

#HYMATHON2023

A 24 hour virtual symposium
from the International Society of Hymenopterists

30 November – 1 December 2023



#Hymathon2023

International Society of Hymenopterists virtual symposium



Organising Committee:

Natalie Dale-Skey, Jessica Awad, Erinn Fagan-Jeffries, José Fernández-Triana,
Taisuke Kawano, Cristina Vasilița, Miles Zhang

- All start times in the program are given **in UTC exclusively** (see <https://www.timeanddate.com/worldclock/timezone/utc> to compare with your time zone)
- The schedule can also be accessed via a public Google calendar (see next page)
- Talks titles (with the name of the presenter only and Twitter handles when available) are listed in the first part of the program - these link to the abstracts with full authorship listed in the second part of the program; abstracts can also be accessed directly from the bookmarks panel
- Zoom links to attend the sessions will be sent out to registrants shortly before the symposium (the symposium is free to ISH members but registration is essential)
- The three winning entries of the popular vote of last year's photo competition figure in this program. The entries for this year's art competition will be available for voting at <https://www.hymenopterists.org/hymathon-2023-24-hour-marathon-of-hymenoptera/#artcompetition>

Cover photo: *Sclerogibba crassifemorata* Riggio & De Stefani-Perez, 1888 (Chrysoidea: Sclerogibbidae) from Kerman Province, Iran. Photograph by Mostafa Ghafouri



The program can also be accessed via a public Google calendar (click on "Agenda" or choose "Schedule" in the top right corner to have a list view of the talks); all times should appear in your own time-zone:

<https://calendar.google.com/calendar/u/0?cid=aHltYXRob24yMDIyQGdtYWlsLmNvbQ>

or, to avoid signing in:

<https://calendar.google.com/calendar/embed?src=hymathon2022%40gmail.com&ctz=Europe%2FLondon>

#Hymathon2023 - program

SESSION 1, chaired by Miles Zhang

- 17:00** **Introductory remarks**
- 17:05** **KEYNOTE: From genes to species: how ecological divergence causes reproductive isolation**
Catherine Linnen (University of Kentucky, USA)
- 17:45** **Using citizen science to assess the population genetic structure of *Vespula* yellowjacket wasps across the UK**
Presented by Iona Cunningham-Eurich - Twitter handle '@ionace
- 18:00** **A revised terminology for male genitalia in Hymenoptera (Insecta), with a special emphasis on Ichneumonoidea**
Presented by Davide Dal Pos
- 18:15** **Into the Weeds: Factors Suppressing Known Diversity of Aulacideine Herb Gall Wasps (Cynipoidea: Aulacideini)**
Presented by Louis Nastasi - Twitter handle '@toomanywasps
- 18:30** **The Biodiversity Discovery Express**
Presented by Cristina Vasilita - Twitter handle '@nuga_vasilita
- 18:35** **Break 1 Session 1**
- 18:45** **Women of ISH event #1**
Sydney A. Cameron (University of Illinois, Urbana, USA); Elizabeth Murray (Washington State University, Pullman, USA)
- 19:30** **Cryptic species and biological control: the case of the Samba Wasp (Hymenoptera: Figitidae)**
Presented by Matthew Buffington
- 19:45** **Capturing taxonomic history using taxonomy alignment: an example from the Microgastrinae (Hymenoptera: Braconidae)**
Presented by James Whitfield
- 20:00** **Systematics of the bee subgenus *Protandrena* (*Pterosarus*) (Apoidea: Andrenidae)**
Presented by Jason Gibbs
- 20:15** **Break 2 Session 1**



- 20:25 Integrating genomic and fossil evidence to elucidate the evolutionary history of psenid wasps (Hymenoptera, Apoidea, Psenidae)**
Presented by Brunno Rosa - Twitter handle '@BBuenoRosa
- 20:40 Did ants coevolve with mealybugs? Phylogenomics and diversification of Acropyga ants and their root mealybug symbionts**
Presented by Sean Brady
- 20:55 Convergent evolution in Panurgine bees in salty habitats**
Presented by Thomas Wood
- 21:10 Successful gall induction by *Diplolepis rosae* and *D. mayri* on the sweet briar (*Rosa rubiginosa*) under laboratory conditions**
Presented by Zoltan Laszlo - Twitter handle '@_LaszloZoltan_
- 21:25 Wrap-up**

SESSION 2, chaired by Jessica Awad

- 23:00 Introductory remarks**
- 23:05 KEYNOTE: Venom evolution in parasitoid wasps**
Ellen O. Martinson (University of New Mexico, USA)
- 23:45 Investigating one dark taxon, Platygasteridae (Hymenoptera: Platygastroidea), for biocontrol of another: The Blueberry Gall Midge Complex (Diptera: Cecidomyiidae)**
Presented by Monique Raymond
- 00:00 Proctotrupidae of East Asia: their distribution, diversity, and phylogeny**
Presented by Junta Abe - Twitter handle '@junta_proc
- 00:15 Investigating the biodiversity and systematics of Australian 'mummy wasps' (Braconidae: Rogadinae)**
Presented by Mollie-Rosae Slater-Baker - Twitter handle '@molliersb
- 00:20 Stages of Oogenesis in *Polistes dominula* Queen**
Presented by Laura Miller
- 00:25 Break 1 Session 2**
- 00:35 Women of ISH event #2**
- 01:20 Upward mobility and faunal change: insights from the Hawai'i Island *Sierola* wasps (Hymenoptera: Bethyridae)**
Presented by Karl Magnacca - Twitter handle '@kmagnacca
- 01:35 Evidence of olfactory contrast in a parasitic wasp species: a behavioral perspective**
Presented by Tolulope Morawo - Twitter handle '@TMorawo
- 01:50 Break 2 Session 2**
- 02:00 Comparative Analysis of Whole Genome Sequencing and Target Capture of Ultra Conserved Elements for Phylogenetic Studies in Hymenoptera**
Presented by Juanita Rodriguez - Twitter handle '@juanita_rodr
- 02:15 Informational Frankenstein – The order of Hymenoptera in the eye of the international media**
Presented by Kiril Arsovski - Twitter handle '@entomobserver



02:30 **bHYMENOPTERA SHOWDOWN: Microgastrinae** [Jose Fernandez-Triana (Canadian National Insect Collection, Ottawa, Canada)]; **Apoid wasps (Pemphredonines)** [Rin Krichilsky (Columbia University, USA)]; **Platygastridae** [Jessica Awad (State Museum of Natural History Stuttgart); Elijah Talamas (Florida State Collection of Arthropods)]

02:40 **Wrap-up**

SESSION 3, chaired by Erinn Fagan-Jeffries

05:00 **Introductory remarks**

05:05 **KEYNOTE: The ecology and genetics of a honey bee invasion**
Ros Gloag (University of Sydney, Australia)

05:45 ***Coccygidium*? I hardly know 'em: A taxonomic revision of the genus *Coccygidium* throughout Australia.**
Presented by Tareva-Chine Atkin-Zaldivar

06:00 **"To (*Nosema*) Immunity and Bee-yond!" Uncovering the molecular secrets of survivor and managed honeybee immunity in response to *Nosema ceranae***
Presented by Emilia Burnham - Twitter handle '@mimibee822

06:15 **Incongruences between morphological and molecular species delimitation of the Taiwanese *Netelia* (Hymenoptera: Ichneumonidae: Tryphoninae) species**
Presented by Hsuan-Pu Chen - Twitter handle '@chp_shampoo

06:30 **Break 1 Session 3**

06:40 **Field work adventures**
Presented by Yasfir Nadat

06:45 **A Recipe for Brain Soup in *Tetragonula carbonaria***
Presented by Faelan Mourmourakis - Twitter handle '@FumbleBeeFae

06:50 **Phenomenal drilling behavior of the tiny parasitoid *Eupelmus messene* Walker (Hymenoptera: Eupelmidae)**
Presented by Matvey Nikelshparg

06:55 **UCE Phylogenomics of the Australasian Mutillidae: investigations into a little-studied parasitoid wasp**
Presented by Madalene Giannotta - Twitter handle '@WaspGoblin

07:00 **Taxonomic revisions and species with variable molecular, morphological and biological data: examples from temperate and tropical Braconidae parasitoid wasps**
Presented by Jose Fernandez-Triana

07:15 **Skeletomusculature of Hymenopteran male genitalia - Leptanillinae and beyond**
Presented by Ziv Lieberman

07:30 **Potter wasps – the eco-friendly engineers of the insect world**
Presented by Shweta Mukundan - Twitter handle '@cervicapra

07:35 **Iziko: Fellow workers, Field work & Fantastic discoveries**
Presented by Terry Reynolds



- 07:40 HYMENOPTERA SHOWDOWN: Potter wasps** [Shweta Mukundan - Twitter handle '@cervicapra (Indian Institute of Science, Bengaluru, India); Renee M. Borges (Indian Institute of Science, Bengaluru, India); Tejas G Murthy ((Indian Institute of Science, Bengaluru, India); Bhupendra Chand (Indian Institute of Science, Bengaluru, India)]; ***Shillingworthia shillingworthi*** [Natalie Dale-Skey (Natural History Museum, London, United Kingdom)]
- 07:50 *Neodryinus typhlocybae* as a possible biocontrol agent of *Metcalfa pruinosa* in Ukraine: GIS-modeling of potential distribution in the context of climate change**
Presented by Maryna Kaliuzhna
- 08:05 Break 2 Session 3**
- 08:15 International Society of Hymenopterists 2023 business meeting**
- 09:15 Wrap-up**

SESSION 4, chaired by Cristina Vasilița

- 11:00 Introductory remarks**
- 11:05 KEYNOTE: Evolution of unusual life histories of Torymidae (Chalcidoidea)**
Petr Janšta (Charles University, Prague, Czech Republic)
- 11:45 Illuminating a dark taxon: Central-European Eurytomidae (Hymenoptera: Chalcidoidea)**
Presented by Samin Jafari
- 12:00 Wasps going north? *Triteleia peyerimhoffi* (Platygastridae: Scelionidae) in Germany**
Presented by Ecaterina Pîrvu - Twitter handle '@ecaterina_pirvu
- 12:15 Phylogenetic placement of Darwin wasps (Ichneumonidae) in amber, before and after CT scanning**
Presented by Alexandra Viertler
- 12:30 Ants of Cyprus: 150 years in 300 seconds**
Presented by Jakovos Demetriou - Twitter handle '@JakovosD
- 12:35 Break 1 Session 4**
- 12:45 Biodiversity conservation: the key to effective crop protection in organic agriculture**
Presented by Maryna Kaliuzhna
- 13:00 A contribution to the taxonomy of the genus *Calosota***
Presented by Lucian Fusu
- 13:15 The legacy of Ian Gauld**
Presented by Gavin Broad - Twitter handle '@BroadGavin
- 13:30 Break 2 Session 4**
- 13:40 Unknown friends: a phenomenon of the bee-associated mites**
Presented by Justyna Kierat
- 13:45 Peculiarities of taxonomy, morphology and biology of egg-parasitoids of the family *Trichogrammatidae* (Chalcidoidea, Hymenoptera)**
Presented by Victor Fursov - Twitter handle '@DrVictorFursov



- 14:00** **Chromosomes of Symphyta: current state and perspectives of research**
Presented by Vladimir Gokhman
- 14:15** **HYMENOPTERA SHOWDOWN Bees (*Anthophila*) Justyna Kierat (Institute of Botany, Department of Biology, Jagiellonian University, Kraków, Poland) Aphidiinae (Braconidae) M. O. Kaliuzhna (I. I. Schmalhausen Institute of Zoology of National Academy of Sciences of Ukraine, Kyiv, Ukraine)**
- 14:25** **Wrap-up including prize announcements**

CODE OF CONDUCT

#Hymathon2023 - abstracts

SESSION 1, chaired by Miles Zhang

- 17:00** **Introductory remarks**
- 17:05** **KEYNOTE: From genes to species: how ecological divergence causes reproductive isolation**

Catherine Linnen (University of Kentucky, USA)

Dr. Catherine Linnen completed her undergraduate degree at the University of Georgia and her PhD with Dr. Brian Farrell at Harvard University, where she used phylogenetic comparative methods to describe the geography and ecology of speciation in North American pine sawflies in the genus *Neodiprion*. She took a brief break from sawflies during her postdoc (also at Harvard University), where she worked with Dr. Hopi Hoekstra on the genetic basis of adaptive coat color variation in deer mice. Armed with a new set of skills for connecting genotype to phenotype in wild animal populations, she started her own lab in the Department of Biology at the University of Kentucky in 2011 and is now an Associate Professor in the same department. Over the last 12 years, Dr. Linnen and her group have developed pine sawflies into a powerful model system for characterizing not only the patterns of population differentiation and speciation in plant-feeding insects, but also the genetic and evolutionary mechanisms that produce those patterns.

- 17:45** **Using citizen science to assess the population genetic structure of *Vespula* yellowjacket wasps across the UK**

Presented by Iona Cunningham-Eurich - Twitter handle [@ionace](#)

Iona Cunningham-Eurich (Natural History Museum London and University College London, London, UK), Danai Kontou (University of Cambridge, Cambridge, UK), Monika Yordanova (Imperial College London, London, UK), Alejandro Maeda-Obregon (University College London, London, UK), Emeline Favreau (University of Cambridge, Cambridge, UK), Jinliang Wang (Institute of Zoology, London, UK), Adam Hart (University of Gloucestershire, Cheltenham, UK), Seirian Sumner (University College London, London, UK)

Monitoring insect genetic diversity and population structure has never been more important to manage the biodiversity crisis. Citizen science has become an increasingly popular tool to gather ecological data affordably across a wide range of spatial and temporal scales. To date, most insect-



related citizen science initiatives have focused on occurrence and abundance data. Here, we show that poorly preserved insect samples collected by citizen scientists can yield population genetic information, providing new insights into population connectivity, genetic diversity and dispersal behaviour of little-studied insects. We analysed social wasps collected by participants of the Big Wasp Survey, a citizen science project that aims to map the diversity and distributions of vespine wasps in the UK. Although *Vespula vulgaris* is a notorious invasive species around the world, it remains poorly studied in its native range. We used these data to assess the population genetic structure of the common yellowjacket *V. vulgaris* at different spatial scales. We found a single, panmictic population across the UK with little evidence of population genetic structuring; the only possible limit to gene flow is the Irish sea, resulting in significant differentiation between the Northern Ireland and mainland UK populations. Our results suggest that queens disperse considerable distances from their natal nests to found new nests, resulting in high rates of gene flow and thus little differentiation across the landscape. Citizen science data has made it feasible to perform this study, and we hope that it will encourage future projects to adopt similar practices in insect population monitoring.

18:00 A revised terminology for male genitalia in Hymenoptera (Insecta), with a special emphasis on Ichneumonoidea

Presented by Davide Dal Pos

Dal Pos, Davide (University of Central Florida, Orlando, USA); Miko, Istvan (University of New Hampshire, Durham, USA); Talamas, Elijah J. (Florida Department of Agriculture and Consumer Services, Gainesville, USA); Vilhelmsen, Lars (Natural History Museum of Denmark, SCIENCE, Copenhagen, Denmark); Sharanowski, Barbara J. (University of Central Florida, Orlando, USA)

Applying consistent terminology for morphological traits across different taxa is a highly pertinent task in the study of morphology and evolution. Different terminologies for the same traits can generate bias in phylogeny and prevent correct homology assessments. This situation is exacerbated in the male genitalia of Hymenoptera, and specifically in Ichneumonoidea, in which the terminology is not standardized and has never been fully aligned with the rest of Hymenoptera. In the current contribution, we review the terms used to describe the skeletal features of the male genitalia in Hymenoptera, providing a list of authors associated with previously used terminology. We propose a unified terminology for the male genitalia that can be utilized across the order, and provide a list of recommended terms. Further, we review and discuss the genital musculature for the superfamily Ichneumonoidea based on previous literature and novel observations and align the terms used for muscles across the literature.

18:15 Into the Weeds: Factors Suppressing Known Diversity of Aulacideine Herb Gall Wasps (Cynipoidea: Aulacideini)

Presented by Louis Nastasi - Twitter handle [@toomanywasps](#)

Louis F. Nastasi (The Pennsylvania State University, University Park, PA, USA); John F. Tooker (The Pennsylvania State University, University Park, PA, USA); Andrew R. Deans (The Pennsylvania State University, University Park, PA, USA)

The herb gall wasp tribe Aulacideini is a tribe of cynipid wasps that is associated with several families of herbaceous plants. This tribe is currently represented by ~20 species in North America, several of which have been introduced from Europe. We are nearing the conclusion of our revision of this tribe's North American fauna, and have found a far richer fauna than previously suspected. Our observations and experiences in revising this group suggest several biases that have suppressed the recognition of the true diversity of Aulacideini in the Nearctic. We outline several of these possible biases, including taxonomic impediments, challenges in sampling, rearing, and identification, and



several factors diverting the attention of cynipidologists away from herb gall wasps and toward other gall wasp lineages. We offer recommendations for continuing and future efforts in exploring the biodiversity of this intriguing wasp lineage.

18:30 The Biodiversity Discovery Express

Presented by Cristina Vasilita - Twitter handle [@nuga_vasilita](#)

Cristina Vasilița (State Museum of Natural History Stuttgart, Stuttgart, Germany); Vivian Feng (Museum of Natural History, Berlin, Germany); Lars Krogmann (State Museum of Natural History Stuttgart, Stuttgart, Germany); Rudolf Meier (Museum of Natural History, Berlin, Germany)

Six out of the 20 top most species-rich and abundant families of flying insects are within Hymenoptera. In the vast majority of hymenopteran families, the estimated diversity surpasses by far the documented species count. In the midst of a mass insect decline, the epitome of “We can only conserve what we know” is more relevant than ever. The German Barcode of Life III: Dark Taxa (GBOL) project strives to alleviate those problems by training young taxonomists in developing new methods to integratively approach hyperdiverse and highly abundant “dark taxa”. DNA-barcoding is a useful, albeit imperfect tool due to laborious and repetitive procedures, high costs, the need for highly trained staff and designated sequencing facilities. To overcome these shortcomings, we developed the Express Barcoding protocol at the Centre for Integrative Biodiversity Discovery at Museum für Naturkunde, Berlin, which allows for the fast, reliable and cost-efficient species-level sorting of ecological samples for biodiversity research. We combined the quick and cheap HotSHOT extraction method with the performant technology of a NextGenPCR for rapid amplification and nanopore sequencing with ONT’s MinION sequencer. We demonstrate the power of the approach by obtaining 250 barcodes for 285 specimens in less than a day (6 hours). Express barcoding can revolutionize the way we acquire data for biodiversity research, making mass-barcoding of individual specimens available in a time and cost efficient manner. With the express barcoding approach we have the framework to accelerate biodiversity discovery and aid biodiversity monitoring - anywhere, anytime, by anyone.

18:35 Break 1 Session 1

18:45 Women of ISH event #1

Sydney A. Cameron (University of Illinois, Urbana, USA); Elizabeth Murray (Washington State University, Pullman, USA)

S. Cameron presents on the History of ISH and Goals for WISH; discussion with S. Cameron and E. Murray.

19:30 Cryptic species and biological control: the case of the Samba Wasp (Hymenoptera: Figitidae)

Presented by Matthew Buffington

Matthew Buffington (SEL, USDA-ARS); Jeffrey Sosa-Calvo (Smithsonian Institution); Mattias Forshage (Swedish Museum of Natural History)

The impact of the spotted wing *Drosophila* (*Drosophila suzukii*) has prompted an international search for biological control agents. Two figitid wasps, *Leptopilina japonica* and *Ganaspius brasiliensis*, both proved to be potent natural enemies...but while the species limits of *L. japonica* seemed within grasp, those of *G. brasiliensis* appeared to unravel with each new population sampled. We present here how we addressed this systematics conundrum, and provide recommendations for future research involving unresolved species and genera of parasitoid wasp.



19:45 Capturing taxonomic history using taxonomy alignment: an example from the Microgastrinae (Hymenoptera: Braconidae)

Presented by James Whitfield

James B. Whitfield (University of Illinois, Urbana-Champaign, USA); Yi-Yun (Jessica) Cheng (Rutgers University, New Brunswick, USA); Jose L. Fernandez-Triana (Canadian National Insect Collection, Ottawa, Canada)

Classifications from different historical periods for the braconid wasp subfamily Microgastrinae are used to map the history of taxon concepts for genera over time. Taxonomy alignments using Euler/X allow the generation of computer-readable "ontologies" of taxon concepts that could be employed in collection and biodiversity databasing systems in a taxonomically intelligent fashion.

The potential advantages of this are discussed, as well as computational challenges for complex taxonomic cases.

20:00 Systematics of the bee subgenus *Protandrena* (*Pterosarus*) (Apoidea: Andrenidae)

Presented by Jason Gibbs

Jason Gibbs (University of Manitoba, Winnipeg, Canada); Steve Robinson (University of Manitoba, Winnipeg, Canada)

Protandrena (*Pterosarus*) are lovely little black and yellow bees that specialize on various composite flowers. Little is known about the taxonomy of the group or if it is monophyletic. We summarize some recent research on the systematics of *P. (Pterosarus)* and highlight the need for additional work on the group.

20:15 Break 2 Session 1

20:25 Integrating genomic and fossil evidence to elucidate the evolutionary history of psenid wasps (Hymenoptera, Apoidea, Psenidae)

Presented by Brunno Rosa - Twitter handle '@BBuenoRosa'

Brunno B. Rosa (Universidade de São Paulo, Ribeirão Preto, Brazil); Gabriel A. R. Melo (Universidade Federal do Paraná, Curitiba, Brazil); Eduardo A. B. Almeida (Universidade de São Paulo, Ribeirão Preto, Brazil); Bonnie B. Blaimer (Museum für Naturkunde, Berlin, Germany)

The Apoidea include bees and several groups of predatory wasps known as apoid wasps, totaling more than 30,000 living species. Inferring the phylogenetic relationships of such a diverse group has been a challenge for the past 30 years. Most results indicate that apoid wasps are paraphyletic in relation to bees. Among the living apoid taxa, Psenidae is one of the lineages indicated as a possible sister group to bees. Psenidae includes 18 genera, approximately 488 living species and at least six fossils from the Cretaceous and Paleogene. The crown group of Psenidae arose in the Cretaceous, most likely during the Late Cretaceous, with divergence time estimates ranging from Middle Aptian to Early Cenomanian. Although they are frequently represented in phylogenetic analyses of Apoidea, there are no previous works that aimed at resolving the phylogenetic relationships of this family in detail. The main goal of this study is to reconstruct the evolutionary history of Psenidae by investigating their phylogenetic relationships and estimating the time of divergence of fossil and recent lineages using tip-dating in a total evidence approach. To achieve the objectives, phylogenomic data of ultra-conserved elements (UCEs) were generated from museum specimens for a large sample of extant taxa of psenids. In parallel, morphological data were produced for all genera and major species-groups of psenids including fossil taxa. The main phylogenetic results are discussed, as well as the main challenges and advantages of this innovative phylogenomic study.



20:40 Did ants coevolve with mealybugs? Phylogenomics and diversification of *Acropyga* ants and their root mealybug symbionts

Presented by Sean Brady

Sean G. Brady (National Museum of Natural History, Smithsonian Institution); Jeffrey Sosa-Calvo (National Museum of Natural History, Smithsonian Institution); Dietrich Gotzek (University of Hohenheim); Scott A. Schneider (USDA, Systematic Entomology Laboratory); John S. LaPolla (Towson University)

Herder ants – those that tend other insects as 'livestock' – have great potential to serve as models for studying the evolution of animal-to-animal symbioses. Ants in the genus *Acropyga* practice a unique form of herding where unmated alate *Acropyga* queens vertically transmit root mealybugs (from the families Xenococcidae and Rhizoecidae) by carrying a pregnant adult female with them on their mating flights (called trophophoresy). This single mealybug serves as a seed individual for the next generation of symbionts in the new colony. The 42 currently described *Acropyga* species are found pantropically, reaching their highest diversity in the Asian and New World tropics. *Acropyga* nests always contain mealybug trophobionts within them. The vertical transmission of mealybugs across ant generations via trophophoresy and the high specificity of mealybug species inhabiting ant nests lead to the expectation of codiversification between the partners. We sequenced ultraconserved element (UCE) genomic data from a broad representative of the species diversity within both insect partners in this system. This work resulted in phylogenomic data sets of up to ~94,000 parsimony informative sites for the ants (57 terminals) and ~17,000 sites for the mealybugs (40 terminals). We analyzed these data using permutation and event-based methods to test three coevolutionary scenarios for this system: 1) weak partner fidelity (null hypothesis); 2) diffuse-sense codiversification; and 3) strict-sense codiversification. We also discuss how our results provide a deeper understanding of historical biogeography and morphological evolution in the *Acropyga*-mealybug symbiosis.

20:55 Convergent evolution in Panurgine bees in salty habitats

Presented by Thomas Wood

Thomas Wood (University of Mons, Mons, Belgium)

Panurgine bees are typically found most abundantly and with the greatest diversity in dry parts of the Americas and the Old World where they often display floral specialisation (oligolecty), leading to close associations with specific plants and habitat types. In the Mediterranean basin, members of the genus *Camptopoeum* Spinola s. str. can be found in salty habitats where they specialise on Cardueae (Asteraceae), using their long tongues to drink nectar from the deep florets. It was therefore a surprise to find two tiny and long-tongued *Camptopoeum* species, one in southern Iberia and one in northern Africa, collecting pollen from the unrelated *Frankenia* (Frankeniaceae), a strong halophile. Furthermore, taxonomic investigation revealed that the Iberian species is actually completely unrelated to the true *Camptopoeum*, and has instead morphologically converged upon a similar morphology in order to utilise the genus *Frankenia*. This led to the creation of the new genus *Halopanurgus* Wood, Patiny & Bossert, 2022 and a clear example of the labile nature of tongue morphology, and a cautionary tale about its use in bee classification.



21:10 Successful gall induction by *Diplolepis rosae* and *D. mayri* on the sweet briar (*Rosa rubiginosa*) under laboratory conditions

Presented by Zoltan Laszlo - Twitter handle '[@_LaszloZoltan_](#)

Zoltán László, Bálint Szilágyi, Borbála Macalik, Mátyás Biró, Constantin-Teodor Iordache, Marco Nicula, Dorina Podar

Plant galls are unique outgrowths caused by various organisms, including insects, serving as nourishment for the inducer's larvae. Despite the taxonomists and ecologists attempts to elucidate the mechanisms behind plant gall formation, its understanding is still incomplete. Modern genetic techniques allow in depth analysis of the molecular processes, but variations across species entangle the analysis. Establishing laboratory-friendly plant-gall inducer communities is crucial, yet past attempts have faced challenges. We aimed to create a sustainable laboratory community involving wild roses (*Rosa* sp.) and as gall-inducing insects rose gall wasps belonging to the genus *Diplolepis*. Controlled indoor conditions were optimized for plant growth. Wild roses were transplanted, then exposed to gall inducers, and monitored. Successfully initialized gall growth was measures and analysed, revealing insights into the impact of plant vigour on gall size. Our study successfully established a novel laboratory community for further research on gall formation mechanisms.

21:25 Wrap-up



SESSION 2, chaired by Jessica Awad

23:00 Introductory remarks

23:05 KEYNOTE: Venom evolution in parasitoid wasps

Ellen O. Martinson (University of New Mexico, USA)

Dr. Ellen Martinson completed her undergraduate degree at Concordia College in Moorhead, Minnesota and her PhD with Dr. Betsy Arnold at the University of Arizona, working on the fig and fig wasp mutualism. She began her research on the venom of parasitoids during a postdoc at the University of Rochester. As an Assistant Professor at the University of New Mexico, her research explores the evolution, ecology and genetics of the interactions between insects and other organisms, with a specific focus on how organisms repurpose existing genes/pathways or acquire new tools to facilitate species interactions. The current focus of Dr. Martinson and her lab members is on parasitoid wasp venom and galling insects.

23:45 Investigating one dark taxon, Platygastriidae (Hymenoptera: Platygastroidea), for biocontrol of another: The Blueberry Gall Midge Complex (Diptera: Cecidomyiidae)

Presented by Monique Raymond

Monique Raymond (Univ. New Hampshire); Elijah Talamas (Florida State Collection of Arthropods); Istvan Miko (Univ. New Hampshire)

The Blueberry Gall Midge Complex (BGMC) is a cryptic amalgamation of leafcurling gall midges (Diptera: Cecidomyiidae) with global potential for damage of high and lowbush blueberry *Vaccinium* (Ericales: Ericaceae). Specialist platygastriine parasitoid wasps (Hymenoptera: Platygastriidae) may offer biocontrol potential against the complex, but like the larval stage of its host, Platygastriinae requires expanded diagnostic effort. In this study, the interaction between two dark taxon groups is investigated by integrating DNA barcoding with morphological analysis. These diagnoses will provide new information about the parasitoid and pest assemblages of BGMC in an expanded geographic area while supporting the ongoing taxonomic exploration of Platygastriidae.

00:00 Proctotrupidae of East Asia: their distribution, diversity, and phylogeny

Presented by Junta Abe - Twitter handle '@junta_proc

Junta Abe (Entomological Laboratory, faculty of Agriculture, Kyushu University, Fukuoka, Japan); Toshiharu Mita (same affiliation above)

The Proctotrupidae are uncommon but cosmopolitan wasps. About 700 species in 32 genera are known all over the world, and most of them are belonging to the subfamily Proctotrupinae with three tribes. The proctotrupid wasps are known as the larval endoparasitoids of beetles or fungus gnats. The most distinct morphological character of them is the stout ovipositor sheath. When laying eggs, females insert it in the host body.

The fauna of this family is relatively well studied in Russia and southern part of China. In Japan, which is located between these two countries, most of the Palaearctic genera (13/16) are known. Moreover, some Oriental genera, for example *Phoxoserphus* and *Maaserphus*, were also discovered in recent years. Many other unknown taxa have been recognized in the wasp collection of some institutes in Japan, suggesting that the species diversity in East Asia, especially Japan, may be much higher. Previously, phylogeny of the family has been largely overlooked. Our preliminary analysis of the Palaearctic genera based on four gene regions revealed discrepancies with the current systematics. The diverse tribe Cryptoserphini was found to be paraphyletic. One of them, *Nothoserphus*, is the sister group of another tribe Disogmini in the same clade. This clade (Disogmini + *Nothoserphus*) is sister to a clade comprising the other two tribes Proctotrupini and the rest of



Cryptoserphini. The genus *Nothoserphus* has some notable traits in morphology and biology among the tribe Cryptoserphini, such as the narrow head, the short ovipositor sheath, and the host (lady beetles).

00:15 Investigating the biodiversity and systematics of Australian ‘mummy wasps’ (Braconidae: Rogadinae)

Presented by Mollie-Rosae Slater-Baker - Twitter handle '[@molliersb](#)

Slater-Baker, M-R (The University of Adelaide, Adelaide, Australia), M. Guzik (The University of Adelaide, Adelaide, Australia); J. Rodriguez (Australian National Insect Collection, CSIRO, Canberra, Australia); E. Fagan-Jeffries (The University of Adelaide & South Australian Museum, Adelaide, Australia)

Rogadinae is a subfamily of parasitoid wasps belonging to the megadiverse family Braconidae. Rogadines are commonly known as ‘mummy wasps’, as members of the subfamily share the unique trait of mummifying their caterpillar hosts as the larvae develop. These wasps are found throughout Australia, however only a fraction of their estimated diversity is formally documented. A particularly poorly studied tribe, the Betylobraconini, was only found to belong to Rogadinae within the last decade following molecular work. Betylobraconini is largely endemic to Australia and surrounding regions, however the biology of all members of the tribe remains completely unknown, and their likely hosts can only be speculated based on morphology and the habits of related taxa. This project employs a combination of DNA barcoding, phylogenomics and morphological approaches to explore the diversity of the Australian Rogadinae, and forms a foundational taxonomic and systematics framework for further work. With a focus on members of the Betylobraconini, the project also aims to provide a better understanding of the biology and evolutionary history of this poorly understood group.

00:20 Stages of Oogenesis in *Polistes dominula* Queen

Presented by Laura Miller

Laura Miller (PhD Student, Drexel University, Biology Department), Kari Lenhart (Drexel University, Biology Department), Sean O'Donnell (Drexel University, Biology Department)

The paper wasp genus, *Polistes*, is considered primitively eusocial and displays reproductive plasticity. Temperate *Polistes*, such as those local to Pennsylvania, follow an annual cycle in which a queen produces only sterile female workers in the spring. She then produces future female reproductives (gynes) during the late summer and early fall. Adult gynes emerge in reproductive diapause. Workers are kept reproductively suppressed while the queen is present, but workers can activate their ovaries to produce males if the queen is lost. Both nutritional and social experience differences between worker-destined and reproductive-destined larvae influence adult ovary development in *Polistes*: feeding rates and antennal drumming behavior performed by the queen contribute to worker/gyne differentiation. My goal is to use imaging tools developed for *Drosophila* to understand the cell biology of *Polistes* caste differences in ovary development.

I am comparing the early stages of oogenesis between the reproductive castes in *Polistes dominula* using immunofluorescence imaging. With these tools, we are also quantifying cellular processes such as DNA replication, cell growth, cell division, and apoptotic cell death to distinguish the cell biology of ovary development between the castes. Our analysis spans the full course of oocyte development from the most anterior portion of the ovariole, where stem cells begin to differentiate into the nurse cells and developing oocytes, to the most posterior egg chambers. Our data will yield a new understanding of the cell development basis of reproductive plasticity and caste differences.

00:25 Break 1 Session 2



00:35 Women of ISH event #2

Future Directions of WISH followed by WISH committee breakout discussion of editorial paper on hiring of women entomologists ([Walker 2023](#))

01:20 Upward mobility and faunal change: insights from the Hawai'i Island *Sierola* wasps (Hymenoptera: Bethylidae)

Presented by Karl Magnacca - Twitter handle '@kmagnacca

Karl Magnacca (Division of Forestry and Wildlife, State of Hawaii, USA)

The parasitoid wasp genus *Sierola* is the largest in the family Bethylidae, centered in the Austro-Pacific region. Hawai'i contains an extraordinary radiation of over 500 species, attacking a wide variety of small moth caterpillars and dominating the endemic parasitoid community. I review the current state of *Sierola* taxonomy across the islands, focusing on that of Hawai'i Island. Work on revising the species there shows that they exhibit different patterns of both diversification and physical habitation compared to older islands, which makes collecting and identifying them more challenging. Still, a robust fauna of at least 100 species is present.

01:35 Evidence of olfactory contrast in a parasitic wasp species: a behavioral perspective

Presented by Tolulope Morawo - Twitter handle '@TMorawo

Tolulope Morawo (United States Army Reserve, Salt Lake City, USA; Auburn University, Auburn, USA), Henry Fadamiro (Texas A&M University, College Station, USA; Auburn University, Auburn, USA)

Parasitic wasps use odor cues from infested plants and herbivore hosts to locate their hosts. Plant volatiles are more abundant and considered important long-range cues for host patch location. Herbivore cues are less abundant and considered more reliable short-range cues for host discrimination. For short-range host discrimination, we hypothesized that plant volatiles serve as background odors to enhance detection of herbivore host odors. To test this hypothesis, the parasitoid *Microplitis croceipes* (Hymenoptera: Braconidae) and its larval host *Heliothis virescens* (Lepidoptera: Noctuidae), a pest of cotton and soybean, were used as a study system. The preference of female parasitoids for cotton-fed or soybean-fed hosts was observed in Petri dish oviposition two-choice tests. A background odor of host-infested cotton or soybean was provided during the bioassays. Inexperienced female *M. croceipes* did not discriminate between cotton-fed and soybean-fed hosts in oviposition choice tests. Interestingly, parasitoids attacked more soybean-fed than cotton-fed hosts in two-choice tests when a background of host-infested cotton odor was supplied. Likewise, parasitoids attacked more cotton-fed than soybean-fed hosts in two-choice tests when a background of host-infested soybean odor was supplied. This suggests an evidence of olfactory contrast in *M. croceipes*, with plant volatiles creating a background contrast to enhance detection and discrimination of herbivore cues. We discussed the ecological significance of the results and highlight the role of olfactory contrast in parasitoids and other foraging insects.

01:50 Break 2 Session 2



02:00 Comparative Analysis of Whole Genome Sequencing and Target Capture of Ultra Conserved Elements for Phylogenetic Studies in Hymenoptera

Presented by Juanita Rodriguez - Twitter handle '@juanita_rodr'

Juanita Rodriguez (Australian National Insect Collection, Canberra, Australia); Olivia Evangelista (Australian National Insect Collection, Canberra, Australia); Alicia Grealy (Australian National Insect Collection, Canberra, Australia)

Phylogenetics of non-model organisms often relies on selecting appropriate sequencing methodologies to obtain high-quality genomic data. In this study, we present a comparative analysis of two prominent approaches, Whole Genome Sequencing (WGS) and Target Capture of Ultra Conserved Elements (UCE), within the context of phylogenetic research. We utilized a set of aculeate Hymenoptera from the families Pompilidae, Mutillidae, Colletidae, and Apidae as our study subjects. We extracted DNA from 205 specimens using a non-destructive method employing the Qiagen DNAeasy blood and tissue kit. Libraries were prepared in miniaturized reactions using an acoustic liquid handler. The libraries underwent two processing methods: 1) target capture in pools of 8 using the UCE Hymenoptera 2.5Kv2A bait set, followed by sequencing, and 2) whole genome sequencing at a target 5x coverage, assuming a genome size of approximately 600Mb. After sequencing, data from both approaches underwent quality control using Trimmomatic and were assembled into contigs using SPAdes. To extract UCE loci, we employed Phyluce, a robust bioinformatics toolkit designed for UCE-based phylogenetics. For the WGS dataset, we adopted two distinct approaches: (1) direct UCE extraction from contigs and (2) UCE extraction from contigs transformed into 2bit sequences, subsequently processed through the genome Phyluce pipeline. Our comparative analysis encompasses multiple dimensions, including data quality, cost-effectiveness, coverage depth, and uniformity. This study not only elucidates the relative advantages and limitations of these methodologies but also underscores their adaptability to specific taxonomic groups, as exemplified by the ant-specific UCE capture set.

02:15 Informational Frankenstein – The order of Hymenoptera in the eye of the international media

Presented by Kiril Arsovski - Twitter handle '@entomobserver'

Kiril Arsovski (Institute of communication studies, Chair of Environmental Communication, Skopje, Macedonia)

Informational Frankenstein – The order of Hymenoptera in the eye of the international media

The reporting of the international media is significantly influencing the creation of public opinion, policy and decision making. Since, the modern society is mediatized, media have crucial role in informing the public on the state of biodiversity and the ways humans are influencing it. This means that the reporting can play crucial role on the societal response and behaviour regarding wildlife and biodiversity.

The insect order of Hymenoptera due its historical, cultural, agricultural, and ecological ties with the human culture, as well their overall presence and human-insect interaction are frequent topic, covered by the international media on different magnitude.

By cross reference analyse of the reporting, regarding different species and group of Hymenoptera insects, done by the most influential international media outlets in the last three (3) years (published in English), we sorted the media products based on their type and using the journalistic quality standards we measured the quality, context, and tone in which they report. Additionally, by sorting the reporting in four (4) separate groups (honeybees, wild bees, wasps, and ants) we established the most covered group species and by adding the date of publishing we followed a time frame and seasonality of publication of the media stories.



Overall, the international media reporting on the Hymenoptera showed lack of understanding of the ecology and ecosystem values of the order and the reports were frequently based on misinformation on the species appearance, ecology, or role in the ecosystem.

02:30 HYMENOPTERA SHOWDOWN:

Microgastrinae

Jose Fernandez-Triana (Canadian National Insect Collection, Ottawa, Canada)

Apoid wasps (Pemphredonines)

Rin Krichilsky (Columbia University, USA)

Platygastroidea

Jessica Awad (State Museum of Natural History Stuttgart); Elijah Talamas (Florida State Collection of Arthropods)

02:40 Wrap-up



Pollen grains cling to the antennae of a perilampid wasp (*Euperilampus triangularis*) as it visits an aster flower. Photographed July 4th, 2021, in the Supawna Meadows, National Wildlife Refuge, New Jersey, USA. Photograph by Ian Schramm



SESSION 3, chaired by Erinn Fagan-Jeffries

05:00 **Introductory remarks**

05:05 **KEYNOTE: The ecology and genetics of a honey bee invasion**

Ros Gloag (University of Sydney, Australia)

Dr. Ros Gloag completed her PhD at the University of Oxford. She then took up a University of Sydney Postdoctoral Fellowship, followed by a Lectureship in Evolutionary Biology at USYD's School of Life and Environmental Sciences. She is currently an Australian Research Council DECRA Fellow and USYD Robinson Fellow. Dr Gloag's research focus is the evolutionary ecology and population genetics of bees, and the application of new knowledge in this area to global challenges associated with climate change, invasive species and pollinator conservation. She has worked particularly to understand the behaviour and genetics of Australian native stingless bees, and the invasion genetics of the honey bee *Apis cerana* in Northern Australia.

05:45 ***Coccygidium*? I hardly know 'em: A taxonomic revision of the genus *Coccygidium* throughout Australia.**

Presented by Tareva-Chine Atkin-Zaldivar

Tareva-Chine C. Atkin-Zaldivar (The University of Adelaide, Adelaide, Australia); Erinn P. Fagan-Jeffries (The University of Adelaide, Adelaide, Australia, South Australian Museum, Adelaide, Australia)

Coccygidium is a genus of parasitoid wasps recorded in Australia since the early 2010's with Museum specimens collected of the genus since the 1960's, yet no Australian species have been described. Overseas the genus is most notably being trialled as a biocontrol measure against the invasive crop pest Fall armyworm. As of 2020 Fall armyworm has also established in Australia and during rearing of the pest species *Coccygidium* was collected. *Coccygidium* was also collected during the citizen science initiative Insect Investigators, using these specimens along with museum samples, and those from the rearing of Fall armyworm, 5 species of species of *Coccygidium* were described using morphological and CO1 molecular differentiation. Three of these species were named by the schools that originally collected them, two of which have been reared for Fall armyworm which places the descriptions of species within the genus at the intercept between citizen science and a necessary step before applied taxonomy.

06:00 **"To (*Nosema*) Immunity and Bee-yond!" Uncovering the molecular secrets of survivor and managed honeybee immunity in response to *Nosema ceranae***

Presented by Emilia Burnham - Twitter handle '[@mimibee822](https://twitter.com/mimibee822)

Emilia Burnham (Department of Entomology, University of California: Riverside); Dr. Boris Baer (Department of Entomology, University of California: Riverside); Dr. Kerry Mauck (Department of Entomology, University of California: Riverside);

Nosema ceranae is a fungal spore parasite that affects honeybees and causes various symptoms including diarrhea, fatigue, and even death. There are two genotypes of honeybees: managed, which are typically kept by commercial and hobbyist beekeepers, and survivor, which live without management in nature. It has been found that survivor bees are able to tolerate pathogens such as *N. ceranae* better than managed bees. The life cycle of *N. ceranae* germinates within the bee's midgut, which requires them to be alive. What happens when these spores are dead? Could they be used like a vaccine to help the honeybees defend against an infection before it actually occurs? There are three specific immune indicators that I am measuring: vitellogenin, a lipo glycoprotein that is formed in the fat body and has immunological effects, juvenile hormone, which controls



what the honeybee's task is at that time in its life, such as being a nurse or forager, and chitinase, an enzyme that breaks down chitin and also has been shown to be able to kill other species of *Nosema* and will be using this to help confirm the results of the other two hormone levels. In my research, I am investigating the immunocompetence of *N. ceranae* in survivor and managed honeybees after feeding them live and dead spores by measuring the quantities of vitellogenin, chitinase, and juvenile hormone in their hemolymph, and confirming infection by measuring the spore counts in their midguts.

06:15 Incongruences between morphological and molecular species delimitation of the Taiwanese *Netelia* (Hymenoptera: Ichneumonidae: Tryphoninae) species

Presented by Hsuan-Pu Chen - Twitter handle '[@chp_shampooh](#)

Hsuan-Pu Chen (Department of Entomology, National Taiwan University, Taipei, Taiwan); Shih-Feng Shiao (Department of Entomology, National Taiwan University, Taipei, Taiwan)

The species-level taxonomy of the diverse nocturnal darwin wasp genus, *Netelia* Gray, 1860, largely relies on distinct structures of male genitalia gonostyles owing to their similar appearance. However, the significance of these specialized structures in speciation needs to be clarified, and previous taxonomic hypotheses still need to be validated using molecular data. In this study, we employed an integrated taxonomic approach to re-examine the taxonomy of Taiwanese *Netelia*. We performed species delimitation by using over 70 morphospecies from Taiwan and Japan, more than 200 newly acquired COI and 28S sequences, and over 300 COI sequences from the BOLD systems. The species delimitation was based on morphological data, including external morphologies and male genitalia structures, and molecular data, using mitochondrial COI-based ASAP and bPTP as well as monophyly from the nuclear 28S gene tree. Our results reveal incongruences between morphological and molecular criteria. Specifically, four morphospecies from the subgenus *Prosthodocis* and three from the subgenus *Netelia* were considered conspecific in molecular data. In contrast, significant genetic divergence was observed among morphospecies within the obesis species group of the subgenus *Apatagium*, even though they have similar male genitalia morphology. The results suggest that the diversity observed in male genitalia morphology may not accurately reflect species diversity within the genus *Netelia*. Incongruence with low genetic divergence in certain morphospecies might result from local morphological adaptation or sexual selection-driven diversification of male genitalia morphology. Meanwhile, cryptic species may also exist within some *Netelia* groups.

06:30 Break 1 Session 3

06:40 Field work adventures

Presented by Yasfir Nadat

Yasfir Nadat (North West University, Potchefstroom, South Africa)

A few novel observations of wasp behaviour and field work adventures in Zimbabwe

06:45 A Recipe for Brain Soup in *Tetragonula carbonaria*

Presented by Faelan Mourmourakis - Twitter handle '[@FumbleBeeFae](#)

Faelan Mourmourakis (Macquarie University, Sydney, Australia); Andrew Barron (Macquarie University, Sydney, Australia)

Despite their brains being the size of a sesame seed, the common bee displays remarkable cognitive capabilities. A honeybee's brain contains just under a million brain cells, enabling this complex cognition. However, little is known about the bee-brains in our own backyard. For the first time, I have used the isotropic fractionator "brain soup" method on the brain of an Australian native bee:



Tetragonula carbonaria. Although their bodies are even smaller than that of a honeybee – four millimetres – *T. carbonaria* possess an impressively large number of brain cells, especially in contrast with North American Hymenopteran species of a similar size. Further investigation is required to expand our knowledge of native Australian bee brains beyond *T. carbonaria*, and to uncover potential differences across taxonomies.

06:50 Phenomenal drilling behavior of the tiny parasitoid *Eupelmus messene* Walker (Hymenoptera: Eupelmidae)

Presented by Matvey Nikelshparg

Matvey I. Nikelshparg (Ben-Gurion University of the Negev, Beer-Sheva, Israel) (Saratov State University, Saratov, Russia); Evelina I. Nikelshparg (Ben-Gurion University of the Negev, Beer-Sheva, Israel); Vasily V. Anikin (Saratov State University, Saratov, Russia); Alexey A. Polilov (Lomonosov Moscow State University, Moscow, Russia)

The ovipositor of parasitoid wasps is capable of drilling holes in different natural materials, such as galls, woods, and puparia, to attack the concealed hosts and lay eggs. The complex functionality and possibilities of the organ are promising but challenging to study. In this research we discovered an unusual behavioral pattern of oviposition of the female parasitoid *Eupelmus messene* Walker, 1839 (Hymenoptera: Eupelmidae): she drilled a hole in a wall of polystyrene Petri dish with her ovipositor and laid her egg outside the dish. Generally, *E. messene* attacks the gall wasps *Aulacidae hieracii* Linnaeus, 1758 (Hymenoptera: Cynipidae), which form galls on the hawkweed *Hieracium x robustum*. *E. messene* drills the wall in a gall with her ovipositor and upon finding the gall wasp larva, lays egg next to it. However, we found the phenomenon, in which the drilling process with the ovipositor is not associated with the host and any natural substances. The transparency of the plastic allowed us to describe the technique of oviposition, which we divided into four steps: pushing, rotational, ejection, and cementing. We found that *E. messene* isolates the perforation after the oviposition with a specific substance. Also, we studied the structure of the ovipositor as well as the perforation made by it, using scanning electron microscopy. The research was recently published in the Journal of Hymenoptera Research (Nikelshparg et al. 2023) and was described in the New York Times (<https://www.nytimes.com/2023/09/21/science/parasitoid-wasp-drill-plastic.html>).

06:55 UCE Phylogenomics of the Australasian Mutillidae: investigations into a little-studied parasitoid wasp

Presented by Madalene Giannotta - Twitter handle '@WaspGoblin'

Madalene Giannotta (ANU/ANIC); Dr Juanita Rodriguez (ANIC); Dr Kevin Williams (CDFA); Prof. Craig Moritz (ANIC)

The Mutillidae (velvet ants) are a diverse, and often-times abundant, family of parasitoid wasps, characterised by extreme sexual dimorphism and anti-predator adaptations. Females of the group are apterous and often exhibit a suite of defensive traits, namely: a painful venomous sting; the largest sting-to-body ratio of any hymenopteran; a thick slippery exoskeleton; large cuticular spines or heads; olfactory and auditory aposematism; and striking visual aposematism leading to their participation in one of the largest known Müllerian mimicry complexes. Despite their diversity, abundance, ecological importance, and evolutionary significance, mutillids are often underrepresented in our collections and severely understudied, especially in Australia. Most Australian species have been temporarily dumped into the morphologically diverse genus, *Ephutomorpha*, with a mere 4% of described species known from both sexes, and with much of the diversity remaining undocumented. Due to the challenging nature of mutillid taxonomy, a comprehensive molecular phylogeny is key to understanding the true diversity and relationships



within the Australasian mutillid fauna. Here, we use a large morphometric and phylogenomic dataset spanning all currently described Australasian genera, to reconstruct the first-ever molecular phylogeny of the Australasian Mutillidae and elucidate previously unclear generic and species boundaries. Using colour-trait data from 5000 female mutillid wasps (approximately 200 species from 10 genera), we also document the presence of four putative mimicry rings in Australia, with strong colour-pattern similarities, which are not due to shared ancestry. This study builds on evidence of velvet ants forming large Müllerian mimicry complexes and provides a framework to assess how evolutionary and ecological processes shape present-day patterns of diversity.

07:00 Taxonomic revisions and species with variable molecular, morphological and biological data: examples from temperate and tropical Braconidae parasitoid wasps

Presented by Jose Fernandez-Triana

Jose Fernandez-Triana (Canadian National Collection of insects, Ottawa, Canada)

Species recognition, diagnosis and descriptions can be facilitated by extensive use of molecular data (e.g., DNA barcoding), combined with other approaches (e.g., morphology) to increase the accuracy, quality, and usability of the results. However, in practice this is complicated because species have variable amounts of information associated, ranging from taxa well characterized by many available specimens and a wealth of data (molecular, morphological, biological, etc.) to taxa very poorly understood, with one/few specimens known and barely any information. The disparity of data prevents or difficult a uniform treatment of all species. This is further complicated for hyper diverse taxa (such as parasitoid wasps), and for groups with many species described in the historical literature (mostly in temperate areas). Here examples are presented on how to rank all species based on the accessibility and quality of name-bearing types, availability of other specimens, possibility to assess morphological and biological traits, and availability (or potential availability) of molecular data. Based on the ranks assigned, species are then diagnosed and integrated into the taxonomic work at different levels, as allowed by the available data. The fauna from tropical and temperate areas present different sets of challenges that nevertheless could be overcome by the approach proposed here.

07:15 Skeletomusculature of Hymenopteran male genitalia - Leptanillinae and beyond

Presented by Ziv Lieberman

Griebenow, Z. H. (Colorado State University, Fort Collins, USA); Richter, A. (Friedrich-Schiller-Universität Jena, Jena, Germany, Okinawa Institute of Science and Technology, Onna-son, Japan); van de Kamp, T. (Karlsruhe Institute of Technology, Eggenstein-Leopoldshafen, Germany); Economo, E. P. (Okinawa Institute of Science and Technology, Onna-son, Japan); Lieberman, Z. E. (University of California, Davis, Davis, USA)

Male genitalia are a perennial fascination for hymenopterists, famous both for their structural and functional diversity, and as a source of phylogenetic signal indispensable to classification. Morphological study of ants, however, is largely limited to that of workers. The enigmatic subfamily Leptanillinae is an exception, in that male morphology is fundamental to classification at various ranks. These ants are further exceptional in the spectacular degree of modification of the male genitalia, relative to other ants and Hymenoptera more broadly. In order to understand the evolutionary context of the bizarre leptanillines, we undertake a comparative study of their male genitalia across all major lineages in the subfamily, including direct comparison to ant outgroups and aligning our observations with the remaining Hymenoptera. We take a homology-explicit approach to understanding and describing skeletomusculature based on recently adduced interordinal homologies for the Hexapoda, and provide a new, consistently constructed musculature nomenclature consistent with schemata for other taxa and tagmata. We discuss our



system in relation to other recent recommendations regarding male genitalic terminology, and reflect on the coexistence and co-illumination of terminologies from the morphemic, homological, and ontological perspectives.

07:30 Potter wasps – the eco-friendly engineers of the insect world

Presented by Shweta Mukundan - Twitter handle '@cervicapra

Shweta Mukundan (Indian Institute of Science, Bengaluru, India); Renee M. Borges (Indian Institute of Science, Bengaluru, India); Tejas G. Murthy (Indian Institute of Science, Bengaluru, India); Bhupendra Chand (Indian Institute of Science, Bengaluru, India)

Animal-built structures have been a source of inspiration to mankind and have application in diverse fields such as architecture and engineering, material science, biomimicry, robotics and sustainable design. Studying the process of nest building in animals not only imparts knowledge on the ecology and behaviour of the concerned taxon but also act as model systems for biomimetics. Nests are built to serve a variety of purposes like reproduction, offering protection and shelter to developing offspring, assist in social organization and are often sites for resource storage. Hymenopterans show remarkable plasticity in nests ranging from simple cavity boring (in wood or soil) to complex nests made with mud, chewed plant material or combs from beeswax. Even though common, the nests and nesting behaviour of solitary wasps have not been documented thoroughly. Here we report some preliminary observations made on the nesting behaviour of commonly seen potter wasps (Vespidae: Eumeninae) – *Phimenes flavopictus* and *Delta conoideum* on the campus of Indian Institute of Science, Bengaluru during the months of January 2023–May 2023. The sequence of events in the construction of the mud nests have been carefully documented. We plan to conduct a suite of tests on the nests which will unveil its chemical and physical properties and the knowledge thus gained can be extended to use in sustainable architecture and eco-friendly urban planning.

07:35 Iziko: Fellow workers, Field work & Fantastic discoveries

Presented by Terry Reynolds

Terry Reynolds (Agricultural Research Council), Simon van Noort (Iziko Museums of South Africa), Nokuthula Nhleko (Iziko Museums of South Africa), Mikhaila Gordon (Iziko Museums of South Africa), Paula Strauss (Grootbos Foundation)

An overview is given into the happenings at Iziko Museum of South Africa, Entomology. Where have we been sampling? Why are sampling there? What fun stuff have we uncovered? and Who are our collaborators?

07:40 HYMENOPTERA SHOWDOWN:

Potter wasps

Shweta Mukundan - Twitter handle '@cervicapra (Indian Institute of Science, Bengaluru, India); Renee M. Borges (Indian Institute of Science, Bengaluru, India); Tejas G Murthy ((Indian Institute of Science, Bengaluru, India); Bhupendra Chand (Indian Institute of Science, Bengaluru, India)

Shillingworthia shillingworthi

Natalie Dale-Skey (Natural History Museum, London, United Kingdom)



07:50 *Neodryinus typhlocybae* as a possible biocontrol agent of *Metcalfa pruinosa* in Ukraine: GIS-modeling of potential distribution in the context of climate change

Presented by Maryna Kaliuzhna

M. O. Kaliuzhna (I. I. Schmalhausen Institute of Zoology of National Academy of Sciences of Ukraine, Kyiv, Ukraine); E. E. Perkovsky (I. I. Schmalhausen Institute of Zoology of National Academy of Sciences of Ukraine, Kyiv, Ukraine, Natural History Museum of Denmark, Copenhagen, Denmark); L. M. Bondareva (National University of Life and Environmental Sciences, Kyiv, Ukraine); L. G. Titova (Plant and Fruit Crop Quarantine Research Station, Institute of Plant Protection, National Academy of Agrarian Sciences of Ukraine, Odesa, Ukraine); Yu. E. Klechkovskiy (Plant and Fruit Crop Quarantine Research Station, Institute of Plant Protection, National Academy of Agrarian Sciences of Ukraine, Odesa, Ukraine)

The citrus flatid planthopper, *Metcalfa pruinosa* (Say, 1830), is native to North America and is one of the most important invasive species in Europe. Its invasion began in Italy in 1979, and *M. pruinosa* is now widespread in 27 countries and territories throughout Eurasia (EPPO, 2023). The first finding of *M. pruinosa* in Ukraine was documented in 2011 in Odesa (Uzhevskaya et al., 2012), and now this species is registered in 10 regions of the country (Bondareva et al., 2023, in press). Effective chemical control of *M. pruinosa* is challenging due to the polyphagous nature of the species, its prolonged nymphal hatching period, and the waxy secretion that covers the nymphs during development; in addition, the use of pesticides may lead to further ecological problems in urban and agroecosystems. A promising solution for the regulation of *M. pruinosa* is the implementation of biological control by its natural enemy, the parasitoid *Neodryinus typhlocybae* (Ashmead, 1893) (Hymenoptera, Dryinidae). This species, also native to North America, is now actively spreading in Europe (Vétek et al., 2019).

Using GIS modeling, we assessed the suitability of the territory of Ukraine for *M. pruinosa* and its natural parasitoid *N. typhlocybae* under current and future climatic conditions. The most favorable areas for both species are located in the southern, eastern, and central parts of the country, as well as in the Zakarpattia region (western Ukraine). There are prospects for the introduction of *N. typhlocybae* for classical biocontrol, especially in the southern regions of Ukraine.

08:05 Break 2 Session 3

08:15 International Society of Hymenopterists 2023 business meeting

09:15 Wrap-up



SESSION 4, chaired by Cristina Vasilița

11:00 Introductory remarks

11:05 KEYNOTE: Evolution of unusual life histories of Torymidae (Chalcidoidea)

Petr Janšta (Charles University, Prague, Czech Republic)

Dr. Petr Janšta completed his PhD at the Charles University, Faculty of Science (Prague, Czech Republic). In 2019 he was awarded a Fulbright Visiting Scholar Program at University of California, Riverside in Prof. Heraty's lab, followed by a postdoc at Department of Entomology, State Museum of Natural History, Stuttgart, Germany in the team of Prof. Lars Krogmann. He is currently on permanent position as an assistant professor at Charles University in Prague. His research focuses on taxonomy, phylogeny and evolution of various groups of Chalcidoidea, especially those associated with galls (mostly Megastigmidae and Torymidae). He and his research team are exploring the role of morphological and functional adaptations on diversification of parasitoids. Recently he has broadened the scope of his team to include population genomics and coevolution of Darwin wasps and their hymenopteran parasitoids.

11:45 Illuminating a dark taxon: Central-European Eurytomidae (Hymenoptera: Chalcidoidea)

Presented by Samin Jafari

Samin Jafari (Leibniz Institute for the Analysis of Biodiversity Change, Bonn, Germany), Gerard Delvare (Centre de Biologie pour la Gestion des Populations (CBGP), Montpellier, France), Hossein Lotfalizadeh (Iranian Research Institute of Plant Protection (IRIPP), AREEO, Tehran, Iran), Sergio Avila-Calero (Leibniz Institute for the Analysis of Biodiversity Change, Bonn, Germany), Anne Ankermann (Leibniz Institute for the Analysis of Biodiversity Change, Bonn, Germany), Ralph S. Peters (Leibniz Institute for the Analysis of Biodiversity Change, Bonn, Germany)

Eurytomidae, a family within the Chalcidoidea, comprises over 1400 known species worldwide. In Germany, there are records of 101 species from six different genera. Eurytomids exhibit a wide variety of life histories, with many species acting as parasitoids of various insect taxa and life stages, while others are secondarily phytophagous, feeding on seeds or stems, or inducing galls on different plant taxa. As a result, eurytomids play diverse and abundant roles in two crucial ecological niches within natural food webs, namely as specialized herbivores and parasitoids. Generally, distinguishing eurytomids from other parasitoid wasp families is relatively straightforward. However, despite efforts to enhance our understanding of the family, species-level identification remains problematic, and the actual number of species in Germany remains unknown. The GBOL III: Dark Taxa project aims at shedding light on various families, including Eurytomidae, through an integrative taxonomy approach to species delimitation. We focus on two groups of the Central European fauna, the species-rich genus *Eurytoma* and the *Bruchophagus gibbus* species group. Species within *Eurytoma* are remarkably similar, and species limits are often not well defined. In addition, males have never been reliably associated with females. We employ both morphological and molecular approaches (mostly based on COI barcode data) to delimit species within our target groups and to match females with the morphologically even more challenging males. Automated species delimitation methods using the COI nucleotide sequence data that now can be generated at a high success rate using a newly designed primer, yielded promising preliminary species delimitations, indicating a significant increase in the recorded number of *Eurytoma* and *Bruchophagus* species in Germany



12:00 Wasps going north? *Triteleia peyerimhoffi* (Platygastroidea: Scelionidae) in Germany

Presented by Ecaterina Pîrvu - Twitter handle '@ecaterina_pirvu'

Ecaterina Pîrvu ("Alexandru Ioan Cuza" University, Iași, Romania) *Cristina Vasilita* (Stuttgart State Museum of Natural History)

Triteleia peyerimhoffi is a species of parasitoid wasps, with Palaearctic distribution, described in the family Scelionidae (Platygastroidea) and is the only species of this genus known from the Western Palaearctic. *Triteleia peyerimhoffi* presents high intraspecific morphological variability, potentially influenced by a Circum Mediterranean distribution area. In this study, *T. peyerimhoffi* is reported for the first time from Germany (Baden-Württemberg, Rheinland-Pfalz), the most northern distribution point for this species.

In the context of the German Barcode of Life III: dark taxa project, the species *T. peyerimhoffi* is for the first time treated through an integrative taxonomy approach: barcode data is analyzed in search for intraspecific variability signs and the specimen are inspected for morphological variability.

As a result, this study provides the first reliable barcode identification for this species and an updated distribution record, making one more species of dark taxa available for ecological, conservation and biodiversity studies.

12:15 Phylogenetic placement of Darwin wasps (Ichneumonidae) in amber, before and after CT scanning

Presented by Alexandra Viertler

Alexandra Viertler (University of Bern, Bern, Switzerland & Natural History Museum Basel, Basel, Switzerland); *Karin Urfer* (Natural history Museum St. Gallen, St. Gallen, Switzerland); *Georg Schulz* (Core Facility Micro- and Nanotomography, University of Basel, Basel, Switzerland); *Seraina Klopstein* (Natural History Museum Basel, Basel, Switzerland); *Tamara Spasojevic* (Natural History Museum Basel, Basel, Switzerland)

The correct interpretation of fossils and their reliable taxonomic placements are fundamental for understanding the evolutionary history of biodiversity. Amber inclusions often preserve more morphological information than compression fossils, but are often partially hidden or distorted, which can impede taxonomic identification. Here, we scanned four new fossil species of Darwin wasps from Baltic and Dominican amber, using micro computed tomography (micro-CT) scans and 3D reconstructions to accurately interpret and increase the availability of morphological information. We then infer their taxonomic placement in a Bayesian phylogenetic analysis by combining morphological and molecular data of extant and fossil Darwin wasps and evaluate the impact and usefulness of the additional information from micro-CT scanning. The results show that although we gained significant morphological information from micro-CT scanning, especially concerning measurements, and hidden dorsal and ventral structures, this did not impact subfamily-level placement for any of the four fossils. However, micro-CT scanning improved the precision of fossil placements at the genus level, which might be key in future dating and diversification analyses.



12:30 Ants of Cyprus: 150 years in 300 seconds

Presented by Jakovos Demetriou - Twitter handle '@JakovosD'

Jakovos Demetriou (Department of Ecology and Systematics, Faculty of Biology, National and Kapodistrian University of Athens, 15784 Athens, Greece; Joint Services Health Unit Cyprus, BFC RAF Akrotiri BFPO 57, Akrotiri, Cyprus; Enalia Physis Environmental Research Centre, Acropoleos 2, Aglantzia 2101, Nicosia, Cyprus)

Bordered by Asia and Africa, Cyprus is the 3rd largest island of the Mediterranean, a global biodiversity hotspot. It is an endemism centre for plants, migrating birds, mammals and insects. Research on the ants of Cyprus dates back almost 150 years, with the first records of species published in 1879 by Auguste Forel and Carlo Emery. Since then, research has been scarce although an increasing interest is evident in the last 30 years. In the framework of my PhD studies (2022 - present) and Darwin Plus Fellowship DPLUS200 "Biodiversity and spatiotemporal patterns of ants on Akrotiri Peninsula" (2023-2025), funded by the UK government through Biodiversity Challenge Funds – The Darwin Initiative, I will be filling-in gaps on ant biodiversity, distributions and conservation on Cyprus. These endeavours are supported by experts on invasive alien species, myrmecology and island biogeography from Cyprus, Greece, Japan, Poland and the United Kingdom. Despite available online data (AntMaps) listing 65 native and 10 alien species for Cyprus, our recent investigations have uncovered numerous new alien and native species. The island's checklist is still taking shape, currently numbering approx. 90 species (unpublished data). The high number of alien species (17) raises concerns and its large number of endemics (16 – including unpublished data) justifies its status as a biodiversity and rarity hotspot for Mediterranean ants. The best is yet to come, stay tuned.

12:35 Break 1 Session 4

12:45 Biodiversity conservation: the key to effective crop protection in organic agriculture

Presented by Maryna Kaliuzhna

M. Kaliuzhna (I.I. Schmalhausen Institute of Zoology of National Academy of Sciences of Ukraine, Kyiv, Ukraine, LLC "Institute of Organic Agriculture", Agro-Industrial Group "Arnika", Hlobyne, Ukraine); V. Kulinich (LLC "Institute of Organic Agriculture", Agro-Industrial Group "Arnika", Hlobyne, Ukraine); V. Fursov (I.I. Schmalhausen Institute of Zoology of National Academy of Sciences of Ukraine, Kyiv, Ukraine); Yu. Geryak (Institute of Ecology of the Carpathians of the National Academy of Sciences of Ukraine, Lviv, Ukraine, National Park "Boykivshchyna", Borynia, Ukraine); O. Zhovnerchuk (I.I. Schmalhausen Institute of Zoology of National Academy of Sciences of Ukraine, Kyiv, Ukraine, Institute of Zoology SAS, Slovakia); T. Zhebina (Uzhhorod National University, Uzhhorod, Ukraine); A. Gumovsky (I.I. Schmalhausen Institute of Zoology of National Academy of Sciences of Ukraine, Kyiv, Ukraine, LLC "Institute of Organic Agriculture", Agro-Industrial Group "Arnika", Hlobyne, Ukraine)

The importance of biodiversity conservation in achieving sustainable biological pest control in organic agriculture will be discussed. Using case studies from our research in Ukraine in 2017-2023, we will show that the biological and ecological characteristics of both phytophages and entomophages influence the success of biocontrol programs; higher levels of biodiversity contribute to the resilience of agroecosystems against mass pest outbreaks, and the conservation of areas with natural biodiversity allows to achieve significant results from natural pest control; it is important to be aware of and evaluate the impact of biocontrol products on beneficial organisms.



13:00 A contribution to the taxonomy of the genus *Calosota*

Presented by Lucian Fusu

Lucian Fusu (Universitatea Alexandru Ioan Cuza, Iași, Romania)

The genus *Calosota* groups species of parasitoid hymenoptera from the family Eupelmidae, superfamily Chalcidoidea. Their biology is diverse, with many species being parasitoids of coleopteran larvae such as those from the families Anobiidae, Cerambycidae, Cleridae or Curculionidae. They can also be primary parasitoids of other taxonomic groups such as Lepidoptera, Diptera, Hymenoptera or hyperparasitoids. *Calosota obscura* is one of the most common species of the genus in Europe, but molecular data for two genes, one nuclear and one mitochondrial, indicate it as a complex of two cryptic species. Moreover, the discovery of a new species of *Calosota* from Europe brings into question the morphological limits of the genus.

13:15 The legacy of Ian Gauld

Presented by Gavin Broad - Twitter handle [@BroadGavin](#)

Gavin R. Broad (Natural History Museum, London, UK)

Ian Gauld (1947-2009) is a huge figure in the world of ichneumonid taxonomy, and pioneering in the study of Neotropical Hymenoptera. He was a mentor to many, and a complicated person in some respects. This talk gives a brief overview of Ian's work and life, as there were few published obituaries, and attempts to put his work in context.

13:30 Break 2 Session 4

13:40 Unknown friends: a phenomenon of the bee-associated mites

Presented by Justyna Kierat

Justyna Kierat (Institute of Botany, Department of Biology, Jagiellonian University, Kraków, Poland); Wojciech Witaliński (Institute of Zoology and Biomedical Research, Department of Comparative Anatomy, Jagiellonian University, Kraków, Poland); Marcin Wiorek (Institute of Systematics and Evolution of Animals, Polish Academy of Sciences, Kraków, Poland)

Bees are associated with diverse accompanying fauna from various systematic groups, including mites (Acari). These arachnids often live inside bee nests and can be encountered on adult bees, when 'hitchhiking' to new localities. Some species act as cleptoparasites, but others are neutral or mutualistic. Besides, some bees and mites have apparently evolved a very close relationship, as evidenced by special structures on the bees' bodies (acarinarium), meant to accommodate the mites. The bee-associated mites, particularly their in-nest behaviour and geographical distribution, mostly remain understudied, however. A tell-tale example is *Anoetus halicticola*, a species associated with a European bee *Halictus sexcinctus*. Despite commonness of its host, and observations suggesting that the mite is also not rare, it was acknowledged as a new species as late as 1998, and our two records in Poland and Germany were the first and the second one confirmed record for the country, respectively.

13:45 Peculiarities of taxonomy, morphology and biology of egg-parasitoids of the family *Trichogrammatidae* (Chalcidoidea, Hymenoptera)

Presented by Victor Fursov - Twitter handle [@DrVictorFursov](#)

Victor Fursov (I.I. Schmalhausen Institute of Zoology of National Academy of Sciences of Ukraine, Kyiv, Ukraine)

Problems and peculiarities of taxonomy, morphology and biology of egg-parasitoids of the family Trichogrammatidae (Chalcidoidea, Hymenoptera) are discussed with illustrations. The comparison of morphological characters is given. The review of unique adaptations for egg-parasitism of the



family Trichogrammatidae is discussed. The examples of taxonomical problems in the genus Trichogramma are reviewed. The importance of egg-parasitoids for the development of biological control of agricultural pests is discussed. The importance, prospectives and problems of molecular and morphological study of the genus Trichogramma are discussed.

14:00 Chromosomes of Symphyta: current state and perspectives of research

Presented by Vladimir Gokhman

Vladimir E. Gokhman (Moscow State University, Moscow, Russia)

The current state and perspectives of karyotype research on the Symphyta are discussed. This suborder includes more than 8,000 described species, but karyotypes of just about 400 members of this group are studied up to now. Moreover, data on the chromosome sets of Anaxyelidae, Blasticotomidae, Xiphydriidae and Orussidae are entirely missing, and in some other families, i.e., Xyelidae, Megalodontesidae, Cimbicidae, Pergidae, Siricidae and Cephidae, only several species are examined. The haploid chromosome number (n) in this group can vary from 5 to 35, although the ancestral state of this character is apparently closer to $n = 25$ found in the only studied species of Xyelidae, *Xyela julii* (Brébisson). Metacentrics and submetacentrics prevail in the karyotypes of the majority of Symphyta, but subtelocentrics and/or acrocentrics are often present in the chromosome sets of species with higher chromosome numbers. In the process of karyotype evolution, most horntails and sawflies retained higher n values, but this variable decreased in the superfamily Tenthredinoidea down to $n = 10$ and less. Cryptic species of sawflies detected by their karyotypic features are known in the families Pamphiliidae, Tenthredinidae and Diprionidae, and they are also likely to occur in Argidae. Prospective directions of chromosome research of the Symphyta imply a detailed investigation of the karyotype structure of these insects, including preparation of karyograms and morphometric analysis of chromosomes, as well as the chromosome study of horntails and sawflies by using techniques of molecular cytogenetic analysis, primarily fluorescence in situ hybridization (FISH).

14:15 HYMENOPTERA SHOWDOWN

Bees (*Anthophila*)

Justyna Kierat (Institute of Botany, Department of Biology, Jagiellonian University, Kraków, Poland)

Aphidiinae (*Braconidae*)

M. O. Kaliuzhna (I. I. Schmalhausen Institute of Zoology of National Academy of Sciences of Ukraine, Kyiv, Ukraine)

14:25 Wrap-up including prize announcements

CODE OF CONDUCT

The International Society of Hymenopterists aims to encourage scientific research and to promote the diffusion of scientific knowledge concerning Hymenoptera.

The Society aims to be inclusive to the largest number of contributors, with the most varied and diverse backgrounds possible. As such, we are committed to providing a friendly, safe, and welcoming environment for all, regardless of gender, sexual orientation, ability, ethnicity, socioeconomic status, and religion.

We expect all participants at ISH functions to abide by our Code of Conduct policy (see https://www.hymenopterists.org/ish_code_of_conduct_2019/), and in particular to exercise consideration and respect and refrain from demeaning, discriminatory, or harassing behavior and speech



“That’s Commitment”, Photograph by Jessica Awad

During a collecting trip in Bavaria, Marina Moser’s attempt at a cookie break is interrupted. Cristina Vasilița has hit the jackpot – dozens of *Lagynodes* (Ceraphronoidea: Megaspilidae) swept from nearby vegetation! Marina jumps in to collect the specimens, still holding the cookie in her mouth.