

Hamuli

The Newsletter of the International Society of Hymenopterists



Presentation of the first ISH Distinguished Research Medal to Charles D. Michener. From left to right: Leonard Krishtalka (director of the KU Natural History Museum), Lynn S. Kimsey (then president of ISH), Charles D. Michener, and Jim Woolley, outside of Dyche Hall at the University of Kansas, Lawrence, in Spring 2003 (photograph courtesy of Lynn S. Kimsey).

Charles Duncan Michener, 1918–2015

By: Michael S. Engel, University of Kansas, Lawrence, USA

On 1 November 2015 we bid farewell to one of the most distinguished of hymenopterists, sociobiologists, evolutionary biologists, and humanists. Charles Duncan Michener, widely known to all as 'Mich', was born 22 September 1918 in Pasadena, California, and grew to become the most renowned melittologist of all time. A devoted naturalist from early childhood, Mich was encouraged at a young age by the likes of Theodore D. A. Cockerell and Philip H. Timberlake, melittological giants of the era, and in January 1935 he published his first paper in the *Pan-Pacific Entomologist* (his last paper would appear

in this same journal over 80 years later, in April 2015). In 1936, Mich enrolled at the University of California, Berkeley, eventually completing his Bachelor's (1939) and doctorate (1941), the latter under the supervision of Edward O. Essig. As an undergraduate at Berkeley Mich was among a rarified group of older students who took him on collecting and museum trips, and many of whom went on to prominent positions in Entomology, including Robert L. Usinger, E. Gorton Linsley, and Edward S. Ross, among others. Mich's dissertation centered on the comparative morphology, phylogeny, and classification of bees and was later published as a *Bulletin of the American Museum of Natural History* (1944), and clearly demarcated the beginning of the 'Michener Era' of bee systematics. No single work has had such a transformational role in reshaping the



In this issue...

Charles Michener (1918–2015)
(Engel) ... 1

Fieldwork in Peru (Ferrari)
... 3

Collecting in French Guiana
(Meierotto & Sharkey) ... 4

Fieldtrip to Chile (Packer) ... 6

Murray Blum (1929–2015)
(Schmidt) ... 7

ISH Symposia ... 8

Chalcidoidea symposium
(Heraty) ... 9

Upcoming book (Schmidt) ...
12

Wanted - *Eutrichosoma* (Heraty) ... 13

Chief Editor's updates (Deans)
... 14

Author's Instructions ... 5

Membership Information ... 5

Contact: Andrew R. Deans
Department of Entomology
Pennsylvania State University
501 ASI Bldg
University Park, PA
16802 USA.
Fax: +1 814 865 3048
Ph: +1 814 865 1895
adeans@gmail.com

President:
James B. Whitfield
jwhitfie@life.illinois.edu

Treasurer:
Craig Brabant
brabant@entomology.wisc.edu

Secretary:
Lars Krogmann
lars.krogmann@smns-bw.de

Webmaster/Archivist:
Katja Seltmann
enicospilus@gmail.com

Editor, Hamuli:
Andrew R. Deans
adeans@gmail.com

Associate Editors:
Robert Longair
István Mikó

Art Director:
Nick Sloff

Articles appearing herein should not be considered published for the purposes of zoological nomenclature. Find us on the Web:
<http://hymenopterists.org>

Michener ... Continued

study of bees as did this monograph, and, among other things, included what would today be referred to as a comprehensive ontology for morphological terminology necessary for understanding the evolutionary relationships and biology of the Apoidea. In 1942, Mich took a position as Assistant Curator for Lepidoptera at the American Museum of Natural History, and this appointment brought him into the circle of evolutionary biologists Ernst Mayr, George Gaylord Simpson, Theodore C. Schneirla, and Theodosius Dobzhansky, all of whom had a strong influence on Mich's developing ideas. During World War II, Mich served in the Army Sanitary Corps, first in Mississippi surveying mosquitoes but then relocating to Panama where he was assigned to work on the biology and control of chigger mites. While in Panama he would develop collections that would later form the foundation for his 1954 monograph of the country's bee fauna. Following his return to the American Museum, Mich resumed his lepidopterological investigations, principally on the Saturniidae (resulting in an important monograph of the family published in 1952).

In 1948, Mich relocated to the University of Kansas where he would spend the remainder of his career, ultimately becoming Watkins Distinguished Professor in the Departments of Entomology and Systematics and Ecology, as well as Senior Curator, and one-time Director, in the Snow Entomological Museum (today the Division of Entomology in the University of Kansas's Biodiversity Institute). While at Kansas Mich devoted himself more fully to his interests in bees, exploring virtually every aspect of their biology, behavior, and systematics, and launching expeditions throughout the world as he continued to revise the fauna on a global scale. During the 1950s and 1960s, through his work on the behavior of bees, he developed hypotheses as to the evolution of social behavior and communication and extrapolated these across other hymenopteran societies, therein laying foundations for the revolution in biological thought that would later be dubbed 'sociobiology.' In 1974, Mich summarized his, by then already decades-old, experience with bee social biology in the highly influential book, *The*

Social Behavior of the Bees. Simultaneously, along with the Robert Sokal, Mich worked to develop more rigorous means of building classifications, ultimately arriving at the methodology we know today as numerical taxonomy. It is remarkable to consider what he achieved during these intellectually heady days in Kansas, and that he was continuing to produce sizeable and important treatises on bee systematics and comparative morphology throughout. For his tremendous contributions to these fields he was elected to membership in the American Academy of Arts and Sciences (1963) and the National Academy of Sciences (1965). He received two prestigious Guggenheim Fellowships which supported years working in Brazil (1955) and Africa (1966), respectively, while a Fulbright Award funded a year's work in Australia (1957). Through these and many other expeditions he developed one of the most comprehensive research collections on bees.

Mich formally retired in 1989 but did not slow for even a moment with his research, continuing to publish numerous papers, monographs, and books, the most significant being his nearly 1000-paged tome, *The Bees of the World* (2000), a revised and expanded second edition of which appeared in 2007. During the course of his career he described 579 species- and 262 genus-group names for bees, in addition to various taxa among the Acari, Lepidoptera, and Ichneumonidae. It is fair to say that no single individual will again ever have such an all-encompassing command of the global bee fauna, or such an overwhelming and foundational influence on their classification or the study of their social organization. Recognizing his lifetime achievements on bees, Mich was selected by the ISH as the inaugural recipient of the Distinguished Research Medal in 2002 (see photo on page 1).

Further biographical details are presented by Michener himself (2007, *Annual Review of Entomology*) as well as in a recent obituary (Engel, 2016, *Entomologist's Monthly Magazine*). A bio-bibliography listing his numerous publications spanning the 80 years he was active, as well as the taxa he established, appeared in the *Journal of Melittology* in celebration of his 97th birthday (<http://dx.doi.org/10.17161/jom.v0i54.5006>).

Fieldwork in Peru, June (2015)

By: Rafael Ferrari, York University, Toronto, Ontario, Canada

In late March of 2015, northern Chile and southern Peru received an unprecedented amount of precipitation. This astonishing phenomenon is of particular interest for my research on *Colletes* (Colletidae: Colletinae), a worldwide bee genus with much of its South American diversity endemic to these extremely arid areas. As an opportunity not to be missed, my local collaborator (and friend) Javier Cañote and I collected bees in Peru less than three months after the rains. According to the Peruvian legislation that deals with the issue of collection permits, to be allowed to sample Peru's biodiversity, any foreigner must be accompanied by a local researcher.

The same motivation (i.e. the heavy rains) has also prompted my supervisor, Dr. Laurence Packer, who has been studying the Atacaman bees for over 15 years, to undertake fieldwork in northern Chile. This trip was the subject of a report in the volume 6, issue 2 of *Hamuli*, published last year (Packer, 2015; see also page 6 of this issue).

From June 1st–23rd, Javier and I sam-



Figure 2. Landscape where the couple of *Neofidelia apacheta* was caught. This is the first record of this bee genus in Peru. Photo: R. Ferrari.

pled bees in the biggest central and southern Peruvian valleys, such as the Ica, Pisco, Ocoña and Sama Valleys. We drove from the capital Lima all the way south to Tacna (close to the border with Chile) using the Panamericana Sur as our main route (Fig. 1). Overall, flowering was good. In addition to the indispensable hand net, we also set up a few hundred pan traps and some vane traps with propylene glycol, a highly viscous substance that can last for several months without completely evaporating.

Even though I did not collect as many *Colletes* as any enthusiast of the genus would wish, collecting was not bad. In total, we caught nearly 40 specimens from three species: one of them is *C. gilvus*; the other two are probably undescribed species. Intriguingly, all specimens were caught in central Peru; we collected no *Colletes* south of Chincha Alta (Fig. 1). It should be stressed, however, that although southern Peru received an unexpected amount of rain in March, most *Colletes* species found in the driest areas of Peru are normally inactive in June, as their flight period usually begins in September/October. As a result, we experienced an unfortunate asynchrony between the two biological events. The fact that we were sampling *Colletes* a little early in the year might also explain the reason why the vast majority of the bees collected was male. Overall, the traps worked very well, although no *Colletes* were captured; they are infrequently collected using such methods.

Colletes aside, some other catches are also noteworthy. On our way to Arequipa (Fig. 1), we set up approximately a dozen pan traps near a patch of *Tiquilia* flowers (Boraginaceae), and one of those pan traps ended up capturing the female allotype of a species of *Geodiscelis* (Colletidae: Xeromelissinae), which has recently been published (Ferrari, 2015). Also, one vane trap left near Arequipa (Fig. 2) captured a pair of *Neofidelia* (Megachilidae: Fidelinae): the first record for the genus in Peru. Last but not least, among a few dozens of *Xeromelissa* (Colletidae: Xer-

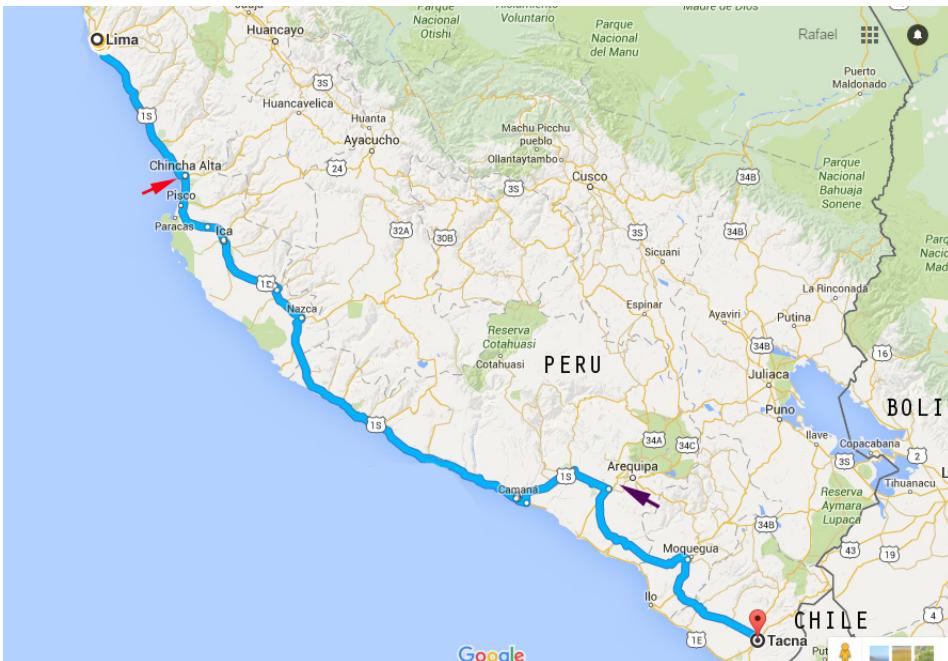


Figure 1. Map of Peru showing the driving route (the Panamericana Sur highway) of my field trip in June, 2015. The distance between Lima and Tacna is about 1,300km. The red arrow points to the city of Chincha Alta; purple arrow indicates where the female allotype of *Geodiscelis antiminera* was collected. Source: Google Maps.

Peru ... Continued

omelissinae) collected over the field trip, at least one species had never before been collected and some others are undescribed but known from earlier samples (Packer, pers. comm.).

I would like to express my gratitude to my supervisor Dr. Packer for making this field work in Peru possible, as well as for encouraging me to write this report. I am also grateful to Julio Rivera for helping me obtaining the necessary permits to collect in Peru, and Javier Cañote for his invaluable help throughout the trip.

References

- Ferrari, R.R 2015. A new species of *Geodiscelis* Michener & Rozen (Hymenoptera: Colletidae: Xeromelissinae) from Peru. *Zootaxa* 4033: 293–300.
Packer, L. 2015. Field trip in Northern Chile, April/May 2015. *Hamuli* 6: 1–2.

Collecting in French Guiana

By: Sarah Meierotto and Michael Sharkey,
Department of Entomology, University of Kentucky, Lexington, KY USA and
Dominique Zimmermann, Natural History Museum Vienna, 2nd Zoological Department, Vienna, Austria

In mid-September 2015 the three authors travelled to French Guiana for a little over two weeks of field work in the Nouragues Natural Reserve (<http://www.nouragues.cnrs.fr/spip.php?rubrique4>) (see map right). The travel was sponsored by the Nouragues Travel Grants Program which some readers may be interested in investigating. It was quite a journey to get to the station from North America for Sarah and Mike. We had to overnight in Miami and fly out the next day. We then took the milk run, (the only route short of traveling through France) stopping in Haiti, Guadeloupe, and Martinique before landing in Cayenne late the next day. Dominique was there to greet us at a research building owned by the Reserve. The next day we took a one-hour helicopter ride to the Saut-Pararé camp, one of two Research Stations hosted by the CNRS (Centre national de la recherche scientifique) in the Nouragues Natural Reserve.

The station included a large kitchen/common area, a lab/storage structure, several sleeping cabarets, and shower/toilet facilities. Most buildings were outfitted with electricity, running water, and even wireless. The station was very comfortable despite the lack of walls on any of the buildings. Hammocks were hung from the rafters of the sleeping quarters and covered with mosquito nets, providing protection on all sides against hungry or curious creatures. Despite the tropical climate, all of us were glad we packed our sleeping bags. We had planned to use the unique COPAS (Canopy Operating Access System) system to access little studied canopy-dwelling arthropods. It is made of three 45 m tall towers 180 m apart and covering an area of ca 1.5 ha which can be accessed with a kind of chair lift. Disappointingly, it was not functioning during our visit.

One goal of our research was to collect specimens to establish trophic links between caterpillars and their parasitoids using Next Generation Sequencing (NGS). NGS will allow detection and sequencing of host and parasitoid (perhaps even hyperparasitoid) DNA from a single extraction and PCR.

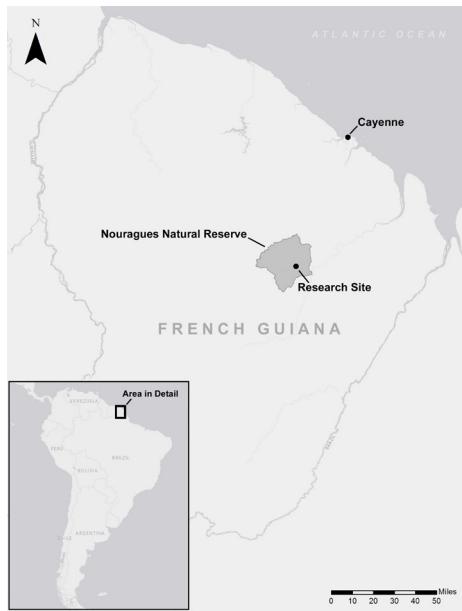
A second goal was to estimate biodiversity of the site using metabarcoding. A variety of insect trapping methods (Malaise, FIT, pitfall, canopy Malaise, light, Berlese) was used daily. The samples



Station facility. Photo by Sarah Meierotto.

will be homogenized and DNA will be extracted. A section of the CO1 barcoding region from all specimens within each sample will be amplified and tagged with a unique code added to the primer. Data from this project will be used to compare morphological and molecular methods of biodiversity surveys, refine metabarcoding methods, and compare the taxonomic and functional diversity of tropical and temperate forests.

The site of the research stations was chosen for the intact and undisturbed forest far from civilization. Indeed, during our collecting efforts we had the opportunity to see and hear a number of large vertebrates. The morning air was filled with howler monkey sounds, and during the day brown capuchins and spider monkeys inhabited the trees. On our night walks, not only did we encounter a whole bunch of creepy crawlers, such as amblypygids, scorpions, and strange cockroaches, but we were lucky enough to spy a pair of glowing



Esri, HERE, DeLorme, MapmyIndia, © OpenStreetMap contributors and the GIS user community



Cryptinae, Ichneumonidae. Photo by Sarah Meierotto.



Non-operational canopy access system. Photo by Sarah Meierotto.



Caterpillar. Photo by Dominique Zimmermann.



French Guiana ... *Continued*

eyes belonging to an ocelot. And what a joy to discover tiny disk-winged bats sleeping in rolled banana leaves, being fixed to their shelters with the little sucker cups on their wings.

Altogether French Guiana is certainly worth a visit. Being a French overseas department, it belongs to the European Union and thus has higher standards than many of the neighbouring countries. The biodiversity is spectacular. We had very good collecting there though for some groups a period at the beginning or end of the rainy season might be more productive. According to Brûlé & Touroult (2014) less than 2000 Hymenoptera species are known from the French Guiana, while over 15,000 are estimated to occur there. Our short collecting trip will surely add many more species to the known fauna of French Guiana but there is great opportunity for more research.

References:

- Brûlé S, Touroult J (2014) Insects of French Guiana: a baseline for diversity and taxonomic effort. *ZooKeys* 434: 111–130. doi: 10.3897/zookeys.434.7582

Meliponine bee nest inside an *Azteca* ant nest.
Photo by Dominique Zimmermann.

A Second Fieldtrip to Northern Chile in 2015 - October/November

By: Laurence Packer, York University, Toronto, Ontario, Canada

In the previous issue of *Hamuli* I wrote about remarkable rains in the Atacama Desert at an unusual time of year. At lower altitudes, if there is any rain, it generally falls in winter. Last year there was record-breaking rain in March, late summer. Remarkably, there were additional heavy rains later the same year in August, early winter rains. These rains precipitated a rapidly arranged return fieldtrip, for which I had to get some of my teaching assignments covered by others. However, given that one heavy rainfall in a year in this part of the world is unusual, having two large rain events in one year is truly unprecedented and everyone understood my need to get back to see what had happened to the bees.

During my earlier visit, I had placed cup traps and vane traps in many places in northern Chile. These had had propylene glycol added to them – to near the brim in the cups, half full in the vane traps. Five to six months later most cup traps still had some propylene glycol to dampen the dead insects. Even some that had completely dried out and had a little dry sand in them retained some interesting bees in remarkably good condition. The vane traps were all in good shape. Detailed searching through these samples remains to be done.

In the October-November trip, I drove north from Santiago, stopping at many potentially interesting collecting localities on the way. In one famous bee-collecting spot – South of Vicuña – I found large numbers of the monotypic Chilean endemic genus *Neffapis* (*N. longilingua*, Ruz) (Andrenidae: Panurginae) as well as many *Chilimalopsis parvula* Toro (Apidae: Apinae). I had found these species the first time I visited this area, in 2000, but had looked for them without success many times in the intervening years; finding that they persisted here was good news. I also caught a specimen of *Euherbstia excellens* Friese (Andrenidae: Andreninae) in a cup trap. Vicuña is the site where Jerry Rozen (AMNH) had studied this species in 1991, but I had never found it here on any of my earlier trips.



Palo Buque. The perennial plants among the scree in the foreground (mostly *Loasa* sp., and *Cleome chilensis*) occasionally give the tops of the coastal hills a greenish tinge, but the entirely green hillsides, primarily from a carpeting of *Nolana jaffueli*, are without precedent.



Alto Patache – a fog oasis where it rained in 2015 for the first time since 1997. The two people are Horacio Larrain and, to his right, Sebastián Toro. On the right, a damaged fog trap – such traps can condense up to 14 litres of water per metre of mesh in 24 hours (daily averages of 7.8 litres per metre per day over 7 years – for more details see Packer, 2012, *Zootaxa*, 3408, pages 54–58 and references therein).

Further north, the storms of August 8th and 9th had been violent in places. The landscape around the fog oasis at Alto Patache was much changed, the larger fog collectors there mostly ripped to shreds and the small research station severely damaged (see Horacio Larrain's blogpost: <http://eco-antropologia.blogspot.ca/search/label/Alto%20Patache>). This storm resulted in the first rainfall there since 1997. Several small coastal communities nearby were destroyed by mudslides, the effects of which were still visible in Novem-

Chile ... Continued

ber. It was the greenest that Horacio had seen in 50 years of visiting the site.

At Palo Buque, just south of the coastal town of Iquique (average annual rainfall 0.6mm per year) the hillsides were green for the first time in living memory. While signs announcing “desierto florido” are not uncommon in the southern Atacama, in late 2015 they were placed at the entrance of Palo Buque for the first time ever.

Just outside of Antofagasta (average rainfall 1.7mm per year), the annual *Nolana* species that made the hillsides white with their flowers in April (see my Figure 2 in the previous issue) were still in bloom at the end of October – an unprecedented 5 months of flowering.

But what of the bees? I spent five hours climbing around the sandhills and scree slopes at Palo Buque under perfect weather conditions for bees (page 6, top figure) and I caught three – two *Callonychium* (Andrenidae: Panurginae) and one *Caenohalictus* (Halictidae: Halictinae). I suspect that rains and subsequent flowering at this locality are simply too rare for a diverse bee fauna, although some areas had already dried up and perhaps I was a little late for some taxa (for more information on the conditions at this site see Horacio Larrain’s blog posts: <http://eco-antropologia.blogspot.ca/search/label/Palo%20Buque>).

At Alto Patache, Horacio and a student, Sebastián Toro (no relative of the late Harold Toro), had put out some pan and vane traps for me on September 28th. When we visited on October 24th, there were numerous *Penapis larraini* (Halictidae: Rophitinae) on the *Nolana* (Solanaceae) flowers as we approached the fogger area of the oasis. However, by the time we got to the oasis proper the conditions were not conducive to bee activity: gale force fog and cold temperatures (page 6, bottom figure). This was my first visit to a fog oasis and having the moisture condense on my beard, moustache, eyebrows and even my nostril hairs, was a new experience. The traps contained many more *Penapis*, plus a few *Parasarus* (Andrenidae: Panurginae), but unfortunately no *Neofidelia submersa* Dumesh and Packer (Megachilidae: Fidieliinae) which may be endemic to Alto Patache. We re-arranged and refilled the traps which Horacio subsequently picked up on December 4th: hopefully there will

be some *N. submersa* and other bees in them. There were still flowers and bees active at that time – another remarkably lengthy flowering period for this part of the world.

Just outside of Antofagasta the same three *Nolana* species that were in bloom in April were still in flower on October 21st, albeit less densely. Bees were more abundant here than when the flowers were denser in April and I caught more *Penapis* and *Parasarus* than I had earlier but also quite a few specimens of *Neofidelia* – which species remains to be discerned. I had not found *Neofidelia* earlier in the year. This suggests to me that the latter genus may only fly when rains occur at the “normal” time of year – ie winter.

Again, I left out many propylene glycol-filled traps, which I plan to pick up in January–February 2016.

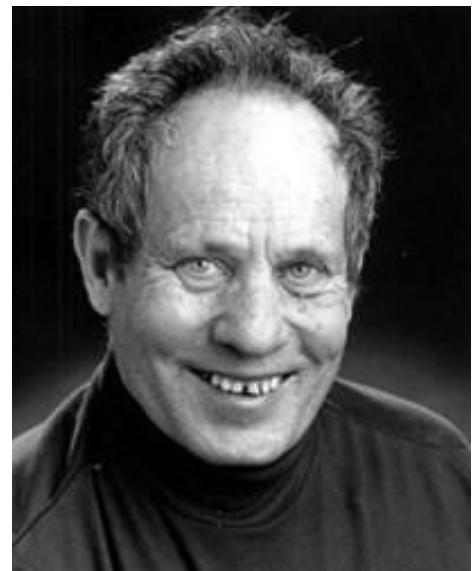
I thank Alfredo Ugarte, Rolando Humire Coca, Sebastián Toro and especially Horacio Larrain for facilitating my fieldwork in late 2015 and I thank Scott MacIvor, Thomas Onufko and Alana Pindar for teaching my classes for me while I escaped.

Murray Blum, 1929–2015

By: Justin Schmidt, Southwestern Biological Institute, Tucson, Arizona, USA

We recently lost a giant of the Hymenoptera world. Murray S Blum arrived in the world July 19, 1929 and departed March 22, 2015; between these dates he changed our views of Hymenoptera, chemical ecology, and much of insect biology. We could talk about his many awards and hundreds of publications – those were presented in the *American Entomologist* 61: 195–96 (2015) – but what’s really important is what Murray did for entomology and science overall.

Almost from the beginning Murray was destined to be an entomologist, and hymenopterist in specific. His first really big entry into the world scientific stage came with his pioneering work starting in the late 1960s on the venom chemistry of fire ants. He showed that unlike other animal venoms, fire ant venoms were composed nearly entirely of piperidine alkaloids, small highly active organic chem-

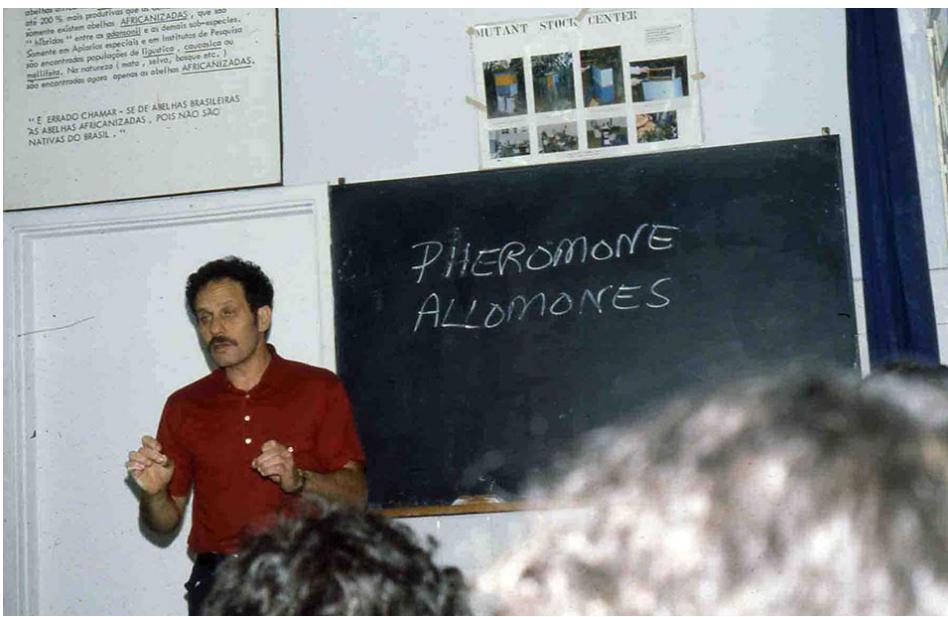


Murray Blum, 1929–2015.

ical compounds. This work was the first example of use of chemical compounds in taxonomy and ushered in the era of chemotaxonomy. One could argue these findings paved the way for use of cuticular hydrocarbons and isozymes in taxonomy and even the current use of molecular DNA for taxonomy.

Murray was a Renaissance man in the field of chemical ecology. His early work on pheromones and allomones of ants and bees continued throughout his career and encompassed many other organisms including wasps, beetles, true bugs, grasshoppers and even mites, millipedes, snakes, and plants, plus many more. His work in this field revealed large trends in how insects, and animals in general, communicate and defend themselves. He showed how certain chemical patterns evolved repeatedly and appeared in diverse taxa. He also initiated early chemical investigations into the lock-and-key mechanisms of pheromone activity in communication, a precursor to similar mechanisms known today to be operating in enzymology and receptor biology. Much of this work was done when chemical tools and techniques were considerably more primitive than they are today.

Murray Blum was a master communicator and his enthusiasm was infectious. Often at scientific meeting just before he spoke, thundering sounds could be heard as people rushed in to hear him and then thundered back out after he spoke. His writing was magnificent, colorful and often enrapturing, qualities rarely seen in sci-



Murray Blum giving a lecture in Ribeirão Preto, Brazil on one of his favorite topics.

Blum ... Continued

entific writing. He mentored his students and postdocs not only in how to “think” and do science, but also how to write science. Murray felt his most valuable contribution to the scientific enterprise was working with his students and his lifelong symbiotic scientific relationship with Hank Fales, a world class chemist who helped make many of his discoveries possible. Throughout life Murray irrepressibly loved his wife Ann and his four lovely daughters, who gave him infinite joy and happiness.

Murray was an amazing man who shifted paradigms in how we view chemical ecology, communication in insects, chemotaxonomy, and Hymenoptera, especially ants. He will live long in the hearts of all who met him and in the textbooks of the future.

Have you paid your 2016 dues?

Want to sponsor a student?

Have you read the constitution?

Looking for a member?

Want to edit your member page?

Have photos of past Congresses?

<http://hymenopterists.org>

Evolution of host range in Aphidiinae (Braconidae) and impacts on diversification
Barbara Sharanowski and Amber Bass
(University of Manitoba, Canada)

Systematics of Microgastrinae wasps (Braconidae): an overview and proposal for worldwide studies

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

Wolbachia in ichneumonids: Prevalence and diversity of parasites of parasitoids

Seraina Klopstein (Natural History Museum Bern, Switzerland)

Gwen Van der Schyff and Andrew D. Austin (University of Adelaide, Australia)

Evolution of convergent adaptations in cryptine ichneumonid wasps: a morphospace approach

Bernardo Santos (American Museum of Natural History, New York)

Life, the universe and Ophion: Systematics and diversity of a little-known ichneumonid genus

Marla Schwarzbeld (University of Northern British Columbia, Canada)

Felix Sperling (University of Alberta, Canada)

Host-parasitoid trophic interactions (Lepidoptera; Ichneumonoidea; Tachinidae) revealed through high-throughput sequencing in eastern North America

Michael J. Sharkey, Sarah Meierotto and Eric G Chapman (University of Kentucky)

New World Aleiodes/Aleiodini (Hymenoptera, Braconidae, Rogadinae): species-groups concepts revision

Eduardo Shimbori (Universidade Federal de São Carlos, Brazil)

Scott R. Shaw (University of Wyoming)

Angelica Penteado-Dias (Universidade Federal de São Carlos, Brazil)

Alejandro Zaldívar-Riverón (Universidad Nacional Autónoma de Mexico)

The Euphorinae (Braconidae), a messy group to deal with

Julia Stigenberg (Swedish Museum of Natural History)

Deep phylogeny of the Ichneumonoidea based on multiple types of evidence

Donald Quicke (Chulalongkorn University, Thailand)

Phylogeny of Microgastrinae: Taxon sampling in the age of NGS
James Whitfield (University of Illinois)

Phylogeny and biogeography of two cosmopolitan braconid wasp radiations: the doryctine tribes Rhaconotini and Spathiini
Alejandro Zaldívar-Riverón (Universidad Nacional Autónoma de Mexico)
Sergey Belokobylskij (Zoological Institute of the Russian Academy of Sciences)
Rubi Meza-Lázaro (Universidad Nacional Autónoma de México)

Evolution and Biology of Chalcidoidea: Integrating Genomics, Fossils, Microbiomes and Natural History

By: John Heraty, University of California, Riverside, CA, USA

Our goal for this symposium at the International Congress of Entomology (ICE 2016) is to bring together researchers that specialize in phylogenetic, evolutionary and biological information on Chalcidoidea to present our current understanding of the group and to develop new integrative ways to address future studies in the group.

Chalcidoidea (Hymenoptera) is one of the greatest of all insect radiations, with a tremendous taxonomic, biological and morphological diversity that is the product of many different evolutionary processes. We will integrate phylogenomic data, fossil data, and morphological data with evolutionary and biological processes to explain what we know about the evolution of this group, and what we see as priorities for future research.

Monday, September 26, 2016: 1:30 PM-5:30 PM

Presentation # 93111; 1:30 PM
Fossil chalcidoid wasps and the history of megadiversity

Lars Krogmann (lars.krogmann@smns-bw.de)¹, Ralph Peters², Roger A. Burks³ and

John M. Heraty³, ¹State Museum of Natural History, Stuttgart, Germany, ²Zoologisches Forschungsmuseum Alexander Koenig, Bonn, Germany, ³University of California-Riverside, Riverside, CA

The evolutionary history of the parasitoid wasp superfamily Chalcidoidea is largely unknown mainly because their rich fossil record has never been comprehensively studied. Here, the first overview of the fossil history of Chalcidoidea is presented based on more than 1,000 fossils from Cretaceous, Eocene and Miocene ambers. Previously unrecognized specimens from Lebanese amber significantly increase the minimum age of the superfamily to about 130 million years. The phylogenetic relationships of these stem group representatives to extant Chalcidoidea are discussed. Chalcidoidea already exhibited a broad diversity in the Lower Cretaceous. Recently discovered fossils from Burmese amber (~99 mya) help dating the crucial transition from endo- to ectoparasitoidism. The minimum ages of further biological transitions are presented based on new fossil records of various chalcidoid families and subfamilies. The new fossils provide important calibration points for molecular dating studies and constitute a rich source of phylogenetically relevant morphological data that is revealed by digital microscopy and µCT.

Presentation # 93112; 1:45 PM

The most ancestral genus of Mymaridae, with comments on generic relationships and evolution within the family

John Huber (John.Huber@agr.gc.ca), Natural Resources Canada c/o Canadian National Collection of Insects, Ottawa, ON, Canada

Several described genera of Mymaridae are the most ancestral group or groups within the family. *Macalpinia* and *Triadomerus* are Cretaceous fossils from Canadian amber and *Myanmymar* is from Burmese amber. Eustochomorpha, from Australia, is extant; it has not been found as fossils. Several other extant genera also have ancestral features and appear to be closely related to the Cretaceous fossils. All are loosely united by several plesiomorphies: female funicle 8-segmented, clava 2- or 3-segmented, and fore wing venation at

least half as long as wing length. Otherwise, they are quite different from one another, suggesting that Mymaridae had evolved and diversified well before 100 million years ago. No synapomorphy has yet been found to unite the genera. Two other Cretaceous fossils, *Carpenteriana* and *Enneagamus* appear to be more derived, due to loss of segments in the female antenna and tarsi; such losses occur in most extant genera. Morphological features of the ancestral genera are illustrated and compared to each other and to features found in Rotoitidae, arguably the next most ancestral family of Chalcidoidea, and Mymaromatidae, the sister group to Chalcidoidea. The relatively few reliable published host records show that species of Mymaridae parasitize a wide range of host families in at least six insect orders – Coleoptera, Diptera, Hemiptera, Hymenoptera, Odonata, Psocoptera – and several doubtful records also suggest Lepidoptera and possibly Thysanoptera. A likely reason for this wide host range is proposed.

Presentation # 93113; 2:00 PM

Phylogenomics, genomics, and our understanding of Chalcidoidea evolution

Ralph Peters (ralph_peters@hotmail.com), Zoologisches Forschungsmuseum Alexander Koenig, Bonn, Germany

Phylogenomics simply means inferring a phylogeny with data that represent a large proportion of the genome. This should – in theory – result in a robust phylogenetic tree that mirrors the real evolutionary branching patterns. Based on this tree, it is possible to trace innovations and modifications over time, i.e., to understand the evolution of a taxonomic group. Accordingly, we put a lot of effort on the generation of phylogenomic trees and the generation of data on character complexes whose modifications we can trace. In Chalcidoidea, we have a dated 48-species transcriptome-based tree. Although it will need many more taxa to be included for the full picture, this tree already allows for some inferences on the evolution of the group. Results show that all early branching lineages of Chalcidoidea are egg parasitoids and that convergent evolution of some rather obvious phenotypic characters has happened more frequently than previously thought. The phylogenomic

Chalcidoidea ... Continued

dataset will be largely extended by ongoing projects that use the latest NGS methods. The extended dataset will allow for more fine-scaled inferences and, eventually, also new classifications. Furthermore, we have sequenced an additional four genomes of chalcid species. Now, Chalcidoidea rank among the best-covered taxa in terms of sequenced genomes in insects. In upcoming years, tracing genomic modifications and linking them to the observed morphological or biological diversity or to species-richness-patterns will become a new field of research that is no longer restricted to a few model species but can be done on a broader scale, for example, in Chalcidoidea.

Presentation # 93109; 2:15 PM

There is more than one way to jump: Eupelmidae, Encyrtidae and the interplay between phylogenomics and morphology

James Woolley (jimwoolley@tamu.edu), Texas A&M University, College Station, TX

It has long been thought that evolution of a complex of morphological characters associated with jumping locomotion is characteristic of a monophyletic group, including Eupelmidae, Tanaostigmatidae and Encyrtidae. These characters, studied most intensively in Eupelmidae, include expansion of the acropleuron to comprise most of the surface of the mesopleuron, together with expanded mesopleural-mesopleural muscles that provide the mechanical force for jumping. Associated adaptations include modifications to the prepectus, mesotibial spur, and mesobasitarsus. The structure of the mesopleuron is similar in Encyrtidae and Tanaostigmatidae and species in both families are powerful jumpers, leading to the hypothesis that all three families form a monophyletic clade. However, these relationships have been difficult to demonstrate with molecular data. Although these three families formed a monophyletic group in a recent, comprehensive analysis using only morphological data, Encyrtidae were not related to Eupelmidae+Tanaostigmatidae when both nuclear (28S D2-D5) and mitochondrial (18S) ribosomal sequences were added to the analysis. The results of analysis of

transcriptomes of exemplar taxa of Chalcidoidea reported by Ralph Peters in this symposium now provide strong evidence that Eupelmidae, Tanaostigmatidae and Encyrtidae are unrelated to one another. If true, each family has acquired jumping behavior independently. This provides an opportunity to re-examine the character systems associated with jumping behavior using a process of reciprocal illumination. These character systems will be explored to determine the features common to all three families, and the characters themselves will be re-examined in the context of related taxa to determine how the convergence has occurred.

Presentation # 93114; 2:30 PM

Figs and wasps arm-in-arm: An 80 million year walk in the jungle

Jean-Yves Rasplus (rasplus@supagro.inra.fr) and Astrid Cruaud, INRA - Centre de Biologie pour la Gestion des Populations, Montferrier-sur-Lez, France

The obligate mutualism between fig trees (*Ficus* species, Moraceae) and their pollinating wasps (Agaonidae, Hymenoptera) stands among the few outstanding cases of plant-insect diversification. Our recent findings strongly suggest that the fig-pollinator mutualism represents an extreme case among plant-insect interactions of coordinated dispersal and long-term co-diversification (Cruaud et al. 2012, *Syst. Biol.*, 61:1029-1047). Phylogenetic analyses for figs and fig wasps (200 spp. each) under relaxed molecular clock assumptions suggested the Cretaceous diversification of crown groups and contemporaneous divergence for nearly half of all fig and pollinator lineages. Event-based co-phylogenetic analyses further supported the co-diversification hypothesis. Recently, we proposed the inclusion of Sycophaginae, an unclassified subfamily of non-pollinating fig wasps, within Agaonidae based on several morphological apomorphies (Heraty et al. 2013, *Cladistics*, 29(5) : 466-542). In our talk, we will present the molecular estimates of a global phylogeny of Agaonidae *sensu lato*, based on ca 500 species and ~6 kb of DNA sequence data. We will investigate the biogeographical histories of the major clades and compare their timing of radiation and dispersion with

available data on *Ficus*. We will compare these results to those inferred from RAD-seq (shallower nodes) and exome capture (deeper nodes) data sets.

Presentation # 93115; 2:45 PM

Unjumbling the jumbled trichogrammatids: NGS to the rescue

Astrid Cruaud (cruaud@supagro.inra.fr)¹, Geraldine Bout², Guenaelle Genson³ and Jean-Yves Rasplus¹, ¹INRA - Centre de Biologie pour la Gestion des Populations, Montferrier-sur-Lez, France, ²UMR ISA INRA / UNSA / CNRS, Sophia Antipolis, France, ³INRA - UMR 1062 CBGP (INRA/IRD/CIRAD/SupAgro), Montferrier-sur-Lez, France

Trichogramma are minute chalcid wasps that are egg parasitoids of ten insect orders (mainly Lepidoptera). Several species are commercialized for the control of crop pests of major economic importance. Nevertheless, experts agree that the taxonomy of the genus needs improvement. Morphological identification is difficult for non-specialists and molecular characterization is only partially and heterogeneously carried out, which may hamper the efficiency of biocontrol programs. Many species of *Trichogramma* are described as highly polyphagous. However, so called "generalists" may be complexes of stenophagous species with uncertain reproductive isolation. Finally, infections by facultative symbionts can influence individual fitness, reproductive isolation and ecological specialization, but there is little data on most symbionts associated with *Trichogramma* species. Classical molecular markers (COI, ITS2) are not informative enough to decipher species complexes, identify potential hybridization between strains, understand the genetic characterisation of phenotypic traits important for biocontrol success. A change of scale is necessary and Next Generation Sequencing brings solutions. In this talk we will present how we managed to tackle the major obstacle of the small size of trichos to obtain ca 120,000 RAD-tags of 100 bp each along the genome of every specimen we analysed. We will show that these unprecedented data sets open new avenues to decipher relationships among species complexes with high confidence and identify genetic flow. In an attempt to elucidate

Chalcidoidea ... Continued

the causes of reproductive barriers, we will analyse our results in the light of the microbiome of each strain obtained with deep sequencing of multiple amplicons of the bacterial 16S rRNA.

Break; 3:00 PM

Presentation # 93118; 3:15 PM

What exactly is an aphelinid anyway?

Andrew Polaszek (A.Polaszek@nhm.ac.uk), Natural History Museum, London, England

Despite being one of the smaller families in terms of currently valid species, the chalcidoid family Aphelinidae is relatively diverse both biologically and morphologically. The composition of the family has varied greatly in terms of included genera, as well as in its tribal and subfamilial classification. Two genera, *Ablerus* and *Cales*, were recently elevated to family status (Azotidae, Calesidae). The history of Aphelinidae classification is reviewed briefly, and the pros and cons of splitting the group and erecting monogenic families, are discussed. Clearly molecular sequence data are contributing very significantly to the clarification of both deep and shallow relationships within the group, but how do we provide even a relatively stable classification as new technologies reveal new patterns?

Presentation # 93123; 3:30 PM

The role of the symbiont Cardinium in shaping the ecology and evolution of Encarsia

Marco Gebiola (marco.gebiola@gmail.com)¹, Suzanne E. Kelly¹, Peter Hammerstein², Massimo Giorgini³ and Martha Hunter¹, ¹University of Arizona, Tucson, AZ, ²Institute for Theoretical Biology, Humboldt-Universität zu Berlin, Berlin, Germany, ³National Research Council of Italy, Portici, Italy

The *Encarsia pergandiella* (Hymenoptera: Aphelinidae) species complex includes parasitoids of whiteflies that vary in reproductive mode and endosymbiotic bacterial infection, and

that are widely used as biological control agents against key agricultural pests such as *Bemisia tabaci* and *Trialeurodes vaporariorum*. Two members of this complex are *E. gennroi*, uninfected by facultative symbionts, and *E. suzannae*, infected by the symbiont *Cardinium*, that causes the reproductive incompatibility known as cytoplasmic incompatibility (CI). *Encarsia gennroi* and *E. suzannae* are morphologically and genetically differentiated, yet they are still able to mate and produce some hybrid offspring. Theory shows that unidirectional CI in conjunction with nuclear incompatibilities in the other direction can cause speciation, yet there are few empirical examples that support this scenario, and the general importance of CI in speciation remains controversial. Using *E. suzannae* and *E. gennroi*, we performed laboratory mating preference and crossing experiments, and also examined competitive outcomes following a secondary contact scenario in population cage and greenhouse experiments. We aimed to 1) assess the role of CI-inducing *Cardinium* and genetic isolation mechanisms in reproductive isolation and competitive interactions of *Encarsia*, and 2) evaluate if and how the interaction of such species affects the biological control of a key agricultural pest. The results support asymmetric pre- and post-zygotic isolation between these species consistent with reproductive isolation of the two species evolving in the context of CI.

Presentation # 93126; 3:45 PM

Genomics and adaptation in Wolbachia, an obligate reproductive parasite in Trichogramma wasps

Amelia Lindsey (alind005@ucr.edu)¹, John H. Werren², Stephen Richards³ and Richard Stouthamer¹, ¹University of California, Riverside, CA, ²University of Rochester, Rochester, NY, ³Baylor College of Medicine, Houston, TX

Wolbachia is a maternally inherited symbiont, known for altering host reproduction to select for female offspring. There is great interest in introducing *Wolbachia* with favorable phenotypes into myriad target hosts. Unfortunately, little is known about the genomic changes that occur as *Wolbachia* adapts to new insects. In *Trichogramma* wasps, infected

populations evolve a dependency on *Wolbachia*-induced parthenogenesis for the production of female offspring. We can use this relationship to identify genomic signatures of adaptation. We present the genome sequence for the obligate *Wolbachia* strain wTpre, infecting *Trichogramma pretiosum*. After comparison to 16 other *Wolbachia* genomes, we show that wTpre has the most unique genes of any arthropod-infecting *Wolbachia*. Comparisons of genomic sequence show the majority of these unique genes are genes that have been truncated through nonsense and frameshift mutations, representing 20% of the genome. To test whether or not wTpre has maintained adaptive ability after these extensive gene truncations, we have developed a system to challenge wTpre with novel *Trichogramma* hosts, and track adaptation. Initially, novel hosts produced fewer females, and a significant proportion of intersexes, resulting from incomplete modification by *Wolbachia*. Over time, *Wolbachia* adapted to the new hosts, seen as recovery of parthenogenesis. We will employ genome re-sequencing to identify the mutations responsible for adaptation in wTpre and contrast them with the mutations responsible for the aforementioned gene truncations. Knowledge of the genomic changes that occur during *Wolbachia* adaptation will be used to inform the transfer of *Wolbachia* to target insects for vector- and biological control.

Presentation # 93129; 4:00 PM

Genetics and genomics of Aphelinus - keeping ahead in the parasitism race

Keith R. Hopper (khopper@udel.edu), USDA - ARS, Newark, DE

Differences in parasitism among potential host species can provide strong selection for divergence and speciation in parasitic Hymenoptera. However, little is known about the evolution or genetic architecture of host specificity. Here we report research on the genomics and genetics of host specificity in *Aphelinus* species. We have sequenced, assembled, and annotated the genomes and transcriptomes of twelve *Aphelinus* species in five complexes. Using coding sequences, we developed a robust phylogeny, onto which we mapped parasitism of seven diverse species of aphids. For some aphids, parasitism was

Chalcidoidea ... Continued

phylogenetically conserved, with closely related parasitoids showing similar levels of parasitism. For other aphids, parasitism diverged between closely related parasitoids, consistent with host-driven speciation. To explore the genetic architecture of differences in host specificity, we crossed and backcrossed *Aphelinus ariplicis*, which readily parasitizes *Diuraphis noxia*, with *Aphelinus certus*, which rarely parasitizes this aphid. Using genetic markers from reduced-representation genomic libraries, we mapped quantitative trait loci (QTL) affecting parasitism of *D. noxia*. We found eight QTL (six of which interacted in their effects) that explained ~40% of the variation in parasitism among backcross females. We compared the genomes and transcriptomes of these parasitoid species to find genes that diverged in sequence or expression, and we tested whether divergent genes mapped to QTL affected parasitism of *D. noxia*. We identified 14 divergent genes that mapped to parasitism QTL or significantly affected parasitism by themselves. These are among the first results on the genetic architecture of host specificity in parasitic wasps.

Presentation # 93130; 4:15 PM

Morphometrics and the description of cryptic species in the Chalcidoidea

Hannes Baur (baur.hannes@gmail.com), Natural History Museum Bern, Bern, Switzerland

Morphometric data play an important role in the differentiation of cryptic species, as they often can only be recognized by gaps in some quantitative characters. This is also the case for many groups of Chalcidoidea, where the use of distance measurements has a long tradition. For instance, it is quite common to include up to 30 body ratios in species descriptions of Pteromalidae, Eulophidae, Aphelinidae, and other families. Here I present multivariate ratio analysis (MRA), a relatively new set of statistical tools addressed to the practical needs of taxonomists. On the one hand, MRA goes far beyond the simple calculation of body ratios, as it allows the examination of covariation for multiple characters and taxa. This is done by modifying the raw data matrix, which is then

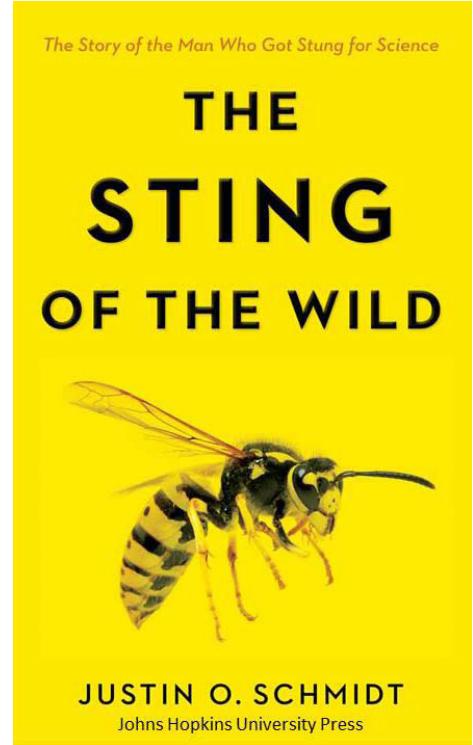
subjected to either a principal component analysis or a linear discriminant analysis. The analysis also allows a clear separation of variation in size and shape as well as an estimation of their correlation (allometry). On the other hand, the results of MRA can be interpreted in terms of body ratios. For instance, it is possible to extract the best separating ratios of two groups, which can be included in identification keys or descriptions. Such best ratios clearly improve the descriptive part of a taxonomic study. The application of MRA is demonstrated using species complexes of the genera *Pteromalus* and *Anisopteromalus*.

Presentation # 93132; 4:30 PM

Immature development of Chalcidoidea: Trends, functional ecology and comparison with other parasitoids

Alexander Gumovsky (entedon@gmail.com), National Academy of Sciences of Ukraine, Kiev, Ukraine; University of the Witwatersrand, Johannesburg, South Africa

The Chalcidoidea, a “megadiverse” parasitoid group, is characterized by high diversity in terms of host associations, life history traits and immature morphology. However, development remains unknown for many groups, and the only comprehensive reviews of larval morphology (Parker, 1924; Parker & Thomson, 1925) are outdated. Recently, molecular and combined research (Munro et al., 2011, Heraty et al., 2013) has produced a reasonably defensible phylogeny for the Chalcidoidea, which facilitates preliminary tracing of the evolutionary patterns of immature development. This report combines original data and critical literature review to generate an evolutionary scenario from mapping the available immature characters based on the likelihood (RAxML) tree reported by Heraty et al. (2013). The distribution pattern of these immature characters suggests that Chalcidoidea share, with other parasitoid groups, a number that are associated with certain modes of parasitism (for example, the head appendages used for siblicide within aggressive solitary endoparasitoids). However, some other characters (for example the serosa) also appear in distantly related and biologically dissimilar groups. Character mapping illustrated that larval morphology of Mymaridae



Upcoming book on Hymenoptera

By: Justin Schmidt, Southwestern Biological Institute, Tucson, AZ, USA

The Sting of the Wild is to be released in early May by Johns Hopkins University Press. It is a book entirely about Hymenoptera – well, ‘fess up time, actually some spiders, cicadas, flies, and such, are included; but they are mainly mentioned as food for Hymenoptera. The book is written about stinging Hymenoptera, why they sting, how their stings have changed their behavior and evolution, and how hymenopterous stings have changed our lives as human beings. The format is storytelling of adventures, historical accounts, natural history, and science told in a style designed for academic and curious readers of all stripes. Insects ranging from sweat bees and fire ants to harvester ants, yellowjacket wasps, tarantula hawks, cicada killers, mud daubers, and miltiid wasps, to honey bees and bullet ants are detailed. These insects are the star performers. They are the stars because their lives and stings are so fascinating and their lifestyles reveal amazing and diverse aspects of biology. A central theme throughout the writing is the pain caused by insect stings and how it affects humans and other animals alike. As a preview, people and toads respond

rather differently to bullet ant stings. The complete Pain Scale for Stinging Insects listing all 83 taxa examined is published for the first time following the references at the end of the book in formats of both the pain levels rated from 1–4, and in vivid descriptive styles: “Red fire ant (*Solenopsis invicta*) – Sharp, sudden, mildly alarming. Like walking across a shag carpet and reaching for the light switch. Pain level 1”; “Florida harvester ant (*Pogonomyrmex badius*) – Bold and unrelenting. Somebody is using a power drill to excavate your ingrown toenail. Pain level 3”.



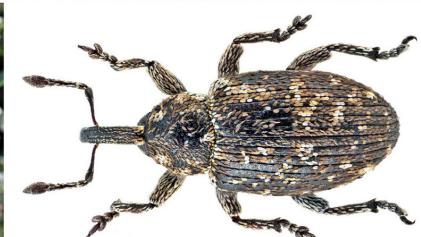
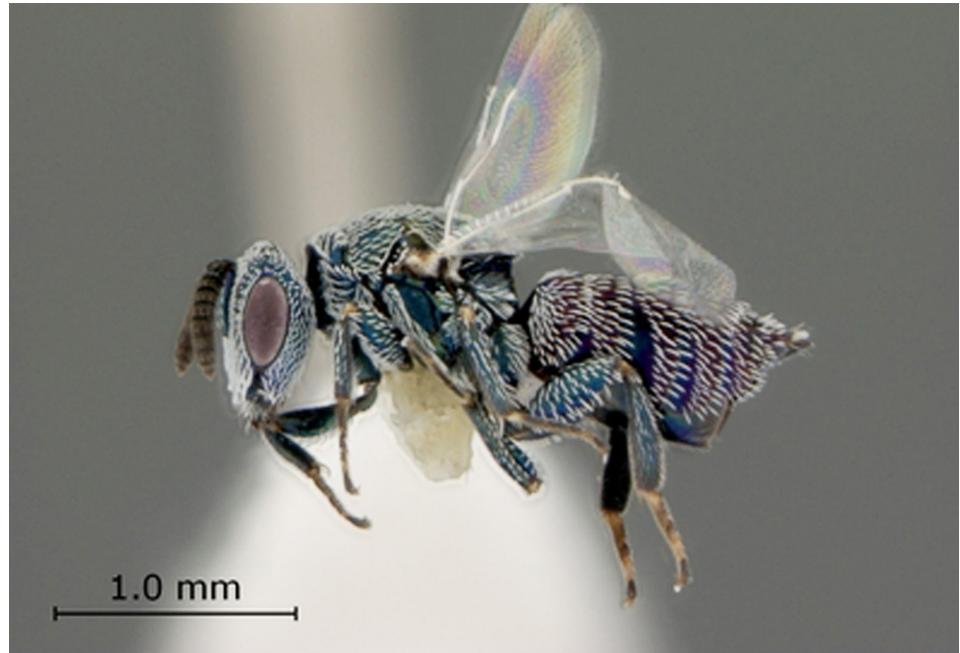
Apis mellifera stinging *Homo sapiens*. Photo CC BY-NC-ND 2.0, by Kris Fricke. See original: <https://flic.kr/p/ecwd6p>

WANTED – alive! *Eutrichosoma mirabile* Ashmead

By: John Heraty, University of California, Riverside, CA, USA

WANTED – alive! *Eutrichosoma mirabile* Ashmead (Chalcidoidea: Pteromalidae) has turned out in all of our latest analyses to belong to a clade that includes Perilampidae and Eucharitidae. The prediction is therefore that this genus could have planidial larvae (small active first-instar larvae that seek out their host). The problem is that other than a host plant (*Parthenium hysterophorus* L.) and host weevils (*Auleutes tenuipes* (Leconte) and *Smicronyx tychoides* Leconte) found in the flower heads, there is nothing else known of their biology. The species is sometimes very common in the southwestern US and northern Mexico, but may range to Brazil. If you do come across these (they can be very abundant), please try to collect fresh flowers and either get them to us here at UCR or try your luck at finding how they lay their eggs and how the first-instars look and behave. John Heraty, john.heraty@ucr.edu. For additional information see Bouček, Z. 1974. The pteromalid subfamily Eutrichosomatinae. *J. Ent. (B)* 43: 129–138. For an idea of what planidia look like, check out:

<https://youtu.be/pBnwjW2Eg2A>



Clockwise from top: *Eutrichosoma mirabile* Ashmead (Chalcidoidea: Pteromalidae), weevil (*Auleutes tenuipes* (Leconte)), fresh flower, host plant (*Parthenium hysterophorus* L.).

Updates from the Chief Editor of Hamuli

By: Andy Deans, Frost Entomological Museum, Pennsylvania State University, USA

I hope you're enjoying the latest installment in what seems to me to be a very successful and informative society newsletter. I am grateful to the members who provided so much compelling content for this issue, which is a bit longer than the last — more than 200% longer, in fact! The stories from the field are especially inspiring, and we look forward to seeing where our members end up next.

I am also grateful to my assistant editors, Rob Longair and István Mikó, who continue to solicit content, provide boundless encouragement, and work each draft over for typos and other problems introduced by yours truly.

Some of you might know (and probably most of you don't care) that every issue so far has been put together using Adobe InDesign (Adobe Systems, San Jose, California), a powerful publishing platform that has served us well ... until lately. Our

use of multiple versions of InDesign, along with some file corruption issues, delayed the publication of volume 7, issue 1—altogether a frustrating situation.

We're now migrating to LaTeX, which is more robust and a lot more flexible. This publishing environment uses text files and is operating system agnostic (and it's a professional standard).

Why should you care? This transition will affect the look of future issues, at least in the short term. It might be a bit rough at first, but the layout control, formatting, etc. will be *much* easier on our end. Please contact me if you have LaTeX experience and/or are concerned about any changes being made. We appreciate any feedback!

In the meantime, please keep sending me your contributions. Word documents are fine—text files (.txt) are preferred—and we really want to have images as separate (not embedded) files. See author instructions on the right.

Thanks again to all the contributors for making this newsletter fun to edit and hopefully to read!

Authors' Instructions

Have an article, note, opinion piece, news item, story, photo, poem, joke, or other item you'd like to publish in *Hamuli*? Current members of the International Society of Hymenopterists are welcome to submit materials for publication at no cost. Just send your text to the editor (adeans@gmail.com) as .rtf or .doc files, and please send/include images as separate .jpg or .tif files (i.e., not embedded in the word processing file). Make sure images are of a reasonable resolution: larger than 500 x 375 pixels, with a resolution of 72 pixels per inch (or 28 pixels per cm).

Not a member of ISH? No problem! You can use the form below to become a member, or you can visit our website (<http://hymenopterists.org>) to join / pay dues electronically.

2016 Membership Information (visit hymenopterists.org for more options!)

[] \$15 Student (requires signature of advisor: _____)

[] \$45 Regular [] \$50 Family [] \$80 Sustaining

[] \$750 Life [] \$0 Emeritus

Fees listed in US\$. Checks should be made out to *International Society of Hymenopterists*. For payment by credit card please add \$2.00 processing fee. Dues, sponsorships, *JHR* back issues, donations, and other purchases can also be paid using PayPal: <http://hymenopterists.org/purchase.php>

Name: _____

Address: _____

credit card #: _____

credit card type: [] Visa [] Mastercard

security code: _____ expiration date: _____

signature: _____

name on card: _____

Phone: _____

Email: _____

Interests: _____

send payment to:

Craig M. Brabant, Treasurer ISH
Department of Entomology
University of Wisconsin-Madison
1630 Linden Drive, room 445
Madison, WI 53706 USA
+1 608.262.2078 phone +1 608.262.3322 fax
brabant@entomology.wisc.edu