mediates larval performance. Larvae maintained constant carbohydrate intake by choosing how much to eat, but tolerated broad variation in protein. However, their consumption rules changed over development. Pollen is layered within provisions, perhaps tailored to offspring's changing needs.

Finally, we simulated climate change by manipulating nest temperature. Growth was mediated by carbohydrate below 25°C, but by protein at 25°C. Accordingly, at 25°C, larvae reversed their eating rules and prioritised protein rather than carbohydrate, suggesting sensitivity to thermal environments. Our findings shed valuable light on bees' resilience to changing environments and will help future-proof pollinator management strategies.

Other authors: Dr Alex Austin, Strategy & Environment, Ku-ring-gai Council, Gordon, NSW, Australia
Dr Lori Lawson Handley, Centre for Ecology & Hydrology, UK

P11 - Lola Torres—Montagner, Royal Botanic Gardens, Kew
Has reproductive success in insect-pollinated orchids changed through time?

Orchids (*Orchidaceae*) are one of the most diverse plant families. This high diversity has been associated with highly specific interactions that orchids have with their insect pollinators. Orchid and insect populations are in global decline due to increasing anthropogenic pressures and climate change; however, when this decline started has not yet been addressed. This decline is disrupting plant-pollinator interactions and could contribute to reduced reproductive success in some orchids. Therefore, this study aims to investigate when and how orchid reproductive success changed within the last 200 years. To address this, we assessed insect pollination on historical and non-historical specimens from the Kew Herbarium.

We examined hundreds of specimens across three genera (*Disa, Oncidium* and *Ophrys*), each from a specific major region (Africa, Europe, and Central and South America, respectively). For each specimen, we recorded pollinaria removal, pollinia deposition, and fruit set. Our results reveal a significant decline in pollination success over time in the deceptive *Oncidium* and the rewarding *Disa*, intensifying during the second half of the 20th century. No sign of decline was found in the deceptive *Ophrys*, aligning with its current non-threatened status and stable natural habitat. Our study suggests that orchid decline is related to the orchid identity, origin and the intensification of human activities.

Other authors: Carlos Martel, Royal Botanic Gardens, Kew

P12 - Marzia Zagallo, Free University of Bozen-Bolzano
From Urban to Alpine Ecosystems: Pollinators as Bioindicators of Environmental Health

Pollinators are essential for plant reproduction, biodiversity maintenance and overall ecosystems health. Pollinators also play a crucial role in global food security and agricultural productivity. However, pollinators face many threats due to habitat loss and fragmentation, climate change and increasing pesticides exposure. This project aligns with the objectives of the EU Biodiversity Strategy for 2030 and the EU Pollinators Initiative, addressing the urgent need to reverse pollinator decline.

This study investigates the correlation between the presence of three key pollinators, Apoidea (Hymenoptera), Lepidoptera and Syrphidae (Diptera) and environmental health conditions in two areas: Trento and Stelvio National Park. The project in Trento, ACT4BEES, supported by European funds has lead so far to over 300 Apoidea individuals collected, using pan traps and transects, and five families (*Apidae, Halictidae, Andrenidae, Megachilidae,* and *Colletidae)* and many genera identified. Additionally, pollen samples from local bees are soon to be analysed to detect eventual pesticides and heavy metal residues.

Furthermore, standardized transects are extended to grassland environments with different grazing gradients in Stelvio National Park to monitor and identify all three key pollinators. This research contributes to a deeper understanding of environmental health conditions and assess exposure to agrochemicals and other pollutants.

Other authors: Maria Vittoria Zucchelli, Muse - Museo delle Scienze di Trento, Italy. Luca Pedrotti, Stelvio National Park, Italy. Sergio Angeli, Free University of Bozen-Bolzano, Faculty of Agricultural, Environmental and Food Sciences, Italy.

P13 - Zoe Bird, University of Southampton
Investigating the impact of land-use change on the occupancy of tropical montane bees in Malaysia

The wild bee communities of tropical montane forests (TMFs) are highly understudied, with little known

about the species that make up these communities, let alone their occupancy, foraging preferences, and other life history traits. And yet, TMFs are being rapidly degraded due to agricultural expansion and urbanisation, removing the natural habitats on which many bee species will depend for both food and nest provisioning. This study assesses bee occupancy and distribution across forest fragmented TMF landscapes in Peninsular Malaysia. We sampled across a land-use gradient, including primary and secondary forests, tea plantations, urban and rural sites, to identify important habitat types for different bee families, as well as the key environmental drivers of bee distribution.

The results of this study will help us to better understand the impact of forest loss and subsequent land-use change on these highly diverse bee communities. We have generated novel data on the previously neglected TMF bees and identified key habitats and resources for the rare and specialist species in the community. The results will help to inform future conservation strategies for bees in Malaysia and across TMF forests.

Other authors: Kelvin Peh (University of Southampton), Malcolm Soh (National Parks Board Singapore), Zestin Soh (National Parks Board Singapore), Chong Leong Puan (Universiti Putra Malaysia), John S Ascher (National University of Singapore)

P14 - Alice Walker, University of Edinburgh

How effective are conservation strategies for pollinators within arable systems? Taking a "real-world" approach

Wild insect pollinators provide an essential ecosystem service, regulating crops and wild plant species, thereby encouraging ecosystems to be more resilient to disturbance. Continued pollinator population declines threaten this service, thus, increasing the importance of utilising effective management strategies. However, despite considerable pollinator conservation effort, research identifying strategy effectiveness within the 'real-world', where practical problems and local farm differences are recognised, is still scarce.

Outcome-based or Results-based payment schemes attempts to address these trade-offs by creating a score for the habitat using a multi-metric. By focusing on hedgerows, a key frequently surveyed agroecosystem habitat, this project assesses the effectiveness of these multi-metrics on pollinator communities, diversity and ecosystem function within South-East Scotland. It's findings should provide future policy recommendations and, through suggesting potential adjustments, ultimately improve current schemes. This poster outlines the 2022-2023 data collection process across 8 Lothian farms and presents preliminary results.

Other authors: Dr Gail Jackson, University of Edinburgh. Dr Lorna Cole, SAC Consulting. Dr Cathy Hawes, James Hutton institute. Dr Graham Begg, James Hutton institute

P15 - Clare Boyes, Harper Adams University

Microplastics collected by solitary bees when foraging for pollen

Many sources of microplastics have been identified in terrestrial ecosystems, including the use of agricultural fertilisers. It has been shown that microplastics are collected by foraging honeybees. Honeybees collect pollen on a specialised structure on their hind tibiae. However, solitary bees collect pollen using feathery hairs which are concentrated either on the hind tibia and propodeum, or underneath their metasoma. It is likely that electrostatic charges are also involved in attaching pollen. Microplastic pollution could have a significant impact on solitary bees as these features make it more likely that they will also collect environmental microplastics as they forage.

Courtene-Jones (Plymouth University) confirmed the presence of microplastics in solitary bee pollen samples collected in 2021, although it is possible that there was some contamination in the sampling (pers.comm. 2024). The objectives of this research are:

1. To analyse and quantify solitary bee pollen loads for the presence of microplastics from fertilised and unfertilised land.
2. To compare the amount of microplastics found in pollen samples from ground-nesting Andrena with aerial nesting Osmia.

Other authors: Dr Heather Campbell, Harper Adams University

P16 - Duncan Bell, University of Suffolk

An X-ray Micro-CT study conducted in Bombus terrestris . Experience with a simple sublimated Iodine technique to enhance external and internal anatomical definition

An X-ray Micro-CT study conducted in Bombus terrestris . Experience with a simple sublimated Iodine technique to enhance external and internal anatomical definition.
Bell G D1, Collins D2,3, Corps N,4 and 2Gretton S.

A simple method of tissue staining to enhance contrast in micro CT scanning of biological tissues was previously reported using Iodine sublimation (Boyde et al, 2014) but to date there has been no formal study in insects.

We studied 32 Bumble bees (10 workers, 10 Gynes, 10 drones and 2 queens) taken from two commercially available hives and reared under standard conditions. They were stored at -80 degrees Centigrade before being thawed and scanned using a benchtop micro CT scanner at isotropic voxel sixes varying from 2-20 microns. Each specimen was then placed in individual air-tight plastic screw top bottles at room temperature either with or without Iodine crystals. The specimens were then rescanned after periods of 1-3 weeks.

Using this simple method, much better visualisation of intra-abdominal structures such as the crop, proventricular valve, mid and hind gut and Malpighian tubules were seen at 3 weeks. In contrast, tissues that were partially or completely exposed to the surrounding air such as the bristles, antennae, mouthparts and either the endophallus or sting recess were well seen at 1 week post iodine vapour without any loss of definition to the tracheal system.

Other authors: as above on the abstract - Dr David Collins and Dr Svetlana Gretton University of Suffolk and Mr Nick Corps from Wonderful Scientific Ltd
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P17 - Laura Briggs, University of Strathclyde & The James Hutton Institute

The Importance of Bumblebee Buzz - Pollination in Blueberries

Many soft fruit crops, including tomatoes, kiwi, aubergine and blueberries achieve increased pollination through sonication, also known as buzz pollination. Buzz pollination requires bees to apply vibrations to flowers and is restricted to a subset of bee species, including bumblebees. Blueberries have a low ability

to self-pollinate and therefore particularly benefit from buzz pollination. Supplemental pollination in commercial blueberry crops is often provided by mechanical shakers, or additional pollinators, including honeybees or bumblebees. A change in climate is likely to affect foraging behaviour in bees however there is limited knowledge about the effects of temperature change on buzz pollination. Research on sonication properties has largely focused on tomatoes. Limited studies on blueberries focus on number of bee visitations, not length or quality of the sonication event.

This research will utilise acoustic and environmental sensors to measure and characterise sonication activity in the field, by recording climatic conditions and the length and frequency of bumblebee sonication on individual blueberry flowers. Field trials of the bee vibrations and environmental conditions will provide important information for growers to optimise commercial blueberry yields in a changing climate.

Other authors: Professor Mario Vallejo-Marin, Uppsala University. Professor James Windmill, University of Strathclyde, Glasgow. Dr Jenni Stockan, The James Hutton Institute. Dr Carolyn Mitchell, The James Hutton Institute.

P18 - Daniel Lim, University of Edinburgh
Seasonal and temporal dynamics in urban plant-pollinator networks

The ecological importance of urban centres to pollinators has become increasingly apparent, with some urban habitats potentially serving as reservoirs for different pollinator taxa. To improve the robustness of urban pollinator populations, we need to understand how the interactions between plants and pollinators (i.e. plant-pollinator networks) change across time and habitat types, and so how landscape managers can influence these networks to achieve conservation goals.

To address this knowledge gap, I am constructing quantified plant-pollinator visitation and pollen transfer networks for multiple seasonal time points and habitat types in Edinburgh, Scotland. My approach includes quantified surveys of floral abundances and visit visitation, with DNA barcode-based validation of insect species identity. I will use DNA barcode-based analysis of insect pollen loads to explore how use of this additional information resource alters our understanding of insect-flower interactions.

My overall aim is to identify key plant species in each season and habitat that support different modules within flower-visitor interaction networks, particularly those involving rarer plants and pollinator species with restricted ranges. The resulting information, I hope, will facilitate targeted biodiversity enhancement of urban green spaces.

Other authors: Graham Stone, University of Edinburgh
Gail Jackson, University of Edinburgh

Evolution, Genomics & Endosymbionts

P19 - Agnes Man Sum Chan, Imperial College London & Natural History Museum
Phylogeny and evolution of host-use in British nocturnal *Ichneumonoidea*

Despite the significance of parasitoid wasps, which comprise a quarter of British insect diversity, their taxonomy and ecology are largely overlooked. This study focuses on two genera of nocturnal ichneumonid wasps, Netelia and Ophion species, with three aims: (i) reconstruct species-level phylogenies and test species limits to investigate speciation and general trends in evolution; (ii) reveal how host specialism and

generalism are distributed across the phylogenetic tree; and (iii) assess which species are more host-specific and how that may impact extinction risk.

Through phylogenetic reconstruction, ASAP species delimitation, PSVt metrics of host-range, ancestral state reconstruction and bipartite network visualisation, this study offers a holistic analysis of systematics and host range evolution in mainly British Netelia and Ophion. There has been a degree of genetic drift between geographically separated populations of some species, such as Ophion minutus. A higher proportion of Netelia species are more generalist, with a clear divide between ancestral specialists and recent generalists. Within Ophion, host range varies considerably between closely related species. Finally, vulnerability to extinction is context-dependent, as both generalism and specialism offer differing adaptive advantages. The findings set a valuable foundation for future research in the biosystematics, ecology and conservation of native parasitoid Hymenoptera.

Other authors: Dr Gavin Broad, Natural History Museum

P20 - Jessica Frith, University of Lincoln
Tracing the Evolution of Heteromorphic Sperm Across Insect Lineages

Sperm heteromorphism—the production of two or more distinct sperm morphs within a single ejaculate—is an uncommon and understudied reproductive trait found in the animal kingdom. Insect sperm heteromorphism can involve extreme differences in morphology, particularly length, as well as function between sperm types, raising questions about its evolutionary implications and significance.
Our research investigates the phylogenetic distribution and evolutionary history of sperm heteromorphism across insects, using a comparative framework based on previously published reproductive trait data, alongside imaging and analysis to fill data gaps, and a time-calibrated insect phylogeny. Analysis includes all levels of morphology, including trait covariation with female reproductive traits.

We identify origins and losses of sperm heteromorphism and assessed whether its occurrence is clustered within particular insect clades or associated with specific reproductive ecologies which could be driving this evolution. The findings contribute to understanding how and where sperm shapes and unique traits evolved, aligning with broader objectives of comprehending the evolution of sperm cell shape and motion.

P21 - Laura Chatterley, University of Strathclyde
Novel Wolbachia strains identified in *Anopheles* mosquitoes

Anopheles (An.) mosquitoes exclusively transmit malaria in sub-Saharan Africa. Recently, two species of *Anopheles* have been identified as hosts of Wolbachia, an endosymbiotic bacteria shown to prevent transmission of Plasmodium parasites (the causative agent of malaria) under laboratory conditions. Wolbachia is capable of host-manipulation through induction of a reproductive phenotype known as cytoplasmic incompatibility (CI) that enables Wolbachia to invade mosquito host populations. Two novel strains of Wolbachia identified as endosymbionts of *An. demeilloni* (strain wAnD) and *An. moucheti* (strain wAnM) have recently been discovered. This work aimed at assessing the ability of these novel strains of Wolbachia to induce CI, observe the impact of Wolbachia infection on the *Anopheles* microbiome and elucidate the host-microbe interactions.

Both strains show potential of CI-induction. In *An. demeilloni*, evidence of Wolbachia presence within the head-thorax is promising for the potential implication of wAnD in preventing Plasmodium transmission. This work highlights the high prevalence of wAnD in wild *An. demeilloni* populations and the potential

capacity of both wAnD and wAnM to induce CI and establish stable infections within the Anopheles host.

Other authors: Laura Chatterley, Isabel Hughes, Seynabou Sougoufara, Eva Heinz and Thomas Walker

P22 - Shannon Keenan, University of Strathclyde
Comparative Ecology and Wolbachia Prevalence of Simulium Blackfly Larvae in Urban and Forested Scottish Streams

Urbanisation alters ecological conditions that influence the abundance, diversity, and pathogen potential of insect vectors. Simulium blackflies, recognised vectors of avian malaria (*Plasmodium relictum*), are widespread in temperate freshwater systems, including Loch Lomond. This study examined how urban and forested environments differ in supporting blackfly populations and how habitat conditions shape diversity and Wolbachia prevalence.

From April to July 2021, 1,953 larvae were collected weekly from four rivers using rock and artificial traps. Environmental parameters were recorded at each site. Species were identified using PCR and RFLP, with the assay expanded via novel restriction enzymes to identify urban taxa. Wolbachia infection was detected using qPCR targeting the coxA gene.

Blackfly abundance and species diversity were both significantly higher in forest streams. Abundance was shaped by water depth ($p = 0.0019$), while diversity was influenced by collection method ($p = 0.0045$) and a velocity–location interaction ($p = 0.03$). Urban sites were dominated by *S. ornatum, S. reptans*, *and S. equinum.* Wolbachia prevalence was higher in forests (20%) than urban (1.5%), declining from April to July ($p < 0.05$).

These findings suggest urban stressors reduce blackfly diversity and symbiont persistence, with implications for ecological resilience in changing environments.

Other authors: Dr. Francesco Baldini, Dr. Heather Ferguson, Dr. Georgia Kirby, all The University of Glasgow

Insect Decline & Population Change

P23 - Beatrix Ward, University of Cumbria
From Forests to Farmland: Effects of anthropogenic land-use and environmental factors on carrion beetle (*Silphinae spp.*) communities

Biodiversity is declining globally due to factors such as anthropogenic land-use intensification, with invertebrates including carrion beetles (*Silphinae spp.)* being impacted. These species play a key role in ecosystem function by facilitating decomposition and nutrient cycling, yet the effects of land-use and local environmental factors on their community structure remain under-researched. With that, this study investigated the impacts of anthropogenic land-use and local environmental factors on the community structure of carrion beetles in the summer of 2024 in Teviotdale, Scottish Borders. The environmental variables included were ground vegetation composition, canopy openness, percentage (%) soil organic matter, and moisture content. Data were collected from 12 sites representing three habitat types (broadleaved woodland, conifer plantation, and improved grassland), using baited pitfall traps, vegetation sampling, canopy measurements, and soil sampling. The results showed broadleaved woodland

supported the highest species richness, diversity and abundance of Silphids. Additionally, analysing the bycatch showed that broadleaved woodland supported the highest overall Lepidoptera abundance. Although broadleaved woodland also supported the highest overall Coleoptera abundance, coniferous woodland had the highest species richness. None of the environmental variables tested had a statistically significant effect on Silphid community structure.

These findings suggest broadleaved woodlands support more diverse invertebrate communities, likely due to their diverse structure and diversity of flora. However, it is important to note that many Silphid species are habitat generalists, and that the availability of carrion may determine their distribution more so than habitat. Future research should consider this along with additional environmental variables and habitat types, to further investigate how these are linked, to better understand Silphid ecology, and therefore conserve them.

P24 - Ivy Ng'iru, UK Centre for Ecology and Hydrology & Cardiff University

Temporal shifts in field margin structure and lepidopteran larval use: towards a likelihood of exposure framework

Butterflies and moths are in decline in farmland habitats. Pollution, including from chemicals and waste, has been attributed as a major driver of biodiversity loss. As vital components of agricultural landscapes, field margins offer habitats that support biodiversity, while buffering agrochemical displacement into the wider environment. This study investigates how seasonal variation in plant cover and height across three pollen and nectar margins influence the abundance and diversity of Lepidopteran larvae, and their likelihood of exposure to pesticide spray drift. Using plant cover, plant height, distance from the crop edge and species abundance, weighted species risk of exposure scores were calculated for the species collected within each margin.

These data quantified the contribution of field margin vegetation structure in attenuating spray drift exposure in non-target lepidopteran species and provide evidence that may help design field margins that maximise both habitat quality (for beneficial species) and protection against pesticide spray drift.

Other authors: Melanie Gibbs - UK Centre for Ecology and Hydrology. Stephen Short - UK Centre for Ecology and Hydrology. Dave Spurgeon- UK Centre for Ecology and Hydrology. Pete Kille- Cardiff University. David Buckingham - Royal Society for the protection of birds (RSPB).

P25 - Sarah Meredith, Royal Entomological Society

Applying Royal Entomological Society research on the Large blue (*Phengaris arion*) butterfly to increase the distribution and abundance to chalk grassland sites in Denmark

The RES conservation science team have been contracted to carry out research and give advice to the 'Life Orchids' project based in Vordingborg Kommune over the next four years on *Phengaris arion*.

Over the course of the last century, all but one colony of *Phengaris arion* have become extinct. One population remains on the nature reserve of Hovblege situated on the island of Møns. The Danish Nature Agency and Vordingborg Kommune want to ensure this population persists and for *P.arion* to fly on other sites in the area.

The focus of the work will initially be undertaking population studies of *P.arion* on Hovblege through adult and egg counts, ant surveys and temperature data logger experiments. Alongside carrying out surveys on the existing population, nearby chalk grassland sites will be assessed for their suitability for *P.arion* in the future with the possibility of introductions being considered in the coming years. Introductions would

enable a meta-population to be created and remove the possible threat of Denmark losing it's one remaining *P.arion* colony.

Other authors: David Simcox - Royal Entomological Society

P26 - Sam Appleyard-Sanderson, University of Bristol
Effects of Targeted-Selective Ivermectin Treatment on Dung Insect Communities and Ecosystem Functions

Ivermectin, a widely used antiparasitic drug in livestock management, can persist in dung and adversely affect non-target insect communities that provide vital ecosystem functions. Using a population-based simulation model developed in R, I examined how different proportions of ivermectin-treated versus untreated dung influence the long-term dynamics of three key dung-insect guilds: flies, dwelling dung beetles, and tunnelling dung beetles. The model simulates multiple years of growth, reproduction, and dispersal, incorporating both lethal (e.g. mortality) and sublethal (e.g. delayed development, reduced fecundity, impaired feeding) effects of ivermectin exposure. Preliminary results suggest that insect populations tend to recover when access to untreated dung increases; however, responses are nonlinear and vary by guild, reflecting underlying life-history traits.

These findings highlight potential population-level risks of veterinary pharmaceuticals and underscore the value of targeted selective treatment (TST) strategies to balance livestock health with insect biodiversity. More broadly, this work illustrates the power of simulation modelling in predicting anthropogenic impacts on functional insect communities.

P27 - Helen Barber-James, National Museums Northern Ireland
Underexplored freshwater habitats in Ireland – what are we missing? A case study using riverflies

Ireland's freshwater landscape encompasses over 12,000 lakes and extensive river networks, primarily shaped by Pleistocene glaciation. While these systems face increasing anthropogenic pressures from agricultural intensification, urbanisation and climate change, current biodiversity monitoring efforts remain narrowly focused on conventional habitats. Standard aquatic surveys consistently target riffle zones, boulder substrates, and macrophyte beds, systematically overlooking specialised microhabitats such as seeps, temporary streams, and turloughs, and those with groundwater sources including springs and the hyporheic zone of rivers that may harbour unique invertebrate communities. Using Ephemeroptera (mayflies), Plecoptera (stoneflies), and Trichoptera (caddisflies) as focal taxa, this talk examines the current state of knowledge regarding Ireland's specialised aquatic habitats. We highlight significant distributional gaps in existing datasets and demonstrate how conventional monitoring protocols may systematically underestimate national biodiversity.

Case studies from recent fieldwork in the Burren's limestone landscape illustrate the conservation importance of these overlooked systems. We explore how karst hydrology creates unique habitat conditions, discuss the ecological requirements of rare and threatened species, and examine the vulnerability of these systems to environmental change.

Given Ireland's commitments under the EU Water Framework Directive and national biodiversity strategies, this research has immediate policy relevance. This presentation challenges current approaches to freshwater biodiversity assessment and provides a roadmap for more comprehensive ecological surveys that could fundamentally reshape our understanding of Ireland's aquatic biodiversity.

Other authors: Craig R. Macadam, Buglife, Stirling University Innovation Park, Stirling, Scotland

Insects & Society

P28 - Cintia Akemi Oi, University College London
Naga traditional knowledge and Asian hornet rearing

Giant Asian hornets are widely distributed across Asia and certain indigenous communities have developed a close and significant relationship with them. One such community is located in Nagaland, Northeast of India, where hornets play an integral role in both cultural practices and local livelihoods. This study aims to explore and document the human-hornet relationship within the Chakhesang and Angami communities in Nagaland.

We conducted focus group surveys across 15 different villages located in Nagaland, to investigate traditional hornet domestication practices, including nest discovery, nest relocation, rearing techniques and product consumption and commercialization. Additionally, we sought to capture the communities' ecological knowledge of the species and their methods of hornet management. Our goal is to contribute to the improvement of hornet husbandry practices while preserving local indigenous cultural heritage.

Other authors: Femi E. Benny (University College London); Thejavikho Chase; Seirian Sumner (University College London)

P29 - Luke Durston, University Centre Askham Bryan
Do Visual Barriers Reduce the Occurrence of 'Black Eye' in Captive *Hierodula membranacea?* Investigating the Effects of Enclosure Design and Environmental Parameters on Mantis Health and Welfare

Animal welfare in captivity is a growing concern, yet evidence-based guidelines for invertebrates remain scarce. This study investigated the effects of enclosure design and UV exposure on the welfare of giant Asian mantids (*Hierodula membranacea*), with a focus on the development of the "black eye" condition as a stress indicator. Sixty mantids were reared from newly hatched nymphs and randomly assigned to two groups (blocked vs. open enclosures) with half of each group exposed to 1.5 UVI and the other half to 2.0 UVI. Health scores were recorded weekly using a six-point system, while black eye occurrence, mortality, and growth (weight and length) were monitored. Results indicated no significant differences in median health scores between enclosure types or UV treatments. However, black eye incidence was significantly higher in open enclosures ($\chi^2(1) = 7.12$, $p = 0.0076$), and mantids with black eye had increased mortality risk (OR = 14.61, $p = 0.02267$).

Although composite growth measures did not differ significantly between treatments, a borderline trend in growth was observed between UV levels ($p = 0.06174$). These findings show the importance of species-specific, evidence-based husbandry practices and highlight the need for further research into environmental choice and optimal captive conditions for invertebrates.

P30 - Mark Taylor, University of Glasgow
Assessing Antennal Grooming as a Flexible Self-Protective Behaviour in Two Spotted crickets (*Gryllus bimaculatus)*

Insects are used in the trillions annually for farming, research, and animal feed, yet remain excluded from welfare legislation due to unresolved questions about their capacity for suffering and pain. One proposed indicator of sentience is 'flexible self-protective behaviour' in response to noxious stimulation, as outlined by Birch et al. (2021). Grooming has been identified as a self-protective response when directed toward

the site of stimulation, persisting beyond the stimulus, and potentially alleviating discomfort- features consistent with pain behaviour in vertebrates. While grooming responses to noxious stimulation have been documented in Diptera and Hymenoptera, Orthoptera remain underrepresented in this area, despite their widespread use. Here, we investigated whether site-specific grooming in the two-spotted cricket (*Gryllus bimaculatus*) reflects such behaviour.

Using a within-subjects repeated-measures design, 100 adult crickets received four trials: two noxious (65 C° heated probe) and two non-noxious (25 °C) antennal stimulations. The frequency and duration of grooming were extracted from video recordings and analysed using generalised linear mixed models. A significant increase in site-specific antennal grooming following noxious stimulation would support its interpretation as a nociceptive response. Results will contribute empirical evidence to the insect pain debate and inform welfare policy, ethics, and sustainable insect farming.

Natural History & Taxonomy

P31 - Karmannye Chaudhary, Queen Mary University of London
Reviving a Lost Lineage: Rediscovery of a forgotten genus and description of a new species of *Losgna* (Cameron 1903)

The Darwin wasp genus Losgna (Cameron, 1903) has long been enigmatic, with no valid species described or specimens collected since Heinrich's 1965 monograph, and it was thought to be lost. Here, we unveil its dramatic history & rediscovery in India and formally describe *Losgna occidentalis sp. nov.* A specimen historically associated with "*Losgna quintaxa*" lacked a formal description and thus remains a nomen nudum under the International Code of Zoological Nomenclature. As the first valid nomenclatural act, L. occidentalis sp. nov. receives its holotype designation at the Natural History Museum, London. We provide an illustrated diagnostic key for all Indian Loxgna species and present detailed morphological comparisons against type material housed in NHM London, the Hope Collection (Oxford), and ZSM Munich.

Our analyses expose taxonomic discrepancies, highlighting challenges created by dispersed type specimens and limited historical collection data. By extending Losgna's known Oriental range more than 2000 km westward, this work reveals the underexplored diversity of Ichneumoninae in India. The reemergence of this fascinating genus addresses critical gaps in Hymenoptera taxonomy and reinforces the necessity for sustained international collaborative research and discussion of the potential consequences of historical undersampling and the importance of enhanced digitisation protocols to improve access to museum specimens.

Other authors: Sophia Reinisch, Imperial College London

P32 - Emma Dickson, University of Huddersfield
The Detailed Separation and Identification of *Hydrotaea capensis* and *Hydrotaea aenescens* Through Comparison of Morphological Features for Future Educational Use

The ability to appropriately identify and separate insects, specifically insects that are visually similar, is a key skill within entomology. This presentation will look at the different methods used to identify and separate two closely related *Hydrotaea species, H. capensis* and *H. aenescens*, while showcasing a new method of side by side comparison. Both species, while established within the United Kingdom, are

classified as non-native. Whereas *H. aenescens* is less abundant than *H. capensis* both species are found in a multitude of environments together and identification is critical to understand potential impact from the species.

While there are copious amounts of research and identification keys for a multitude of insects, they can be difficult to follow, especially as they focus on using anatomically correct words with little to no appropriate visuals. With that in mind, this study aims to create more 'easily digestible' identification techniques for academic use, with real world impact in the sphere of entomology and forensic entomology.

Other authors: Dr. Esta Bostock - University of Huddersfield (Supervisor). Dr. Katie Addinall - University of Huddersfield (Supervisor).

P33 - Hassan Naveed, Basatin Landscaping LLC

***Deltocephalinae* leafhoppers (Hemiptera, *Cicadellidae*) from Pakistan with descriptions of two new genera and five new species**

Paralimnini Distant, 1908, is a notable leafhopper tribe that exhibits a wide distribution across all biogeographical regions, namely the Palearctic, Nearctic, Afrotropical, Oriental, Neotropical, and Australian regions. Among these, the Oriental region demonstrates the highest diversity of Paralimnini, with a significant portion of this diversity remaining unexplored according to recent investigations. A comprehensive morphological study is conducted, which includes the description of two new genera, *Paralimnolusgen. nov.* and *Lalianlusgen. nov*., with *P. bicolor sp. nov.* and *L. bifurcates sp. nov.* within the tribe.

Additionally, the leafhopper genus Stirellusis reviewed from Pakistan with the description and illustrations of five new species S. kumratensis Naveed & Zhang,S. neoconvexus Naveed & Zhang, Stirellusmankiensis Shah, Naveed & Duan, Stirelluspakhtunensis Shah, Naveed & Duan, Stirelluspakistanicus Shah, Naveed & Duan and four new records *Stirelluscapitatus, Stirellusindrus, Stirellusrotundus, Stirellusrubrolineatus*. A checklist and key for the known species of Stirellusfrom Pakistan are also given.

Leafhopper specimens were freshly sampled by sweep net in Pakistan during 2019-2021 and were preserved in 90% ethanol, subsequently air dried and point mounted for further studies. Morphological characters including color, markings, size and shape of the head, thorax, and abdomen were carefully examined for the description. The adult abdomen was removed and boiled in 10% NaOH on a hot plate until the muscles were completely dissolved (maceration), then rinsed in pure water and transferred to a glass slide with a drop of glycerol for further observation, imaging, and storage. Digital images of the Pakistani material were taken with a Q-Imaging Micropublisher 3.3 digital camera mounted on an Olympus BX41 stereo microscope and with a Nikon D1x digital SLR camera configured with lenses by Microptics, Digital Lab XLT system. Digital images were compiled and edited to balance color and contrast, and to remove background using Adobe Photoshop CS. Species distribution map is created using ArcGIS 10.4.1 software.

P34 - Robert Wilson, Museo Nacional de Ciencias Naturales (MNCN-CSIC)

Developing a national reference collection for pollinating insects in Spain

The insect collections of Natural History Museums (NHMs) could be vital resources to support pollinator identification and provide information about the distributions, abundance and diversity of pollinating insects. However, the potential of NHMs to achieve these aims is hampered by the large proportion of historical specimens that are yet to be properly identified, catalogued, digitised or made publicly

accessible. Here we describe a project (INC-STEP) that aims to create a national pollinator reference collection for Spain, beginning with six groups of pollinators: the butterfly families *Papilionidae* and *Hesperiidae*; the syrphid subfamily *Eristalinae*; and the bee genera *Bombus, Colletes* and *Xylocopa*.

We show how combining information from five NHMs can be used to provide accessible reference material by filling gaps in material held by individual collections. We document the challenges to creating a national reference collection, including investments in time, resources and personnel, and present solutions to these.

Finally, we highlight initiatives using the reference collection as a resource to engage with the public about insect biodiversity and conservation. The steps we outline to make entomological specimens Findable, Accessible, Interoperable and Reusable (FAIR) are proposed as a key part of ongoing measures to tackle the insect crisis.

Other authors: Adrián Sánchez-Albert, Celia Santos-Mazorra, Manuel Sánchez Ruiz, Marina González-Cristóbal, Mercedes París, Piluca Álvarez-Fidalgo (Museo Nacional de Ciencias Naturales, MNCN-CSIC), Berta Caballero López, Irene Lobato-Vila (Museu de Ciències Naturals de Barcelona, MCNB), Sergio Montagud Alario (Natural History Museum of the University of Valencia, MuseuHN-UV), Ana Amezcua, Ángel Chaves, Arturo H. Ariño, David Galicia, María Imas (University of Navarra Zoology Museum, MZNA), Francisco José Cabrero-Sañudo, Sandra Grzechnik (Madrid Complutense University Entomology Collection, UCME).

P35 - Elsa Heywood, University of Oxford

Butterfly size changes over 140 years are influenced by habitat ecology and phylogeny

Decreases in body size are widely considered to be a universal response to a warming world, though an array of ecological, life history, and phylogenetic factors can also affect size. Whether insect size responses to global change are affected by such factors is unknown and long-term patterns in morphology remain elusive. To address these knowledge gaps, I developed a time series of morphometric data from 3000 British butterfly museum specimens, collected over 140 years. Using this dataset, I analysed long-term trends in wing and abdomen size and modelled which ecological, climatic, and phylogenetic factors may explain these patterns.

My results reveal that, on average, butterfly body size has significantly increased over time but these morphological trends are strongly modified by species habitat ecology and phylogeny. Importantly, this suggests that body size trends exist on different scales to those previously imagined and undermines the concept of a universal size response to global change. I also demonstrate that museum collections can be effectively used on small scales to answer ecological questions which advance global change research.

Other authors: Dr Ailsa McLean University of Oxford, Dr Chris Terry University of Oxford, Zoë Simmons Oxford University Museum of Natural History

P36 - Joseph Rees, University of Lincoln

Wasting Away: The effect of diet on the aposematic signals of *Nicrophorus vespilloides*

The burying beetle, *Nicrophorus vespilloides*, exhibits a striking aposematic signal. The parents prevent decay of a carcass for their offspring to feed on. Adults have shown preference for fresh carcasses and produced fewer, lighter larvae when breeding on older carcasses. While research has previously focussed on the size and aposematism of the primary stripe on the elytra, there has been limited research into the shape of the signal. The parents were provided carcasses of varying quality (fresh, 3-day-old, 1-week-old,

2-week-old) and the larvae was left to pupate. The shape of offspring's stripe was then analysed using geometric morphometrics to determine whether diet can affect this aposematic component.

The analyses exhibited significant differences between aged carcasses and the controls, showing that diet can affect the stripe. This means that the stripe shape is phenotypically plastic, dependant on environment as well as genetics.

Other authors: Dr Sheena Cotter, University of Lincoln; Dr Marcello Ruta, University of Lincoln

P37 - Kwang Pum Lee, Seoul National University

Heat stress during early development poses lasting threats to a montane stag beetle, *Lucanus maculifemoratus ssp. Dybowskyi*

Climate warming has increased not only average temperatures but also the frequency and intensity of extreme thermal events. This study examines how exposure to stressful heat during early development affects survival and growth in the larvae of the stag beetle *Lucanus maculifemoratus dybowskyi* (Coleoptera: *Lucanidae*), a species inhabiting the montane regions of northeastern Asia. Larvae reared continuously at 25 °C throughout their entire larval stage exhibited reduced growth and survival compared to those maintained at 15 °C or 20 °C, suggesting that even moderately elevated temperatures is detrimental to this cold-adapted species.

To investigate the effects of early thermal stress, some larvae initially reared at 25 °C during the first two stadia were transferred to 20 °C at the onset of the third larval stadium, which accounts for ca. 90% of the total larval period. Despite this shift to a more favorable temperature, individuals exposed to high temperatures (25 °C) during early larval stages showed high mortality and reduced body mass. These findings indicate that thermal stress during early development has lasting negative impacts on fitness in this stag beetle. This study highlights the potential vulnerability of cold-adapted species such as *L. maculifemoratus dybowskyi* to climate warming and offers insights for developing effective conservation strategies.

Other authors: Seong-woo Jeon, Seoul National University. Dae-Am Yi , Yeongwol Insect Museum.

P38 - Rosy Christopher, Newcastle University

Friend, Foe or Freeloader: Using molecular methods and community science to investigate the ecological outcomes of a potential arachnid-plant commensalism

Non-trophic interactions contribute significantly to ecosystem functioning and may be positive, neutral or negative for either of the interacting parties. Commensalisms are interactions in which one party, the commensal, is benefiting from the interaction, and the other party, the host, is neutrally affected. Despite significantly impacting ecosystem functioning and service provision, commensalisms are scarcely incorporated into wider studies of ecological networks. Flower crab spiders (*Misumena vatia*) use flower heads as platforms from which to predate flower visitors attracted by the rewards offered by the flower. We can predict the outcome to the flower visitor, but how does this impact the flower, if at all?

Using a combination of spider dietary metabarcoding to detect trophic interactions, surface eDNA from flowers to detect recent visitors and nectar macronutrient analysis to determine nutrient provision, ecological and nutritional networks will be constructed. Alongside community science data and public records of spider-flower-prey interactions, we are investigating the nature, diversity and drivers of the potentially commensal interactions between flower crab spiders and their flowers, and the implications of and for their prey. Using this model system, we will determine the ecological outcomes of

commensalisms, approaches for their integration into wider ecological networks and their implications for ecosystem service provision.

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Integrated Pest Management (IPM)

P39 - Adi Kliot, Volcani Institute Agricultural Research Organization

Different aspects of the effect of global warming on effective control of the pest mite *Tetranychus urticae*

T. urticae is a pest mite, damaging numerous plant species. In recent years, in the Mediterranean basin, it is becoming a pest of high economic impact. *T. urticae* is now considered a primary pest in some crops, where it was previously a minor one. This is hypothesized to be linked to global warming. This mite is highly thermophilic; studies show it can thrive in temperatures far over 30°C.

As reports of outbreaks of *T. urticae* in the field became more frequent, indicating the failure of both biological and chemical means of control, our group started studying different aspects of heat-related effects on *T. urticae*, both in field and lab conditions. Our survey, started in 2022 and continuing today, documented outbreaks of *T. urticae* with resistance to different pesticides derived from at least seven different mode-of-action classes.

In the lab, we tested two different short-term heat stressors on adult female mites and shown that those can have highly diverse effects, depending on the genetic and climatic background of the population. As we continue to study more and more aspects in which heat can affect these mites, we hope to improve both our abilities of outbreak prediction and control of this pest.

Other authors: Orna Ben-Aziz, Noya Yair, Volcani Institute

P40 - Md Munir Mostafiz, Teagasc

Impacts of Clone-Specific Life-History Traits on the Fitness and Population Dynamics of Metopolophium dirhodum on Winter Barley

Metopolophium dirhodum, the rose-grain aphid, is a key pest on cereals in Europe, where infestations can significantly impact crop yield and quality. Life-history traits of aphid clones play a critical role in shaping population dynamics and pest pressure on cereal crops. However, there is limited understanding of how clonal variation in *M. dirhodum* influences fitness traits and population growth and pest potential, particularly in comparison to other grain aphid species. This study investigates the life-history variation among geographically distinct clones of *M. dirhodum* and their impact on population growth. Under controlled laboratory conditions, we assessed key biological parameters including development time, fecundity, longevity, and reproductive duration.

The results indicate that the Irish clone of *M. dirhodum* exhibits significantly higher adult longevity, fecundity, and reproductive period compared to other cereal aphid species, including the English grain aphid, resulting in a higher intrinsic rate of increase (r_m = 0.288) and greater potential for rapid population growth. Data from two UK clones will be included for comparative analysis to evaluate inter-clonal variation in fitness traits.

These findings improve our understanding of population-level variation in *M. dirhodum*, which can be utilised to improve predictive pest models and establishing region-specific integrated pest management strategies.

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P41 - Larissa Collins, Fera Science Ltd

An industry collaborative project to improve wireworm (Elateridae) Integrated Pest Management

Several species of 'wireworms', the larval stages of click beetles (*Elateridae*), are causing an increasing amount of economic damage across several crops in several countries.

We designed a project in collaboration with industry partners to increase our knowledge of the distribution and biology of these insects in the U.K. and in collaboration with a partner, inov3PT, in France. The project was designed to provide the following outcomes:

1. Design DNA barcoding to identify larvae, and DNA metabarcoding to detect multiple species of wireworms from soil samples.
2. Determine whether we can use DNA metabarcoding to identify gut contents.
3. Assess cover crops in the glasshouse to determine whether they reduce subsequent crop damage.
4. Assess current distribution in the U.K., and whether this will increase with climate change.
5. Assess whether climate change will reduce development time.
6. Identify species-specific risk factors related to field and landscape features which agronomists can use to risk assess fields before planting crops.

We used molecular biology techniques, life history measurements under varying temperature conditions, greenhouse trials, monitoring, field metadata surveys, and climate modelling. We communicated frequently with industry partners, including running a wireworm and click beetle identification and multi-way knowledge exchange workshop.

Other authors: Larissa Collins, Ian Adams, Martyn Cox, Andrew Crowe, Damian De Marzo, Rachel Down, Jacqueline Dunn, Hannah Fenton, Rowan Howe, Eleanor Jones, Roy Macarthur, Bruno Ngala, Valeria Orlando

P42 - Amrithapriya Bindu, John Innes Centre

Fighting the Flea Beetle: Genetic Secrets of Resistance in *Sinapis alba*

Cabbage stem flea beetles (CSFB) are among the major threats to oilseed rape (OSR) cultivation. The predominant method for CSFB control frequently involves the repetitive and widespread application of chemical insecticides. However, the withdrawal of neonicotinoid seed treatments, combined with the emergence of pyrethroid resistance, has resulted in a lack of effective pest control, serious crop losses, and a 50% reduction in the UK cropping area since 2013. Consequently, there is an urgent need for more sustainable and effective pest management alternatives. Exploiting host plant resistance is one promising strategy, with white mustard (*Sinapis alba*) emerging as a noteworthy candidate due to its expression of both *antixenosis* (feeding deterrence) and larval antibiosis resistance mechanisms against CSFB. However, there is considerable variation in flea beetle feeding preferences among white mustard lines, and not all

of them exhibit the same degree of resistance. Despite this, there remains a significant gap in understanding the genetic foundation and molecular mechanisms underlying this variation.

This project aims to improve our understanding of Sinapis-CSFB interactions, identify potential resistance genes, and investigate their potential for deployment in other Brassica crops through gene editing or introgression. Ultimately, the findings will support efforts to develop insect-resistant crops.

Other authors: Rachel Wells, John Innes Centre. Steve Penfield, John Innes Centre. Ryan Brock, John Innes Centre. Sebastien Faure, Innolea. Coretta Kloeppel, Limagrain.

P43 - Carolyn Mitchell, James Hutton Institute

Companion cropping in Scottish seed potato production – the impact on aphid abundance and virus control

The intensive management of seed potato crops, with a heavy reliance on insecticides, has led to the dominance of insecticide-resistant aphid species which are efficient virus vectors. Loss of permitted insecticides and inefficient alternative strategies to control vector-borne diseases are an immediate threat to the sustainability of the Scottish seed potato industry. Alternative methods are needed that reduce reliance on insecticides. A two-year study at the Centre for Sustainable Cropping trialled a strategy to combat these issues by diversifying the potato system with companion crops. A mixture containing vetch, buckwheat and peas was sown into the potato crop with the aim to understand the impact of companion cropping on aphid abundance and their natural enemies. Aphid and natural enemy abundance was monitored throughout the two seasons together with weed pressure and soil nutrient availability.

The results indicate that companion cropping may play a role in reducing aphid abundance but that this method alone would not control virus spread effectively and it would need to be supplemented with other measures throughout the season.

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P44 - Danica D Cruz, John Innes Centre

Exploring multi-pest resistance in oilseed rape (*Brassica napus*)

Crop pests present a global threat to food production, causing yield losses of up to 40% a year. Oilseed rape (*Brassica napus*; OSR) is an important vegetable oil source and break crop with a damaging pest assemblage. The 2013 neonicotinoid ban coupled with increasing pest resistance to pyrethroids has prompted an increase in OSR pest pressure, leading to a 66% decline in UK OSR cropping area since 2012. With chemical-based pest control options becoming limited, breeding pest-resistant OSR is a key priority. Despite this, determining the genetic basis of resistance is challenging, with such traits usually controlled by multiple genes. An ongoing project involves the generation of a recombinant OSR population from eight parental lines, providing a resource for understanding the genetics of complex traits. However, pest resistance variation within these parental lines is currently unknown.

This project therefore aims to assess parental resistance to three economically important pests: the cabbage stem flea beetle (*Psylliodes chrysocephala*), the green peach aphid *(Myzus persicae*), and the grey field slug (*Deroceras reticulatum*). Identifying variation in pest resistance among the parental OSR lines will guide future genetic mapping of resistance traits within OSR, ultimately contributing to the development of pest-resistant cultivars.

Other authors: Rachel Wells & Ryan E Brock

P45 - Leqi Zhang, UK Centre for Ecology and Hydrology (UKCEH) & University of Liverpool
Impacts of climate change on the resilience of natural enemy communities for biocontrol of insect pests

Climate change significantly affects agricultural ecosystems, disrupting crop-pest dynamics, particularly with aphids, which challenges pest management strategies such as biocontrol. To enhance biocontrol methods, it's crucial to explore how to effectively use biocontrol agents like entomopathogenic fungi (EPF) and soil bacteria that may enhance plant immunity under climate change conditions. However, the interactions and combined effects of these biocontrol agents on aphids remain understudied. This study investigates the influence of climate change factors on the interactions between these biocontrol agents.

An experimental aphid-barley system is used to study the described interactions. The experiments aim to assess the impact of aphids on barley plant development, the effect of various barley cultivars on aphid populations, and the impact of temperature on the in vitro growth rates of EPF isolates (as a proxy of virulence). Results indicate that while aphid infestation significantly reduced barley biomass, neither barley cultivar nor aphid strain significantly affected final barley biomass or total aphid populations.

Temperature variations influenced the growth rates of different EPF isolates, indicating their different potential virulence levels. These outcomes will aid in screening potential EPF isolates and developing bioassays for evaluating their in vivo efficacy in controlling aphids alongside beneficial soil bacteria.

Other authors: Supervisors: Dr. Helen Hesketh, UKCEH; Dr. Sharon Zytynska, University of Liverpool; Dr. Gia Aradottir, Mamoré Research and Innovation Limited.

P46 - Madeleine Workman, John Innes Centre
DsRNA based biopesticides offer a sustainable alternative to chemical controls against the Cabbage Stem Flea Beetle (*Psylliodes chrysocephala*)

Oilseed rape (Brassica napus; OSR) is an important source of vegetable oil in the UK, yet cropping area has declined by 60% over the past decade, in part, due to rising pest pressure from the Cabbage Stem Flea Beetle (*Psylliodes chrysocephala*; CSFB). The 2013 EU ban on neonicotinoid insecticides, coupled with rising pest resistance to pyrethroid alternatives, has made OSR an increasingly challenging crop for farmers to grow. With CSFB pressure predicted to further increase under climate change, there is an urgent need for sustainable alternatives to conventional chemical controls. DsRNA-based biopesticides offer a possible solution, eliciting species-specific mortality and protecting farmland biodiversity and pollinators. This technology utilises the endogenous RNA interference pathway for targeted mRNA degradation of essential transcripts, resulting in insect mortality.

This project will assess the potential of dsRNA-based biopesticides for CSFB control by testing a range of gene targets. We aim to identify optimal concentrations for maximising mortality and assess a range of topical application methods considering the challenges of field-based application. This research contributes to a rising body of knowledge on the potential benefits of sustainable biopesticide use and highlights their potential for effective CSFB control, aiding in reversing the decline in UK OSR production.

Other authors: Rachel Wells, John Innes Centre. Ryan Brock, John Innes Centre. Ian Wood, Croda Europe Ltd. Vanessa Rose, Croda Europe Ltd.

P47 - Shuchao Wang, University of Exeter
Molecular mechanism of aphid resistance to cyantraniliprole

Green peach aphid (*Myzus Persicae*) is one of the most damaging crop pest and have developed many kinds of resistance mechanisms to different chemicals. However, the molecular mechanism of aphid resistance to cyantraniliprole, one of the most popular and efficient diamides insecticide, still remains unclear. Here we tested that whether cyantraniliprole resistance was conferred by target-site mutations and we have revealed a new resistance mechanism that overexpressed cytochrome P450 genes CYP6CY7 and CYP6CY3 could confer resistance to cyantraniliprole.

The findings and tools generated in this study provide a platform for the development of strategies that aim to slow, prevent or overcome the evolution of more potent resistance to cyantraniliprole.

Invasive Species & Community Ecology

P48 - Stephen Gillanders, University of Aberdeen, AFBI, SAERI & Queen's University Belfast
Earwigs in the Falklands: How big is the threat?

European earwigs *Forficula auricularia* have become an established introduced species in the Falkland Islands and southern South America. In the Falklands they are widespread in the urban environment, and considered serious horticultural pests and public nuisance, however the ecological impacts have not been investigated.

F. auricularia and other earwig species receive considerable interest in entomological research due to its importance as a food-crop pest-predator and as an evolutionary and ecological research model owing to several uncommon traits, such as sociality and egg and nymph care. This talk will present findings from two years' fieldwork, describing the distribution and phenology of the earwig invasion in the Falklands which was first recorded in the 1990s.

Comparing invaded and non-invaded areas, we can assess invertebrate diversity and determine the impact of earwigs on native species. Are earwigs taking advantage of disturbed or degraded habitats? Or are they just highly commensal to anthropic environments? A conclusion is sought whether this problem is more social than ecological. Interestingly, off the back of this research, we now have a huge collection of Falklands invertebrates to be identified and catalogued.

A talk not just about earwigs, but potential sub-Antarctic invasion and South Atlantic invertebrate diversity!

P49 - Chang-Ti Tang, University of Edinburgh
PCR-based detection of non-native insects in the UK: the case of the chestnut gallwasp *Dryocosmus kuriphilus and* its biocontrol agent *Torymus sinensis*

Biological control has long been used to control insect pests. Despite many successes, risks that control agents may attack non-target native species remain. Monitoring range expansion and host use by biocontrol agents are key components of estimating this risk. The advancement of PCR-based approaches provides an opportunity to develop methods for detection of target species cheaply and at scale. Here we describe the development and testing of species-specific primers for *Torymus sinensis*, a parasitic wasp that is a globally important biocontrol agent for a globally-invasive pest, the chestnut gallwasp

Dryocosmus kuriphilus. Chestnut gallwasp is spreading through the UK, and T. sinensis was deliberately released in 2021.

We designed primers to amplify a short fragment of the nuclear gene ITS2, and confirmed their specificity against a test panel comprising T. sinensis and 16 native parasitoids known to attack chestnut gallwasp. Quantitative PCR (qPCR) assays confirmed amplification even at very low concentrations of *T. sinensis* DNA (116 fg/µL), suggesting that these primers can be used in screening of whole gall samples, removing time-consuming and labour-intensive gall rearings. To facilitate wider application of this diagnostic tool, we will test the primers' specificity against parasitoids in other regions where *T. sinensis* has been released.

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Medical Entomology

P50 - Elin Cunningham, University of Birmingham

Integrating Morphological and Molecular Methods to Identify *Anopheles* Mosquitoes in Western Kenya

Accurate identification of *Anopheles (An.)* mosquito species is critical for understanding malaria transmission dynamics and informing effective vector control strategies. However, field-based morphological identification is often limited by the presence of morphologically similar species, especially within the *An. gambiae* and *An. funestus* complexes which are major malaria vectors. This study aimed to assess the accuracy of morphological identification against molecular techniques using mosquitoes collected from Bigege village, Kenya, in January 2025. Mosquitoes were collected over four nights using CDC light traps. A total of 46 Anopheles specimens were preserved and transported to the University of Warwick for laboratory analysis. Morphological identifications were compared to results from PCR and Sanger sequencing of conserved regions of the Internal Transcribed Spacer 2 (ITS2).

Findings revealed a 65% mismatch rate between morphological and molecular identification, highlighting substantial limitations in morphology-based species ID. Molecular techniques also detected several specimens that could not be classified to species level using existing genetic databases, suggesting the presence of potentially undescribed Anopheles species in Kenya.

These results emphasise the need for integrating molecular tools into routine entomological surveillance, especially in regions with high malaria burdens and complex mosquito fauna. Future work will improve amplification protocols and expand reference sequence libraries.

Other authors: Isabel Hughes, University of Warwick. Cyprian Adala, Kenya Medical Research Institute. Dr Shehu Awandu, Kenya Medical Research Institute. Dr Tom Walker, University of Warwick.

P51 - Emily Webber, Edge Hill University

Ecological Determinants of Cuticle Morphology in *Aedes aegypti*: The Role of Larval Density and Body Size

Arboviruses such as dengue endanger approximately 3.9 billion people in tropical and subtropical regions, with *Aedes aegypti* among the most prolific vectors. Climate change is expanding mosquito habitats,

increasing outbreak frequency and intensity, and disproportionately impacting high-risk populations, posing a growing threat to global health security. While insecticides have been central to vector control, the increasing prevalence of insecticide resistance is undermining their effectiveness. A key resistance mechanism involves morphological adaptations in the cuticular profile which reduce insecticide penetration. However, the environmental and physiological factors driving this adaptation remain poorly understood.

This study investigates how larval density and adult body size affect the cuticle, and how these changes influence insecticide penetration. Electron microscopy will be used to analyse cuticle structure in relation to rearing conditions and overall body size. Additionally, this study will investigate the use of eosin Y dye bioassays to quantify cuticular penetration, offering insights into the functional impact of any morphological changes observed.

By linking developmental conditions to resistance-related morphology, this research will improve understanding of how ecological factors contribute to cuticle-mediated resistance in *Aedes aegypti*. These findings may inform more targeted and sustainable vector control strategies to mitigate arbovirus transmission in a changing global environment.

Other authors: Dr Clare Strode, Edge Hill University. Dr Jasmine Morgan, Edge Hill University (Previous) and LSTM (Current).

P52 - Fatma Bursali, Aydin Adnan Menderes University
Investigating the Effects of Asaia Bacteria on the Developmental Biology of *Aedes aegypti*, the dengue fever vector

This study investigated the impact of Asaia and Acetobacter bacteria—common insect microbiome members—on life history traits of the dengue vector *Aedes aegypti*. We specifically examined how these bacteria influence mosquito development and reproduction. One-day-old first instar larvae (n = 100) were exposed to 10 ml of bacterial suspension (100 mg/ml) containing Asaia spp., Acetobacter spp., Escherichia coli, or Tetramin® (fish food). Larvae were reared to adulthood to assess the nutritional effects of each diet. Results indicated that bacterial type significantly influenced larval development time and adult emergence rates. To evaluate reproductive outcomes, adult females from the Asaia, E. coli, and Tetramin® groups were allowed to blood-feed, after which their egg production was measured. Fecundity did not differ significantly among the groups, suggesting no impact of larval diet on oviposition.

Overall, our findings show that Asaia exerts strain-specific effects on larval development but does not influence adult reproductive capacity. Further studies are necessary to explore the long-term implications of bacterial exposure on mosquito fitness.

Other authors: Mustapha Touray- Swansea University, BioHUB Research

P53 - Gemma Harvey, Liverpool School of Tropical Medicine
Making power analysis easy: browser-based apps for designing mosquito Experiments

Malaria is the world's deadliest vector-borne disease, spread by the bites of *Anopheles* mosquitoes. To prevent malaria, insecticide-based controls are widely used in sub-Saharan Africa to repel or kill mosquitoes. Bench-top laboratory bioassays are key to identifying effective mosquito-control tools, yet robust experimental design is needed for results to be sufficiently reliable for decision-making.

Here we present a user-friendly, free web application for designing WHO cone experiments, the core

laboratory method to evaluate insecticide-treated bed nets. Using simulation-based methods, we evaluate how sample size impacts the power to detect differences in mosquito mortality between treatment groups.

We demonstrate the biggest factor in determining the number of samples to produce a significant result is how small a difference can be detected between groups. Larger differences (e.g. a 20% difference in mortality) are readily detected with existing WHO proposed sample sizes yet smaller differences (e.g. 10%) generally require more than triple this sample size. Finally, we demonstrate the importance of plausible assumptions about variability, based on real data.

Based on our simulation framework, our user-friendly browser application allows researchers to easily design robust WHO cone bioassays (link: https://fmechan1.shinyapps.io/who_cone_app). This framework can be readily adapted and applied to other insect bioassays.

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P54 - Mauro Pazmino, University of Glasgow

Effects of temperature fluctuations and humidity variation on survival and life history traits of two *Anopheles malaria* mosquito species

Increased global temperatures and frequency of extreme weather events are predicted to impact the ecology of mosquitoes and their ability to transmit vector-borne diseases. While most laboratory studies rear mosquitoes under constant temperature (CT), the effects of fluctuating temperature (FT) on mosquito ecology remain limited. Here, we measured the effects of CT and FT temperatures and humidity variation on the life history traits of two malaria mosquito species, *Anopheles gambiae* and *An. coluzzii*. Mosquitoes were reared at two mean temperatures (27 ºC and 24 ºC) either constant or with two different diurnal temperature ranges (DTR) of ±3 and ±6 ºC; and under two humidity levels (50% and 80% RH). Mosquitoes were also exposed to a sublethal dose of deltamethrin or a control treatment to assess the influence of environmental variation on insecticide efficacy. Larval survival and developmental time, and adult survival and body size were measured.

Our results show that FT significantly influenced larval development and adult body size and survival in both species when compared to CT. As temperature, DTR and humidity increased, adult survival decreased, regardless of the species. Moreover, insecticide exposure only reduced survival under higher humidity, with no effect at 50% RH. These results show the importance of including daily temperature variations and different humidity levels when studying the impact of temperature on mosquito ecology, and provide useful insights to improve laboratory mosquito rearing conditions.

Other authors: Alena Miller, University of Glasgow. Maria Katsoni, University of Glasgow. Ivan Casas Gomez-Uribarri, University of Glasgow. Fredros O Okumu, University of Glasgow, Ifakara Health Institute. Simon A Babayan, University of Glasgow. Francesco Baldini, University of Glasgow, Ifakara Health Institute.

P55 - Rosie Hobbs, Pirbright Institute

Exploring Variation in infection of different Virus Particles in *Culicoides* biting mites

Culicoides biting midges (Diptera: Ceratopogonidae) serve as vectors for orbiviruses of livestock such as Bluetongue virus (BTV) and Epizootic Haemorrhagic Disease virus (EHDV), which can lead to significant economic losses. Recent expansion of the range and prevalence of these vector-borne diseases to

temperate regions, including northern Europe and the UK, and resulting socio-economic impacts highlight the importance of understanding virus–vector interactions.

Infection rates of vector Culicoides with BTV varies with species and population, but also with BTV serotype and strain. One of the factors that may determine this variation in infection are the different types of virus particles BTV forms. Infectious subviral particles (ISVPs) are generated through the interaction of BTV with proteases and are believed to enhance virus infection of the vector, producing approximately 100-fold greater infectivity in insect cell lines. Culicoides salivary gland proteases have been shown to generate ISVPs with increased infectivity, however, the role of ISVPs in the infection of Culicoides and the impact of protease within the saliva and midgut has not been determined.

In this study we investigated the interaction of BTV virus particles, ISVPs and insect proteases and their impact on infection in Culicoides. Here we discuss the degree to which the formation of ISVPs and interactions with vector proteases determine the infection phenotype in Culicoides of different BTV serotypes and therefore transmission.via

Other authors: Dr Marc Guimera, Dr Christopher Sanders, Dr Laura Jones

P56 - Roumik Banerjee, Birla Institute of Technology and Science, Pilani, K K Birla Goa Campus
Juvenile hormone-mediated chromatin remodeling: insights into synergistic action of downstream transcription factors, Hairy and Krüppel homolog 1

Insect-specific juvenile hormone (JH) controls mosquito post-eclosion (PE) development, a stage crucial for subsequent blood meal-driven egg maturation. During PE, JH functions through the independent or synergistic actions of repressors Hairy and Krüppel homolog 1 (Kr-h1), initiating the downregulation of different target gene cohorts. A key factor governing candidate gene expression is its chromatin state, determined by the tightness of DNA wrapping around associated proteins. Chromatin remodeling alters DNA accessibility and impacts gene expression.

Despite advances in our understanding of the JH signaling pathway, little is known about JH/Met-induced chromatin remodeling during gene repression. Using the Dengue mosquito *Aedes aegypti*, we show that repressors Hairy and Kr-h1 induce alternative chromatin modifications to repress their target genes. While Hairy causes widespread histone H4 deacetylation of target genes, Kr-h1 induces histone H3K9 trimethylation and chromatin compaction. For the candidate genes co-repressed by both Hairy and Kr-h1, the two factors have a cumulative effect on the chromatin modification of the target gene loci synergistically downregulating their expression. Our findings shed light on the mechanism behind the synergistic action of transcriptional repressors Hairy and Kr-h1 involved in JH signal transduction.

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P57 - Ryan Carmichael, Queen's University Belfast
Mosquito surveillance across wetlands in Northern Ireland, 2025

Mosquito-borne disease emergence is a rapidly growing concern in the Irish & British Isles. Usutu virus and West Nile virus have seen introductions in England in 2020 and 2023 respectively, and the introduction of other arboviruses like Sindbis virus remains a pertinent threat. Yet, to-date most surveillance in the UK is focused on England & Wales, with no descriptions of native mosquitoes in Northern Ireland being published in over 30 years. This study aims to fill this gap by surveying larval and adult mosquitoes across six habitat types (wet woodlands, wet grasslands, ponds, saltmarsh, reedbeds & urban gardens) over the six Northern Irish counties. Larvae and pupae were sampled through 'larval

dipping' at suitable habitats. Adults were sampled using BG-Pro (Biogents) traps, baited with dry ice and BG-Lure.

Mosquitoes were identified to species/complex level through morphological methods. This study describes for the first time since 1991 the diversity, abundance & geographic distribution of species present in Northern Ireland, and potential factors which may influence these. This work is of great importance as it will begin to build the evidence to evaluate whether mosquito-borne diseases could indeed emerge in Northern Ireland.

Other authors: Ryan Carmichael1,2, Georgia Kirby3, Aidan Desjardins1, Emilie Pondeville2, Jean-Phillipe Parvy2, Francesco Baldini3, Katarzyna Modrzynska4, Simon Babayan3, Jaimie Dick1, Heather Ferguson3, Ross Cuthbert1
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P58 - Shannara Eilean Smith, University of Glasgow

Mosquito age at infection affects malaria parasite development and transmission, in a laboratory setting

Age-related senescence has wide-ranging impacts on gene expression, immune function, microbiome composition, barrier integrity, digestion, and metabolism in model insects. However, little is known about ageing in vector taxa. Anopheles mosquitoes are best known as carriers of the malaria parasite - Plasmodium. Senescence generates considerable heterogeneity in physiology which could alter vector competence and Plasmodium development. The malaria parasite in turn has a capacity to alter its development in response to environmental cues, but not much is known about its capacity to sense and respond to vector age.

To explore how vector age affects malaria transmission, *Anopheles stephensi* mosquitoes were infected with Plasmodium berghei at 7-, 14-, and 21-days post-emergence (young, middle-aged, and old). The parasite development was then followed through the period of 3 weeks. Fluorescent microscopy was used to examine and quantify different parasite forms in the midgut and salivary glands; and assess their development. Young mosquitoes showed significantly higher infection intensity, parasite size, and maturation rates compared to the other age categories. Only young and middle-aged mosquitoes transmitted *P. berghei* to a rodent host.

Overall, young mosquitoes showed increased vector competence, which decreased with chronological age at the time of infection. This study provides preliminary phenotypic evidence that age does affect vector competence in a laboratory setting.

Other authors: Dr Katarzyna Modrzynska (Centre for Parasitology, School of Infection and Immunity, University of Glasgow). Dr Joanne Power (Centre for Parasitology, School of Infection and Immunity, University of Glasgow).

- Online posters

We are pleased to welcome a selection of online posters from delegates joining virtually. We encourage all in-person delegates to take the time to view these posters using the QR code below and contact presenters with any questions you have about their research.

royensoc.co.uk/ento25-online-posters

Conservation and Management of Forest Insects

OP1 - Benjamin Brough, Royal Horticultural Society
Tracking the distribution and identity of an aphid causing novel symptoms on Buddleja in the UK

The Royal Horticultural Society's Gardening Advice service first received reports of unusual distorted and discoloured growth on Buddleja in 2023, with 58 observations in a limited distribution in SE England. Aphids were isolated as the cause, and in 2024 67 observations encompassed a slightly broader geographic range. RHS entomologists worked with the Rothamsted Insect Survey to obtain a tentative identification of melon-cotton aphid (Aphis gossypii) from a sample of affected buddleja at RHS Garden Wisley.

In order to track the distribution of this phenomenon the RHS launched an online survey in May 2025. This has the facility for recorders to upload photographs and select whether active aphid colonies are associated with the symptoms. It allows sample request from the recorders, to gather aphid material for morphological and DNA identification.

The survey launch has coincided with a year of high aphid activity, and several thousand reports have been received. These indicate that the aphid presence and symptoms on buddleja is now very widely distributed in the UK. Further work will confirm the identity of the aphid and explore its biology and spread.

Other authors: Josie Stuart (RHS), Alex Greenslade (Rothamsted Research), Dr Andy Gladman (ADAS - Sustainable Agricultural Systems), Dr Hayley Jones (RHS)

Pollinators

OP2 - Martina Janků, Palacký University Olomouc
Nitric oxide as a key signalling molecule for antimicrobial peptide production in the honey bee (*Apis mellifera*)

Honeybees are essential pollinators, playing a vital role in sustaining biodiversity and supporting global agriculture. With alarming global colony losses, there is an urgent need to deepen our understanding of

honeybee immunity. Its innate immunity includes the production of nitric oxide (NO), regulating immune responses by a still unclear mechanism. Our hypothesis is that NO affects the production of antimicrobial peptides (AmPs) - frontline defenders, targeting pathogens in epithelial tissues and also systemic circulation.

In our study, we fed newborn honey bees with substances that interfere with NO metabolism. The interventions leading to a reduction in NO levels, in the form of enzymatic inhibition of NO synthase, resulted in lower AmP levels in immune stimulated bees. This finding concerned both humoral and epithelial components of insects' immunity. These data support our hypothesis that NO is key signalling molecule for AmPs production and demonstrates its irreplaceability in the immune system of honey bees. Although this research is primarily fundamental, it offers promising applications for beekeeping.

Supporting NO production, potentially through targeted nutrition, could help strengthen bees' immune responses and improve colony resistance, contributing also to ecosystem stability.

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OP3 - Silas Biggin, University of Stirling
Does learning differ between wild-caught honey and bumblebees?

Pollination depends on bees' foraging abilities, requiring bees to learn flower features, such as colour. Additionally, the ability to learn new associations is vital in changing environments. Understanding how these capabilities differ between species may help us understand how increasingly erratic environments impact bees. We tested wild-caught bumble and honeybees' ability to learn colour-reward associations. Bees were presented with 8 training and 2 test trials. During training, bees experienced 2 paper strips of different colours (blue or yellow) with one colour rewarded. At test, both strips were unrewarded. This procedure was repeated to test ability to "unlearn" associations (e.g., rewarded yellow) and learn new ones (e.g., rewarded blue). Contrasting with bumblebees, in test trials honeybees did not select rewarded colours above chance and showed no performance increase over reversal training trials.

Importantly, training trial performance differed: honeybees selected correct strips more often than bumblebees. These results suggest these groups use different learning strategies, producing different learning effects. It is possible honeybees rely more on olfactory learning, so lose the association when nectar's scent is removed. Bumblebees may therefore be better at associating colour with rewards than honeybees, be more adaptable to changing circumstances or more exploratory of different food sources.

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OP4 - Zoltán Tóth, Plant Protection Institute, HUN-REN Centre for Agricultural Research
Effects of flupyradifurone exposure on the antennal detection and chemosensory orientation of buff-tailed bumblebees (*Bombus terrestris*)

Pesticides are used to protect seeds and crops from weeds, herbivore pests and pathogens in agricultural production, but many of these agrochemicals can also negatively impact human health, biodiversity and ecosystem services. Recent evidence indicates that flupyradifurone, a butanolide insecticide which is regarded relatively 'bee safe' and approved to use globally, may exert sub-lethal effects on pollinators. Yet, the extent and severity of these effects remain unclear.

In this study, we investigated the effects of one-, two-, and three-week exposure to the insecticide formulation Sanium System (active ingredient: 2.12% flupyradifurone) on the peripheral olfactory detection of a synthetic floral blend and foraging behaviour in buff-tailed bumblebees *(Bombus terrestris*). Preliminary analyses showed that antennal responses were dose-dependent and increased with concentration in both control and pesticide-exposed individuals, but the applied treatment did not have a substantial effect on olfactory detection even after three weeks of exposure. However, pesticide exposure altered foraging initiation and the probability of finding the floral blend, depending on the duration of exposure.

We propose that future studies are needed to clarify how such sub-lethal effects influence bumblebee population dynamics and the ecosystem services they provide in agricultural landscapes where flupyradifurone is routinely applied.

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OP5 - Bailey Lankford, University of North Carolina Asheville
Parasite Hideouts: Preserving Native Hymenopterans Through Pollinator Hotel Management

As many insect species decline due to climate changes, managing populations of native pollinator species is more important than ever. Pollinator hotels can provide a safe, protected space suited for many insects. However, these areas also attract parasites, which can easily multiply if hotels are not maintained. Pollinator hotels are usually filled with a variety of different materials, including cardboard, reeds, bamboo, wooden blocks, and native plant stems. This study sought to determine whether any materials used for pollinator hotels are more or less prone to parasitic infestation. We first conducted a survey to determine which species were present in the UNC Asheville hotel. Secondly, we collected samples of nests made in different material types and reared them to observe any differences in parasite load. Thirdly, we investigated overwintering boxes as a tool to facilitate cleaning and maintenance of pollinator hotels, which results in a reduced parasite burden.

We observed that cardboard tubes were far more susceptible to parasitic infection than other materials. Removal of these materials, coupled with regular maintenance, may help safeguard against parasitism. This data will provide guidance for selecting nest materials that safeguard pollinators, leading to overall enhancement of the surrounding ecosystem.

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OP6 - Evgenia Kapsi, Agricultural University of Athens
Assessing the Recovery of Insect Pollinators After Megafire Disturbance: A Two-Year Study in Mediterranean Landscape, Greece

Climate change is amplifying wildfire frequency and intensity, driving ecosystem transformations and disrupting critical insect communities, particularly pollinators. This research presents a two-year monitoring period (2022-2023, 2023-2024) in northern Evia, Greece, subsequent to the 2021 megafire event. Standardized pan traps (blue, yellow, and white) were used to sample pollinators across replicated plots representing various levels of post-fire vegetation recovery.

Specimens were taxonomically resolved to the lowest practicable level within Hymenoptera, Diptera, Coleoptera, and Lepidoptera. Yellow traps demonstrated significantly higher capture efficiency ($p<0.05$), with Apidae (Hymenoptera) and Syrphidae (Diptera) constituting the dominant taxa.

Results indicate pronounced temporal heterogeneity in pollinator community composition and affirm the critical role of early-successional habitats in maintaining post-fire entomofauna diversity. The findings underscore the need for continuous monitoring of pollinator communities in fire-prone regions under changing climate conditions.

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OP7 - Fiona Tainsh, University of Warwick
Population genetics of the commercially significant red mason bee, *Osmia bicornis*

Commercial companies use red mason bees, *Osmia bicornis* (synonym *Osmia rufa*) (RMB) for crop pollination in mainland Europe and is being developed for use in the UK. Despite separate sub-species being recognised in mainland Europe and the UK, there is no restriction against importing European RMB for use in the UK. Additionally, populations of RMB are locally adapted to microclimates and in other Osmia species, fitness is reduced by translocation. The movement of RMBs around the country and its potential impact is a real concern as there are currently several individuals selling RMBs online, with no information about their provenance.

We characterised the population genetics of RMBs using microsatellite markers – noncoding regions of a genome where short sequences of code are repeated a variable number of times between individuals – to quantify levels of genetic variability and infer population genetic structure. This talk will cover the preliminary findings and future planned work. The final outputs will be used to support risk assessments of RMB as commercial pollinators. This work was funded by the CB Dennis Trust and forms part of a PhD project addressing knowledge gaps to inform the use of RMBs in the UK as supplemental pollinators in orchard crops.

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Evolution, Genomics & Endosymbionts

OP8 - Madison Bone, Deakin University
Exploring bacterial contributions to the role of *Lucilia cuprina* as an Australian flystrike pest

The Merino sheep industry contributes significantly to the Australian economy and subsequently the Australian sheep blowfly, *Lucilia cuprina*, remains an uncontrolled myiatic pest. Flystrike or myasis, is a serious welfare concern to Australian Merino sheep, developing from the infestation of blowfly larvae as they feed on the tissue of live sheep. Whilst many explorations have advanced understandings of the prevalence of *Lucilia cuprina*, the bacterial contribution to this diverse feeding behaviour remains unclear.

This research aims to establish a baseline profile of key bacterial taxa associated with the gut and salivary glands of Lucilia cuprina, in comparison to other locally relevant blowflies. To assess organic microbial communities of the selected blowfly species, solar traps were set over two consecutive flystrike seasons, 2023 – 2024 and 2024 – 2025, where wild blowflies were trapped from various Australian locations. Species identification was completed before dissections of the gut and salivary gland were performed.

The bacterial community composition samples were assessed by 16S rRNA Next Generation Sequencing and compared.

Differences were observed in the global bacterial communities dependent on fly species and sample type (gut/salivary gland), with some similarities present between select species, likely from explained by shared feeding behaviours and cohabitation.

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Insect Decline & Population Change

OP9 - Anna Evans-Woolf, Royal Botanic Gardens Kew, Queen Mary University of London
How does agricultural land use affect hymenoptera diversity in North West Zambia?

Insects provide crucial ecosystem services, such as maintaining plant diversity, in every ecosystem. However, they are facing a global decline driven by anthropogenic pressures, the biggest being land conversion from primary habitat to agriculture. Left unchecked, this decline will have serious ecological repercussions. Despite this clear global issue, research is latitudinally biased towards temperate areas. In African countries such as Zambia, insects are essential in the maintenance of food crops, with Hymenoptera performing a multitude of diverse ecosystem functions and services. Knowing how agricultural land expansion is affecting Hymenoptera diversity is key for supporting smallholder farmers and biodiversity conservation within the country. This study compares Hymenoptera diversity across three land use types (forest, forest edge and agriculture) in Northwest Zambia. A two-tier random stratified sampling approach was used with malaise, pitfall and pan traps.

Our preliminary results indicate a higher richness and abundance of Hymenoptera species in the agricultural areas, followed by forests. These differences seem to be explained by the ants and wasps predominantly occurring in the agricultural sites. Our preliminary results highlight the importance of comparing related insect groups with different ecological functions to understand the effects of land use type on insect biodiversity.

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OP10 - Bardh Xerxa, Universum International College, Prishtina
The Conservation Status of EPT Taxa in Kosovo

The aquatic insect orders Ephemeroptera, Plecoptera and Trichoptera (EPT) are vital indicators of freshwater ecosystem health and biodiversity. The Republic of Kosovo harbors a diverse assemblage of aquatic insect fauna, notably represented by species of the EPT orders. Despite their ecological importance as indicators of freshwater ecosystem health, information on the conservation status of these taxa in Kosovo remains scarce. In recent years, there has been an increased focus on the research of EPT taxa and their conservation, primarily through academic research and protection by law.

Current biodiversity records document 190 Trichoptera, 60 Plecoptera, and 52 Ephemeroptera species within Kosovo. However, EPT diversity faces significant threats, primarily due to land degradation, water pollution, and a persistent lack of political will and public awareness regarding the importance of aquatic insect conservation. Of these, 64 species have been evaluated according to the IUCN Red List criteria, as reported in the Kosovo Red Book on Fauna. Additionally, over 80 species of EPT are conserved by the Kosovo government under Administrative Instruction No. 12/2000 for the proclamation of protected and strictly protected wild species.

The assessment revealed a concerning conservation outlook: A significant proportion of the critically endangered species belong to the Trichoptera and Plecoptera orders. Major threats to these species include habitat degradation, water pollution, and insufficient public and political engagement in freshwater conservation efforts. The findings underscore the urgent need for targeted conservation actions, habitat restoration programs, and broader public awareness initiatives to safeguard the EPT biodiversity of Kosovo.

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OP11 - Dodly Prosper, Queen Mary University of London & Royal Botanic Garden Kew

Flies on the Edge: Land-Use Change and Community Shifts in Zambian Diptera

Land-use change (LUC), especially agricultural expansion, drives global biodiversity loss. Flies (Diptera)—among the most diverse insect orders, functioning as pollinators, decomposers and biocontrol agents—are understudied in this context, particularly in tropical Africa. We assessed fly richness, abundance and community composition across three Zambian land-use categories: forest interior, forest edge and agriculture.

A stratified random design placed 1 km² grid cells into forest-cover classes (>95 %, 25–75 %, <5 %). 30% of cells in each class were sampled with Malaise, coloured-pan and pitfall traps run for 48 h. Specimens were preserved, identified to family or morphospecies and scored for key traits (relative mass and wing aspect ratio). Richness, Shannon diversity and trait patterns were modelled with generalized linear and multivariate analyses.

Agricultural and edge assemblages were compositionally indistinguishable and only marginally differed from forest interiors. Abundance declined from forest interior to edge to agriculture, whereas richness followed forest interior > agriculture > edge. Thus, although overall differences were modest, LUC most affects Diptera at transition zones, highlighting the need to manage edges to conserve fly diversity.

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OP12 - Jasvinder Kumar, Panjab University, Chandigarh

Assessing How Environmental Variables and Carcass Microhabitat Drive Changes in Histeridae Beetle Populations during Buffalo Calf Decomposition

Forests function as complex ecosystems that host a diverse array of organisms ranging from microscopic invertebrates to large mammals. When an animal dies, its carcass becomes a transient yet vital resource,

serving as a substrate for decomposers and offering shelter to a myriad of small insects that facilitate its breakdown. This process transforms the carcass into a microhabitat that is integral to nutrient cycling and ecological succession.

Blowflies are typically the primary colonizers of a carcass, arriving shortly after death, whereas Histeridae beetles are among the subsequent successional species that use this resource. In the present study, we employed a multiple linear regression predictive model to examine the influence of various environmental variables on beetle population dynamics. Additionally, we investigated how factors such as carcasses and decomposition stage correlated with fluctuations in these populations. This integrative approach aims to provide deeper insights into the ecological roles and interactions that govern the decomposition processes in forest ecosystems. We evaluated five predictors—pH, temperature, humidity, four carcasses of buffalo calf, and decomposition stage—using a stepwise multiple linear regression with 10-fold cross-validation. The results revealed that increasing the soil pH during the decomposition of carcasses significantly reduced beetle numbers ($p < 0.001$). Additionally, carcasses also played a crucial role; beetle numbers were significantly higher for carcass number 3 and 4, with increases significant counts, respectively ($p = 0.006$ and $p = 0.022$, respectively).

The overall model explained 85.6% of the variance (adjusted $R^2 = 82.97\%$) and demonstrated a robust predictive power (10-fold $R^2 = 78.1\%$). Although other variables were initially considered, they did not significantly contribute to the final model, underscoring the primary influence of soil pH and carcass microhabitat heterogeneity on beetle succession.

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OP13 - Upasana Sengupta, Ashoka University
Living on the edge: understanding patterns of insect herbivory in a fragmented landscape

Fragmentation delineates landscapes into a gradient of patches ranging from suitable to unsuitable for diverse herbivore-populations. Associational-resistance alone cannot explain the observed effects of herbivory in mixed-forest stands. A trait-based approach, examining intraspecific-variation in plant-traits across diverse neighbourhoods, might be critical to comprehend herbivory patterns. In an agricultural-mosaic system in the Aravalli Range of India, we analyzed: i) if proximity to edges influenced insect herbivory, ii) is herbivory damage mediated by herbivore diversity, individual-level plant traits(size, defenses) or local neighbourhood? We laid out plots (n=77) along interior and edge transects, recording plant and herbivore composition, defense traits, percentage herbivory and five nearest-neighbours of each plant. Preliminary analysis showed 5% higher herbivore damage in edges with notable inter- and intra-specific variations in herbivory both at the edge and interior.

The proportion of conspecific-neighbours negatively influenced herbivory, revealing a potential dilution effect. Individual-level traits such as leaf area positively influenced herbivory, while plant defenses showed a negative correlation. Our results show that within-species variations in herbivory are explained by a combined effect of external factors, such as local neighbourhood and intrinsic factors, such as plant traits. Our findings spotlight the synergy between plant traits, spatial patterns, and community diversity in fragmented habitats.

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Insects & Society

OP14 - Andritafitanomenjanahary Toky Sitrakiniaina, University of Antananarivo
Distribution of anthropophilic *Culicidae* in the new protected area (NPA) of Ambohidray and in the Special Reserve of Ambohitantely, Madagascar

The transmission of vector-borne diseases such as malaria, filariasis, and arboviruses by hematophagous Culicidae in the genera *Aedes, Anopheles, Culex,* and *Mansonia* pose a major global health challenge. Vector dynamics and distributions are influenced by both environmental and anthropogenic factors, however these are poorly studied in many habitat types. The diversity of anthropophilic *Culicidae* was investigated in the new protected area (NPA) of *Ambohidray* and in the Special Reserve of Ambohitantely, Madagascar. The human landing catch method was used in three micro-habitats: forest, edge and village, throughout two seasons.

In total, 888 adult mosquitoes were captured, and 90% of them were found in *Ambohidray.* Species observed include Madagascar endemic species *Ae argenteopunctatus*, *An mascarensis, Cx. giganteus*, and others. Species richness and composition varied by site, habitat, and season, with significant seasonal variation (p = 2.256e-08). Principal Component Analysis (PCA) showed that each of the three habitats has its own characteristic species, highlighting three forest species: A*e argenteopunctatus, Cq grandidieri, Cx giganteus*, and two peri-urban species: *An pharoensis* and *An squamosus*.

We observe forest degradation impacts mosquito diversity in Madagascar. The New Protected Area of Ambohidray is vulnerable but still preserves its forest fauna based on species distribution.

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Natural History & Taxonomy

OP15 - Andres Martinez, Instituto de Investigaciones Forestales y Agropecuarias Bariloche (IFAB; CONICET-INTA)
Lack of inbreeding avoidance in yellowjacket gynes in an invaded area

Inbreeding can reduce offspring survival and fertility, leading to inbreeding depression. Thus, its avoidance can often be adaptive, but it may also result in loss of mating opportunities, particularly in scenarios were finding mates is difficult such as in invasive populations. Under these circumstances, the degree of attraction and mating between siblings can have profound consequences in establishing or spreading populations.

We evaluated the influence of kinship in the mating behavior of Vespula germanica, an invasive eusocial wasp in Argentina, through olfactometer bioassays and mating trials. Specifically, we assessed (1) whether gynes were attracted to males and whether kinship affects this attraction, and (2) whether gynes mated with their nestmates when no other mates are available. Our results show that gynes exhibit no olfactory attraction to males, nor any bias towards related or unrelated individuals (p = 0.169). In the mating trials, gynes exposed only to sibling or non-sibling males showed similar mating rates (p = 0.750), indicating the lack of inbreeding avoidance under no-choice conditions.

These findings provide insights into the reproductive behaviour that may modulate the rates of establishment and spread of invasive social wasps.

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OP16 - Emily Gilford, University of Exeter

Trait-specific behavioral plasticity in response to repeated predatory threats in wild crickets (*Gryllus campestris)*

Habituation allows animals to reduce responsiveness to repeated, non-threatening stimuli. While well-studied in vertebrates, little is known about how wild insects adjust their behaviour to repeated stressors in natural settings. This study tested whether field crickets (Gryllus campestris) habituate or sensitise to repeated simulated predator attacks, and whether responses vary with threat intensity. Across trials, crickets showed limited evidence of habituation. Instead, emergence time and distance fled both increased slightly over repeated exposures, suggesting modest sensitisation, while escape speed remained stable.

These results indicate that behavioural plasticity was trait-specific, with some responses more flexible than others. Crickets also responded more strongly to the stronger stimulus in terms of distance fled, though emergence latency and escape speed were unaffected by stimulus intensity. Contrary to our predictions, individuals did not respond consistently across stimulus types, and correlations in plasticity across contexts were weak.

Together, these findings suggest that wild crickets exhibit limited habituation, trait-dependent plasticity, and substantial individual variation in behavioural trajectories, with implications for how animals manage risk in dynamic environments.

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OP17 - Jakob Wiil, University of St Andrews

From First to Second: Does Environmental Temperature Shape Reproductive Investment Trajectories

Work ongoing - Environmental temperature plays a critical role in shaping reproductive strategies in ectotherms. In this study, we examine how constant thermal conditions affect patterns of reproductive investment and parental care across successive breeding attempts in the burying beetle *Nicrophorus vespilloides.* Breeding pairs were maintained under two ecologically relevant thermal regimes (20°C and 23°C) and allowed to reproduce twice with the same partner.

For each breeding bout, we quantified reproductive output (egg count, brood size, and mean larval mass) and parental care behaviors, including carcass preparation and post-hatching care duration. This repeated-measures design allows us to assess whether investment shifts over time, and whether such changes are modulated by temperature.

Our results will shed light on how ectothermic parents balance current versus future reproduction under warming conditions, providing insight into behavioural plasticity and potential constraints under chronic thermal stress.

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OP18 - Zuzana Dybalová, Swansea University

From Protection to Production: How Ants (*Myrmica rubra, Lasius niger*) Shape Extrafloral Nectaries and Plant Fitness in Temperate Climates

Extrafloral nectaries (EFNs) are glands found on leaves, stems, or petioles of plants that secrete nectar outside of flowers to attract mutualistic predators, particularly ants, as a defence against herbivores. Despite extensive tropical studies, EFN-ant mutualisms in temperate ecosystems like the UK remain understudied, leaving gaps in understanding their ecological and agricultural potential. This study aims to examine how UK native ants *Myrmica rubra* and *Lasius niger* influence EFN traits, plant growth and reproduction of common vetch (*Vicia sativa*). Controlled lab experiments quantified how ant presence (*Lasius niger* vs. *Myrmica rubra*) and herbivory damage modify EFN traits (nectar sugar, cell structure, abundance) and plant fitness (growth, seed output) in *V. sativa*.

These findings aim to enhance our understanding of temperate EFN-ant dynamics and have broader ecological implications, particularly for understanding how mutualistic interactions influence the structure of invertebrate communities and their spatial distribution. They will also redefine ants' role in the UK ecosystem resilience with potential relevance to climate change adaptation. Furthermore, this study can be used to inform pest management and contribute to using EFNs as biological pest control.

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Integrated Pest Management (IPM)

OP19 - Jude Woodcock, University of Bristol
Investigating the effects of repeated cold exposures on the fertility of a winter-active parasitoid

Climate change is leading to warmer winters in temperate regions. As a result, ectothermic insects are undergoing a reduced incidence of diapause, instead remaining winter-active. Increased winter activity may expose insects to unpredictable extreme cold events which cause both lethal and sublethal effects on their populations. One such sublethal effect is the impact of cold exposure on fertility and fecundity.

Thermal fertility limits (TFL) such as the thermal fertility minimum (TFmin) tend to occur at less extreme values than lethal limits but can incur similar costs to population viability. Although research on TFLs is increasing, impacts of cold exposure have seen less attention than heat but may also have significant effects on fertility. This study investigates how a scenario of repeated cold exposures, such as a period of extreme cold, could impact the fertility of *Aphidius ervi*, a beneficial aphid parasitoid. *A. ervi* were repeatedly exposed across several days to extreme cold of varying levels of intensity. Dissections were then performed to determine the impact of these treatments on female fertility and to reveal their TFmin. Preliminary results show a significant effect on egg volume but not on egg load. An ongoing follow up experiment aims to discover the impact of this reduced egg volume on life history traits of the progeny of which the impact is currently unknown in koinobiont parasitoids.

This research should help inform whether populations of winter active A. ervi will persist following extreme weather events which has wider implications on their ability to perform their agroecosystem service of natural biological control. Additionally, it will contribute to our understanding of TFLs as a blossoming area of research.

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OP20 - Dachena Romain Gracia, Mohammed VI Polytechnic University

Diversity of phytophagous and auxiliary insects of quinoa from humid to arid regions in Morocco: implications for crop sustainability

Quinoa (*Chenopodium quinoa Willd.*) has gained global attention as a climate-resilient crop with high nutritional value and tolerance to drought and salinity. In Morocco's arid, semi-arid, humid, and sub-humid regions, quinoa is emerging as a promising crop capable of adapting to diverse and harsh conditions. Understanding limiting factors to its cultivation requires considering the broader crop ecosystem, particularly identifying both phytophagous and beneficial insect species in these agroecological zones and assessing quinoa accessions for insect preference.

Field surveys in two regions using 100 accessions identified around 10 insect species, including sucking insects (Aphididae), piercing-sucking insects (*Miridae*), and chewing insects (Lepidoptera larvae). Pest damage varied significantly by region and genotype (Genotype × Environment interaction) throughout different growth stages, manifesting as leaf curling, leaf cuts, and seed damage.

The concurrent presence of predators and parasitoids offers potential for adaptive biological control. These findings emphasize the value of integrated approaches to monitoring, biocontrol, and cultural practices such as sowing dates to ensure sustainable quinoa production in fragile ecosystems.
Pest presence across regions underscores that crop performance is shaped not only by soil, water, and nutrients, but also by insect interactions within the ecosystem.

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OP21 - Diligent Oboho, University of Uyo, Nigeria

Effects of Methanol leaves Extract of Botanicals on Metabolic Parameters of *Callosobruchus maculatus Fab.* and *Sitophilus zeamais L*.

Africana and Uvaria chamae on metabolic parameters of Callosobruchus maculatus and *Sitophilus zeamais*. Newly moulted fourth instar larvae of the weevils were randomized into Control, and 2% and 4% extract groups; fed disc dibbed in water and the extracts respectively. Metabolic parameters assessed include, approximate digestibility (AD), relative growth rate (RGR), relative consumption rate (RCR), and feed efficiency. Data were subjected to univariate analysis of variance (ANOVA) using student-Newman Keuls test. The extracts reduced food consumption significantly, especially the 2% and 4% U. chamae which were 46.3% (± 2.4) and 41.4% (± 3.2) respectively for C. maculatus, and 36.3% (37.4% (± 3.4) and 37.4% (± 3.2) for S. zeamais respectively. The extract reduced *C. maculatus* and *S. zeamais AD*, RGR and RCR, especially the 4% extracts concentration.

All three extracts reduced relative growth significantly. The low consumption rate in larvae treated with the different extracts may be attributed to the deleterious effects of allelochemicals of the extract that passed through the peritrophic membrane of insects and damaged the epithelium of the insect midgut; and the inhibition of feed utilization may be due to the activity of some extract which inhibit digestive enzymes. This study provides evidence of the potency of the three extracts against *C. maculatus* and *S. zeamais*.

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OP22 - Emily Ballara, University of Bristol

The effects of dietary supplementation on the thermal tolerance and life history traits of a beneficial insect parasitoid in a warming climate

Rising global temperatures and climatic extremes are threatening the viability of parasitoids in biological pest control systems. As agricultural demand rises to meet the needs of a growing population, developing methods to enhance parasitoid resilience are critical for sustaining effective pest management. Floral nectar, rich in sugar, may offer supplementary nutrition to boost parasitoid survival and performance. This study investigates the effects of nectar sugars on life history traits of the parasitoid wasp A*phidius ervi* under simulated heatwave and low-temperature conditions. Using controlled dietary treatments of several sugar constituents of nectar, we assessed the impact of diet on parasitoid longevity, egg load, parasitism rate, and thermotolerance. Results suggest that diet exerts a measurable but modest effect on the life-history traits and thermal tolerance of *A. ervi*.

These findings indicate that supplementary feeding through nectar-rich plantings, such as flower strips, could enhance parasitoid survival and efficacy under climatic extremes. This ongoing research highlights the potential for tailored ecological strategies to mitigate the effects of climate change on agricultural pest control systems, and underscores the importance of nectar composition in promoting parasitoid fitness. Further work will elucidate the full extent of dietary effects on overall pest control outcomes.

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OP23 - Frankie Amanesih, Natural Resources Institute, University of Greenwich

Fungal-derived technology for control of the invasive pest, *Drosophila suzukii*

First recorded in the UK in 2012, *Drosophila suzukii (Matsumura*), also known as Spotted Wing Drosophila (SWD), is a significant invasive worldwide pest, threatening horticultural production in the UK, Europe, and the US. Currently, control of SWD primarily involves insecticide spraying of fruit crops and labour-intensive hygiene practices. Laboratory studies have established that entomopathogenic fungi (EPF) can kill SWD, but current fungal formulations have not been effective in field trials.

We combine fundamental study of fly behaviour with aspects of fungal ecology and biochemistry to understand how *D. suzukii* resists EPF infection with the aim of developing new sustainable technologies for crop pest control.

We have established EPF infectivity by conducting a series of mortality assays using four commercial EPF products previously proven effective against SWD in the laboratory. The fungal formulation with the most promising results will be used in a series of behavioural assays, consisting of two parts: identifying the interactions of SWD with fungal volatiles and discovering their species-specific behaviours following fungal infection. Finally, the secondary metabolites of EPF will be identified to develop novel EPF-derived technologies, enhancing its efficacy through the combination with botanical extracts and adjuvants.

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OP24 - Josie Stuart, Royal Horticultural Society
Aphid vs predator - an exploration on aphid management for home gardeners

Several aphid species feature consistently in the top ten most frequent entomology enquiries to the Royal Horticultural Society's Gardening Advice service. Management advice currently given to home gardeners includes encouraging natural enemies, physical removal and introduced biological control. There is a dearth in knowledge regarding the efficacy of methods for attracting appropriate natural enemies for home gardeners.

Two projects are underway to explore management of aphids using natural predators found in gardens.

Project 1 is assessing the effectiveness of different earwig shelter designs; evaluating which attracts the highest number of earwigs, to manage woolly apple aphids (*Eriosoma lanigerum*). Four different shelter designs are being compared in a field trial across 9 groves of apple trees in the orchard at RHS Wisley.

Project 2 is exploring companion planting of cabbages (*Brassica oleracea Capitata* 'Red Rookie') with the poached-egg plant (*Limnanthes douglasii*). This field experiment replicated in a garden-realistic environment will test the idea that the poached-egg plant is attractive to hoverflies by conducting FIT counts. Aphid management potential of this companion plant strategy will be measured by monitoring populations of mealy cabbage aphid (*Brevicoryne brassicae*) and hoverfly larvae.

The results will inform the advice provided by the RHS to home gardeners; approaches for pesticide free management of aphid populations and natural enemy recruitment in the garden will be updated.

OP25 - Lauren Diepenbrock, University of Florida
Developing *Bulimulus sp.* management in Florida citrus

Bulimulus bonariensis is an invasive land snail species in the Southeastern U.S. that has increasingly infested commercial crops in recent years, threatening productivity and causing concern among growers. In Florida citrus, *B. bonariensis* has been observed clogging microjets, defoliating trees within individual protective covers, and girdling young trees with pre-existing damage.

There is very limited information available on population trends and potential chemical control of these snails, which are important to consider when developing management programs. To explore snail population trends, experimental traps were deployed alternately between trees and along grove edges at three sites and were checked for snails biweekly for two years. The count data reveal seasonal trends in snail activity that varies across sites, highlighting the importance of monitoring. Additionally, heat maps indicate a random distribution of snails within fields, implying that whole grove management may be necessary.

At present, there are no recommended chemical controls for *Bulimulus sp.,* therefore we screened foliar chemistries and molluscicidal baits registered for use in Florida. Molluscicidal baits and abamectin foliar spray exhibited the highest mortality rates to date. The results of this study reveal pertinent information that may help growers manage *B. bonariensis* and mitigate its impact on citrus production.

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OP26 - Samuel Brizio, University of Bristol

Utilising supplementary feeding to enhance the winter longevity of a parasitoid and biological control agent

Many insects withstand challenging cold temperatures during winter by entering a state of cold-tolerant suspended development known as diapause. However, due to warming winter temperatures, many insects are no longer entering diapause and remain winter active.

This increases insect vulnerablity to unpredictable extreme cold events brought about by climate change, particularly at a time when food resources are scarce. Landscape management strategies must therefore be developed to enhance survival during these otherwise floristically impoverished months. Nectar provisioning through winter-flowering species can promote the performance and survival of biological control agents: the parasitoid wasp *Aphidius ervi*. Understanding how diet can be augmented to offer the greatest outcomes for their life-history traits, a major one being longevity, is key to informing solutions. We investigated the effect of three sugar constituents of nectar on parasitoid longevity. Results revealed that diet has a significant effect on the longevity of *A. ervi,* indicating that supplementary feeding is an effective method of enhancing survival of parasitoids. However, all tested sugars were equal in their effect.

This research emphasizes the value of targeted ecological strategies in reducing climate change impacts on agricultural pest control and highlights the role of nectar composition in supporting parasitoid fitness.

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OP27 - Shimat Joseph, University of Georgia

Evaluating the Response of Ambrosia Beetles (*Xylosandrus spp.)* to Sub-Optimal Ethanol Concentrations

Xylosandrus crassiusculus (Motschulsky), commonly known as the granulate ambrosia beetle, is a major pest in ornamental nurseries throughout the eastern United States. A widely used method for assessing insecticide efficacy against this species involves treating tree bolts infused with ethanol concentrations of 50% or higher, which are highly attractive to the beetles.

This study evaluated beetle responses to lower ethanol concentrations through a series of experiments. Bolts were infused with ethanol at the following concentrations: (1) 0%, 3%, 5%, 15%, 30%, 60%, and 90%; (2) 10% and 50% ethanol combined with indoxacarb and bifenthrin; and (3) 10% and 50% ethanol paired with the repellent verbenone placed nearby, and permethrin treatment. Results indicated that *X. crassiusculus* attacks were significantly reduced on bolts infused with ethanol concentrations below 30%. Attacks on bolts treated with 10% ethanol were too infrequent to detect statistically significant differences among insecticide treatments. Additionally, beetle attacks on bolts treated with either 10% or 50% ethanol in combination with verbenone were similar.

Notably, permethrin effectively reduced ambrosia beetle attacks regardless of ethanol concentration. These findings support the continued use of ethanol concentrations ≥ 50% in standardized insecticide efficacy evaluations.

OP28 - Luke Nwosu, Atlantic Technological University, Galway City

Resistance studies of intact and decorticated cowpea varieties to *Callosobruchus maculatus* (Coleoptera: *Chrysomelidae*) infestations: The findings will add value to the grain industry

Cowpea, *Vigna unguiculata (L.)* Walp seed is a very important source of protein. The successful storage of

the product is seriously challenged by *Callosobruchus maculatus Fabricius* attack. The study determined new sources of cowpea seed resistance to C. maculatus. Detailed morphological, physical and chemical studies were conducted on intact seeds of ten cowpea varieties using visual observation, standard equipment and procedures.

The characters responsible for resistance were lectins and trypsin inhibitors while the mechanisms of resistance were antibiosis, antixenosis and preference. High tannin quantified in test varieties elongated the development time C. maculatus and inadvertently increased insect weight at emergence. High seed weight supported and produced insects with heavier weights at emergence. The broad site of cowpea seed was most susceptible to emergence. Decortications increased varietal resistance to the insect.

The study found that seed coats were vital for the optimum development of C. maculatus in cowpea. There were variety and variety x seed condition interaction effects on the reproduction, survival and activities of C. maculatus on intact and decorticated cowpea seeds. Thus, storing cowpea seeds without seed coats may offer an effective alternative to insecticide application in postharvest grain protection.

Keywords: Cowpea, Resistance, Decorticated seeds, Preference, Grain protection.

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OP29 - **Suman Barman, ICAR - Indian Agricultural Research Institute, New Delhi**

Quick identification of the invasive melon fly, *Zeugodacus cucurbitae*, through a LAMP assay coupled with simplified one-step DNA extraction technique

The melon fly, *Zeugodacus cucurbitae (Coquillett*), is a major tephritid pest native to India, known for its broad host range and high invasive potential, leading to substantial crop losses. Rapid and accurate identification of this destructive pest is essential for effective control. To address this, a colorimetric Loop-Mediated Isothermal Amplification (LAMP) assay termed Melon fly-LAMP has been developed targeting the mitochondrial cytochrome oxidase subunit I (COI) gene.

This assay identifies all life stages of *Z. cucurbitae* within 30 minutes at 60°C. Specificity tests with five closely related tephritid species: *Z. tau, Bactrocera dorsalis, B. divenderi, B. zonata*, and *B. correcta* confirmed species specificity of the assay. The assay also showed high sensitivity, detecting as little as 1×10^{-12} ng/µL of genomic DNA and 1×10^{-11} ng/µL of plasmid DNA. Quick sample preparation using double-distilled water (ddH_2O) was found most suitable for its use in field detection and the assay's applicability was successfully tested in field conditions and vegetable mega-markets, with validation across six geographical regions in India.

The Melon fly-LAMP assay provides rapid, reliable, and sensitive detection, making it a valuable molecular tool for field-level surveillance, biosecurity, and pest management of *Z. cucurbitae*.

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Invasive Species & Community Ecology

OP30 - Jessica Anderson, University of Stirling

Assessing the impacts of Impatiens glandulifera on terrestrial invertebrate communities in an ancient woodland habitat in the UK

Impatiens glandulifera is a prolific plant invader, often disrupting ecological communities in riparian systems in the UK and Europe. However, the presence of *I. glandulifera* in woodlands is on the rise, with little known of its impact on these ecosystems. The threat of invasion to ancient woodlands is particularly concerning, given the unique biodiversity in these habitats.

This research aimed to assess the impact of *I. glandulifera* invasion on terrestrial invertebrate diversity in an ancient woodland, and whether this differs seasonally. The study site was Pontburn Woods, UK, an ancient woodland with long-established, complex ecological networks that host a range of rare and specialised invertebrate species. The focal groups for the study were Insecta, Arachnida, and Isopoda, chosen to represent a broad range of functional groups that are integral to woodland systems.

The results of this study showed that terrestrial invertebrate community composition was affected by the presence of *I. glandulifera*. Arachnida and Isopoda communities were significantly affected in invaded areas, and seasonal variation enhanced these changes. Multivariate models (NMDS) showed the homogenisation of invertebrate assemblages found in invaded plots, which can lead to cascading effects throughout the ecosystem.

This study highlights the importance of monitoring biological invasions across seasons and the impact this can have on native invertebrates, leading to more efficient conservation strategies that target species more susceptible to invasions.

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OP31 - Maité Masciocchi, Instituto de Investigaciones Forestales y Agropecuarias Bariloche (IFAB) (CONICET – INTA)

Tasteful coexistence: niche partition in yellowjacket wasps

The coexistence of ecologically similar species often depends on niche partitioning, a mechanism through which differential use of resources reduces competition. The yellowjackets Vespula germanica and Vespula vulgaris, two invasive social wasps co-occurring in North Patagonia, can forage on the relatively low concentrated sugary excretions (honeydew) of the giant willow aphid (*Tuberolachnus salignus*). We hypothesized that *V. vulgaris*, due to a lower sucrose acceptance threshold, exploits the exudate more than V. germanica, promoting sensory-based niche partitioning, thus facilitating coexistence.

To test this, we measured the abundance of both wasp species below aphid-infested trees and the sugar concentration of the exudate during February–April. Sucrose content ranged from 5 to 25°Brix (mean 15°Brix), decreasing in lower branches and throughout the season.

Both species foraged on the resource; however, *V. vulgaris* used the resource in a higher proportion than *V. germanica* ($p < 0.05$). Furthermore, while sugar concentration did not affect the overall higher V. vulgaris abundance, V. germanica captures correlated positively with richer exudate concentrations. These results support the hypothesis that sensory-based niche partitioning may facilitate the coexistence of these species in invaded habitats.

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Medical Entomology

OP32 - Afsana Al Latif, Jahangirnagar University

Starvation and Different Host Blood Meals Impacting Energy Reserve Modulation in *Culex quinquefasciatus Say* (Diptera: Culicidae)

Culex quinquefasciatus poses a significant public health threat by transmitting diseases like filariasis, West Nile Virus (WNV), and Break Valley fever. Effective vector control strategies require a thorough understanding of mosquito biology, including the role of sugar and blood meals on energy reserves in their body.

This study aimed to quantify basal reserve energies in adult *Cx. quinquefasciatus* and to determine the effect of starvation and different host blood meals. The results show that initially, female and male mosquitoes have nearly the same amounts of lipid, glucose, and glycogen. After 5 days of starvation, lipid and glucose levels unexpectedly increased and glycogen level decreased. However, prolonged starvation (10 days) led to a significant drop in reserve energies. In contrast, mosquitoes not under starvation maintained higher reserve energy throughout the experiment. Mosquitoes fed pigeon blood showed significantly higher lipid, glucose, and glycogen content compared to those fed human or rat blood.

This research underscores the role of sugar and host blood meals in mosquito energy balance and provides valuable information for the development of targeted interventions aimed at controlling mosquito populations and reducing disease transmission. Further study should be done on wild mosquito and their feeding on different kinds of sugar.

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OP33 - Jinsong Zhu, Virginia Tech

A Membrane-Tethered Axis of PVR and MET Drives Juvenile Hormone Signaling in Aedes aegypti

Although Methoprene-tolerant (MET) is well established as the intracellular receptor mediating the genomic actions of juvenile hormone (JH) in insects, the identity of the receptor responsible for initiating extranuclear JH responses has remained unclear.

In the yellow fever mosquito *Aedes aegypti*, we identify PVR—a receptor tyrosine kinase homologous to mammalian PDGF and VEGF receptors—as a key mediator of membrane-initiated JH signaling. JH treatment induces robust phosphorylation of PVR in the fat body of adult female mosquitoes. Loss of PVR function suppresses JH-induced activation of the phospholipase C (PLC) and phosphatidylinositol 3-kinase (PI3K) signaling pathways and impairs primary follicle growth during the previtellogenic stage. Notably, JH-induced PVR phosphorylation and downstream signaling require MET, specifically its ligand-binding activity but not its DNA-binding capacity. A subpopulation of MET localizes to the plasma membrane of fat body cells, where it physically interacts with PVR from 24 hours post-emergence to 24 hours post-blood feeding, suggesting that membrane-localized MET serves as the membrane JH receptor.

Transcriptomic analyses following RNAi-mediated knockdown of Met or Pvr demonstrate that PVR contributes broadly to JH-regulated gene expression. Importantly, PVR-dependent signaling modulates genes that are also regulated by nuclear MET and enables JH to control additional gene sets independently of MET-mediated transcriptional regulation.

These findings reveal a previously unrecognized MET–PVR signaling axis and support a more integrated model of JH action that combines membrane and nuclear pathways to enhance the specificity and complexity of JH function during the previtellogenic phase in mosquitoes.