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METALEPTEA

THE NEWSLETTER OF THE ORTHOPTERISTS' SOCIETY

President's Message

By **MICHAEL SAMWAYS**
President
samways@sun.ac.za

It is summertime from where I am sitting here in the southern tip of Africa. The night air is filled with the lovely trills of a nearby mole cricket, the resonance of various field crickets, and the fizz of a host of katydids. Of course, much of this sound, at least from the katydids, is ultrasonic, and as soon as one switches on a bat detector, there is a whole new orchestra of glorious sounds, each proclaiming that the singer is mate worthy. Then there is the delightful chorus of chirps and warblings that come from the various orthopterans in a flower-filled meadow on a sunny day.

It would be a very dull world indeed if it were not for these characterful choruses around the not-so-cold parts of the world. The evolution of song has indeed been one of the great wonders of biodiversity. Then there is the intriguing trade-off in many species between retaining the sound-producing apparatus on the very part of the body that is essential for their aerial movement… the wings. To be able to sing and fly makes Orthoptera a most intriguing group of insects indeed! Orthoptera are such an interesting window into the living world, not just in terms of these insects, per se, but also for understanding many general biological principles.

Then, almost as if to emphasize the point that Orthoptera are among the most fascinating creatures, they come in so many life forms with so many life styles. They embroider the tapestry of life with a whole host of different morphological splendours and colourful palettes, making it a joy to behold and also to study in almost infinite depth.

Wishing all Orthopterists the world over a year filled with new adventures among this wonderful insect group!

Clonia sp. (Tettigoniidae: Saginae), Cederberg, South Africa, Feb. 2009. (photo credit: H. Song)

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Orthoptera Species File Grants Funded in 2016

By **MARIA MARTA CIGLIANOA**
Orthoptera Species File Officer
cigliano@fcnym.unlp.edu.ar

The OSF grants committee received twenty eight applications and the following proposals were funded. The proposals were selected based on the relation to the amount of data expected to be added into the Orthoptera Species File or to any other Species File within Polyneoptera, and it was also considered if the proposal was related somehow to a taxonomic research project, and/or if the candidate demonstrated knowledge of the taxa involved.

Funding availability for 2017 will be announced in October 2016. All requested information must be submitted by November 30, 2016 to receive full consideration. The committee will complete its assessment and announce the results by January 10, 2017. Please visit **http://orthoptera.speciesfile.org/HomePage/Orthoptera/Grants.aspx** *for detail.*

1. Paul Brock (The Natural History Museum, London, England) & Thies Henning Büscher (Christian-Albrechts-University (CAU), Kiel, Germany). **“Training regarding Phasmida Species File (http://phasmida.speciesfile.org”**
2. Oscar Cadena-Castañeda (Universidad Distrital Francisco José de Caldas, Bogotá, Colombia). **“Photographic, sound and distribution data to some Neotropical Orthoptera Groups and Colombian Phasmatodea”**
3. Dragan P. Chobanov (Institute of Biodiversity and Ecosystem Research, Sofia, Bulgaria), Ionuţ Ş. Iorgu (National Museum of Natural History, Bucharest, Romania), Elena I. Iorgu (National Museum of Natural History, Bucharest, Romania) & Simeon B. Borisov (Faculty of Biology, Sofia University, Sofia, Bulgaria). **“Orthoptera of the Eastern Balkans and the Carpathian Basin (Bulgaria, Macedonia, NE Greece and Romania): a database of collections, literature and digital data in the Orthoptera Species File”**
4. Dhaneesh Bhaskar (Kerala Forest Research Institute, Kerala, India) & Axel Hochkirch (Trier University, Trier Germany). **“Photographic documentation of the Orthoptera of the Southern Western Ghats (Kerala, India)”**
5. Josip Skejo (Faculty of Science, University of Zagreb, Croatia) & Josef Tumbrinck (Germany). **“Digitalization of Tetrigoidea type secimens and rare species’ specimens in European museums”**
6. Ricardo Mariño-Pérez (Texas A&M University USA). **“Supplement to the grant: Enhancing digital content for Pyrgomorphidae (Orthoptera: Caelifera) in the Orthoptera Species File”**
7. Gellért Puskás (Hungarian Natural History Museum, Hungary). **“Contribution to the knowledge of the West Balkan Orthoptera fauna”**
8. Klaus Riede (Germany, Uruguay). **“Grasshopper songs from Southern South America (SSA): Digital recordings for Orthoptera Species File (OSF)”**
9. Rob Felix (University of Nijmegen, The Netherlands). **“Study and photography of type specimens in the Collection of NHM London”**
10. Daniela Santos Martins Silva (Universidade Federal de Viçosa, Brazil). **“The Neotropical Tetrigidae (Caelifera: Tetrigoidea) deposited in the Academy of Natural Sciences, Philadelphia, USA”**
11. Slobodan Ivković (University of Belgrade, Serbia). **“Photo documentation of types from Mladen Karaman’s collection and acoustic and photographic documentation of the Orthoptera of Serbia”**
12. Marcio Bolfarini (Universidade Federal de São Carlos, Brazil). **“Brazilian cave Crickets, the digital records and conservation”**

The Theodore J. Cohn Research Fund: Call for applications for 2016

(Deadline : March 31, 2016)

By **MICHEL LECOQ**
Chair, Theodore J. Cohn Research Fund Committee

Dear Orthopterists,

I have the pleasure to announce a new call for 2016. I remind you that this research grant is primarily to fund research projects in Orthoptera (*s. l.*) by young researchers often as part of a master’s or Ph.D. project, though postdoctorates may also sometimes be funded. A total amount of $15K per year is available and it is possible to fund research grants for up to $ 1,500 per grantee.

The proposals should be in the following format and restricted to the indicated number of pages:

DESCRIPTION (one page)

1. TITLE

2. SIGNIFICANCE, stressing the new ideas and aspects of the proposal, expected contribution to theory, relation to previous work, etc. (applicants should emphasize the nature and significance of their proposal to provide the judges with the basis for weighing different projects, especially in fields outside their expertise)

3. RESEARCH PLAN, including the particular orthopterans to be studied, methods, logistics, etc.

4. TIMETABLE, even if approximate, to give the judges some idea of feasibility.

CURRICULUM VITAE (half page) including name, full address, present position or years in graduate school, education, number of papers published or completed, citation of selected publications pertinent to the proposal to aid the judges.

BUDGET (half page) including justification of items where appropriate (i.e. why special equipment is necessary unless clearly obvious), other funding for the project, etc. Overheads cannot be provided for on Society grants.

The Committee prefers proposals applicable to broad biological problems, even though the actual research may be narrower in scope. Proposals also should include clearly stated hypotheses and aims, and the nature of the evidence to be gathered to test the hypothesi(e)s and possible outcomes.

Proposals from graduate students must include a simple recommendation from their major professor or advisor. Those not affiliated with an educational or research institution should indicate where the work is to be done.

A short report will be required from the successful applicants. It will be written for our newsletter *Metaleptea*, and be suitable for both orthopterist and non-specialist readers.

Proposals should be submitted to the Chair at the following address: **Michel Lecoq (mlecoq34@gmail.com)**

Last year, 28 projects were submitted to the Committee and 11 proposals funded demonstrating the continuing interest in our grants in support of students and young scientists. I'm sure we will receive again this year, as usual, a lot of exciting and innovative projects of high quality. So, start writing!

The 12th International Congress of Orthopterology "*Orthoptera in a Changing World*"

By **MARCOS LHANO**
President, ICO 2016
entomology@gmail.com

Dear friends,

It is a great pleasure to invite you to contribute and to attend the 12th International Congress of Orthopterology (ICO). The Congress will be held in the city of Ilhéus, Bahia, Brazil from **October 30 to November 3, 2016.**

We´re still working to complete information about the Congress and it will all soon be displayed on the Congress website, the address for which will be announced on The Orthopterists´ Society website and The OS Facebook page.

The local committee would like to announce that the Registration Fees, for those who register before July 31, 2016, will be:

- Participant/person: R$ 1.450,00 (approx. US$ 350.00)
- Student/person: R$ 680,00
- (approx. US$ 170.00)
- Companion/person: R$ 680,00 (approx. US$ 170.00)

It´s important to highlight that due to Brazilian laws, the fees must be charged on a credit card in Brazilian Reais (R), so the rates in US dollars may vary depending on the exchange rate on the purchase date. Registration must be done on the official ICO website.

The venue of the event will be in a beachfront hotel, close to the suburbs of Ilhéus and 5 minutes by car (2 km) from the airport. It is a small hotel with beautiful gardens, swimming pools and restaurants, and it can be used to accommodate all the attendees. We have negotiated special rates for the rooms (including breakfast, four lunches, and two dinners - without beverages), and the reservation will **ONLY** be possible on the ICO website.

Ilhéus Bahia Brasil • 2016

12° INTERNATIONAL CONGRESS OF ORTHOPTEROLOGY

The Congress will include the following activities:

- Opening Ceremony
- Poster sessions
- Workshops
- Information Sessions
- Oral Presentations
- Special Meetings
- Awards

We will also have a new activity during the Congress: "Information Sessions", consisting of short courses where the attendees will have the opportunity to discuss and learn about specific topics, such as new methods and statistical techniques for data generation and analysis.

I am glad to announce that the "Open Call" for those interested in proposing and organizing a Plenary Symposium and/or an Information Session are open until **February 14, 2016.**

Proposals must be submitted by email and should contain the requested information listed below. Decisions will be made by the 30th of February, 2016 and will be selected according to the relevance of the theme, novelty of the topic, and controversial nature of the proposed issues.

The overall theme of the congress is ***"Orthoptera in a Changing World"*** and the program will include theme-related Plenary Lectures, Plenary Symposia, Workshops, and Information Sessions as well as Poster Sessions. We strongly encourage proposals from individuals and groups on a specific topic of interest, such as: behavior & communication, ecology & conservation, systematics & taxonomy, functional genomics, phylogeography & speciation, physiology, morphology, and development, biotechnology in locust control, grasshopper and locust control, and integrated pest management.

If the proposal is accepted, all speakers will be required to submit an abstract during the call for abstracts. It is also the responsibility of the symposium/workshop/information session organizer to make sure that all speakers register for the ICO.

The categories are:

- "Symposium" – A symposium is designed to be a focused session in which speakers present a common theme, an issue, or a question, and will last for two hours. Presentation length must be between 15 and 25 minutes. Time for discussion must be included in each presentation and the last 10 minutes must be left open for discussions. The maximum number of speakers is seven per symposium and each one should come from different institutions.
- "Workshop" – A workshop is more interactive than a symposium and it often has an educational/ technical component, and will last for two hours. Presentation length must be between 20 and 30 minutes. Time for discussion must be included in each presentation with at least the last 20 minutes of the workshop left open for discussions. The maximum number of speakers is five per workshop.
- "Information Session" – This session is a novelty at the ICO and is dedicated to short courses that could be four to eight hours in length (always 2 hours per day for each one, distributed across the four days of the ICO). We invite you to offer training sessions in specific topics of key relevance to orthopterology for students or for any other professionals. Preference will be given to proposals that address tools or concepts that course participants can easily share with others. Topics related to photography, sampling methods, software, data analysis, database, preparing manuscripts, etc. are all welcome.

Proposals must be submitted by email and must contain the following information in a .pdf file:

1. *Category (Symposium, Workshop, or Information Session)*
2. *Title*
3. *Organizer(s) name, affiliation, and complete contact information, including email address*
4. *Justification and description (maximum one page)*
5. *List of speakers (name, affiliation, and complete contact information, including email address) and presentation titles (not required for individual proposal for the Information Session)*
6. *Logistic requirements (e.g., a room with internet access, computer, etc.)*

It is the responsibility of the organizers of symposia, workshops, and information sessions to obtain funding for their own expenses and those of their invited speakers or invited participants. The Local Organizing Committee are not responsible for obtaining funds to support speaker travel to the meeting and cannot guarantee that any support will be available. Preference may be given to proposals for which organizers can demonstrate that funds are likely to be available.

To submit a proposal according to the call instructions and requirements, please address all the information to: **ico2016@zoho.com** (you will receive an email receipt afterwards).

Also, if your working group would like to organize a Special Meeting, please do not hesitate to contact us and provide all relevant information on or before **February 14, 2016**. The ICO 2016 organization will try to accommodate all appropriate requests, but available time slots are limited.

Finally, the local committee would like to remind everyone that a Post Conference Tour will consist of a trip to the amazing Chapada Diamantina region and Salvador city. This is a very attractive tour with more details to come on the ICO website. It is important to note that it will mainly be a touristic and photographic tour since collecting insects or any other organisms is not allowed in Brazil without collecting permits and the ICO 2016 organization is not able to make any arrangements for collecting permits for the whole group or individuals. If somebody is interested in collecting Orthoptera material, then each scientist will be responsible for getting the permits to collect and the paperwork/permits to carry the material outside Brazil - they are different permits within the Brazilian Government: Ministry of the Environment (MMA) and at the Ministry of Science and Technology (MCT). Also, we kindly ask those who do acquire permits to notify the local committee in advance, so we can manage the Post Conference Tour according to Brazilian laws because the whole region of Chapada Diamantina is a National Park.

Important dates for your agenda:

- Deadline for submissions of Symposia, Workshops, and Information Sessions as well as Special Meeting submissions: **February 14, 2016**
- Deadline for abstract submissions: **July 31, 2016**
- 12th International Congress of Orthopterology: **October 30 to November 3, 2016**

As President of the ICO 2016 organization, I am delighted to cordially invite you to join us and contribute to the success of our congress.

The First European Congress on Orthoptera Conservation

(Trier, 18-20 March 2016)

By **AXEL HOCHKIRCH**
hochkirch@uni-trier.de

The First European Congress on Orthoptera Conservation will take place from 18 to 20 March 2016 at Trier University (Trier, Germany). Trier is the oldest city in Germany and known for its Roman buildings, which are on the UNESCO World Heritage List. Trier has also a grasshopper fountain (possibly the only one), which has been built in honour of the local carnival society (“KG Heuschreck” = “Carnival Society Grasshopper”). The congress is the first opportunity for European Orthopterists to meet and discuss issues of Orthoptera conservation and other aspects of Orthoptera biology, such as ecology, evolution, and behaviour. The keynote lecture will be given by Professor Karim Vahed (University of Derby) on post-copulatory sexual selection in Tettigoniidae. The congress is in parallel with the bi-annual meeting of the German Society for Orthopterology (DGfO). The conference fee is 40 €. Members of the DGfO or the IUCN Grasshopper Specialist Group (as well as students) pay a reduced fee of 30 €. Registration is possible via the conference website: https://www.uni-trier.de/index.php?id=58281&L=2 or contact the organizer, Axel Hochkirch (hochkirch@uni-trier.de).


The First European Congress on Orthoptera Conservation
Trier, 18 - 20 March 2016

Orthopteroid Symposium Recap from ESA, 2015

By **DEREK A. WOLLER**
Texas A&M University
U.S.A.
asilid@gmail.com

During the annual Entomological Society of America (ESA) conference in Minneapolis, Minnesota, U.S.A. on November 17th, 2015, I organized a 4-hour symposium ("Orthopteroids: a nexus of synergy between scientific disciplines and innovative partnerships") focused solely on orthopteroids, a useful term that includes 10 extant orders: Blattodea (Isoptera), Dermaptera, Embioptera, Grylloblattodea, Mantodea, Mantophasmatodea, Orthoptera, Phasmatodea, Plecoptera, and Zoraptera. The title explains the emphasis of the symposium well and example synergistic topics included the intersections of robotics and ethology, climate change and phylogenies, and highly acute parasitoid hearing and microphone miniaturization. I would declare the symposium a great success overall, particularly based on the consistent size of the audience (around 60 at any given time) drawn in, no doubt, by the fascinating talks being given within the room.

To start the event, I, with assistance from Tyler Raszick, gave a short introductory presentation on the taxonomic history of orthopteroids and their underrepresentation at ESA meetings followed by my research talk and nine other speakers. Unfortunately, one speaker was unable to make it due to circumstances beyond his control: Yu Zeng and Robert Dudley - *The evolution of flight in stick insects (Phasmatodea)*. Of the nine present speakers, three are graduate students, one is a post-doc, and the rest are seasoned researchers (Fig. 1): (in order of presentation) Sydney Brannoch, Matan Shelomi, Tyler Raszick, Sean Schoville, Janice S. Edgerly, S. Bradleigh Vinson, William D. Brown, Spencer T. Behmer, and the concluding keynote speaker, Andrew C. Mason. Represented orthopteroid orders included: Orthoptera (Acrididae and Gryllidae), Mantodea, Phasmatodea, Grylloblattodea, Embioptera, and Blattodea. The wide breadth of topics presented on was equally impressive, such as phylogeography, gut bacteria, and sexual cannibalism. If you'd like to learn more about the presentations, there is, for almost all, a brief abstract and figure provided below by each speaker (organized in order of presentation). After the final talk was given, it was time to begin the well-earned celebration, so the majority of the speakers headed into downtown Minneapolis to experience some great


Figure 1. Symposium speakers (left to right): back row: Spencer T. Behmer, Sean Schoville, Matan Shelomi, Tyler Raszick; front row: Derek A. Woller, Janice S. Edgerly, S. Bradleigh Vinson, Sydney Brannoch, Andrew C. Mason, and William D. Brown.


Figure 2. The after-symposium celebration at Hell's Kitchen in downtown Minneapolis. Thank you, Society! May your crickets (and other taxa, if applicable) ever-sing!

local cuisine and craft beer at Hell's Kitchen with the generous assistance of funding by the Society. As you can clearly see, a good time was had by all (Fig. 2)!

My overarching goal with this event was to bring orthopteroids, particularly Orthoptera, back into the spotlight at ESA. As some might recall, at the 2014 ESA meeting, I co-organized the first symposium on orthopteroids since a 2004 Orthoptera-focused one by Hojun Song. I am, therefore, pleased to announce that orthopteroids are gaining further momentum because Alexandre V. Latchininsky (University of Wyoming) and I have organized yet another symposium on the subject to be held at the 2016 International Congress of Entomology, which will be in Orlando, Florida, U.S.A. during September 25-30 (http://ice2016orlando.org/). We will have presentations from 13 speakers from eight countries (Russia, the U.K., Italy, Germany, New Zealand, Brazil, Mexico, and the U.S.A.) across four continents, including an introductory keynote presentation by Piotr Naskrecki. I sincerely hope that other Society members will be inspired by these symposia to organize one of their own at ESA or elsewhere. Please feel free to contact me if you have questions or would like advice.

In addition to all the wonderful speakers who breathed life into this symposium, I'd also like to thank some deserving individuals, such as Hojun Song for his continued support and mental rolodex, and the Society members who graciously approved the funding for the after-symposium celebration: David Eades, Michael Samways, David Hunter, and Pamm Mihm.

The phylogeography of an intriguing group of xerophile grasshoppers (Acrididae: *Melanoplus*: The Puer Group)

Derek A. Woller (asilid@gmail.com) and Hojun Song, Texas A&M University, College Station, TX, U.S.A.

One of the oldest ecosystems in the southeastern U.S.A. (Florida, Alabama, Georgia, and North and South Carolina) is scrub, characterized by clusters of pygmy oak trees and other xeric vegetation interspersed with swaths of white sand. These ecosystems are also often associated with ridges, typically in Florida, which are thought to have been used as refugia during sea level shifts 1-3 million years ago. The sea has now receded and relatively stabilized, but the ridges essentially remain landlocked islands due to their unique soil composition and relative lack of plant diversity. Thus, scrub is home to a myriad of endemic species of both the plant and animal variety, particularly arthropods, some of which belong to the grasshopper (Orthoptera: Acrididae) genus, *Melanoplus*. The majority of the members of this genus in the southeast are flightless and lack the ability to disperse well and, combined with their propensity to be endemic to specific habitats and regions, *Melanoplus* species are ideal candidates to closely examine the concept of speciation from a multitude of angles. To narrow the field, the Puer Group, currently comprising 24 species, was chosen because it spans 5 states, contains a plethora of scrub endemics, and its males possess amazing variation in their genitalia. Using mitochondrial genes, a phylogeny was reconstructed to illuminate the relationships between members of the Puer Group.

The phylogeny of the Puer Group was then overlaid onto the geography of the southeast in order to look for phylogeographic patterns. To obtain a more comprehensive understanding of such patterns, a free program called GenGIS (v.2.4.1: http://kiwi.cs.dal.ca/GenGIS/Main_Page) was employed to place the tree in three dimensions onto the landscape (Fig. 3). In addition to a tree in NEXUS format, this process is quite simple and only additionally requires a map file (easy to obtain) and georeferenced species records. Then, multiple options can be explored for output appearance. A number of intriguing patterns were observed that, in most

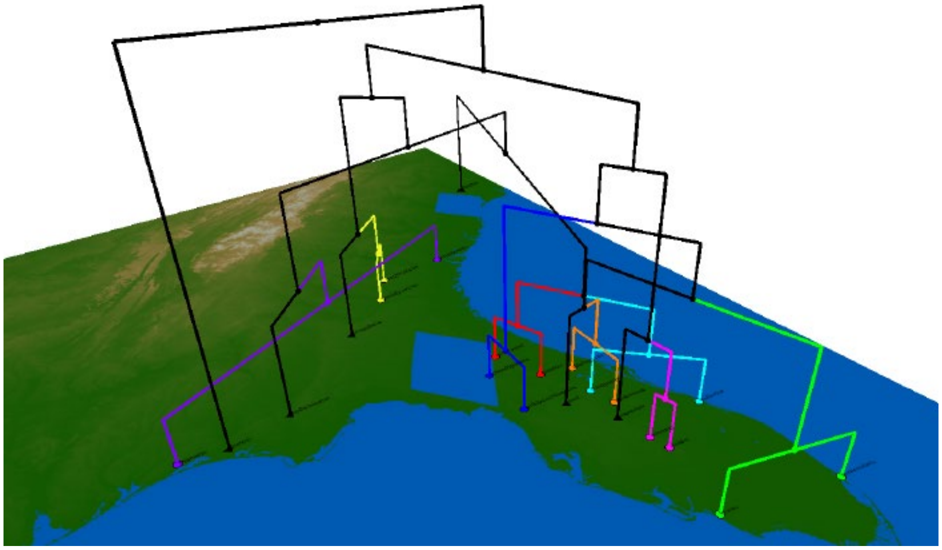


Figure 3. Phylogeography of the Puer Group using GenGIS (v.2.4.1). Branches that are not colored black are sister species. Each point on the map of the southeastern U.S.A. touched by a branch tip is a consensus location for a species. Outgroups are not shown.

cases, met expectations based on previous morphological evidence. For instance, the sister species, *M. rotundipennis* (Scudder, 1878) and *M. withlacoocheensis* Squitier, Deyrup, & Capinera, 1998 (Fig. 3 - in blue), were found to be in close proximity to one another. While *M. rotundipennis* is widespread across Florida and southern Georgia, *M. withlacoocheensis* is restricted to a ridge found around the lower blue dot in Figure 3, suggesting that, in the past, its populations became isolated from *M. rotundipennis* and became their own unique species. Similar situations can most likely explain similar patterns seen in Figure 3, but there are also patterns, like the one highlighted in green that are currently baffling. *M. peninsularis* Hubbell, 1932 is found along the east coast of Florida (right green dot) and is associated with a ridge, but *M. bonita* Otte, 2012 ("2011"), found along Florida's west coast (left green dot) is not near any ridges and, yet, they are found to be sister species with the Everglades separating them. Further research is being undertaken to understand these patterns and more.

The utility of female genitalia characters in Mantodea

Sydney Brannoch (skp72@case.edu) and Gavin J. Svenson, Cleveland Museum of Natural History, Cleveland, OH

Within the praying mantises (Insecta: Mantodea), taxonomists have historically relied on geographic distributional records and external morphological characters, as well as male genitalic characters, for species delimitation and higher-level taxonomy. The systematic utilization of male and female genitalia within Mantodea has been explored over the greater part of a century, with different trajectories developing between the sexes. While both male and female genital complexes within various mantodean families were shown to have superficial systematic merit in the early part of the twentieth century, the more sclerotized male genital complex was eventually favored and has since been developed into a primary taxonomic character system for the order with female genitalia remaining largely understudied. As ambiguous and overlapping species- and higher-level boundaries occur, it is important to consider and develop novel character systems to enhance taxon delimitation, and, as such, we explored female genitalia as a potential site for taxonomic characters within Mantodea.

To test the taxonomic utility of female genitalic characters, we investigated two genera (totaling four species) with a complex taxonomic history: *Nilomantis* Werner, 1907 and *Ilomantis* Giglio-Tos, 1915 (Fig. 4 A & B, respectively). This investigation demonstrated that female genitalic characters were able to consistently delimit generic- and species-level boundaries within our study taxa, the results of which were validated via traditional taxonomic data (i.e., geographic distributional records, external morphological characters, and male genitalic characters). Using female genitalic characters, we found evidence supporting the validity of *Ilomantis*, which is presently a junior synonym of *Nilomantis*, as well as evidence leading to the delimitation of a new species within *Ilomantis*. From these results, we conclude that female genital characters have taxonomic utility within Mantodea, which subsequently underscore the need for a more thorough investigation of female genitalia as sites for taxonomic characters across the order. The development of a female genitalic character system will both enhance taxonomic stability and enable taxonomists to move past sexual dimorphism as a limitation to specimen determination.

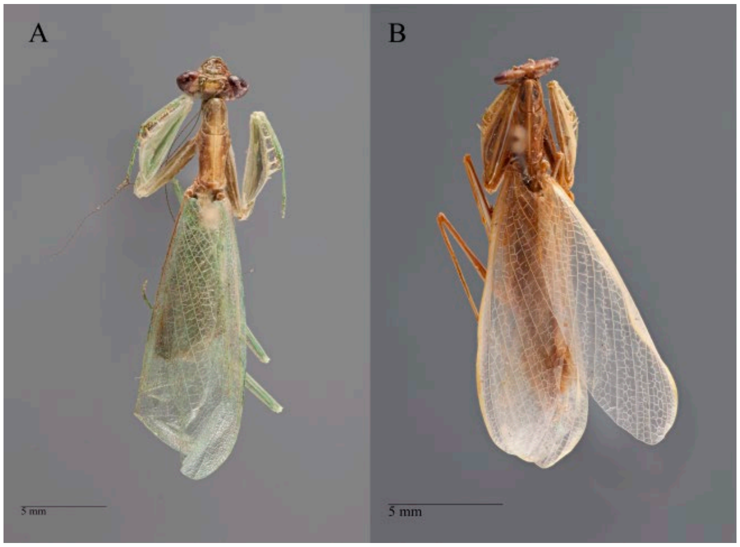


Figure 4. Dorsal views of pinned female specimens of: **A.** *Nilomantis* and **B.** *Ilomantis*.

From Proteobacteria to Phasmatodea: partnering with the 1KITE Project to time a horizontal gene transfer event

Matan Shelomi (mshelomi@ice.mpg.de) and Yannick Pauchet, Max Planck Institute for Chemical Ecology, Jena, Germany

Recent transcriptomic data found endogenously-produced plant cell wall degrading enzymes in the Phasmatodea (Fig. 5): beta-1,4-endoglucanases (cellulases) and polygalacturonases (pectinases). The latter are homologous to bacterial genes despite being encoded in the insect's own genome, suggesting a horizontal gene transfer. Each phasmid species also has several pectinase genes, most of which are highly expressed, suggesting that some changed their function. The questions this project sought to answer were: When did these specific

Figure 5. A representative species of Phasmatodea: *Extatosoma tiaratum* (Macleay, 1826).

pectinase genes appear in Insecta relative to Phasmatodea, from what source, and how did the genes and the functions of their associated proteins evolve over time?

To determine the origins of these pectinases, far more species needed to be examined. In light of the overall theme for the Entomological Society of America's meeting, "Synergy in Science," this talk focused on a collaboration between the investigators and the 1K Insect Transcriptome Evolution (IKITE) project Consortium. Upon request and agreement, their preliminary, unpublished transcriptomes for all Phasmatodea and exemplars from every polyneopteran order were made available and mined for pectinase genes. The goal was to determine when and where in the Polyneoptera or Phasmatodea evolutionary tree did the horizontal transfer event and subsequent gene duplications occur. Such large-scale transcriptomic datasets are changing the way horizontal gene transfer events are being discovered, and evidence is growing that cross-domain transfers may be ubiquitous rather than exceptional. The results of this work are pending submission.

Collaborating with such a large consortium has pros and cons. The availability of data from an immense diversity of species that could not otherwise be collected or afforded by smaller research groups comes at the cost of control over exactly what data is collected and how. A greater number of authors have to agree on the manuscript and can apply their stylistic and artistic abilities to the final manuscript and its figures respectively. Overall, the collaboration proved successful. In addition, at the symposium itself, two speakers were able to form a new collaboration, as Dr. Edgerly provided me with Embioptera specimens that I needed to complete my research on cellulases. Thus, the symposium served as a nexus of synergy and partnerships itself.

What's happening in hoppers: Explorations of the acridid alimentary canal

Tyler Raszick (tjraszick@gmail.com), Viya C. Verma Gabrielle Corso, Gregory A. Sword, and Hojun Song, Texas A&M University, College Station, TX

Metagenomics is a discipline that enables the genomic study of uncultured microorganisms with applications to ecology, medicine, environmental science, and agriculture, among others. The metagenomic approach to community analysis involves extracting DNA from multiple species in an environmental sample and using DNA barcoding to sequence all of the species' copies of that gene or genes to make species identifications. Coverage, or the number of copies of a gene, for each species can also be used to estimate relative species abundance. Here, we use a metagenomic approach to test if the microbial community structure of a host-associated grasshopper (*Schistocerca lineata*) reflects the divergence patterns of the ecotypes. We also demonstrate that a similar approach can be used to evaluate plant community structure in grasshopper guts (*Melanoplus differentialis* feeding in cotton fields). To carry out the ecotype microbial community structure study, we collected eight populations of *S. lineata* representing the two best-characterized ecotypes of the species in Texas (three *Rubus*-feeding populations and five *Ptelea*-feeding populations). Ten nymphs were collected from each site and placed directly into 100% EtOH. Specimens were then surface-sterilized and total DNA was extracted from the entire body of each grasshopper. The 16S ribosomal DNA barcode for bacteria was then amplified using PCR, and sequenced on the Roche 454/pyrosequencing platform at Research and Testing Laboratory in Lubbock, TX. Quality control and diversity

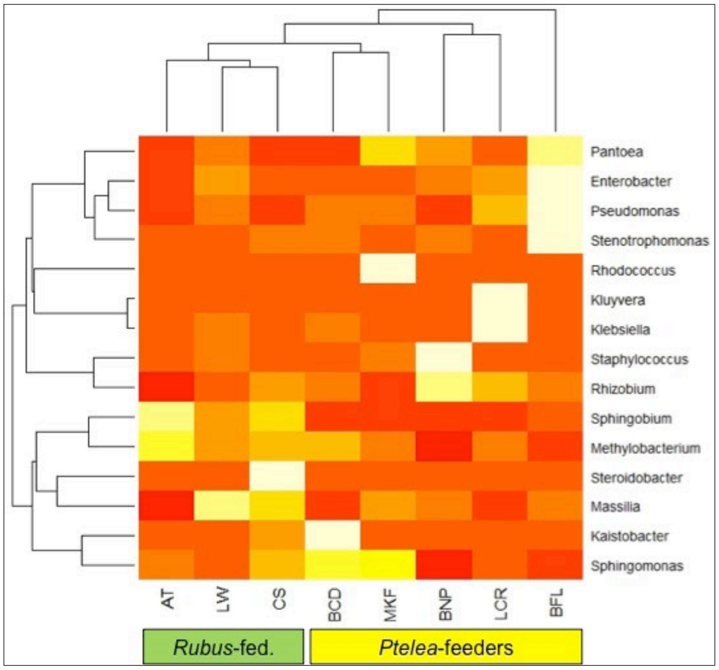


Figure 6. Hierarchically-clustered heat map illustrating bacterial community structure across eight populations of *Schistocerca lineata* based on the 15 most abundant bacterial genera.

analyses were carried out using the UPARSE pipeline.

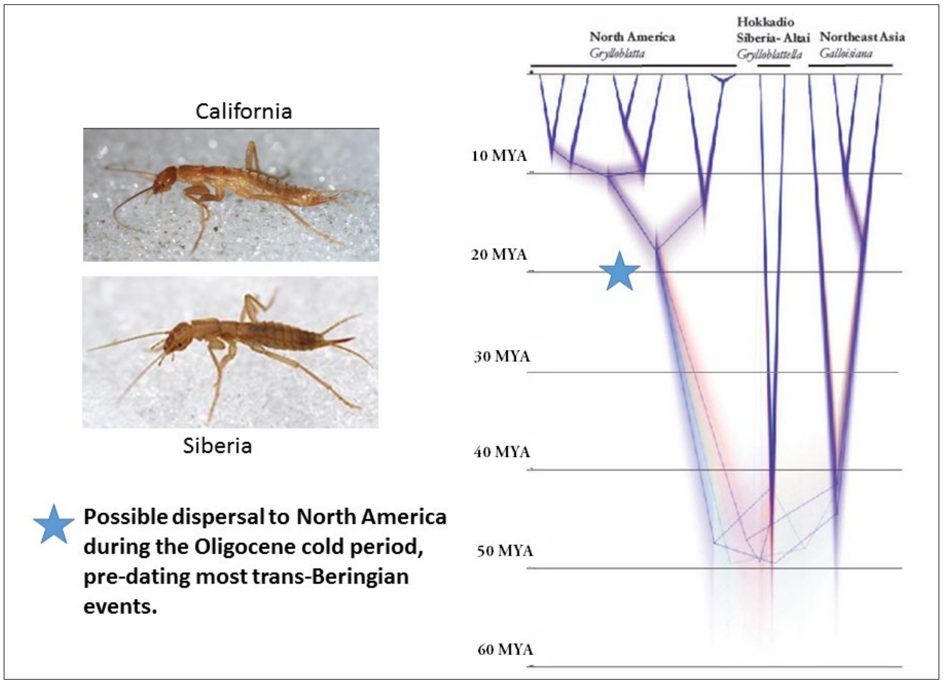
Figure 6 is a hierarchically-clustered heat map illustrating the similarity of bacterial community structure across eight populations of *S. lineata* (three *Rubus*-feeding populations and five *Ptelea*-feeding populations) based on the 15 most abundant bacterial genera. We have shown that the bacterial community structure in the *Rubus*-feeding ecotype is tightly-clustered, whereas the bacterial communities found in populations of the *Ptelea*-feeding ecotype is relatively divergent. *Ptelea*-feeding populations were also found to have a significantly higher Shannon-Wiener diversity metric on average when compared to *Rubus*-feeders. We also carried out a similar study to determine if a metagenomic approach could be applied to analyze gut contents of an herbivorous grasshopper. Eight *M. differentialis* specimens were collected from 3 types of fields on a cotton farm near College Station, TX (dryland, irrigated, and pasture). Grasshoppers were preserved in 100% EtOH and the guts were dissected out for DNA extraction. The rbcLA chloroplast DNA plant barcode marker was PCR-amplified for each individual, and then samples were pooled and re-aliquoted into 3 technical replicates for each field type. Amplicons were sequenced on the Illumina platform at MR DNA. In both the dryland and irrigated cotton fields, the populations were found to have gut contents that were primarily cotton, whereas grasshoppers collected in the pasture had gut contents that were comprised of a variety of grasses. This indicates that this approach is likely very accurate and could be used for other gut content analyses in herbivorous species.

Phylogenetic roots of the Grylloblattodea and implications for past environmental change

Sean Schoville (sean.schoville@wisc.edu), University of Wisconsin, Madison, WI

Members of the order Grylloblattodea are notable among orthopteroids for their rarity, lack of species diversity, and unusual affinities for cold habitats. The North American genus, *Grylloblllata*, is known for foraging on alpine snow fields and in ice caves at below-freezing temperatures. A central question in my research is whether past climate change explains grylloblattid distribution patterns? I present data on evolutionary genetics and thermal physiology. First, physiological experiments show that *Grylloblatta* thermal breadth is remarkably narrow (-4 to 27 Celsius) and ice-crawlers are unable to survive freezing. Furthermore, these thermal limits are highly conserved across taxa and populations spanning nearly 4 degrees of latitude. In contrast, genera in northeastern Asia forage in warmer environments, including rocky soils in Japan and South Korea, and have higher critical thermal maxima.

Using comparative transcriptome sequencing, I show that gene regulatory responses to heat and cold varies among lineages and may be an important component in physiological differences observed among genera. Using population genetic and phylogenomic approaches, I estimate the divergence time and biogeographic response of lineages and populations to past climate change. A deep split in the Asian and North American lineages (Fig. 7) suggests *Grylloblatta* may have colonized North America during ancient cold events predating the Pliocene-Pleistocene land bridge connections through the Bering Strait. Similarly, patterns of population and species diversification within North America are closely-tied to glacial climate cycles, with species moving between alpine and low-elevation sites during episodes of glacial expansion. Species diversity has thus increased recently during the Pleistocene period as populations have become isolated on different mountains.



★ **Possible dispersal to North America during the Oligocene cold period, pre-dating most trans-Beringian events.**

Figure 7. There is a long history of isolation in Asia and North America.

Adaptations for tube living produces a silly (but fast) backwards gait in Embioptera

Janice S. Edgerly (jedgerlyrooks@scu.edu)[1], Thomas Libby[2] and Robert J. Full[2], [1]Santa Clara University, Santa Clara, CA, [2]U.C. Berkeley, Berkeley, CA

An order-defining trait for the Order Embioptera is the presence of silk glands packed into the swollen basitarsi of the front legs. They spin silk into tunnel-like passageways and sheet-like coverings that serve to protect them from predators and the elements. Large tropical embiopterans, such as our study subject *Antipaluria urichi*, are particularly adept at spinning copious amounts of silk on exposed bark where they graze on epiphytic algae and lichens in groups of offspring alongside their mothers, often in large colonies. Reliance on silk appears related to their lack of a tough cuticle and, in its place, a flexible body capable of tight U-turns and rapid backwards locomotion as they travel within their silken domiciles. When threatened while at the edges of their domiciles, they quickly bolt backwards, a behavior that takes them into the relative safety of thick, complex sections of the silk. Adult females walk to disperse outside their silk and are often confronted by predators, particularly ants and spiders. When tested under laboratory conditions, with taps to the head, middle thorax, or posterior of the abdomen, they run backwards except when touched on the abdomen. Thus, even if touched in the middle of their body, their choice is to run backwards; these runs are significantly faster than the corresponding forward runs by each of ten females tested (Fig. 8).

Backwards running is extremely rare in animals and kindled questions about how they are able to locomote in this direction. Analysis of high-speed videography revealed that they utilize the alternating tripod gait typical of hexapods when running forwards and backwards, although the backwards runs showed bouncing rises and falls of the head and abdomen. In addition, during many strides, females running backwards slam down against the substrate - the faster they run, the greater the frequency of body slamming. Despite the sloppiness of the backwards runs, they achieve faster and smoother strides than when going forward. Getting them to run forwards in front of the camera was surprisingly challenging. Perhaps this reluctance is a reflection of the difficulty of propelling the body forwards with feet swollen with silk glands.

Research focused on hexapods, such as the recent work on embiopterans just described, has revealed general principles that have led to the development of very efficient robots. Among these, RHex, VelociRoACH, and iSprawl were all inspired by analyses of running cockroaches, orthopteroids well known for their extraordinary speed. How knowledge of a fast backwards runner, such as embiopterans, can be applied is not known, but their abilities to run fast backwards, to make U-turns in tight spaces, and to achieve higher speeds by adding body slamming to the alternating tripod gait are intriguing.

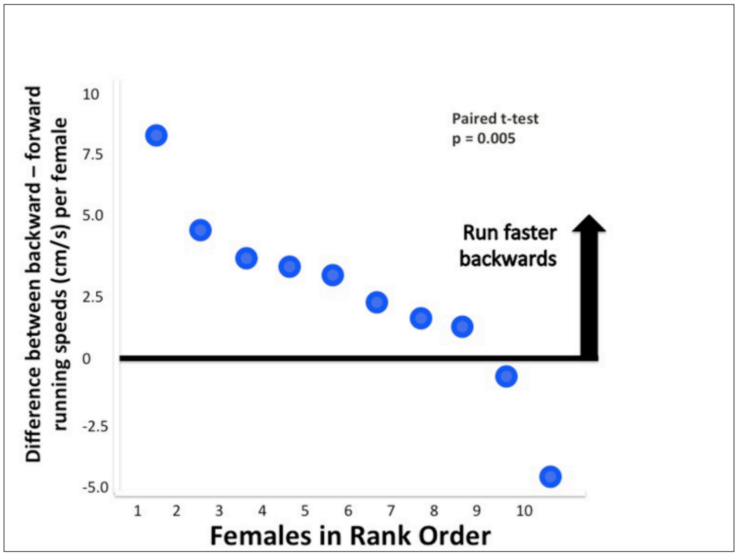


Figure 8. *Antipaluria urichi* females often prefer to run backwards and their speed in this direction is usually faster than when running forwards.

The evolutionary ecology of sexual cannibalism in praying mantids

William D. Brown (William.Brown@fredonia.edu), Department of Biology, State University of New York at Fredonia

Models of the evolution of sexual cannibalism argue that the degree of sexual cannibalism will depend on expected mating frequency of males and additional offspring produced from the resources obtained by cannibalism. Thus, males are predicted to alter their risk-taking approach to females depending on perception of mate availability and the fecundity of benefits of cannibalism. I report the results of a series of experiments on the praying mantis *Tenodera sinensis* (Saussure, 1871) (Fig. 9), examining the effect of (1) level of predatory risk, (2) frequency of mating opportunities for males, and (3) use of male soma for offspring production by females. Males with fewer mating opportunities showed greater risk-taking behavior. When given daily encounters with females, males responded to greater female-imposed risk by slowing their rate of approach and remaining a greater distance from females prior to mounting. In contrast, males without recent access to females were greater risk takers, approaching females more rapidly and to a closer proximity, regardless of risk, and these males consequently suffered greater rates

Figure 9. An example of *Tenodera sinensis* (Saussure, 1871) (the Chinese mantis) in the wild.

of mortality by cannibalism. Theory also suggests that males may offset the cost of cannibalism if materials of their soma are allocated to the eggs that they might father. We also studied male reproductive investment via sexual cannibalism. Males and females were each fed different radiolabeled amino acids and allowed to mate. We allowed half of the pairs to progress to sexual cannibalism and prevented cannibalism in the other half. The results show that male somatic investment contributes to production of offspring. The eggs and reproductive tissues of cannibalistic females contained significantly more male-derived amino acids than those of non-cannibalistic females, and they produced more eggs.

The curious case of the post oak grasshopper

Spencer T. Behmer (s-behmer@tamu.edu), Texas A&M University, College Station, TX

The post oak grasshopper, *Dendrotettix quercus* Packard, 1890 (Fig. 10A&B), is an oak defoliator first recorded from Texas (Bruner 1887) and Missouri (Riley 1888, 1893). It has been reported as occurring throughout much of the United States, most commonly in the eastern half. In the early 2000's, Hilliard and Himes (2005) documented an infestation in east Texas, and I first became acutely aware of them in the spring of 2006 (they occurred in large numbers in key areas around Bryan/College Station where TAMU is based). In 2007, however, their numbers around the Bryan/College Station area steadily declined, and, since 2009, they have only been found in small numbers in a few locations. However, they continue to be observed in large patches on an annual basis in other parts of Texas, especially in the Dallas/Fort Worth Area (including Palestine, Argyle, Corsicana, and Tyler).

In Texas, post oak grasshoppers hatch (from the ground) in late-March/early-April and become very noticeable (due to their increasing body size) in late April. Observations in the field and laboratory have revealed a number of interesting aspects about their behavior and ecology. First, unlike many grasshoppers, they have a strong inclination to climb vertical objects. My lab measured the time it took late instar nymphs to reach the top of a 4-foot high wooden dowel, which, on average, took 10 seconds. In contrast, late instars of the grasshopper *Melanoplus differentialis* (Thomas, 1865) rarely climbed higher than halfway up the dowel, and this usually took greater than 1 minute. Interestingly, this propensity to climb appears to override thermoregulatory behavior. Initially, when post oak grasshoppers were returned to the lab and placed in standard BioQuip cages with heat lamps sitting on top, it was difficult to keep them alive. It was later discovered through an accidental power outage that post oak grasshoppers survived fine in such cages if the heat lamps were off,

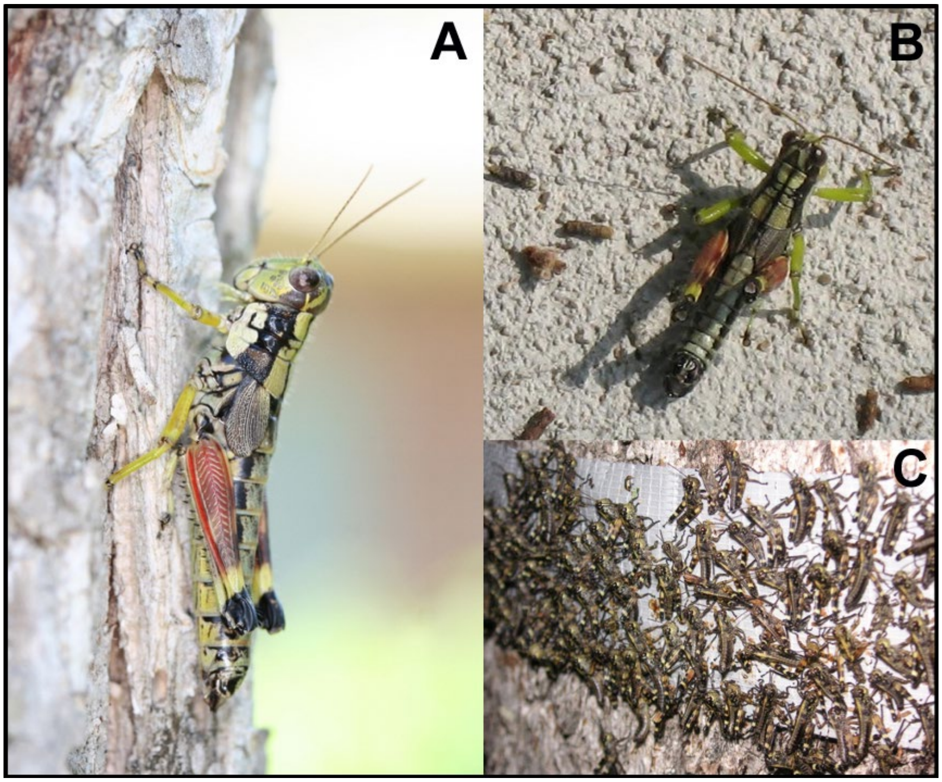


Figure 10. *Dendrotettix quercus* specimens in the wild: **A)** on the side of a tree, a common sight when encountered; **B)** on the side of a house with fecal pellets near-by; **C)** dozens of nymphs stuck to the sticky side of duct tape wrapped around the base of an oak tree to prevent its defoliation.

implying that climbing behavior is hardwired into this species.

Reproductive output in this species was also investigated. On average, females produce six eggs/pod. This was somewhat surprising given the population sizes observed, and considering this species is brachypterous. It was also discovered that post oak grasshopper population crashes are likely regulated by an entophathogenic fungus. Dead grasshoppers were observed in the field and usually attached to a vertical structure (tree or house wall), loaded with unidentified fungal spores. Spores were also found in grasshoppers returned to the lab.

On a final note, I have received many reports of post oak grasshopper outbreaks from concerned homeowners. These grasshoppers create two problems. First, they defoliate oak trees, causing potential death when combined with other sources of stress. Second, they climb houses and leave stains when they defecate (Fig. 10B). This is likely a function of tannins, found in oak leaves, that can complex with various substrates, and darken when oxidized. Controlling post oak grasshoppers with insecticides is difficult because they reside in tree canopies. As an alternative approach, banding the base of trees with duct tape, with the sticky side out, has proven effective (Fig. 10C).

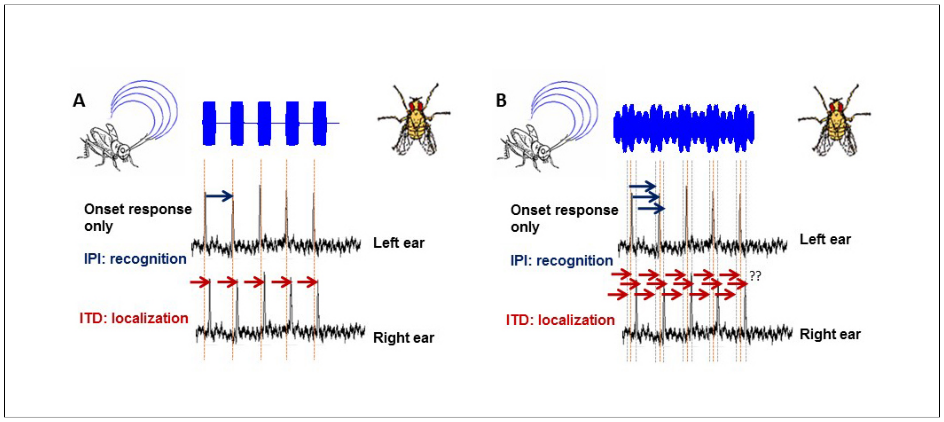


Figure 11. Auditory temporal cues are important for both recognition and localization of host calls for the acoustic parasitoid fly *Ormia ochracea*. **A)** The host (cricket) produces a chirp consisting of a series of brief sound pulses separated by a characteristic interval (interpulse interval or IPI). Auditory neurons in the fly respond only at the onset of sound pulses, registering the timing of sound pulses, and recognize cricket chirps on the basis of the IPI. The mechanics of fly eardrums amplify small differences in sound arrival-time (interaural time-differences, ITD) that vary with the direction of the sound source (cricket). **B)** Noisy conditions, or multiple overlapping sources

Following the cues: Flies, crickets, phonotaxis, and technology

Andrew C. Mason (amason@utsc.utoronto.ca), University of Toronto, Scarborough, ON, Canada

The fly *Ormia ochracea* makes decisions based on limited sensory information. These flies reproduce by depositing larvae on crickets where they develop as parasites. Female flies are able to exploit crickets when they hear and home in on their songs. I examine how the flies are able to accomplish this task.

Ormia ears are insensitive to most differences in sound quality and register only the location of cricket songs. I examined sound localisation performance (phonotaxis to cricket song) under complex acoustic conditions to identify mechanisms of source segregation and recognition in the parasitoid fly, *Ormia* (Diptera: Tachinidae). In behavioural experiments (tethered fly on spherical treadmill), we identified a range of conditions, involving multi-source stimuli, under which flies show mis-directed sound localisation. The flies are subject to a “phantom-source illusion” analogous to vertebrate hearing, and this effect can be reproduced in the field. Most such conditions are resolved by small inter-source time differences (<200 µs) via a precedence effect in the auditory pathway. Interaural time differences on this scale also encode auditory directionality, suggesting that both directional hearing and source segregation rely on common auditory cues and these may be strongly affected by noise (Fig. 11).

In other studies, masking noise degraded detection and localisation of sound sources, but with spatial effects distinct from previously studied auditory systems, in which masking effects are stronger for noise sources in closer proximity to the target source (i.e. spatial release from masking or SRM). In flies, we show noise sources spatially displaced from targets have a stronger effect on localisation and equivalent effect on detection thresholds (no SRM). This suggests a model of auditory localisation based on an acoustic symmetry detector with high temporal resolution. Localised noise sources distort the symmetry of auditory inputs and cause directional deviation; conditions that generate highly symmetrical input from multiple sources (e.g. synchrony) generate a phantom source illusion. Flies only orient to a specific class of sources (host cricket song) implying that phonotaxis requires detection of specific stimulus features (recognition). Basic-science data from these studies support efforts to develop miniature microphones based on *Ormia* ears.

Regional Reports - What's happening around the world?

East Europe
North and Central Asia

By **MICHAEL G. SERGEEV**
Novosibirsk State University
Institute of Systematics
and Ecology of Animals
RUSSIA
mgs@fen.nsu.ru

Outbreaks of the Migratory, Italian, and Moroccan locusts, and several other grasshopper species continued in different semi-arid and arid regions of the former USSR. This resulted in some active discussions between acridologists and plant protection specialists and managers during several Workshops and Meetings on locusts in Caucasus and Central Asia organized by the Food and Agriculture Organization of the United Nations (FAO). The last workshop was held in Saint-Petersburg in October, 2015. Acridologists and plant protection specialists and managers from this region discussed the main problems of applied acridology and locust population management. These meetings were organized under the FAO's "Five-year Programme to improve national and regional locust management in Caucasus and Central Asia (CCA)" (http://www.fao.org/ag/locusts-CCA/en/index.html). Besides that, the group of acridologists from Kazakhstan, Russian Federation, Turkmenistan, Uzbekistan, and the U.S.A. finished the editing of a book about Italian locusts, which will be published in electronic form in Russian in January, 2016.

Euchorthippus pulvinatus (Fischer de Waldheim) - the typical grasshopper of the dry steppes and semi-deserts of West Eurasia

Field camp of the Novosibirsk State University expedition in the central part of the Kulunda Steppe (West Siberia)

The All-Russian Conference with International Participation on Biogeosystem Ecology and Evolutionary Biogeography was held in Novosibirsk in 2015 (December, 14–19). The Conference was hosted by the Novosibirsk National State University and the Institute of Systematics and Ecology of Animals. This Conference was dedicated to Professor Igor Stebaev (1925-2009), the famous Russian orthopterist. Several dozen entomologists, ecologists, and biogeographers attended this meeting. The Programme included several presentations concerning terrestrial and aquatic orthopteran insects as well as some informal talks. We also discussed the main problems of basic and applied acridology in context of modern trends in ecology, biogeography, and evolutionary biology.

There are now orthopterists, or at least plant protections specialists/managers in the field of applied acridology, in almost all countries of East Europe–North and Central Asia. Many of them are involved in projects concerning either Orthoptera conservation or pest management. Among them are several young researchers who are preparing for their PhD dissertations or have just finished them.

The scientists of the region continue to work to solve some problems of fundamental and applied orthopterology. For instance, they are investigating the spatio-temporal distribution patterns of taxa, populations, and assemblages. They are also trying to create digital maps describing these patterns in order to reconstruct the phylogenetic relationships and evaluate the taxonomic structure of several taxa based on the synthesis of the classic (ecologo-geographic, morphological, cytogenetic) and modern (molecular/phylogeographic) approaches. Comparative studies of acoustic patterns of different taxa of Orthoptera relative to their taxonomy, phylogeny, and ecology are also continued. Several projects of orthopterists were supported by the Russian Foundation for Basic

Research and other foundations. As an example, one project included orthopterists from different parts of Russia (Novosibirsk and Nalchik) and was focused on the concerned migratory potential of grasshoppers and other orthopteroid insects in spatially-structured landscapes. Main aspects of grasshopper migrations (including the nocturnal ones) were evaluated for different spatial scales in the steppe and forest-steppe regions.

Middle East & Caucasus

We have found several "Noah Arks"!

By **Battal Çiplak**
Akdeniz University Antalya
TURKEY
ciplakbattal@gmail.com

When you ask Google "where is the Middle East" you will meet 17 countries (e.g. in WIKIPEDIA: Middle East) and when you add in three countries in the south of Greater Caucasus this number will raise to 20 in total. No one wishes to really learn what is happening in this part of the world nowadays! But, some information on orthopterology in this area may relieve us a little bit. A search in ISI using the key words "orthoptera, country (for each of the 20 country names)" for 2015 will found 13 papers with orthopterology content. Considering the address on the papers, 10 are from Turkey, two are from Iran and one is from Israel. Of these 13 papers, six are on biodiversity (faunistic, taxonomic), five are on biology (ecology, behaviour, pest management etc.) and two are on evolution and biogeography. All of these show that there is a considerable research activity in orthopterology in the region.

Apart from the numerical parameters, the issue most highlighted is conservation of Orthoptera in the region. As previously reported, lineages from different origins are harboured in this area, especially in Anatolia, Caucasus, Iran, and Levant (Kosswig, 1955; Çıplak, 2003). There are two unique features of this area. First, this region is the crossroads for organisms of three biogeographic regions, namely Palaearctic, Ethiyopya, and Orientalis (Ayal et al., 1999; Çıplak, 2003). Second, there are several Palaearctic glacial refugia within the region that hosted many populations/taxa during the cold periods of Pleistocene climate cycles and led to their divergence resulting in unique endemic Orthoptera fauna. The mountain ranges connecting Caucasus, Anatolia, Levant, and Balkans to each other are either distribution corridors or present day refugia for the cold-preferring populations/taxa of Orthoptera (Ayal et al., 1999; Çıplak, 2003, 2008; Şekercioğlu et al., 2011; Chobanov et al., 2016). However, climate warming, together with anthropogenic activities, constitutes the main threat to Orthoptera species with such habitat preferences. Some taxa, such as *Psorodonotus salmani* and *Psorodonotus caucasicus anatolicus* have gone extinct (possibly since the 1950's; Çıplak, 2008; Kaya & Çıplak, 2016a) while some others retreated to restricted habitats on summits of these mountain ranges due to habitat loss at low elevations (Çıplak et al., 2015; Kaya & Çıplak, 2016b). The Beydağları bushcricket *Psorodonotus ebneri* (Fig. 1) has been listed under the top 100 endangered species (Baillie & Butcher, 2012). The same situation seems true for *Psorodonotus hakkari* (Kaya & Çıplak, 2016b) and some species/populations of *Anterastes* (Çıplak et al., 2015), plus some of *Poecilimon* (Kaya et al., 2015).


Figure 1. Beydaglari Bush-cricket (*Psorodonotus ebneri*), Photo by Sarp Kaya & Battal Çıplak

According to mythology, the Prophet Noah had built an ark to rescue living things from the Great Flood and the ark landed on top of a mountain in the Middle East when the flood ended. Ararat Mountain in the Caucasus and Cilo Mountain in the northern end of the Zagros Mountains are two mountains suggested as the place where "Noah's Ark" landed. The mythological suggestions cannot be tested scientifically, but Noah's Ark mythology provides a great metaphor to define the present role of the mountain ranges for conservation of cold-preferring Orthoptera in the Caucasus and Middle East. Drawing conclusions from the above summarized case studies, we claim (!) that we have found the real Noah's Ark. The Cilo (Hakkari, Turkey) is the Ark for *Psorodonotus hakkari*,

Figure 2. A view from İmecik, Beydağları, Antalya, Turkey (habitat of *Psorodonotus ebneri*)

Beydağları Mountain (Antalya, Turkey) is the same for *Psorodonotus ebneri* (Figs. 1 and 2), Uludag (Bursa, Turkey) is for *Anterastes uludaghensis*, Bozdag (Izmir, Turkey) is for *A. tolunayi*, and several others are Arks for some other species (Çıplak 2003, 2008). Unfortunately, some of the arks, such as Bozoğlan Mountain (the home for *P. salmani*) have started bilging. Thus, there is no single Noah's Ark, instead there are several and they serve as conservation stewards, just in our time instead.

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Theodore J. Cohn Research Grant Reports

Morphological and biogeographical analyses of the genera *Thalpomena* and *Pseudoceles*

By **LARA-SOPHIE DEY**
& MARTIN HUSEMANN
Martin-Luther University Halle-Wittenberg
GERMANY
lara-sophie.dey@student.uni-halle.de

The *Oedipodines*, or band-winged grasshoppers, represent an interesting model system for biogeographic and evolutionary studies. Despite high flight ability, with their large number of species, and their complex acoustic and behavioral traits, we can gain deeper insights into speciation mechanisms. However, although they possess high potential, relatively few studies have used this group as a model in evolutionary and phylogeographic studies. Earlier phylogenetic studies have suggested that the subfamily is rather young (Song et al. 2015), but have also shown that the relationships within the subfamily and its biogeography are difficult to resolve (Fries et al. 2007, Chapco & Contreras 2011). This may be partially due to patterns of large scale morphological convergence, exemplified by the Trimerotropini, Bryodemini, and Sphingonotini (Husemann et al. 2012), which may have caused some of the taxonomic confusion. Besides such larger scale studies, the phylogeny and biogeography of the genus *Sphingonotus* have been explored in a number of studies (Husemann et al. 2012, 2013, 2014, 2015), which suggested the presence of cryptic diversity and complex colonization and diversification patterns. Similar studies for other

Figure 1. Photograph of *Pseudoceles persa* taken in Iran.

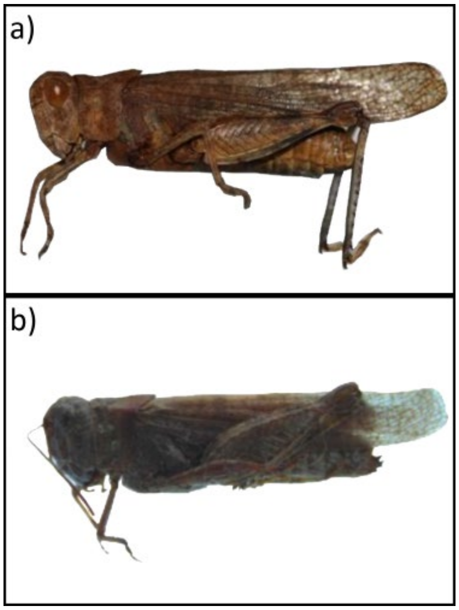

Figure 2. a) lateral view of *Pseudoceles inornatus* from Iran; b) lateral view of *Thalpomena algeriana algeriana* from Algeria

genera are, however, largely missing.

Two interesting genera for such targeted studies are *Thalpomena* and *Pseudoceles* (Figs. 1 and 2), which both are restricted to mountainous areas where they have undergone small radiations (Dirsh 1949). Most species of *Thalpomena* are endemic to North Africa, where they occur in the Atlas Mountains, except for a single species, which can be found in the highlands of Somalia. *Pseudoceles*, in turn, is distributed across several mountain ranges in the Southern Caucasus and Western Asia, i.e. the Caucasus-, Elburs-, Zagros-, Pontic- and Taurus Mountains (Fig. 3). Interestingly, both genera are relatively similar in their morphology and habitat requirements raising the question if these similarities are the result of common ancestry or convergence. This morphological resemblance has led to a variety of taxonomic problems, which have not been addressed, and both genera have not been subject to any recent taxonomic and systematic evaluation rendering the status of many species doubtful. Finally, no studies have been performed investigating the biogeography of the genera despite their interesting distribution patterns, which may provide further insights into the evolutionary drivers of differentiation in mountain systems and the biogeographic history of the regions.

In order to answer these questions, we are using a combination of molecular and morphological methods, and distribution mapping. We are combining mapping of all records of the species obtained from museum collections, field trips, and literature surveys with 13 morphological measurements analyzed with multivariate statistics, and DNA sequencing of two mitochondrial and two nuclear genes in order to evaluate the status of species and understand the biogeography and the relationships between the genera.

So far, we have obtained records for 9 species of *Peudoceles* with a total of 93 records and for 15 species (including subspecies) of *Thalpomena* with a total of 178 records (Fig. 3). The distribution records show that both genera are geographically separated and, as expected, all records are restricted to mountainous habitats. The map further shows that many species and subspecies have overlapping distributions, which suggests either wrong identification of specimens or a false status of subspecies (either they deserve species status or the differences represent intraspecific variation), as subspecies generally should not occur sympatrically (Zusl 1982). Our hypotheses (wrong identification vs. wrong assignment) will be tested with additional data in the future. Here we plotted primary morphological measurements, which show that both genera have similar phenotypes, but, for the greater part, different proportions (Fig. 4). This suggests that Pseudoceles and Thalpomena do not belong to the same genus. Also, preliminary analysis of the COI and H3 genes suggest strong differentiation between *Pseudoceles* and *Thalpomena*, indicating that they are not sister genera. Hence, the initial results of this study provide further evidence for large scale convergence within the Oedipodinae. However, these results will have to be verified by including additional specimens, species, and genetic markers in the analysis.

Besides these larger-scale systematic questions, the two genera pose a variety of more specific questions regarding the status and evolution of single species. One such example is represented by *Thalpomena schulthessi*, which is the only species of the genus not found in Northern Africa. Instead, this species is endemic to the highlands of Eastern African Somalia. The species shares some characters with other species of its genus, but resembles another genus, *Sphingonotus*, in other traits. Hence, the status of the species needs to be clarified before its evolution can be studied. Unfortunately, no recent material of the species is available to us so far and hence we were only able to analyze the species morphologically. First comparisons revealed several differences separating it from other *Thalpomena* species, e.g. its very

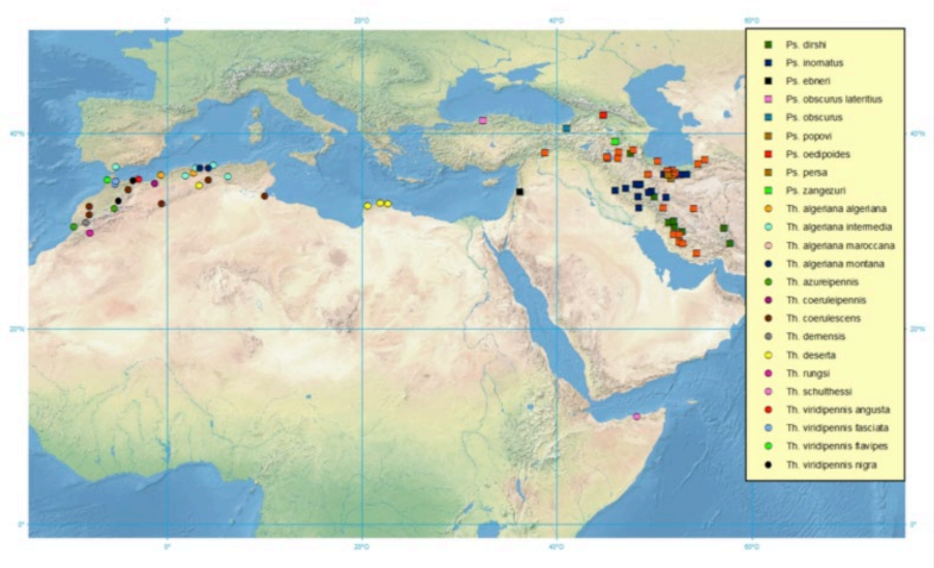

Figure 3. Map displaying the distribution of species and subspecies of the genera *Thalpomena* and *Pseudoceles*.

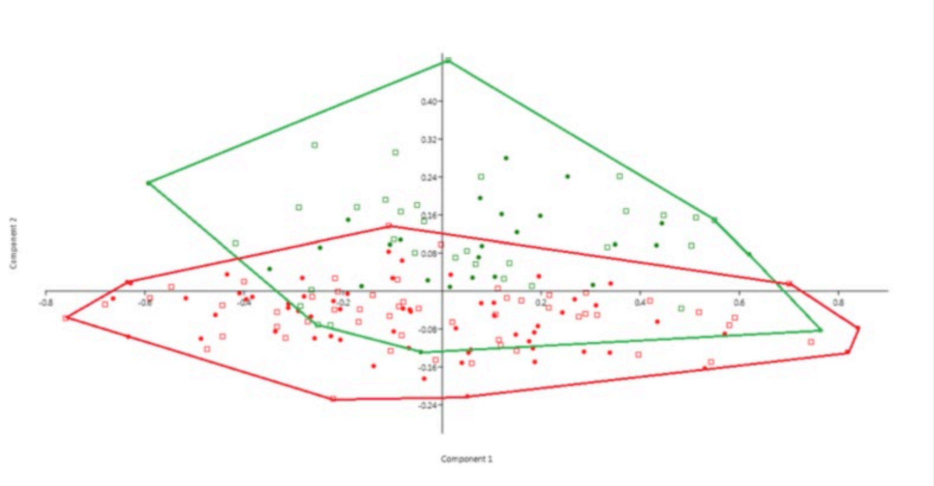

Figure 4. Plot of 13 morphological characters with a sample size of 171 individuals (114 *Thalpomena*, 57 *Pseudoceles*); ***red***: *Thalpomena*, ***green***: *Pseudoceles*; ***filled circle***: female, ***open square***: male.

broad and dark wing band, the dark violet color of the hind wing disc, and the proportions of several quantitative morphological measurements. Future analyses need to include larger numbers of specimens and additional morphological and, if possible, genetic markers to clarify the status of the species.

Additional interesting questions relate to the genus *Pseudoceles*. During field trips, specimens with multiple wing coloration phenotypes were collected sympatrically and syntopically in Northern Iran. This poses the questions: do these differences represent phenotypic variation or do the different phenotypes represent different species? Again, a combination of molecular and morphological analyses are being employed to resolve such questions. We are planning to sequence the same set of genes for all specimens available from these locations and the same morphological traits will be measured. First analyses of the COI gene suggest that all specimens with different phenotypes represent a single monophyletic group. However, the analyses also indicate a shallow genetic split into a blue-violet wing group and a red wing group; these results will have to be verified using finer resolution genetic markers. First morphological analyses suggest no differentiation in quantitative phenotypic measurements, so the next step will be the analysis of male and female genitalia structures and then acoustic and behavioral assays.

While all our results are only preliminary currently, they already demonstrate the complex relationships within the genera and suggest their suitability for evolutionary studies. In the future we plan to obtain additional samples of *Thalpomena* and *Pseudoceles* during field trips in Iran, Morocco, and Turkey. Furthermore, we need to include more material from museum collections (e.g. from the Muséum National d'Histoire Naturelle, Paris, the Museum of Natural History, Berlin, and the Jalal Afshar Zoological Museum, Tehran).

Acknowledgement

We thank the Orthopterists Society and Synthesys for financial support. We are further grateful to the NHM London, the Národni Muzeum Prague, the Jalal Afshar Zoological Museum Tehran, the German Entomological Institute Müncheberg, the Zoologische Staatssammlung München for access to their collections. PD Dr. Axel Hochkirch, Prof. Dr. Thomas Schmitt, and Dr. Benjamin Price provided additional material and intellectual input to the project. Finally, we want to thank Prof. Dr. Robert Paxton, Dr. Antonella Soro, Matthias Seidel, and the whole General Zoology group at the MLU Halle for suggestions for the project and access to laboratory facilities.

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The effect of gut microbiomes on nutrient regulation in a grazing insect

By **PAUL ALVARADO LENHART**
University of Kentucky
U.S.A.
palenhart@gmail.com

Microbes that form symbioses with multicellular hosts can provide complementary physiological machinery that enables the host to exploit new resources or environments as well as defend against natural enemies. One of the most common functions of symbiotic microbes is enhanced nutrient uptake via the production of digestive enzymes or synthesis of limiting nutrients (Douglas 2013). As a result, microbes (mainly bacteria) may be integral to nutrient regulation in many animals.

All manner of animals have been found to tightly regulate their intake of macronutrients in metabolically optimal ratios, making specific compromises when food is suboptimal (Simpson and Raubenheimer 2012). Researchers are only beginning to examine the effects of microbes on macronutrient regulation but have found strong consequences of the gut microbial community (Douglas 2013, Pernice et al. 2014), including links to obesity in humans (Mullin and Delzenne 2014).

While the composition and function of symbiotic microbial communities are becoming well-characterized in some insects, little is known about symbiotic bacteria in grasshoppers, a well-studied model for nutritional studies. The few surveys in Orthoptera have found numerous gut-associated bacteria (Dillon et al. 2008, Yun et al. 2014) and manipulative studies on crickets show an effect of antibiotics on carbohydrase production and diet selection (Kaufman and Klug 1991, Schmid et al. 2014). Given the presence of gut microbes and the long history of grasshoppers as a model system for understanding nutrient regulation, we tested if the gut microbiome of a generalist grasshopper affected basic macronutrient regulation. In short, in a laboratory-based experiment we attempted to alter the grasshopper

Figure 1. A *Melanoplus femurrubrum* grasshopper nymph used in this experiment.

Figure 2. Collecting grasshopper nymphs in Lexington, KY, U.S.A.

gut microbiome through antibiotic exposure and assessed grasshopper macronutrient regulation on various diets.

Methods. This study used a common, widely-distributed, and well-studied acridid (Pfadt 1994): *Melanoplus femurrubrum* (De Geer) (Fig. 1). Early instar nymphs were collected (Fig. 2) at the University of Kentucky's Ecological Research Facility (ERF) in Lexington, Kentucky, U.S.A., brought into the lab, and reared on mixtures of fresh herbaceous plant clippings until their 5th nymphal stadium.

We utilized a 2×3 factorial design (n=12 grasshoppers per treatment) with two antibiotic treatments (AB+, AB-) and three diet treatments: artificial diet (C), fresh leaves (Ff), or lypholized ground leaf powder (Fp) from a host aster, the goldenrod *Solidago altissima*. Because earlier studies suggested that orthopterans have bacteria which produce carbohydrases and even cellulases (Kaufman and Klug 1991, Shi et al. 2013, Su et al. 2014) we incorporated a treatment to investigate how the gut microbiota might interact with nutrient regulation when plant cell walls and other structural barriers to digestion were compromised through grinding, and compared this to both an artificial diet control and whole-plant digestion (see Clissold et al. (2009)).

Upon reaching the final instar (5th), we orally administered a short-term antibiotic cocktail composed of gentamycin sulfate, ampicillin, and cefotaxime to half of the individuals to eliminate or severely reduce the gut microbial community. We then individually fed nymphs from the AB+ and AB- treatments artificial diets for 24 hours that allowed them to regulate their macronutrient intake. We then gave grasshoppers one of the three experimental diet treatments (C, Ff, Fp) *ad libitum* for 48 hours. Finally, we returned all grasshoppers to the same artificial diet pairing for 24 hours allowing them to correct for nutritional deficits incurred across the previous two days. Across each phase of the feeding trial, food intake was quantified and we calculated and compared protein:carbohydrate intake.

At the conclusion, we removed and stored grasshopper gastrointestinal tracts. Additionally, we collected a sample of 15 5th instar *M. femurrubrum* from the ERF to investigate how the experimental protocol altered the gut microbiome compared to wild controls. We are currently in the process of extracting whole DNA from individual guts, which will then be used to characterize microbiomes via sequencing of bacterial 16S rRNA. Bacterial communities will then be compared between treatments using ordination and cluster analysis to identify effects of antibiotic and diet treatments.

Results and Discussion. With the extraction of DNA from the grasshopper guts ongoing we do not yet know how our antibiotic treatment affected the gut microbiota of the grasshoppers. But, based on analysis of artificial diet consumption, we have some evidence that macronutrient regulation was altered by the antibiotic treatment. First, we compared nutrient intake on the fourth day of the experiment when the artificial diets allowed the grasshoppers to correct for any macronutrient deficiencies experienced during the treatment diets (C,Ff,Fp) eaten on days 2-3. We were unable to find a strong effect of antibiotic treatment on protein and carbohydrate regulation during the 4th day of feeding (Fig. 3, MANCOVA AB: $F_{2,58}=0.09$, $P=0.916$, AB×Diet: Approx. $F_{4,116}=1.99$, $P=0.100$). However, grasshoppers previously fed on fresh leaves (Ff) and dried/ground (Fp) goldenrod leaves consumed 19-23% more carbohydrate than controls (Fig. 3, ANOVA Diet: $F_{2,59}=3.76$, $P=0.029$) hinting that carbohydrates are limiting to the grasshoppers, at least when feeding on this host plant.

When we compared intake of the control diet treatments (AB+C, AB-C) across all four days of the study, we found that grasshoppers treated with the antibiotic cocktail regulated for ~18% more carbohydrate than the antibiotic control (Fig. 4, ANOVA Sex: $F_{1,21}=4.32$, $P=0.050$, AB:$F_{1,21}=4.08$, $P=0.057$). A tentative hypothesis is that this could be a correction by the grasshoppers for a reduction, or loss, of gut bacteria that produce carbohydrases. This would fit with previous findings that microbe-produced carbohydrases are present in the guts of Orthoptera (Kaufman and Klug 1991, Shi et al. 2013, Su et al. 2014) and would mean that the host's macronutrient regulation could adapt to shifts in the

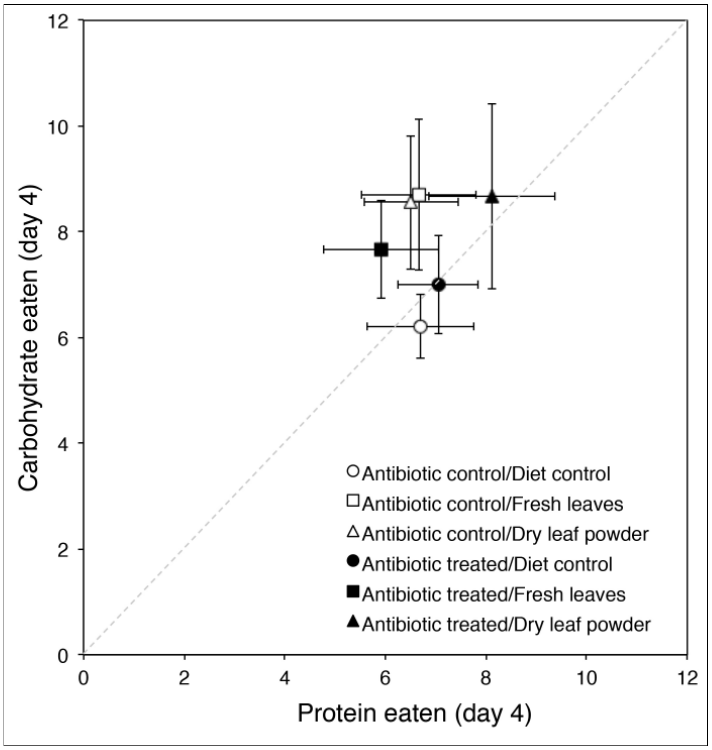

Figure 3. Macronutrient intake of grasshoppers following treatment with antibiotics and different diets.

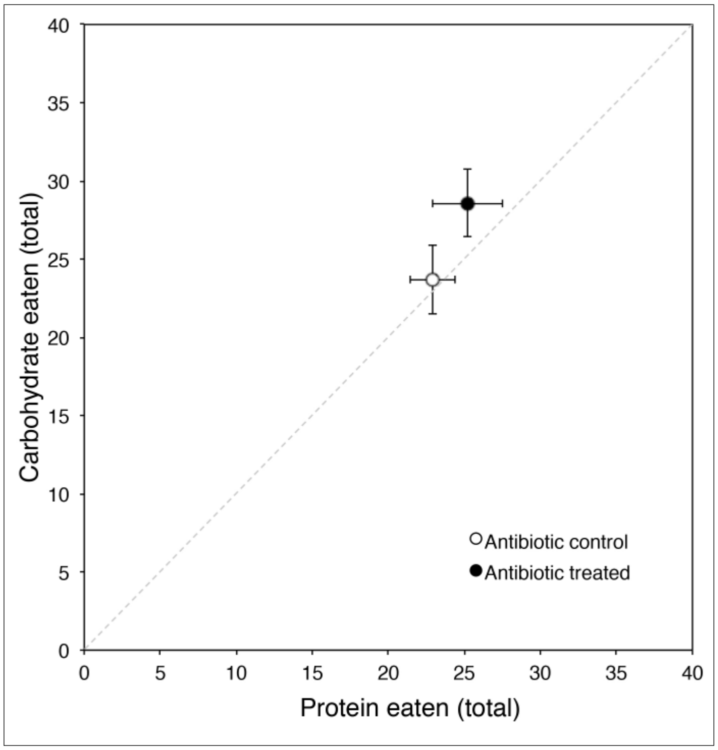

Figure 4. Total macronutrient intake of grasshoppers fed artificial diets for four days.

gut microbes. Identification of the gut bacterial communities present across treatments in this study is now critical to understand why the grasshoppers altered their macronutrient intake. If modified macronutrient regulation were an effect of the microbiome, we would expect AB+ gut bacterial communities to differ significantly from AB- communities.

This grasshopper system could be a model for understanding of how gut microbes interact with nutrient regulation in generalist feeders. Most acridid grasshoppers graze between host plants and can even be omnivorous, so, therefore, gut microbial communities would need to function well across a range of foods or have high rates of species turnover. Establishing such a model system could provide a counterpart to work on vertebrates, like humans, which have generalist feeding patterns.

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Status of Europe's Native & Invasive Phasmatodea Collections

By **MATAN SHELOMI**
Max Planck Institute for Chemical Ecology
GERMANY
mshelomi@ice.mpg.de

Bergmann's Rule is an ecogeographical law that states organisms within a species or clade should be larger at higher latitudes, to better retain body heat. Several hundred studies have been done on insects and Bergmann's rule, and Orthoptera are the most highly represented group. Out of 204 cases, nearly equal amounts showed no size clines or converse-Bergmann clines [decreasing size with higher latitude], with a minority following Bergmann's law (Shelomi 2012).

One order conspicuously missing from the literature was Phasmatodea. I say conspicuous, because what better organism to study the effects of latitude on length and width than the nearly cylindrical stick insects, and what more tantalizing a target for morphological studies than the order whose members' lengths range from the centimeter-sized *Timema* to the half-meter long *Phobaeticus chani*, the world's longest insect? In 2014, I set off to gather data for the world's first assay on ecogeographical size clines in the Phasmatodea, focusing on European species, as their native distributions (Brock 1991) fall within the ideal range of latitudes for accuracy in such studies (Shelomi 2012).

The species I set off to study were *Bacillus rossius*, found along both sides of the Mediterranean Sea coastline, and Clonopsis gallica, with a distribution along southwestern Europe that goes a bit higher into France. I was able to add three more species to the project: the Iberian *Leptynia attenuata* and *Pijnackeria hispanica* (see Scali 2009 for taxonomic revision), and the global invader *Carausius morosus*, native to the Tamil Nadu region of India, but since established in the UK and Azores among other locations and raised as a pet globally. *Carausius* was particular useful to see if phasmids that invaded or are reared in different climates from where they evolved show subsequent size differences, though obviously the variables involved are considerable.

Given the preliminary nature of this work, I decided to use museum specimens. Having obtained permissions from the major entomology collections of Europe that had pinned specimens of the above species, I applied for the Theodore J. Cohn Research grant to cover the cost of travel. In the summer and fall of 2015, I visited 18 museums in eight nations (Fig. 1), and measured various body segments, and limb lengths and widths for a total of 1,437 specimens (including other species within the above genera) from 23 nations according to extant borders (Fig. 2) and from as far back as 1873 (Fig. 3). Another 18 museums responded to my inquiries saying they lacked the species in question or were closed for renovations, and were thus not visited. I am in the process of analyzing the data and will be adding more detailed climate and plant productivity data to complement the basic latitude measurements. Here, I would like to give a brief review of the state of the Phasmatodea collections I used.

Firstly, of the 1,437 specimens measured, 258 could not be analyzed further due to illegible or ambiguous locality labels, and this does not count the many specimens I did not measure because they lacked locality labels at all. Some older labels only stated the region of origin ["France," "Dalmatia," "USA"], which is not useful for biogeographical analysis. Hand-written labels in cursive were another frustration. One challenge of such a multinational project was translating location names that were sometimes themselves translations: for example, *Lessina* is Italian for the Croatian island of Hvar.

Frequently, I came across localities that no longer existed: the location had changed names and possible hands as borders shifted. For example, Nemours in Algeria is now Ghazaouet, Saint-Aygulf in France is now the Fréjus commune, and Karl-Marx-Stadt of the GDR is now Chemnitz of a united Germany. Some designations are now completely historic, such as the Estremadura province of Portugal and the nation of Yugoslavia. Translations and transliterations added complexity: the city of Targlitz in Marruecos Español is Targuist in now-independent Morocco. In one case, I could not identify the city [written in cursive German] for a specimen collected in what was then Istria, Italy because the Istrian peninsula is now mostly Croatian and Slovenian and each nation has cities with similar names in the area.

War and revolution had other, more damaging effects on collections. For instance, the Manchester Museum collection record has a gap from December 1937 to August 1947, and I did not visit the Budapest museum, as their once large collection of Eastern European phasmids burned in the 1956 Hungarian revolution. In contrast, the Hamburg museum's Phasmatodea and Mantodea are among their only dry specimens to survive a World War II fire, as they had been relocated along with the

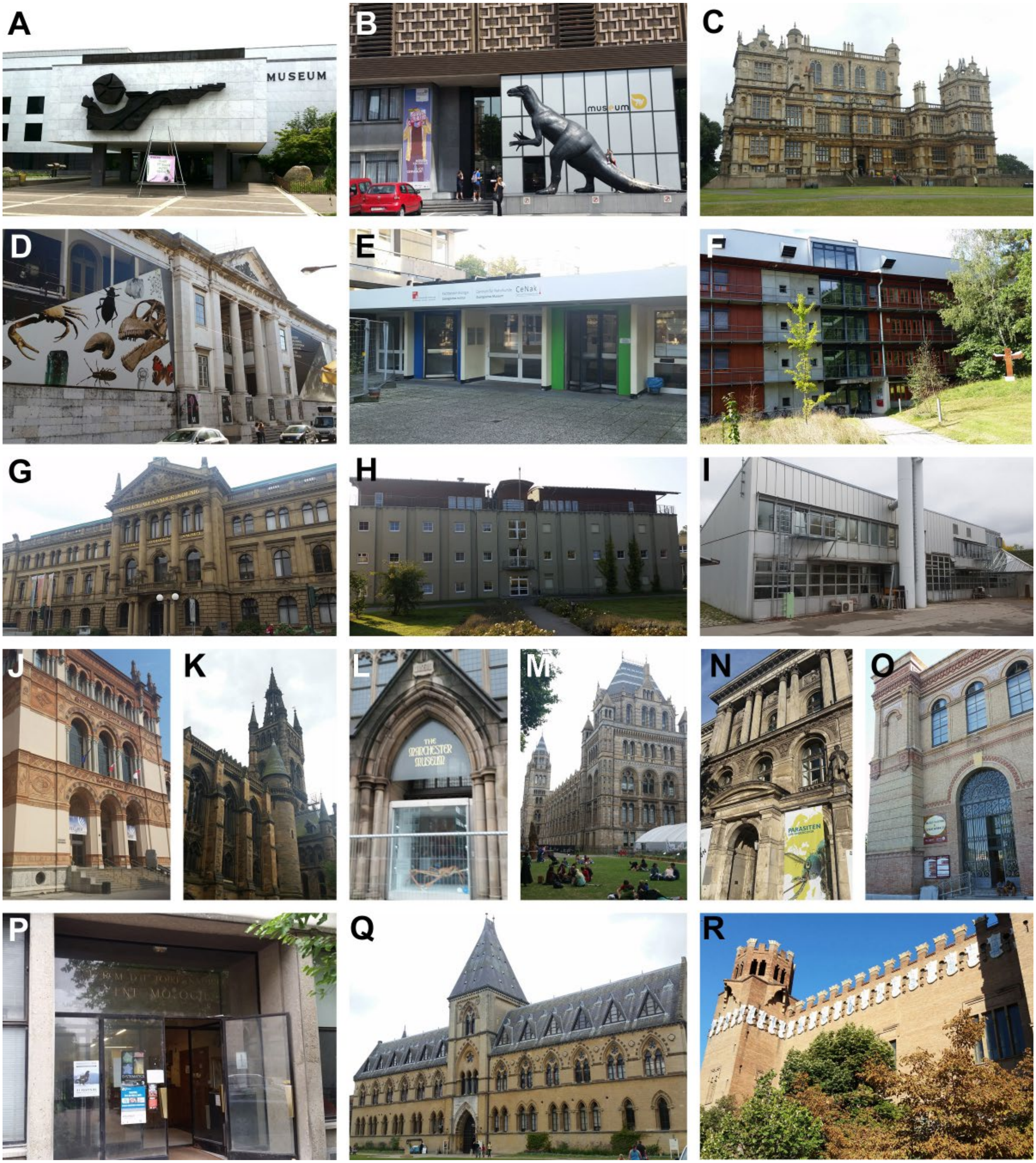

Figure 1. Museums visited during this study. **A)** Muséum d'histoire naturelle, Geneva, Switzerland. **B)** Royal Belgian Institute of Natural Sciences, Brussels, Belgium. **C)** Wollaton Hall, Nottingham, UK. **D)** Museu Nacional de História Natural e da Ciência, Lisbon, Portugal. **E)** Centrum für Naturkunde, Hamburg, Germany. **F)** Senckenberg Naturhistorische Sammlungen Dresden, Germany. **G)** Zoologisches Forschungsmuseum Alexander Koenig, Bonn, Germany. **H)** Senckenberg Deutsches Entomologisches Institut, Müncheberg, Germany. **I)** Zoologische Staatssammlung München [Munich], Germany. **J)** Museo Civico di Storia Naturale, Milan, Italy. **K)** The Hunterian Museum, Glasgow, UK. **L)** Manchester Museum, Manchester, UK. **M)** Natural History Museum, London, UK. **N)** Museum für Naturkunde, Berlin, Germany. **O)** Museo Nacional de Ciencias Naturales, Madrid, Spain. **P)** Muséum National d'Histoire Naturelle, Paris, France. **Q)** Oxford University Museum of Natural History, Oxford, UK. **R)** Museu de Ciències Naturals de Barcelona, Spain.

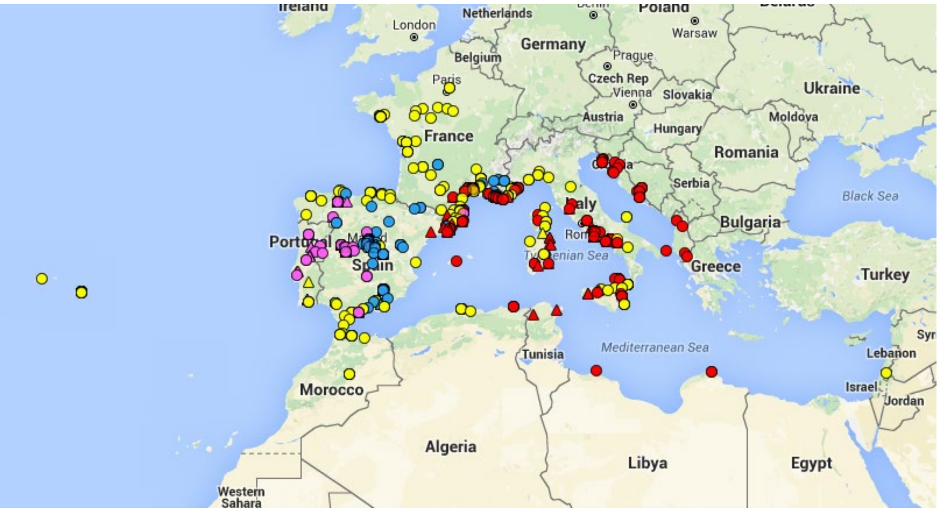

Figure 2. Map showing the collection locations for wild-caught female (circle) and male (triangle) specimens of *Bacillus rossius* (red), *Clonopsis gallica* (yellow), *Leptynia attenuata* (violet), and *Pijnackeria hispanica* (blue). Carausius was not included as most specimens were not wild-caught and/or not European. Made with HamsterMap.com.

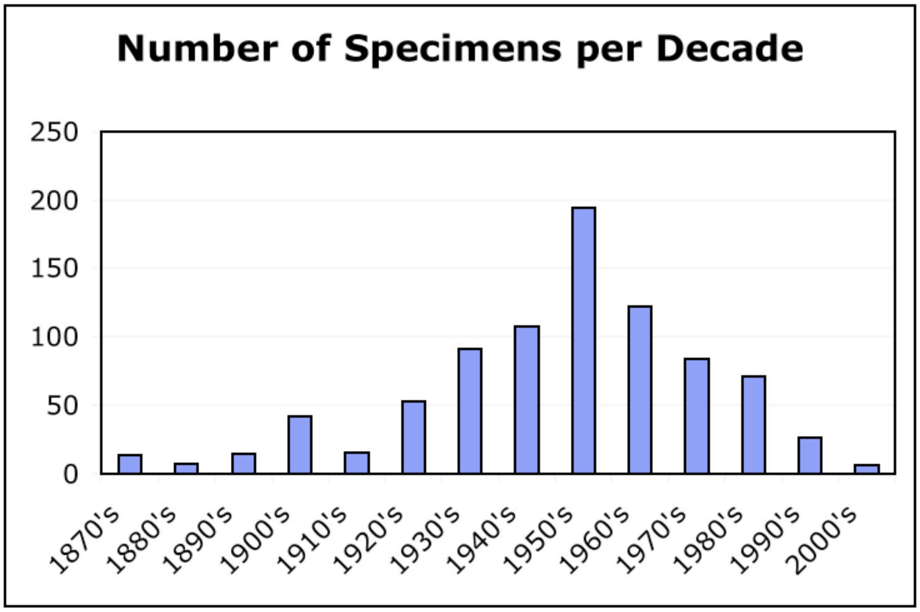

Figure 3. Number of museum specimens collected within a given decade generated from the wild-caught specimens of all species combined.

Figure 4. A) Phasmatodea collection from the Dresden collection, showing the noticeably different poses that specimens can be found in. **B)** Uniquely-posed specimen from the Müncheberg collection affixed to a branch, illustrating the ideal posing of forelimbs forward and slightly angled down.

flammable alcohol collections to an underground train station. The Hamburg fire did consume the books containing intake and locality data, however, along with around 10,000 type specimens. Overall, while one sees a decline in the number of specimens collected during the first World War, entomology research continued during World War II (Figure 3). Note that very few specimens exist of European specimens from the past few decades and nothing since 2004. In part, this could be due to instabilities in the Balkans, which would otherwise be the focus of future European Phasmatodea studies, plus a possible loss of interest among Western European collectors in their local fauna relative to tropical fauna, which are ever more easily-accessible and imperiled as travel costs and rainforest area both decrease.

Measuring the Phasmatodea samples was not always easy as many had crumpled and curled or shriveled. Others retained their body size well with a rare few having been stuffed with cotton or impaled with a metal stake through their body. Different collectors seemed to have different ideas on how best to arrange the legs of Phasmid specimens: should they be straightened against the insect, making a long and thin specimen, or be folded in a standing position, producing a shorter but wider, taller, and more fragile specimen (Fig. 4)? I encourage those collecting Phasmatodea to use the former, aligning the limbs close to the body with the hind limbs pointing rearward and the other pairs forward. Samples so arranged ultimately take up less space, are less likely to be damaged or lose limbs, and are much easier for researchers like myself to measure. The forelimbs in particular should be posed at a downwards angle just so as not to obscure the head, which is similar to how some living phasmids hold their forelimbs forward and together when frightened in order to better imitate a branch. Another option observed is pasting the six tarsi onto a rectangle of paper, which has the advantage of ensuring limbs and body stay together and is more commonly used for nymphs, though otherwise has no benefits over the straight line pose.

A database containing the measurements and localities for all these specimens will be added to Dryad (http://datadryad.org/), with the locations translated into English and given their extant names and approximate GPS coordinates. This database can be used for any future ecogeographical studies on Phasmatodea, saving others from having to redo my work. It is my hope that this study can be the start of further inquiry into what affects Phasmatodea body size and how they evolved their iconic mimesis and record-setting sizes.

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Grigs are great: Characterizing *Cyphoderris monstrosa* survival of low temperatures

By **JANTINA TOXOPEUS**
Western University
CANADA
jtoxopeu@uwo.ca

Low temperatures limit the distribution and abundance of many organisms, particularly ectotherms, whose body fluids can freeze at subzero temperatures (Sinclair et al., 2012). There are two dominant strategies to survive very low temperatures: freeze avoidance and freeze tolerance. Freeze-avoidant insects, such as the grasshopper *Chorthippus fallax* Zubovsky (Orthoptera: Acrididae) (Hao & Kang, 2004), depress the temperature at which their fluids freeze, but die if cooled to the point of internal ice formation. Freeze-tolerant insects, such as the New Zealand alpine weta, *Hemideina maori* Pictet & Saussure (Orthoptera: Anostostomatidae) (Ramløv et al., 1992), survive internal ice formation. Although many orthopterans inhabit temperate and montane environments, studies on orthopteran cold tolerance are few and far between, especially in North America.

The great grig, *Cyphoderris monstrosa* Uhler (Orthoptera: Prophalangopsidae), is 20 – 30 mm long and is one of three members of the genus that inhabits high-elevation coniferous forests of western North America (Morris & Gwynne, 1978). They overwinter as nymphs (Fig. 1), with adults emerging in late May or early June, and remaining active until late August (Mason, 1996). *C. monstrosa* are nocturnal and climb trees to feed on staminate cones of lodge pole pines (*Pinus contorta*) and western white spruce (*Picea glauca*) (Ladau, 2003; Morris & Gwynne, 1978). *Cyphoderris* spp. males sing via tegminal stridulation, typical of ensiferans (Morris & Gwynne, 1978), but are active at much lower temperatures than is characteristic for acoustic insects, singing at temperatures near 0°C (Dodson et al., 1983; Morris & Gwynne, 1978). While much of the research on *Cyphoderris* spp. has focused on their acoustic and mating behaviour, their ability to remain active at low

Figure 1. *Cyphoderris monstrosa* nymph on a tree trunk in Kamloops area, British Columbia. (Photo by Brent Sinclair)

Figure 2. Intrepid grig collectors (l-r): Jantina Toxopeus (PhD student), Alexander McKinnon (MSc student), Brent Sinclair (Associate Professor), and Jacqueline Lebenzon (MSc student). (Photo by Jacqueline Lebenzon)

temperatures and overwinter in montane North America warrants an investigation of their cold tolerance. To collect *C. monstrosa*, I travelled to Kamloops, British Columbia, Canada (50.8°N, 120.1°W) in late May, 2015 with three other orthopteran enthusiasts from the Sinclair lab at Western University (Fig. 2). We searched low montane coniferous forests after sunset, picking grigs off tree trunks and out of the underbrush and placing them in individual containers. We collected 30 *C. monstrosa* nymphs, and opportunistically collected *C. buckelli* Hebard (Orthoptera: Prophalangopsidae) nymphs as well. We shipped the insects back to Western University, and maintained them at 4°C, with apple pieces for food, until they were used in experiments.

To expose nymphs to low temperatures, I placed them in 35 ml plastic vials in an aluminum block cooled by methanol from a programmable refrigerated circulator, and monitored survival of nymphs that were frozen and thawed. I recorded the body temperature of nymphs in contact with a thermocouple connected to a computer via a Picotech TC-08 thermocouple interface. The temperature at which freezing occurred (supercooling point or SCP) was identified as the lowest temperature before the exotherm caused by internal ice formation (Sinclair et al., 2015). As well as whole-body SCP, I measured the SCP of hemolymph and tissues extracted from a subsample of *C. monstrosa* nymphs. I also extracted hemolymph for cryoprotectant analysis.

C. monstrosa and *C. buckelli* nymphs remained active at low temperatures until they froze at –4.6°C, a SCP similar to other freeze-tolerant orthopterans (McKinnon, 2015; Sinclair, 1999). Isolated *C. monstrosa* gut and muscle tissue had a SCP near to that of the whole nymphs, suggesting that gut contents and/or muscle tissue may contain molecules that initiate ice formation (Zachariassen & Kristiansen, 2000). Both *C. monstrosa* and *C. buckelli* were freeze-tolerant, surviving being frozen for 1.5 hours and regaining motility within 48 hours of thawing. *C. monstrosa* could survive exposure to temperatures as low as -9°C and could recover after being frozen and held at -6°C for at least 5 days.

I determined concentrations of glycerol, trehalose, and proline (Carillo & Gibon, 2011; Crosthwaite et al., 2011; Tennessen et al., 2014) in *C. monstrosa* nymph hemolymph as these common low molecular weight cryoprotectants can help protect cells from low temperature and osmotic stresses associated with ice formation (Zachariassen, 1985). I detected hemolymph trehalose and proline, but not at concentrations as high as the freeze-tolerant alpine weta, *H. maori* (Neufeld & Leader, 1998), or the spring field cricket, *Gryllus veletis* (Orthoptera: Gryllidae) (McKinnon, 2015). Hemolymph glycerol was absent in field-fresh specimens, but accumulated following freezing and thawing.

This first examination of cold tolerance in Prophalangopsidae indicates *Cyphoderris* nymphs are active at subzero temperatures and can survive internal ice formation, a strategy that likely facilitates their ability to overwinter. We collected these nymphs in May, which is near the end of the season where subzero temperature exposures are likely. Their ability to increase glycerol content following a freeze event in the lab suggests *C. monstrosa* may have greater capacity for cold tolerance earlier in the season, during the winter.

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The Meet Your Neighbours Method: How to illustrate Orthoptera biology with amazing photos

By **PIERRE ESCOUBAS**
VenomeTech, Valbonne, FRANCE
escoubas@venometech.com
CLAY BOLT
Meet Your Neighbours™, Montana, USA
NIALL BENVIE
Brechin, SCOTLAND
DOUGLAS W. WHITMAN
Illinois State University, U.S.A.

Imaging Nature and the Meet Your Neighbours™ initiative

Digital cameras and the digital era have revolutionized nature photography because high-quality images can now be produced, viewed, processed, and transferred almost instantaneously, at virtually no cost beyond the initial investment in equipment. This has spurred the creation of huge digital, on-line image resources that now allow for much easier identification of specimens, even by non-specialists, provided image quality and accuracy are sufficient. For example, field guides are now abundantly illustrated with digital images and accurate colors as opposed to the classical sheets of drawings that still were the norm a decade or two ago. However, the quality of such pictures, both printed and on-line, varies greatly. Small size, poor resolution, bad positioning of the insect in the picture, poor or uneven lighting, improper color, or distracting or non-contrasting backgrounds can produce poor-quality pictures, sometimes misrepresenting the specimen or impeding the discrimination of morphologically-close species. This is seen on some websites where collections of low-quality macrophotography images fail to provide adequate identification. The Meet Your Neighbours™ (**MYN**) method produces high-quality digital illustrations while eliminating many of the problems mentioned above.

The Meet Your Neighbours™ project (www.meetyourneighbours.net) was founded in 2009 by wildlife photographers Clay Bolt and Niall Benvie with the aim of illustrating “backyard biodiversity” in a manner that would draw the viewer’s attention exclusively to the subject. The project is a worldwide photographic initiative dedicated to reconnecting people with the wildlife on their own doorsteps and enriching their lives in the process, through a better appreciation of biodiversity. The living organisms that compose a given ecosystem are vital to people, and local fauna and flora represent the first, and for some, their only contact with wild nature. Yet, too often local wildlife is overlooked and undervalued. The project, therefore, aims to promote appreciation of biodiversity by producing inspiring imagery, showing the striking beauty of living organisms and thus

Figure 1. A juvenile Egyptian locust (*Anacridium aegyptium*) from the first author’s garden, in Meet Your Neighbours™ style.

encouraging people to see, appreciate, protect, and perhaps even, document the wildlife in their backyards with their own cameras.

MYN images have an instantly recognizable look (Fig. 1). Each subject is usually photographed on location using a field studio. A brilliantly-lit white background removes all distracting background, encouraging appreciation of the isolated subject as a living individual captured in a moment of its life, rather than as a species. The individual constitutes the composition, and, when viewed this way, animals and plants we thought we knew reveal another side of themselves, encouraging a second glance, and perhaps even a renewed interest. Likewise, species that are generally overlooked by the public, because they are small, cryptic, nocturnal, or inconspicuous can become stunningly beautiful and intriguing when photographed by the MYN method. The MYN initiative encourages photographers from around the world to produce images from their local community or field of interest, and share them online, through exhibitions, and via other forms of outreach. Partnerships with local museums, nature centers, and conservation NGO's outreach efforts ensure that images are widely seen, usually on a non-profit basis.

Imaging Insects in the field with the MYN method

The technique produces well-lit, true-color, in-focus, high depth-of-field, high-resolution, macro-images of insects "floating" above a pure-white background, free from background clutter, the distraction of surrounding vegetation, and dark shadows. This gives the characteristic brilliance and translucence seen in MYN photos and facilitates design and compositing. Photoshop cutouts can't match this look, especially in respect of how out-of-focus edges and fine details, such as body hairs, are rendered. Diffused front lighting eliminates most shadows, while rendering maximum subject detail. The MYN technique can generate crystal-clear illustrative images of live insects in the field, meaning that shapes, colors and all fine structures are perfectly recorded. As the method gets all its light from flashes, one may even work on dark days and still produce brilliant, sharp images. Flashes actually illuminate for only a fraction of a second – typically between 1/800 and 1/4000 of a second, depending on flash type. High-speed synchronization of flashes with high shutter speed can produce shake-free, sharp, and well-lit images provided the subject is in focus. Under those conditions, all insect motion is frozen, and photos of live insects in their natural positions can be taken, even on windy or cloudy days.

How is it done?

Superior images are produced by photographing the insect as it rests on top of a white, translucent plastic sheet, with two or three flashes positioned at different angles and distances from the subject. One flash illuminates the white-translucent plastic from below, creating a uniform white background with no shadows, while also illuminating the underside of the subject. One or two "fill" flashes, positioned in front, above, or to the side of the insect illuminate the portion of the insect facing the lens and provide dorsal or anterior highlights. The flashes work together to light the insect simultaneously from below, and from the front and/or side or above, illuminating most of the body, while reducing shadows and dark areas. To obtain the best lighting, first adjust the intensity of the flash under the subject, to yield a white background while avoiding "light spill" (lighting so intense that it washes out color and details on the underside of the subject). Next, turn on and adjust the fill flash(es) to provide appropriate front/side lighting. The distance, angle, and light intensity of the flashes must be carefully adjusted to give perfect lighting and to avoid overexposure of the image. The fill flashes are covered with "diffusers," (white-translucent plastic, paper or small "softboxes") which diffuse the light, producing a "soft" light emanating from a larger area than the flash head, thus eliminating sharp shadows, strong highlights, and flash reflections on the subject. It is this overall brilliance - i.e., no dark shadows and a uniform white background - which distinguishes MYN photographs.

The flash behind or beneath the plastic sheet should be positioned so as to illuminate the entire plastic sheet uniformly, and at proper intensity to produce a uniform pure white background without any detail. Proper exposure is essential. The

Figure 2. A transparent container can be used to restrain the subject. The container can be partially lifted to allow the picture to be taken while avoiding escape. Here, the first author photographs a centipede in French Guiana.

background should be just barely overexposed and the color balanced so that it is pure white, with RGB (red, green and blue) values of 255 in each of the three color channels. If too much light comes from below, there will be “light spill” on the underside, and legs of the subject will be washed out. This can be controlled using the in-camera “show highlights” setting, whereby the overexposed parts of the image will blink when the image is examined on the back screen. Conversely, underexposing the background may shift the overall color to warmer or cooler. Photographers should therefore take several test shots and adjust the exposure and white balance accordingly (in the field). Obtaining a perfect, pure white background is thus, essentially, an exposure issue, independent of the nature of the plastic used. Although minor overexposure or underexposure can be adjusted later at the image post-processing stage, proper exposure of the plastic background is a critical part of the process and must be done properly at the time of image capture.

For a more complete technical explanation of exposure, flash use, and RGB values the reader should refer to the author’s e-book The Field Studio (http://niallbenvie.com/our-e-books/the-field-studio/).

Basic Equipment

- Standard insect collecting equipment including nets and transparent plastic containers.
- Digital camera with close-focusing zoom or macro lens and manual exposure capability.
- Two or three flash units with diffusers. Synchronization cables, radio controllers or flash detectors to synchronize flashes.
- A table or light-box containing a horizontal sheet of at least 20 x 20 cm translucent white plastic or acrylic, such as Lexan® (by Sabic), Acrylite®,or Makrolon® (by Bayer), the materials most often used in the USA.
- Tripods with strong adjustable clamps can be used to hold and position the flashes. Alternatively, an assistant can hold flashes and release and position specimens.

Figure 3. Equipment used for photographing insects by author P. Escoubas includes a light-weight folding table with a translucent white acrylic surface, a digital camera with a 105-mm macro lens, and two flashes, each with a diffuser. One flash lights the underside of the translucent acrylic, and a tripod-mounted flash provides fill light from the front. An infrared controller (mounted on top of the camera) assures that all flashes fire at the same time. In this photo, Pierre (left) and Alexandre Escoubas (right) photograph grasshoppers in the French pre-Alps - August 2014.

Step by step protocol

1. Set up: Place your table in a flat spot, close to where you will collect insects. Set your camera and strobe exposure modes to manual. Position one flash directly under the table so that it evenly lights the entire underside of the plastic or acrylic sheet. Position the “fill” flash(es) above the table and to the side, above, or directly in front of the subject. The fill flashes are best mounted on sturdy tripods, but can also be mounted on the camera, or held by an assistant.
2. Test and calibrate the equipment: First find a test subject, such as a short twig or leaf, and place it at the center of the plastic. Then run some trial exposures to adjust the flashes such that the background is a uniform bright white, and the subject is well lit, without over- or under-exposure, or dark shadows. Once basic settings have been adjusted, including flash distance and angle, ISO value, speed, aperture, and flash power, only minor adjustments should be made during the shooting, according to insect size, body color, etc., as different subjects may need a little more, or less lighting.
3. Start shooting! Collect and isolate each insect in a separate clear plastic container. Keep containers shaded and cool, otherwise insects will heat and become too active. Select specimens that are in good condition, with all legs and antennae. Place insect at the center of the plastic sheet, covered by an upside-down transparent plastic container such as a food storage box or

Petri dish (Fig. 2). When insect is calm, gently remove the container. Frame up the insect, keeping the lens parallel to the subject's body to maximize depth of field. An assistant can help to keep the insect positioned correctly and a soft-bristled paintbrush can also be used to corral the subject. Shoot several images, and then re-cover the insect while you inspect the results. If necessary, adjust equipment and reshoot. When perfect images have been obtained, release the unharmed specimen where it was found (unless it is being collected for additional scientific work).

If you don't like the results, adjust the lighting or camera settings, and reshoot. To adjust exposure from any of the flashes, adjust their manual power settings, add more diffusion, or simply move lights back or forward, or to a different angle. You can change the camera aperture, but this will change the exposure for the background and the depth of field. Remember that the closer the diffused fill light is to the subject, the softer and lighter the shadows will be. If you want to emphasize translucence of the insect, for example the translucence of a butterfly wing, slightly increase the backlighting without overexposing the insect body, and diminish the front fill. However, simply increasing background flash output leads to more unattractive lighting wrap-around and, potentially blending. The optimal way to illustrate the translucence of the subject is by moving the background closer to or further away from the subject. With plants, in situ, this is easily done by moving a vertically positioned plastic sheet, while for insects, it may be necessary to use an additional layer of transparent material such as glass or Plexiglas® positioned above the white acrylic sheet.

Placing subjects on a transparent background (such as clear Plexiglas®) with the white background some distance behind, makes it practical to photograph very pale subjects on a white background. Indeed, if pale or translucent subjects are placed directly on the white plastic sheet, some light spiking forward can unattractively wrap around the subject and even cause them to blend with the background. There are different practical ways to do this and for detailed explanations, please refer to the Meet Your Neighbours web site or the author's e-book.

Post-processing the images

The resulting images can be processed on the computer, back in the office. Optimally, the digital camera should be set to record images in RAW format (often called "digital negatives"). A RAW image contains all the data recorded by the camera sensor and must be "developed", i.e., processed and then converted into a TIFF or JPEG format, prior to printing or posting online. RAW images contain more information than JPEG images (which is a compressed file format often produced directly in-camera) and are therefore a preferred format for photographers, as they offer more post-processing possibilities, especially regarding exposure compensation. RAW development software such as Adobe CameraRaw, Adobe Photoshop or Adobe Lightroom (Adobe Systems, San Jose, USA) are often used. RAW processing may include adjustment of exposure, color balance of all or selected parts of the RAW image, lightening of dark areas, and sharpening. At this stage, the image can also be cropped or rotated.

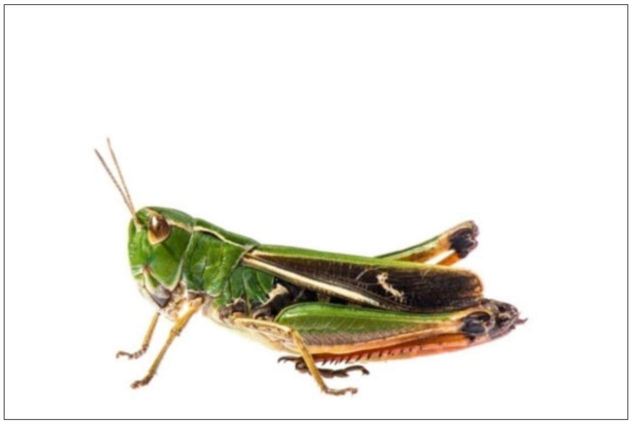

Figure 4. A grasshopper from the French Riviera pre-Alps area, imaged on the Meet Your Neighbours portable field studio using the setup described above.

Producing composite images

The MYN method allows easy construction of composite figures. Because each image is surrounded by a similar pure white background, different subjects can be pasted into the same white document without any concerns over different backgrounds or tonal discontinuity, and more importantly, without having to cut out complex subjects. This not only saves time, but preserves all the fine details, as even the most sophisticated cutout tools will lose some of the finer structures, such as body hairs. In contrast, composite plates made from MYN images preserve all the structures present in the original image (see Figs. 4 and 5).

When composing, one has the option of maintaining consistent magnification ratios (so that subjects remain in true proportion to one another) and lighting (so that the different specimens look as if they were all shot under similar light conditions). In contrast, if the various elements of the composite image are converted to scalable objects in the graphics design software, they can be scaled non-destructively as they are rasterized. From a designer's perspective, this is very useful, as pictures can be dropped straight onto a white page and text laid out around them without having to make any additional selection.

Figure 5. A panel of some of the Acrididae species encountered during a one-day shooting in the French Riviera pre-Alps area (Not to size).

Using MYN images

Although the MYN initiative originally targeted photographers, hobbyists, and backyard naturalists, MYN images are now used more widely in education, science, conservation, and art. Images of single insects in large format draw attention to details normally unseen and unimagined by a general public, and therefore represent fantastic educational and outreach tools. They are used successfully in public displays and school programs to teach biology, raise awareness of biodiversity, and promote conservation. Likewise, composite-image sheets can convey a sense of biodiversity in a given area by illustrating the diversity of insects, including the endless variety of shapes, colors, and body plans of Earth's co-inhabitants.

For scientists, MYN images can greatly enhance one's public presentations, scientific reports, grant applications, and teaching. Qualitatively superior and free from background distraction, they attract the viewer's eye to the detailed structures of the insect body and appendages and can illustrate specific morphological traits of taxonomic or functional value. Below, we highlight some of the uses of MYN images.

Illustrating biodiversity

To illustrate local biodiversity, one of us (P. Escoubas) decided in 2013 to document Orthoptera as well as other arthropods and plants of southeastern France in the MYN style. The Mediterranean area of Southern France is known for its high biodiversity, but the richest and most biodiverse area lies close to Nice, and is listed as a biodiversity hotspot. The "Maritime Alps" county encompasses a narrow seaside, steep hilly areas known as the "pre-Alps" and the bottom of the French Alps, which plunge into the sea east of Nice. This area includes the Mercantour National Park, an alpine mountain area of 685 km² and one of seven of France's National Parks. Amazingly, 71% (3,465 spp.) of all French vascular plants and 60% (8,300 spp.) of French insect species are found on the French Riviera, making it a naturalist's paradise. Orthoptera are no exception as approximately 165 species (69% of the 239 Orthoptera species recorded from France: http://tela-orthoptera.org/wakka.php?wiki=ClassementSystematique2012) are found in the French Riviera Area, including around 70 grasshopper species The dry grassy slopes of the pre-Alps alone support 40 or more Orthoptera species. The pre-Alps area is home, for example, to the Spiked Magician (*Saga pedo*), a protected bush cricket species and the largest orthopteran in France, as well as the endangered and rare Hedgehog Grasshopper (*Prionotropis hystrixazami*).

For this particular project, all images were captured in the field using a field studio made from a folding camping picnic table in which one-half of the tabletop was replaced by a sheet of acrylic plastic (Fig. 3). In the course of several field trips to highly biodiverse areas, insects were captured, placed on the white acrylic sheet and constrained under plastic Petri dishes to be photographed in situ (Fig. 4). Animals were then released unharmed back into their habitat. Equipment used included a Nikon D800e DSLR camera fitted with a Nikon 105 mm macro f/2.8 VR lens, two Nikon SB900 cobra flashes controlled by a Nikon SU-800 infrared transmitter or by Yongnuo YN-622N radio controllers, a light box and tripods to position the flashes. The pictures illustrating this article were primarily taken in two different biotopes in the Alpes Maritimes county (France): (1) grassy patches at altitude 1600 m near Gréolières, and (2) the Plateau of Calern, near Caussols (1300 m). Although the abundance of insects varied, both sites permitted documentation of >20 species of Orthoptera each over a half-day of photography in an area roughly 100x100 meters. A composite plate showing some of the diverse grasshoppers inhabiting the pre-Alps region is presented in Fig. 5.

Yet another possibility offered by the assembly of different pictures on a single panel is the illustration of both landscape and biodiversity in a given biotope to give the reader a glimpse of a specific ecosystem. Integrating an image of the landscape with that of the Orthoptera found on the site, all on white backgrounds, can convey a sense of the species present on that particular site better than a drier, more formal text description of the habitat and its characteristics. Figure 6 illustrates that approach with some of the *Oedipoda* species encountered in this very peculiar rocky plateau near Grasse, France. Upon first glance, the habitat may appear to be a barren, desolated place but is actually an area of extremely high biodiversity, where many Orthoptera species can be found in very high numbers once the sun comes out.

Figure 6. An example of a MYN panel illustrating both the collection site and four cryptic *Oedipoda* specimens encountered, in the French pre-Alps near Grasse.

Use in Orthoptera taxonomy

The MYN technique is particularly useful for illustrating taxonomic differences and intraspecific variation. Identification of field specimens can be difficult, when based on written descriptions, keys, line-drawings, or dried, shrunken, and discolored museum specimens. In contrast, a well-constructed composite figure, illustrating the species in a given habitat (such as Fig. 6) allows both novices and experts to instantly compare their field specimen with high-resolution, well-lit, true-color images. The MYN method can clearly and accurately illustrate specific morphological characters that differentiate taxa. Furthermore, enlargements of key morphological characters, such as genitalia, ovipositors, antennae, tarsae, or carinae, etc., can greatly aid in proper identification (Fig. 7).

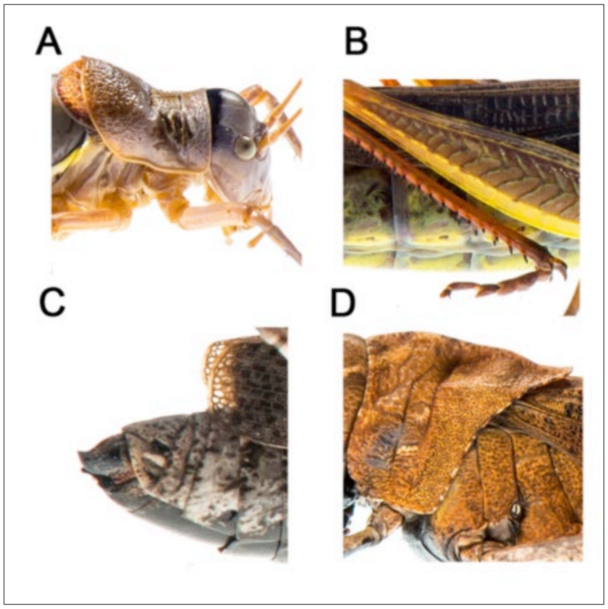

Figure 7. A composite panel illustrating the use of MYN images for Orthoptera taxonomy. Detailed sections of head and pronotum **(A)**, hindleg **(B)**, genitalia **(C)** and thorax **(D)** were obtained by zooming and cropping high-resolution images generated with a 36-megapixel sensor camera.

Where the MYN technique really shines, is in documenting and illustrating the morphological variation that exists in most species, but is often not highlighted. Population and seasonal variation, sex-related differences, ontogenic differences in shape, color, and alation, clines, color polymorphisms, and so on confuse and impede field identification. The MYN method can clearly and accurately illustrate such morphological variation. Color plates illustrating intraspecific variation can be quickly examined and understood by workers, much more quickly and accurately than when using written descriptions or attempting to glean variations from dried museum specimens.

Teaching morphology

MYN images can be used to teach basic and advanced insect external morphology. Students often struggle to match written morphological descriptions and line drawings to the actual specimens in their hands. High resolution, good color images allow students to see structures as they actually exist in live specimens (Figs. 7 & 8), as opposed to dried museum specimens. This is especially effective, when contrasting images are shown side-by-side, one with the trait of interest, and the other without.

Illustrating development and life-history

Although the Meet Your Neighbours approach is designed for photoshoots in the field, the method may be extended to insects bred in captivity, in order to illustrate the different development stages of a species. This is particularly well adapted to metamorphic arthropods. Panels showing all developmental stages from egg to adults can easily be produced from captive-bred specimen. Such life-history composites are invaluable in both informal and formal education. Of course this has been done in the past with drawings, paintings or photographs. But the higher quality of MYN images of live specimens on a white background, the abundance of details and clarity of the images made possible by

Figure 8. A zoomed section illustrating insect eye, hairs, and mouthparts, from a larger image. (*Cicindela* sp.)

high-end digital photography, and the versatility of software enhancements are now bringing a new dimension to that type of illustration. Showing the various life stages of an insect on the same panel, without interference from foliage, flowers, and other elements promotes entomological awareness and conservation and is a great educational tool.

Documenting species range and phenology

MYN photographers should always record the dates and exact collection locations of their specimens, and, whenever possible, make this information available to the public. The on-going accumulation of such images and associated data on the Internet will help scientists to better understand the phenology and ranges of different species, and is especially important for documenting range-change and phenological disruption caused by climate change or habitat degradation.

Promoting conservation, awareness and outreach programs

A key goal of macrophotography is to bring forward some of the unsuspected beauty of life around us. Magnified images of tiny insects or other invertebrates reveal their astonishing morphological features and create a sense of wonder in a non-specialist public. MYN macro-images open a door to an unknown world. This in turn promotes awareness of one's natural surroundings and the need for environmental preservation. Large-format images invariably attract such comments as "What is this?", "Did you find this insect in the Amazon rainforest?" or "I had no idea we had those in our gardens". The MYN style of pictures reinforces those sentiments by focusing only on the specimen photographed.

Figure 9. Exhibit of insect and spider images in Meet Your Neighbours style, in a local city Hall (Valbonne, France). This particular exhibit was subsequently displayed in all local elementary schools as educational enrichment.

Photography exhibits in schools, libraries, museums, shopping malls, or other public places are a great way to enhance public education in ecological matters, especially for children (Fig. 9). Technical scientific publications, although detailed and informative, often remain beyond the understanding of the general public. But simple, bright and colorful images can have a greater impact and stimulate the viewer to learn more about the biology of the animal or plant pictured. Simply put, images carry an emotional force that is often unrivalled by written text, and so much more if they are done in a minimalist style.

Insect photography as art

There is a wealth of hidden beauty in tiny nature, and the MYN method is the perfect vehicle to expose nature's glory. MYN images can be as stunning, spiritual, graceful, inspirational, and beautiful as any painting or sculpture in a museum (Fig. 10).

Recreation

Lastly, we find joy, serenity, and satisfaction in escaping our busy and stress-filled urban world by exploring nature. MYN photography satisfies the need for balance while having the added benefit of creating something useful. We can think of nothing more pleasant than to spend an afternoon searching for and documenting the hidden secrets and beauty of the nature that lives right outside our own backdoor.

Learn more about the Meet Your Neighbours™ project by visiting www.meetyourneighbours.net or on Facebook® at www.facebook.com/meetyourneighbours.

Figure 10. *Araniella cucurbitina* on bamboo leaves.

Treasurer's Report

By **PAMELA MIHM**
Treasurer
p.mihm@regencyapartments.com

The Statement of Assets as of December 31, 2015 and Cash Summary are shown below. The largest cash activity was in support of the Orthoptera Species File. This is funded by an allocation of endowment income from the University of Illinois. The second largest use of cash was publishing the *Journal of Orthoptera Research*. This activity operated at a surplus in 2015 due to increased royalty and revenue sharing. The Orthopterists' Society was able to increase research grants to $15,000 (other than grants in support of species files) in 2015 as a result of the generous bequest from Dr. Theodore Cohn. The Society received a generous endowment from a member in 2015 that will cover accounting costs. If you have any questions, please contact me at p.mihm@regencyapartments.com.

Orthopterists' Society
Statement of Cash Receipts and Expenditures
(1/1/15 through 12/31/15)

Cash Receipts	
Dues	$4,005.00
Publications	3,515.00
Page charges	240.00
Community Foundation endowment	13,451.64
Royalty and revenue sharing	31,353.14
Book reimbursements	404.23
Donations	219.38
Proceeds from sale of investments-grant fund	14,600.00
Proceeds from T. Cohn's Estate	6,615.89
University of Illinois allocation	93,649.00
Total Cash Receipts	$168,053.28
Cash Expenditures	
Publisher JOR	$5,208.17
JOR assistance	21,000.00
Research grants (Ted Cohn)	14,599.00
Executive director remuneration	1,500.00
Ed. Metaleptea remuneration	500.00
Webmaster remuneration	300.00
JOR editor remuneration	1,000.00
Maintenance of Orthoptera Species File	91,937.00
Professional fees (income tax preparation and audit)	6,150.00
Accounting reimbursement	12,000.00
Travel-Int'l Congress planning	1,205.00
Investments in Vanguard-operating	14,600.00
Other	2,099.26
Total Cash Expenditures	$172,098.43
Excess of Cash Receipts over Cash Expenditures	$(4,045.15)
Beginning Cash Balance	15,179.48
Ending Cash Balance	**$11,134.33**
Investment income not included above:	
Interest income and dividends	$40,622.70

Orthopterists' Society
Statement of Assets
(As of December 31, 2015)

Cash		
Paypal cash balance	$381.09	
Midland States Bank	10,753.24	
	$11,134.33	
Investments at market value		
Vanguard:		
Grants (Note 1)		$353,555.39
Operating (Note 2)		693,440.98
		1,046,996.37
Wells Fargo:		
AAAI (Note 3)		12,360.24
Endowment (Note 4)		27,830.21
Operating (Note 2)		217,063.73
Grants (Note 1)		64,717.53
		321,971.71
Total assets		**$1,380,102.41**

Note 1: This fund is restricted and can only be used for research grants.
Note 2: This fund is nonrestricted.
Note 3: This fund can only be used for the Uvarov Award made at each int'l meeting.
Note 4: The income in this account is available for Society expenses; can extract capital but must have a plan for repaying it within 3 years.

Editorial

By **HOJUN SONG**
Editor, *Metaleptea*
hsong@tamu.edu

It has been one year since I moved to Texas A&M University. For sure, 2015 was a year of transition for me. Starting a new position, selling my old house in Florida, searching and buying a new house in Texas, moving, setting up a new lab, going through promotion and tenure process, traveling extensively, finishing up manuscripts, and writing grant proposals... Honestly, I do not know how my first year in Texas has passed. What I do know is that I am very glad that my transition year is over. My lab is now finally all set up and ready to go and several new students have also joined. Things are looking up! But wait. 2016 looks like it's going to be far busier than this past year! I've got to design and teach new courses, there are non-stop grant proposal deadlines, there is the International Congress of Entomology in Orlando (for which I am involved in organizing), and, soon after, there is our International Congress of Orthopterology in Brazil! Being busy is good, I guess. I just hope that I get a chance to do some fieldwork this year, so that I can take a break from the hectic pace of academia and have the opportunity to bond with grasshoppers in the wild. That thought alone makes me excited!

You have probably noticed that this particular issue is a monster issue. This is a good sign that our society is very healthy. I am particularly impressed with the Ted Cohn grant reports that our next generation of orthopterists have submitted. I really do believe that the future is bright for our society as we keep supporting and nurturing these young students. I would like to thank all those who have contributed to this issue. I would also like to thank our associate editor, Derek A. Woller, for his continued assistance in the editorial process.

Metaleptea is an excellent outlet to communicate to our members around the world. There is no limit on what we can publish: articles, stories, photos, artwork, etc. However, specifically, I would like to solicit the following types of contributions for all future issues:
-Collecting travelogues
-Museum visit travelogues
-Highlights of your peer-reviewed publications
-Photography/collecting techniques
-Collecting techniques
-Personal stories

To publish in *Metaleptea*, please send articles, photographs, or anything related to orthopteroid insects to hsong@tamu.edu with a subject line starting with [Metaleptea]. As for the format, a MS Word document is preferred and images should be in JPEG or TIFF format with a resolution of at least 144 DPI. The next issue of *Metaleptea* will be published in May 2016, so please send me content promptly. I look forward to hearing from you soon!

Officers of the Orthopterists' Society

President: Michael Samways, Department of Conservation Ecology & Entomology, Stellenbosch University, Matieland, South Africa. samways@sun.ac.za
President-Elect: Alexandre Latchininsky, Department of Ecosystem Science and Management, University of Wyoming, Laramie, WY, USA. latchini@uwyo.edu
Executive Director: David Hunter, Locust and Grasshopper Control, 125 William Webb Drive, McKellar ACT 2617 Australia. davidmhunter100@gmail.com
Treasurer: Pamm Mihm, 2417 Fields South Drive, Champaign, IL 61822 USA. p.mihm@regencyapartments.com.
Managing Editor JOR: Corinna S.Bazelet, Department of Conservation Ecology & Entomology, Stellenbosch University, Matieland, South Africa. cbazelet@sun.ac.za
Editorial Assistant JOR: Nancy Morris, Department of Biology, University of Toronto at Mississauga, Mississauga, ON, Canada. jor@utm.utoronto.ca
Manager Orthopterists' Society Website: Piotr Naskrecki, Museum of Comparative Zoology, Harvard University, Cambridge, MA, USA. pnaskrecki@oeb.harvard.edu
Associate Manager OS Website: David C.F. Rentz, 19 Butler Dr., Kuranda, Queensland, Australia. orthop1@tpg.com.au
Editor Metaleptea: Hojun Song, Department of Entomology, Texas A&M University, College Station, TX, USA. hsong@tamu.edu
Associate Editor Metaleptea: Derek A. Woller, Department of Entomology, Texas A&M University, College Station, TX, USA. asilid@gmail.com
Orthoptera Species File Officer: María Marta Cigliano, División Entomología, Museo de La Plata, Universidad Nacional de la Plata, La Plata, Argentina. cigliano@fcnym.unlp.edu.ar
The Ted Cohn Research Fund Manager: Michel Lecoq, CIRAD, France. mlecoq34@gmail.com