ANICdotes

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BANNER: *Graphium macleayanus* image: Biodiversity Heritage Library

The Director's Introduction

David Yeates, Director

Welcome to our 20th issue – ANICdotes now spans 10 years in the life of the Australian National Insect Collection. COVID is out and about in Canberra, with around 1,000 new infections a day, and many staff are being affected directly or indirectly by illness or isolation requirements. Our site remains affected by some COVID restrictions, with all staff and visitors required to show proof of vaccination and many staff encouraged to work from home if possible to keep the site human density down. Field work that had been delayed over the summer is beginning to happen again (p. 6-8), and regular activities like the Moth Weekend (p. 9) are being scheduled as usual. Work continues on our new building project, and the first sight of activity was the removal of large trees adjacent to the new building footprint in March. However, in this issue we have much more to be excited about!

First up we celebrate Rolf Oberprieler's career and recent retirement, coinciding with the Whitley book award for his *Australian Weevils volume IV* (p. 4). On the topic of books, ANIC affiliates Glenn Cocking, Suzi Bond and Ted Edwards have been beavering away over the last two years to produce a beautiful guide to the moths of the ACT, published in March and illustrating 700 species in colour (p. 5). This is a must buy for anybody interested in Lepidoptera of south eastern Australia. Mike Hodda's group, with help from many other staff, has been very busy organising insect diagnostics workshops (p. 10), and Mike has also published a major new Catalogue of the entire Phylum Nematoda in *Zootaxa* in March (p. 11). This major monographic work, spanning almost 30,000 species, is a significant contribution to nematode systematics and a career highlight for Mike. Alongside the Catalogue Mike also published a guide to feeding habits for all 3,000 genera and a commentary on trends in nematode classification. All together, these three publications amount to more than 450 printed *Zootaxa* pages.


David Yeates

This issue includes introductions from James Bickerstaff, a new postdoctoral fellow working on ambrosia beetles and their symbiotic fungi, and Jesse Wallace and Claire Yang, who work with Andreas Zwick on the National Biodiversity DNA Library initiative. We are also very pleased to host Dr Karol Szawaryn from Gdansk University in Poland, who is working with Adam Ślipiński and Hermes Escalona on a phylogenomic study of ladybird beetles. We introduce Petra, the new family addition for Dan and Rebecca Huston (p. 3). This issue sees us also celebrate the life and career of Dr David McAlpine (p. 12), who has recently donated a significant sum to the ANIC Schlinger Trust to support our research into acalyptrate Diptera.

Welcome to James, Jesse and Claire

James Bickerstaff, Jesse Wallace and Claire Yang

James Bickerstaff

James is from the Hawkesbury Valley in Western Sydney and is interested in molecular ecology, microbial symbioses, and insect diversity, conservation and systematics. He earned his BSc in Biology in 2014 and Graduate Diploma in Conservation Biology in 2015 from Macquarie University. He then moved to Western Sydney University – Hawkesbury Institute for the Environment to pursue a Master of Research in Markus Riegler's lab focusing on the taxonomy and systematics of Australian ambrosia beetles (Platypodinae), graduating in 2017.

After falling in love with these beetles, he continued on to complete a PhD at the Western Sydney University, focusing on the phylogeography and microbial ecology of Australian bark and ambrosia beetles (Platypodinae & Scolytinae). This recently completed thesis identified several taxonomic changes that need to be made for Australian taxa, found novel species of symbiotic fungi (*Ambrosiella*), a new strain of *Wolbachia* that has important evolutionary consequences for its beetle hosts and identified key phylogeographic processes underpinning their distribution and population genetic structure. Throughout his postgraduate studies James was also engaged in demonstrating and lecturing in undergraduate invertebrate zoology courses.

James recently joined ANIC to work with Hermes Escalona on invasive Scolytinae bark beetles. This project aims to uncover genomic patterns that predict the spread and establishment of invasive species. James and Hermes will use comparative genomic data and analytical methods to identify whether signatures in the genome differ between invasive and related non-invasive species. These data and results will assist in effective biosecurity risk analysis and management. James also hopes to continue working on the systematics and fungal ecology of these beetles as well.

In his free time, James enjoys experimenting with and baking various types of breads and sweet loaves using home-cultured sourdough. Fortunately there are suitably qualified staff in ANIC to peer review the results of these experiments!

James Bickerstaff is working with Hermes Escalona on invasive scolytines

Jesse Wallace

Jesse was born and raised in Canberra. He attended ANU for his B.Sc. in Biology and completed his Honours thesis in 2016 in the lab of the late Sylvain Foret, where he developed a method for tracking brood-care behaviour in honeybees using computer vision. His thesis earned him the Director's Prize for the highest mark earned in the Research School of Biology Honours program.

Jesse Wallace is working with Andreas Zwick as a bioinformatics specialist

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In 2017 Jesse started his PhD on the ecology, genomics, and behaviour of the Bogong Moth at ANU and Lund University in Eric Warrant's lab. In his recently submitted thesis, he developed a novel, automated, camera-based method for monitoring the behaviour and abundance of Bogong Moths in the Australian Alps. Meanwhile, he worked on producing a high-quality reference genome for the Bogong Moth and performed large-scale population genomic, epigenomic and transcriptomic experiments aiming to understand the basis of the Bogong Moth's incredible long-distance navigation.

He has now joined ANIC under Andreas Zwick to work as as a bioinformatics specialist for the National Biodiversity DNA Library, where he will help prepare and analyse DNA sequence data from tens of thousands of species. In addition to recently completing his PhD and starting an exciting new job at CSIRO, Jesse is also a brand-new father!

Claire Yang

Claire grew up in the South China city of Nanning and received a B.Sc. in Biotechnology from Guangxi University. She moved to Canberra in 2006, where she studied for a Master's degree in Biotechnology at the ANU. Since then Claire has worked for several years in microarray and Illumina sequencing in Diversity Arrays, mostly on crops such as wheat, barley, rice and other cereals. From 2018, Claire worked in Gaetan Burgio's lab in JCSMR, ANU, producing CRISPR mouse lines. Those mouse strains were used as a mouse model for human diseases, in hope of developing therapeutic solutions or just for gene-function studies.

Claire is now working in Andreas Zwick's team as part of CSIRO's new National Biodiversity DNA Library initiative, where she will be using high-throughput DNA sequencing of both ANIC and external specimens. Claire will also be doing the DNA extractions and library building for next-generation sequencing using the robotics platform as well as further optimising the workflow. The sequencing information will be mainly used to assemble mitochondrial DNA sequences, as well as sequences from nuclear ribosomal genes.

Claire enjoys gardening in her spare time. She is interested mostly in the plants that are well suited to Canberra's climate—drought/frost-tolerant plants, such as succulents.

Claire Yang is working in Andreas Zwick's team as part of CSIRO's new National Biodiversity DNA Library initiative

Welcome baby Petra

Dan Huston

Petra Melia Huston was born on the 23rd of January 2022 to the joy of her parents, Rebecca and Dan (postdoc in nematodes at ANIC). Here Petra is pictured at seven weeks of age, feeling a bit grumpy after a picnic in the botanic gardens.

Australian Weevils IV wins Whitley Award, and life thereafter

Rolf Oberprieler

Volume IV of the *Australian Weevils* monograph series, written by Rolf Oberprieler and the late Elwood Zimmerman (Zimmie) and published in December 2020, was honoured with a Whitley Award for zoological literature by the Royal Zoological Society of New South Wales in October 2021. It was awarded the Certificate of Commendation for Best Book in the category Zoological Reference.

The Whitley Awards, named after Gilbert Whitley, Curator of Fishes at the Australian Museum from 1926 to 1964 and long-term Councillor and President of the Royal Zoological Society of N.S.W., are awarded annually to recognise the best publications that profile the unique wildlife of the Australasian region. In 2021, the year of the 50th anniversary of the Whitleys, the Society awarded a Special Commendation to Prof. Chris Dickman, an ecologist at the University of Sydney, and 17 Certificates of Commendation in a range of categories including zoological references, handbooks, field guides, periodicals and children's books. Several entomological books published by ANIC researchers have won Whitley awards in previous years, and *Australian Weevils IV* continues this proud tradition.

The *Australian Weevils* monograph series was initiated by Zimmie in 1972, when he arrived in Australia to embark on taxonomic research on the Australian weevil fauna after a hiatus of 40 years, since the death of Arthur Lea, who described almost half of all known Australian weevils during his career. With support from the then Chief of the CSIRO Division of Entomology, Doug Waterhouse, Zimmie embarked on a major revision of the Australian weevil fauna and, in the style of his famous monograph series *Insects of Hawaii*, which he started in 1948 and of which he published nine volumes by 1978, he set about producing another such epic set of monographs on the Australian weevils. After 20 years of working on this project, Zimmie published the first two volumes of the *Australian Weevils* series in 1992, both comprising only colour plates, and in 1993 and 1994 he added three text volumes. These five volumes were not published in sequence, however, leaving a gap of Volume IV, which he intended to publish last, not least because it covered the largest and taxonomically most complex and challenging group, the broad-nosed weevils of the subfamily Entiminae. By the time of his death, in 2004, a rough first manuscript was in existence, but a huge amount of additional work was required to finish it.

To put things into perspective, there are more than 4000 described species of weevils in Australia, which is almost twice as many as all the terrestrial vertebrates in the country together, including all mammals, birds, reptiles and amphibians. Moreover, the estimated actual number of weevil species in Australia is about five times higher, approximately 20000, which means that there is about one weevil species for every plant species in Australia. But how many plant taxonomists are there now and have been over the centuries? The ratio of weevil taxonomists to plant taxonomists is staggeringly skewed! The previous three text volumes of the *Australian Weevils* series cover about 20 % of the described fauna, and Vol. IV adds about another 10 %.

Apart from continuing the treatise of Australian weevils more or less in the format of the previous volumes, Vol. IV also contains a lavishly illustrated account of weevil morphology, including explanations and illustrations of the main characters on which weevils are identified and classified. This was missing in the previous volumes. Volume IV also features identification keys to, and taxonomic accounts of the 11 tribes, 45 genera and 201 species included in the book, together with full colour illustrations of at least one species of each genus. Altogether, the book features 198 colour plates. Lastly, it contains a full obituary of Elwood Zimmerman and a large bibliography of the scientific works on Australian weevils that have been published in the last three decades.

The publication of *Australian Weevils IV* also marked the end of my career as an employed weevil taxonomist, as I took my accrued long-service leave in January 2021 and retired in October. In the usual taxonomic tradition, however, this does not mean the end of taxonomic research for me. In a small laboratory with a good microscope set up at home, I happily continue studying some of the many weevils that enrich the Australian biodiversity and landscapes, albeit at a slower pace and making more time for family, travel and leisure than was possible in the busy life before. I continue engagement with the ANIC and its staff as an Honorary Fellow, catching up with colleagues and students (and weevils) on site at least on a weekly basis. Life in the slower lane of retirement has decided perks!

Elwood Zimmerman (right) and a young Rolf Oberprieler

Moths in the A.C.T. A new book by Glenn Cocking, Suzi Bond and Ted Edwards

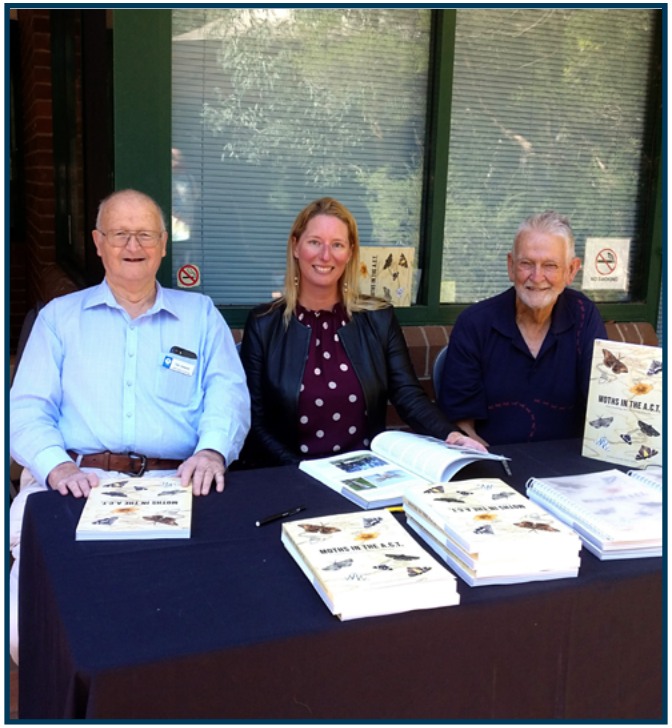
Marianne Horak

This remarkable book by Glenn Cocking, Suzi Bond and Ted Edwards, with its beautiful photos and a wealth of information, is a prime example of what collaboration between citizen scientists and experts can produce – a result that neither group alone could ever achieve. Professional moth publications are based on museum material and nearly always figure set specimens with their wings expanded to show important diagnostic characters. However, moths in the real world mostly sit with their wings folded and present an entirely different appearance. Hence it is often impossible to reliably identify a moth species from a photograph of a live specimen. The huge effort invested in this book, combining outstanding images from 84 passionate photographers and the archive of the CSIRO's Australian National Insect Collection (ANIC) with the (often unpublished) knowledge of experts at the ANIC, finally brings these two parallel streams together.

The book was privately published to avoid compromise on either scope or details, and everybody involved deserves the highest praise! Many services were provided free of charge, most notably the layout, copy editing and distribution of the book. Authors and the Lepidoptera Endowment Fund all contributed to the cost of printing. From the eye-catching cover design to the pleasing and very helpful layout to the quality of the individual photos and their reproduction, one can find no fault. Evocative habitat photographs complement the book and may well change some ideas about Canberra.

The opening chapters provide all the necessary general and technical knowledge and are illustrated with a drawing of adult morphology and numerous excellent photos of all life stages and their structural details. Head structures are taxonomically particularly informative, and the many excellent close-up head portraits are annotated to clearly point out the diagnostic features. This will make the book accessible for everybody, without compromising on scientific accuracy.

The body of the book treats all the moth families and subfamilies present in the ACT in taxonomic sequence, providing as much technical detail as possible without requiring a microscope, including advice on the often difficult task of identifying families. Information on immatures and host plants is given where available, to serve as an incentive for much needed further life history-studies, if possible documented with photographs. The numerous species illustrated of a given group, together with detailed photographs of its diagnostic characters, help to form a concept of its 'Gestalt', something that cannot be conveyed in words but is key to moth identification.



Ted Edwards (left), Suzie Bond (centre) and Glenn Cocking at the book launch of the *Moths in the A.C.T.*

The 1500 photos depicting 700 species provide a stunning and comprehensive survey of the ACT's moth fauna and will allow identification of a large proportion of the specimens encountered. Some iconic species, once seen, will never be forgotten. On the other hand there are cautionary tales, such as the difficult group including *Anthela repleta*, *Anthela varia* and *Anthela acuta*, with six to eight photographs per species required to ensure identification.

Moths in the A.C.T. is equally satisfying simply as a visual journey through the beguiling world of moths and as a riveting account of their varied lives. From keratin-eating tineid caterpillars, which include clothes moths, to larvae of scribbly moths, which induce their own food source in their tunnel in the bark of eucalypts, to oecophorid larvae feeding on leaf litter, there are many exceptions to the notion of a caterpillar chewing on a green leaf. At the extreme end of the range of foods, the larvae of the Epipyropidae are predators of plant-sucking Homoptera and those of Cyclotornidae parasitise leafhoppers first and then ant brood. Unless well camouflaged, unpalatable or protected by stinging hairs, caterpillars usually feed out of sight, in a web or a leaf roll. Others carry their own shelter wherever they go, including the bag moths, the case-bearing clothes moths, many oecophorids that construct often complex shelters from leaf fragments, and the larvae of the tortricid *Spilonota constrictana,* that move around in hollowed young seed capsules of *Melaleuca*, its food plant. Moths that are unpalatable usually advise this by warning colours, often in the caterpillar stage as well, with the Agaristinae and Arctiinae being eye-catching examples. Then there is the story of the spiders hunting moths by attracting certain male noctuids by mimicking the pheromone used by their female. *Moths in the A.C.T.* should forever demolish any notion of boring little grey moths (see https://mothsintheact.org).

On a personal note, I'd love to hand a copy of this marvellous book to Ian Common and Ebbe Nielsen – they would be delighted!

Fieldwork: Looking for leaf mines

Ying Luo

With COVID-19 lockdowns over, and some semblance of normality returning, Ying has been out in earnest looking for gracillariid leaf mines to collect fresh material and new records for her PhD project, which is an integrated taxonomic revision of the leaf-mining moth family Gracillariidae.

In mid-March Ying organised a field trip with researchers from the beetle team, and together they (Ying Luo, Siwanon Paphatmethin, James Bickerstaff and Karol Szawaryn) set out for Tallaganda National Park. It was an excellent collecting trip for Ying, where she was able to locate leaf mines on plants such as *Tasmannia sp.* (Winteraceae) and *Lomatia sp.* (Proteaceae). Karol also found an adult female of a beetle from the Lycidae family, to the excitement of all. The trip was less successful for James whose beetles refused to come to our MV-Light-trap. Regardless, fun was had!

In late March, Ying set off on a 7-day field trip to northern Queensland to collect leaf mines on private property. Her main collecting areas were around Millaa Millaa on the Atherton tablelands and around Kuranda and Cairns. She and her field mate Hannah had a successful field trip as they collected many expected and unexpected leaf mines.

One highlight of the trip was a night of light-trapping with David Rentz, Buck Richardson and a number of other young entomologists. That night they not only collected a beautiful specimen of an undescribed *Caloptilia* species (Lepidoptera: Gracillariidae), they also saw a bandicoot and a young leaf-tailed gecko.

Overall it was an amazing trip and we were able to meet many amazing people. Thank you to Bart Hacobian and his wife Wendy for having us on their property, and to David Rentz and his wife Barbara for also allowing us to visit their property. The trip culminated in a visit to the Cairns Botanic Gardens, where Ying met with Sarah Maunsell, one of the few Australian scientists who has studied leaf-mining insects.

Overall it was a wonderful trip and many new specimens were collected.

Tallaganda NP field work (left to right) Karol Szawaryn, James Bickerstaff, Siwanon Paphatmethin and Ying Luo

Ying and Hannah setting up the “LepiLED” light trap. Photo taken by David Rentz

The stunning yellow and pink *Caloptilia* sp. (tentatively ID’d as “ANIC sp. 4”) from Kuranda

More photos on page 15

Southern NSW field trip – hunting beetles that farm the food of the gods!

James Bickerstaff

James Bickerstaff and visiting researcher Karol Szawaryn went on a round trip of southern NSW to various national parks and state forests to collect bark and ambrosia beetles (Platypodinae & Scolytinae) and any other beetles that they could come across.

They began by visiting Tallaganda National Park, Termeil State Forest and Dampier State Forest. Bark and ambrosia beetles are typically found in mesic forest ecosystems with a high turnover of large trees. These beetles construct nests (referred to as galleries) in fallen, and sometimes living, trees that are still moist so that they can cultivate fungal symbionts to eat. These national parks and state forests contain these mesic forest ecosystems and are dominated by tall eucalypt trees with a rich understory of shrubs and ferns. They are also home to a large diversity of beetles, including those that James and Karol were after.

In Tallaganda, Termeil and Dampier, James and Karol were searching for the ambrosia beetle species *Austroplatypus incompertus*. This species is currently the only known eusocial beetle and colonies of these beetles are long lived (oldest known colony is >40 years old!) and persist in live, healthy stringybark eucalypts. To collect this species, micro-gauze cages are attached to the tree bark over the gallery opening. Many galleries were found in Tallaganda, however, known habitats in Termeil and Dampier State Forests were affected by the 2019-2020 bushfire season and unfortunately no galleries were found.

Austroplatypus incompertus colony that has recently been established (left). Younger colonies produce coarse frass and sawdust. The older colony (right) is identified by the kino tube exuding from the gallery entrance

In Bombala, close to the Victorian state border, James and Karol were on the hunt for invasive pine-boring bark beetles. To collect these, several flight-intercept traps with pheromone lures were established in the pine forests. In the evenings a light trap was set up in the neighbouring South East Forests National Park to survey beetle diversity and to collect groups of interest. This area was also badly burned by fires, however, much of the understory vegetation was flourishing and the tall eucalypts were sprouting with epicormic growth. While James only managed to find one platypodine ambrosia beetle, Karol managed to collect a great diversity of beetles, including: water beetles (Dytiscidae & Hydrophilidae), scarabs (Scarabaeidae), longhorn beetles (Cerambycidae), rove beetles (Staphylinidae), ground beetles (Carabidae), narrow-waisted bark beetles (Salpingidae) and flat bark beetles (Silvanidae).

Gauze cages to collect *Austroplatypus incompertus* as they emerge throughout early autumn

James checking traps for ambrosia beetles in Tallaganda NP. Photo taken by Hermes Escalona

More photos on page 15

COVID lockdown: field-tripping in the home garden

David Ferguson

The recent COVID shutdown caused the cancellation a series of planned field trips. With nowhere to go and an abundance of time, it's an opportunistic field trip to the home garden instead.

An old *Eucalyptus* species (possibly *Eucalyptus viminalis*) tree planted as a seedling (Pl.1, fig. 1) had recently started to shed sections of thick bark on one side of its lower trunk, exposing evidence of insect feeding activity. At first I hoped this was caused by the larvae of a scarab beetle, which serve as host to various interesting parasitoid flies in the family Pyrgotidae. As I removed additional sections of bark, it wasn't long before the larvae responsible were discovered. They were not scarabs but Buprestidae (Plate 1, fig. 5). Later I found several C-shaped pre-pupal larvae at the opening of emergence holes (Plate 1, fig. 9). Photographs of the larvae and a larva preserved as a wet specimen are shown in Plate 1 (figs 6, 7, 8).

The prepupal-stage larvae soon pupated (Plate 1, fig. 10). It became apparent that the head, thorax and legs had darkened while the elytra were still curved under and close to the ventral surface. The beetle soon emerged, with the thin membranous skin of its pupal case crumpled behind and the elytra arranged over the dorsal surface of the abdomen, though still appearing soft and pale. It remained almost motionless and unresponsive to stimuli for some time, but eventually the elytra had fully darkened and the beetle appeared robust and active with an urgent need to fly off. The jewel beetle (Plate 1, figs 11, 12) was identified as *Nascio vetusta* (Boisduval, 1835).

Further up the tree there were blackish horizontal scars across the trunk. These scars appear to take several years to appear at the surface of the trunk (indicated with arrows, Pl.1, Fig. 1). From the upper surface of these scars the sponge-like, sap-filled outer layers could be excavated. Several C-shaped legless beetle larvae of various sizes (Plate 1; fig. 2) were present in the deep layers, where they consume wood and deposit frass. An area at the base of the tree was levelled to install an emergence-trap that held a large quantity of bark removed from the upper trunk where the larvae were located. A few weeks later a single adult weevil appeared in the emergence-trap collection bottle (Plate 1, figs 3, 4) subsequently identified as *Pelororhinus transversus* (Boisduval, 1835). This species was apparently responsible for the blackish horizontal scars on the tree.

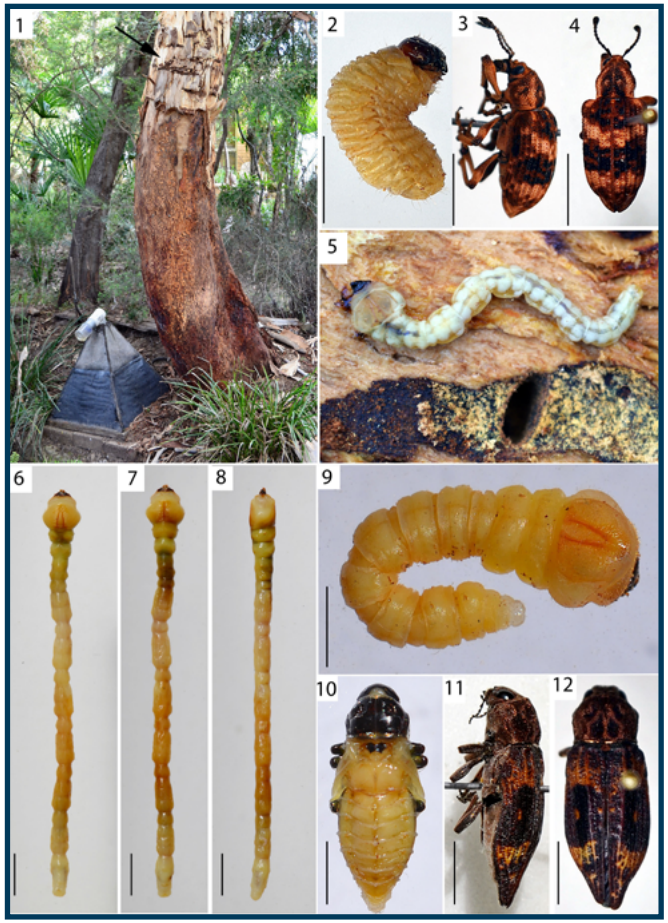


Plate 1: scale bar = 5mm

My family keeps a bucket near the back door of the kitchen for vegetable scraps and coffee grinds which usually go into the compost or chicken coop. I was surprised to see that many large fly larvae had appeared amongst the scraps. Intrigued by this, I emptied the next scraps into another larger plastic container with a layer of sand/soil mix (Plate 2, figs 2, 3) and left it in a cool place outside for a week or so. Sieving the sand/soil mix revealed many fly puparia of various sizes, ranging in colour from dark brown to yellowish brown (Plate 2, fig. 4). These were sorted and separated by size and colour and, despite the colour variation, all emerged as the blowfly *Calliphora auger* (Fabricius 1775) (Plate 2, fig. 1), a species only previously observed to breed on carrion.

Plate 2: scale bar = 5mm

Coccinellid collaboration

Karol Szawaryn

Karol is working on the systematics of the coccinelloid group of beetle families (Coccinelloidea). He received his Ph.D. in Zoology from the Museum and Institute of Zoology, Polish Academy of Sciences, for a thesis on the taxonomy and phylogeny of the herbivorous ladybird beetle tribe Epilachnini. In a series of publications, he revised all Epilachnini genera and proposed a new classification based on the molecular phylogeny.

Karol Szawaryn is collaborating with Hermes Escalona and Adam Ślipiński

Subsequently, he worked as a lecturer at the University of Gdańsk for three years. During his time in Gdańsk, he started working on beetle fossil based on the amber inclusions housed at the University of Gdańsk, which are mainly Baltic amber. He discovered numerous new extinct species of ladybird beetles, which inspired him to become one of the very few young scholars to study the diversity of this beetle group in Eocene deposits from Europe. Later he described ten new species in four beetle genera covered by his studies, which became very important scientific evidence of this beetle family's diversity in Baltic amber.

Karol is a visiting scientist working in the ANIC with Hermes Escalona and Adam Ślipiński on the phylogeny of the ladybird beetles based on genomic data. He is learning computational methods to produce the most comprehensive hypothesis of coccinellid evolution based on analyses of their genomes and transcriptomes, and also incorporating all available data from morphological characters and fossil records. He has also been undertaking fieldwork to familiarise himself with the Australian insect fauna.

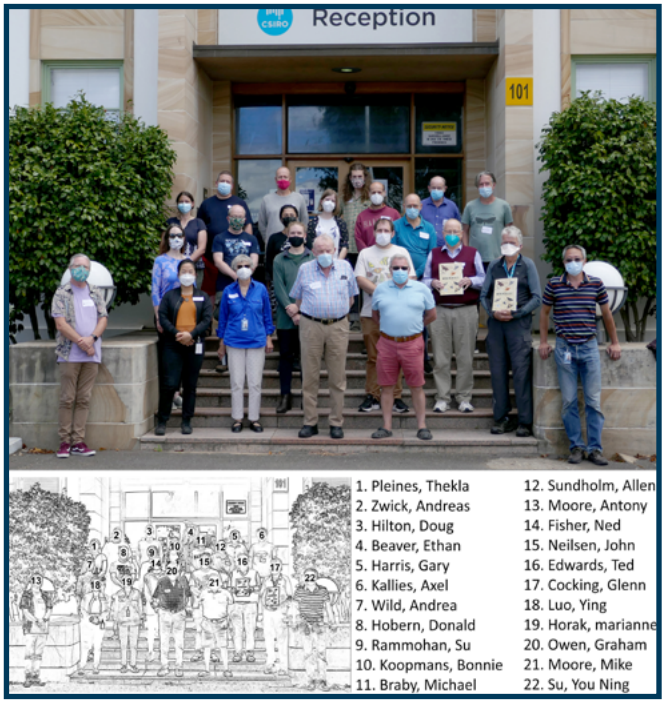
A new species of ladybird beetle from Talaganda NP

10th ANIC Moth weekend

Marianne Horak

Sadly, the 10th ANIC Moth Weekend, the last one before our move to a new collection building, had to be postponed from August 2021 to February 2022 due to Covid-19, with a severely restricted attendance. There were only 11 visitors from NSW and Victoria, but it was still an exciting weekend with emphasis on a promising young generation of students.

The Moth Weekend was also an excellent opportunity to organise permanent loans of some of the wooden insect cabinets that we obtained with collection donations and cannot move into our new building. It has become a tradition that historical insect cabinets, starting with those of A. J. Turner, are entrusted to expert collectors with the understanding that they will come back to the ANIC filled with a life-time's worth of moths.



Insect diagnostics workshops

Manda Khudhir

ANIC is the largest, most comprehensive collection of insects in Australia as well as the home of specialist taxonomists, photgraphs, and taxonomic resources for most insects. ANIC is therefore ideal to host and present dedicated workshops on insect identification, as well as to train generalist diagnosticians who need to rapidly identify and sort many different types of insects. Audits of the Australian diagnostic system have identified a considerable demand for such workshops and few institutions with the capability to present them.

In response to this stakeholder demand, ANIC organised and presented multiple workshops at the Australian National University campus, with more to follow in June. The workshops are an updated version of a previous workshop, presented in 2019, as they include ants, termites, crickets and grasshoppers.

These workshops were developed to meet an ongoing need in Australia to equip quarantine entomologists with the skills to become competent diagnosticians. A survey of university courses in Australia found that current tertiary training in entomology does not provide students with the knowledge and skills needed to identify insects at family level. As a result, the Department of Agriculture, Water, and the Environment commissioned ANIC to present a series of training courses to equip its diagnosticians with the skills, confidence, tools, and materials required for basic insect identification. The attendees represented many biosecurity or plant health laboratories in Australia, with roles ranging from general surveillance, regional vector management to hitchhiker pest intervention – all of which need the knowledge and tools to identify potential insect pests.

Dr Andreas Zwick and PhD Candidate Ying Luo were among the many ANIC staff members who contributed to the workshop

Many ANIC staff and affiliates contributed to the courses. A wide range of topics was covered, from general entomology, principles of taxonomy and nomenclature to specimen curation and packaging techniques. The major emphasis however was on practical family-level identifications for major groups including Coleoptera, Diptera, Hymenoptera, Hemiptera and Lepidoptera.

ANIC staff and workshop participants

Attendees were delighted by the rare opportunity to handle collection specimens and use a range of identification resources to identify insects of potential biosecurity interest. These resources included summarised “cheat sheets” of general morphology and diagnostic features, lists of species of biosecurity interest, printed and online identification tools, and pictures for 200 out of 850 families and across the largest orders of insects.

The workshops received overwhelmingly positive feedback and attracted some high-profile visitors from the Department including Mr Andrew Tongue (Deputy Secretary of Biosecurity and Compliance) and Dr Chris Parker (First Assistant Secretary of the Biosecurity Plant Division). The positive response from these workshops reiterates how important it is to develop courses like these to supplement basic insect identification skills and to support the Australian biosecurity system and its diagnosticians.

As a result of the success of and high demand for these courses, it is hoped that they can be run on a more regular basis to benefit more early-career diagnosticians.

Insect diagnostics workshop participants

Phylum Nematoda

Mike Hodda

Nematodes are undoubtedly the most abundant and ubiquitous multicelluar organisms on earth, with perhaps four out of every five animals being a nematode. They are perhaps second only to arthropods in terms of species diversity, and they have economic effects valued in the billions of dollars.

As with other organisms, dealing with nematodes relies on knowing, and being able to reliably differentiate the many species, of which some are beneficial, some harmful and some benign. This is the realm of systematics and taxonomy.

The classification of nematodes has proven challenging. The phylum Nematoda was only formally recognised relatively recently by Cobb 1932, despite nematodes being known since times in ancient China and Egypt. Concepts of classes, orders, families, genera and species have all changed substantially as workers specialising on different groups of nematodes have independently advanced systematic knowledge and interpretation for each isolated group.

Until recently there was no up-to-date comprehensive classification covering all nematodes. That changed in 2007 when I published a complete classification and census of the whole phylum down to family level. Since then I have received many requests to extend the work to include genera. COVID lockdowns afforded the opportunity of a period of concerted effort to do just this, and the result is a series of three major publications presenting a complete classification of the entire phylum, listing all genera deemed valid, the habitats in which they occur in, and their trophic relationships.Like the pandemic, the task of synthesising the systematics of a group as large and complex as the nematodes proved longer and more complex than anticipated, and the resulting monographs span a substantial 450 pages. It was published in the journal *Zootaxa* in March 2022.

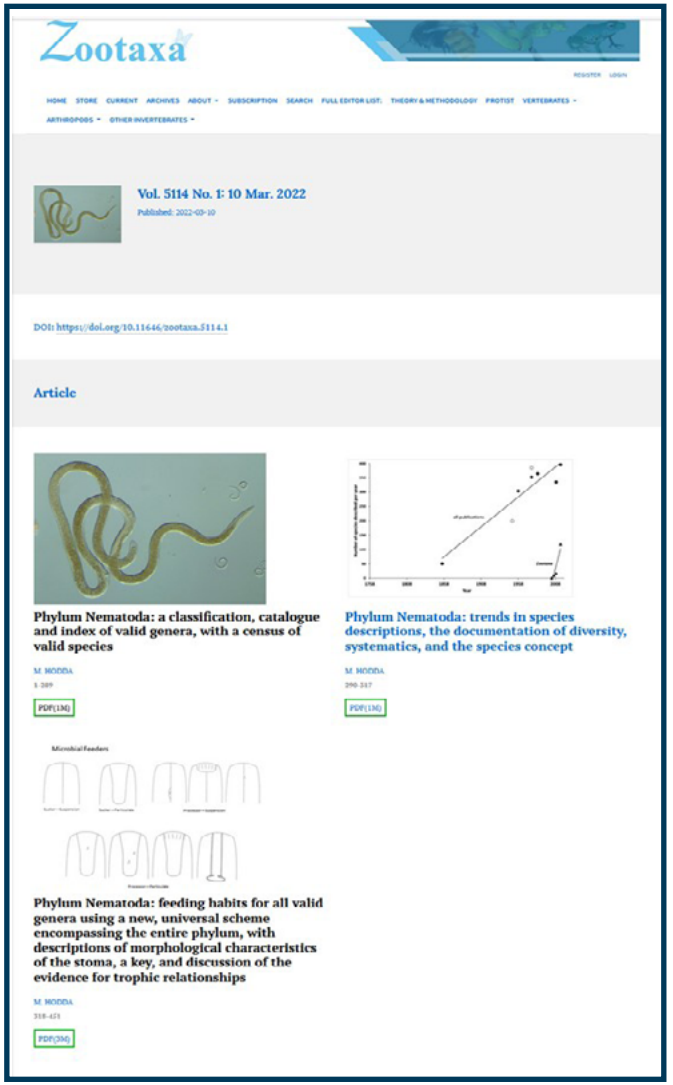
So what does all this tell us about nematodes? Currently there are nearly 30000 valid described species in about 3000 genera, 300 families, 30 orders and 3 classes. This makes Nematoda the phylum with about the 4th-largest number of described species, behind Arthropoda, Mollusca and Craniata and about as many as in Platyhelminthes.

About 400 new species of nematodes are currently described per year, meaning that one eighth of the currently recognised species were described in the last ten years. This is a good reason for producing a new classification and census. Although this rate seems impressive, in fact it is only a slight increase on the rate of descriptions before the advent of molecular taxonomy, digital imaging and electronic publication. (The rate of new descriptions was about 300 per year in the 1980's and 1990's.)

By contrast, the rate of descriptions of new genera has gone down from nearly 400 per year in the latter half of the 20th century to around half that. Perhaps many of the characters and tools used to define and delineate species are not so good at providing information about evolutionary affinities. Despite this, there seems to be no general pattern of diversity. There are many cryptic species that are highly localized and almost indistinguishable but also very widespread species that are equally hard to distinguish, but because of their high morphological, genetic and biological variability rather than their lack of it, as with cryptic species.

There are contradictions between different lines of evidence for relationships, some remaining unresolved due to lack of evidence, and species complexes that are possibly unresolvable. All of which means that these are certainly not the last words in nematode classification.

Nevertheless, I hope that they will do what ANIC and systematics are supposed to do: provide a sound basis for the scientific study of the organisms with which we share the planet and which influence our wellbeing.



Zootaxa paper on Phylum Nematoda

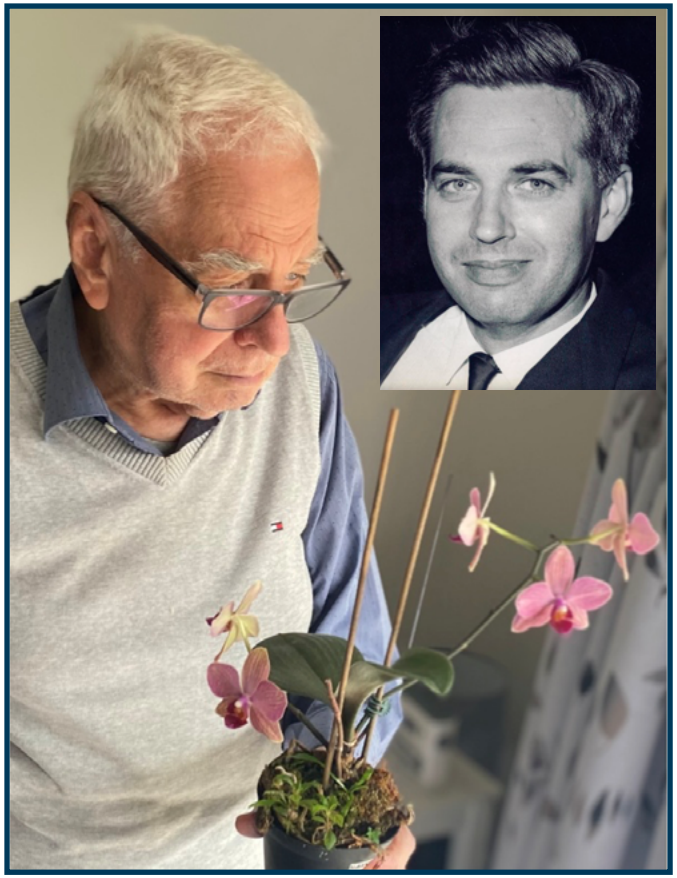
McAlpine donation enhances ANIC Diptera research

David K. Yeates

Recently ANIC received a very significant donation to its endowment fund for Diptera research, the Schlinger Trust. The gift was made by an accomplished and internationally renowned Australian dipterist, Dr David K. McAlpine. Earnings from the gift will be used to further ANIC's research into the systematics of Australia's acalyptrate flies (true fruit flies, vinegar flies, shore flies, leaf miner flies, stalk-eyed flies, etc.), an extremely diverse, ecologically important, but poorly known group.

Much of David's professional life was devoted to the study of the taxonomy and systematics of Diptera. As the first researcher to focus on the acalyptrates of Australia, he succeeded in developing a systematic framework for our essentially unknown fly fauna. Dr. McAlpine proposed nine family-group names, including five new families based on previously unknown species, as a result of his thorough research on Diptera evolution and ecology. He described over fifty genera and hundreds of species, concentrating on the signal flies (Platystomatidae) and sun flies (Heleomyzidae/Heteromyzidae). David completed his PhD in the 1960's at Imperial College, London, and published over 100 peer-reviewed publications during his long career. With Dr Don Colless, Dipterist at ANIC, he wrote the Diptera chapters for *The Insects of Australia* in both its first (1970) and second (1991) editions. I had the pleasure of working with both David and Don on the interactive key to Australian Diptera published in 2006, *On the Fly* (ABRS and the Centre for Biological Information Technology, Brisbane). David retired from the Australian Museum in 1994, but stayed on as a post-retirement fellow until 2019 and was associated with the Museum for more than 60 years. David was a guest of honour and many delegates eagerly sought him out at the 2002 International Congress of Diptera held in Brisbane.

David McAlpine's donation will ensure that his major contribution to understanding Australia's biodiversity will continue long into the future. The gift will be used to fund field work, laboratory and other costs associated with acalyptrate systematic research. We are extremely grateful to David and all the other donors who have contributed to the ANIC endowments over the years, particularly Elwood and Hannah Zimmerman and Evert Schlinger. These generous benefactors have added significantly to the breadth and depth of research we conduct on Australia's insect fauna. Please contact me if you would like more information on the benefits to our scientific works of a donation to the ANIC Trust Funds.



David McAlpine with a *Phalaenopsis* orchid (photo by Barbara Vertucci, 2021). Inset: David McAlpine in 1970 (photo by CSIRO as part of the launch of *Insects of Australia*)

ANIC making news!

Ying Luo, Andreas Zwick and Olivia Evangelista

The Conversation: Moths eating your clothes?

"Have you opened your post-lockdown wardrobe, only to discover some of your beautiful summer clothes have holes in them? You're probably blaming clothes moths but the real culprits are the larvae (caterpillars)." Click here to find out more about these moths in the article submitted to the Conversation by Ying Luo and Andreas Zwick.

The Canberra Times: From Brazil to the ACT, CSIRO entomologist spots new charismatic treehopper

"With fresh eyes for Australian fauna, Dr Olivia Evangelista made a discovery in the ACT in a field which has been dormant for two decades. The CSIRO entomologist, a senior curator at the National Insect Collection who relocated to Australia from Brazil in 2018, was on a field trip in the southern part of the ACT when she made an unusual find." Click here to read more about Olivia's new species of leafhopper.

Wallaciana namadgi Evangelista, 2021: the unusual treehopper found and described by Olivia Evangelista.

Recent publications

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More field work photos

Phyllocnistis sp. larvae (Lepidoptera: Gracillariidae) feeding on the underside of *Lomatia sp.* Article on page 6.

A *Phyllocnistis sp*. (Lepidoptera: Gracillariidae) mine on *Tasmannia sp.* Article on page 6.

James Bickerstaff's field collecting sites in southern NSW: Left to right: Tallaganda National Park, Dampier State Forest, and Bombala State Forest. Article on page 7.