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METALEPTEA

THE NEWSLETTER OF THE ORTHOPTERISTS' SOCIETY

# President's Message

By DAVID HUNTER
President
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Dear Society members,

After a very successful ICO in Agadir, the plans are for the next Congress to be in Paris during 2022. I draw your attention to the report of Board Meeting held in Agadir found later in this issue, which has details of initial plans for the Paris meeting. The Board thanks the Officers of the Society and Regional Representatives whose combined efforts are taking our Society forward. The Treasurer's Report shows that we are in a strong financial position because of the very generous donations by one of our past Presidents, the late Ted Cohn, that allow us to provide many Grants and Awards as well as provide funds for operational matters including the very important move of the *Journal of Orthoptera Research* to open access. The work of the *JOR* editor Corey Bazelet, with able assistance from Nancy Morris, has been instrumental in ensuring that *JOR* continues to go from strength to strength as a place for research articles on Orthoptera. And our society is very much in debt to David Eades and the University of Illinois Foundation for their generous support of the OSF, recently updated to TaxonWorks, a valuable addition to the work of our Society.

It is with sadness that I announce the recent loss of one of our great orthopterists, Carlos Carbonell, after a long and productive career lasting into

his 90s. I must admit that my wife and I were amazed at his vigour during the post-congress tour in Turkey a decade ago, may we all aspire to such a long and productive life!

I see that the Desert locust is having an outbreak again and there are some swarms in Argentina, with outbreaks in Italy, Central Asia, China…more than enough to keep orthopterists busy for the foreseeable future. I hope you had a most productive summer season (winter for us in the southern hemisphere!) continuing the successful work of many as seen from the most interesting reports in this issue of the newsletter. So, it is with great pleasure I present another excellent *Metaleptea*, thanks once again to the tireless efforts of Hojun Song and Derek A. Woller: enjoy!

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# The Orthopterists' Society Board Meeting

## ICO2019, Agadir, Morocco, 28 March 2019 (16:35-19:00)

Compiled by DAVID HUNTER
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1. **Welcome from Chair** *David Hunter*

2. **Apologies: Corey Bazelet, David Rentz**

3. **Next OS Congress:** Congress Organizing Committee: *María Marta Cigliano, Michel Lecoq*

**Presentation: Paris 2022 by Laure Desutter**

Paris is clearly a wonderful site for the 2022 Congress: Paris has fantastic ambience, it is very accessible, and the Museum has offered meeting rooms at no cost. Of course, Paris can be expensive, but the proposal is to have the meeting outside peak season - during the student holiday period in late October 2022. There are lots of accommodations at a price suitable for students. Laure agreed to investigate Airbnb and hotel prices in seeking a package deal for the latter since we could expect 200 or even 250 persons to come to a Congress in Paris. Next steps include a formal proposal for a Congress in Paris outlining advantages including ways of keeping costs to reasonable levels.

4. **Officers of the Orthopterists' Society**

**President:** David Hunter
**Past President:** Alexandre Latchininsky
**President Elect:** Axel Hochkirch
**Executive Director:** Mohamed Abdellahi Ould Babah EBBE
**Treasurer:** Pamm Mihm
***JOR* Editor:** Corey Bazelet
***JOR* Associate Editor:** Nancy Morris
***Metaleptea* Editor:** Hojun Song
***Metaleptea* Associate Editor:** Derek A. Woller
**OSF Officer:** María Marta Cigliano
**Manager, The Ted Cohn Research Fund:** Michel Lecoq
**OS Site Webmaster:** Derek A. Woller
**OS Site Associate Webmaster:** Any volunteers?

5. **Welcome to our new President Elect Axel Hochkirch**

Axel Hochkirch was welcomed by the board as the new President Elect. He expressed his thanks for the confidence put in him and gave a short overview of his vision, which is to strengthen collaboration among orthopterists in the world. He also mentioned some specific plans, such as raising the profile of the *Journal of Orthoptera Research* and introducing a new section in *Metaleptea* where members of the society introduce themselves and why they started to study Orthoptera.

6. **Treasurer's Report 2019** *Pamm Mihm*

Following the very generous donations of $1.24 million by Ted Cohn in early and late 2014, the Orthopterists' Society has total investments of $1.487M as of February 28, 2019. This is up from $1.374M as of December 31, 2018 and $141,000 above the 2013-14 beginning investments. The current balance is after taking out $108K for expenses between 2015 to 2017 and another $136K during 2018, two-thirds of which was for the Congress. At one point the value of our investments was $230K higher, but the recent volatility in the stock market has led to declines. However, before the volatility (which is inevitable from time to time), we put aside $50K into bonds and $20K into cash as a reserve for use in case the declines in the stock market are so great that the amount we have declines below the initial investments. The overall investment strategy is consistent with Ted Cohn's wishes expressed during the 1990s: a diverse portfolio between stocks, bonds, and cash, including moving some of gains to less risky investments. The main investments are both diverse and sophisticated in that there are over a dozen different streams, including some stock funds chosen to maximize dividends while others aim for increases in value. Currently, the OS has 70% of investments in stock mutual funds with a range of degrees of risk and 30% in bonds that normally carry less risk than stocks. If we keep the stock to bond ratio at 70:30, we will be moving money from stocks to bonds when the market is doing well to ensure we have adequate funds when there is a downturn.

The Board passed a resolution in Brazil in 2016 that we can spend 3% per year and a maximum of 6% over 3 years. We went above the 6% this year with board approval. We propose that of the total investment balance (calculated from the balance at the beginning and end of the year divided by 2), we take 3% per year to be used for current OS expenses, as well as some set aside to cover expenses associated with the next Congress. The Board approved this change, which means there would be a ceiling on spending of 9% instead of 6% over 3 years.

The Orthopterists' Society earned dividends of $42,263, net of foreign taxes, in 2018. Three percent of total investments calculated as stated above is $44,900. We do need to be mindful when deciding whether to take on extra projects while the OS has a nice investment balance because we would like to stay within the parameters we set to preserve principal for future years.

7. **Membership report and payment methods** *Pamm Mihm & David Hunter*

We have members from over 50 countries, some of which have preferred ways of transferring money, so we have set up six ways of paying membership dues:

1,2. You can use the OS site to pay either by 1. PayPal or 2. credit card

3. Bank transfer

4. Pay cash to our treasurer at the Congress, who collected $1,085 in 2019

5. Check in USD sent to our treasurer

6. Person in your region collects funds, sends them to the treasurer as a lump sum: avoids fees being nearly as much as dues at times.

8. ***Metaleptea*** *Hojun Song*

With able assistance from Derek Woller, I have been able to continuously publish 3 issues per year (January, May, September) in a timely manner. The content of *Metaleptea* comes from the members: Ted Cohn grant reports, OSF grant reports, regional reports, meeting reports, and member-contributed articles. Following the completion of their work, some have needed to be reminded to send in reports. We have not heard from some regional representatives for a long time and getting their reports remains a challenge.

9. ***JOR*** *Corey Bazelet* (presented a Board Meeting by *David Hunter*)

My main goal as editor is to get an impact factor for *JOR*, which will help to ensure the long-term survival and success of the journal. In October 2017, Pensoft submitted an impact factor application to Clarivate Analytics (Thomson Reuters), and we hope to receive a response by 2020. However, this process is non-transparent, and we are not sure of exact timelines. Towards this goal, I, together with Nancy Morris, the editorial assistant, and the team of 13 subject editors, continue to work hard to ensure consistent publication of two issues annually containing high-quality scientific articles on a variety of subjects related to Orthoptera and allies. We have steadily increased the number of articles published per year since 2014, publishing 23 articles in 2018, which approaches JOR's average of 24 articles published annually per year since 1992.

**Pensoft**

Publication of *JOR* with Pensoft has so far been fruitful. *JOR* has a new website hosted by Pensoft at http://jor.pensoft.net. This website has detailed instructions to authors, links to OSF and the Orthopterists' Society website, and links to journal social media accounts on Facebook and Twitter. Pensoft's public relations team manages the *JOR* Twitter account, which has many followers and does a very good job of marketing the journal. All articles published in *JOR* now appear online as soon as they are ready and are freely accessible to the public. Articles can be viewed in three formats – pdf, html, and xml – with some very handy features for navigating taxa, figures and tables, and references. Online submission and the editorial review process are done through ARPHA, Pensoft's online submission system, which is professional and user-friendly for all editors, reviewers, and authors. Articles are being viewed often and the switch to Pensoft has helped to boost the profile of the journal.

10. **OS website** *Derek A. Woller*

The work of Piotr Naskrecki in maintaining the OS website (orthsoc.org) over a number of years has been much-appreciated and, last year, I agreed to take on these duties. At the Board Meeting, I gave a comprehensive report on my migrating of the look/feel of the old website to a Word Press platform. Some things still need to be done, such as integration of the membership database. Please check it out and if you have comments/ideas please let me know!

11. **Feedback from Regional Representatives and global representation**

Hojun Song mentioned the importance of a report to *Metaleptea* at least once a year from each regional representative as a way of letting everyone know what is happening in their area. There are Guidelines for regional representatives and these will be circulated to all representatives soon.

- **North America** – Welcome to Kathleen King
- **Central and South America** – Marcos Lhano: suggested that someone else take over and we welcome Martina E. Pocco as our new representative for this region
- **West Europe** - Gerlind Lehmann **North and Central Asia, & East Europe** - Michael Sergeev
- **Middle East - Caucasus** – Battal Çiplak commented that there are only a few members in this region, many of whom have been difficult to contact
- **China, North Korea, South Korea, & Taiwan** – Long Zhang: the Committee of Orthopteroidea was founded at the Entomological Society of China meeting in Chengdu China during August 2018, with Dr. Zhang as its director. This committee consists of 37 members from throughout China and aims to promote education about and academic progress of Orthopteroidea, including their

conservation and management
- **Japan** – Haruki Tatsuta: has contacted a number of orthopterists who have joined us
- **South Asia** – Rohini Balakrishnan: outlined some of the areas where orthopterists are working in India, which has been made into a report for *Metaleptea*
- **North, Sahelian, & West Africa** – Welcome to Amina Idrissi
- **East Africa** – Claudia Hemp
- **Central & Southern Africa** – Vanessa Couldridge
- **Australia, New Zealand, and Pacific Islands** – Welcome to Michael Kearney

**12. OS Species File/TaxonWorks** *María Marta Cigliano*

A new platform, TaxonWorks, constituted by a collection of open source tools and services that cover all aspects of the taxonomic workflow is being developed by the Species File Group at Illinois Natural History Survey, University of Illinois, USA and at the Museum of La Plata, Argentina. This new platform will hold the Orthoptera Species File database in the near future and all the important procedures currently being done will assure that all the OSF data (except for the identification keys) will be completely and safely imported into the new system.

In addition, one of the two informatics technicians from the OSF group at the Museo de La Plata, Argentina, will start working full-time thanks to the endowment fund of David Eades to the Species File Group, a third of which is managed by the Orthopterists' Society.

Regarding OSF grants, most of the awardees successfully finish their projects and OSF has largely benefited by the data added resulting from these grants and their reports are published in *Metaleptea*. However, a small fraction of the projects remain unfinished. A copy of the file tracking the OSF grants' status is annually sent to the OSF Committee.

**13. Awards and Grants** *David Hunter*

During the past year we provided about $40K in Awards and Grants: these are funded from the earnings of the Ted Cohn gifts (except for the Uvarov Award). The Board has made a number of suggestions regarding Rules for Grants and Awards:

**a.** The Awards and Grants are open only to members of the Orthopterists' Society.

**b.** Each Award has a Committee with a Chair and members that select winners of the Award or Grant. Committee members may be Board members, but we can call in experts who are members of the Society. And Committees need to be large enough so that members whose students apply can excuse themselves from making choices.

<u>**Types of Grants and Awards**</u>
- **The Theodore Cohn Research Fund:** About $15,000 awarded each year (usually in April) to support Research projects by students and young professionals up to a value of $1,500 each. Funds are taken from earnings of the Research Grant Accounts that currently have just over $400,000. Committee: Michel Lecoq (Chair), David Hunter, and Battal Çiplak.

The remaining grants are funded by the Operating Accounts that have about $1 million.
- **Sir Boris Uvarov Award in Applied Acridology:** Funded in part by a grant from the Association of Applied Acridology, topped up by funds from the Operating Accounts, such that the monetary value of this award is similar to that of the Young Professional Orthopterist Awards. Committee: Alexandre Latchininsky (Chair), David Hunter, and Mohammed Abdellahi Ould Babah EBBE.

Committees need to be set up for each of the remaining Grants and Awards:
- **Travel Grants to Congress:** were just over $15,000 for 2019 ICO.
- **Ted Cohn Award for Excellence as a Young Professional Orthopterist:** two Awards of $2,500 with certificates presented at each Congress.
- **D. C. F. Rentz Award for Lifetime Dedication to Orthoptera:** Awards with certificates presented at each Congress.
- **General support for Society Members:** These grants give financial support for symposia held at other meetings, plus books and publications. These should be submitted in advance as a formal proposal. For books and publications, partial funding is generally envisaged with some support found elsewhere and the books or publications supported need to be refereed as part of keeping high standards for Orthopterists' Society publications.

**14. Suggestions for improvements in OS functioning**

The many grants and awards made possible by the Ted Cohn gifts serve to facilitate support for students and young professionals, which was a clear wish by Ted Cohn while he was President of the Society and thereafter. This support for students and young professionals is not only through our various grants, but for a number of our members, who are directly mentoring individual students, both in our own countries and in developing countries, which encourages and supports orthopterology all over the world as part of making our Society truly international.

**15. Close**

# Save the date: ECOCIII/DGfO 19-22 March 2020

By LUC WILLEMSE
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Dear Conservationists, Grasshopper friends and Nature lovers,

This is an advance notice for the third European Congress on Orthoptera Conservation (ECOCIII) which will be held in Leiden, the Netherlands from 19-22 March 2020. It will be combined with the 16th biannual meeting of the German Society for Orthopterology (DGfO). The venue will be the completely renovated Naturalis Biodiversity Center which by chance celebrates its 200-year anniversary in 2020. Besides attending an exciting program, extending one's network and meeting old acquaintances, the meeting also offers a unique opportunity to consult and work in the Orthoptera collection of Naturalis for those interested. Please save the date already in your 2020 agenda! Starting in October more information about ECOCIII regarding the program, registration etc. will be posted via Grasshoppers of Europe website. In case of questions please contact the coordination team at ecocIII@naturalis.nl.

# Announcing TETTIGONIIDAE (Orthoptera) Species of Argentina and Uruguay

By HOLGER BRAUN[1] AND GASTÓN E. ZUBARÁN[2]
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Explore 95 species of katydids of Argentina and Uruguay from any device, at any time in any place!

Introducing a new online catalogue **"Tettigoniidae (Orthoptera) Species of Argentina and Uruguay."** Available in both Spanish and English, this new catalogue contains information about 95 species, 56 of which have photos, including interesting recent records of some little-known species. More information is slowly being added. Thank you very much to all those who are collaborating with photographic records.

Please check it out at https://biodar.unlp.edu.ar/tettigoniidae

# Polyneoptera Organized Meeting at 2019 Entomological Society of America Meeting: "Small Orders, Big Ideas"

By DEREK A. WOLLER[1], BERT FOQUET[2], AND HOJUN SONG[3]
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Polyneopteran insects (Orthoptera and nine other insect orders) are common and include some of the most recognizable creatures on Earth, but are rarely represented at Entomological Society of America (ESA) meetings. We have been working for some years now to raise their profile by organizing meetings at ESA to highlight the fascinating and novel research being undertaken with them. At this year's ESA, from November 17-20, we will have nine speakers covering a variety of insect orders and topics presented by speakers from a wide variety of backgrounds as well (e.g., countries, research experience level). The meeting will culminate in a keynote presentation given by Clint Kelly from the Université du Québec on his work with wetas. If you're interested in attending this meeting, come to the conference center's room 125 on Sunday, the 17th from 1:30-4:30 PM. We hope to see you there!


https://esa.confex.com/esa/2019/meetingapp.cgi/Session/35913

# Reminder: Seeking Speakers for the 2020 ICE Symposium: "*Polyneoptera for our Planet*"

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Fellow Society members, we are currently seeking speakers for our symposium "*Polyneoptera for our Planet*," which will be part of the 2020 International Congress of Entomology (ICE). The congress will be July 19-24 in Helsinki, Finland and the symposium is currently scheduled for Friday, July 24, from 8 AM-10 AM. Presentations are limited to 15 minutes (8 speakers total) and submission is currently available to the public by going to this site (where more general information on the meeting and symposia can be found): https://ice2020helsinki.fi/call-for-symposia/. Then, click on the "Submit presentation abstract" icon on the upper graphic, find the scientific section "Ecology, Evolution and Behaviour, Track 2" and click on our symposium's name, and then follow the subsequent directions. All are welcome – students, postdocs, seasoned researchers, etc.! Our goal is to have a good mix of polyneopterans represented that demonstrate all the interesting work being undertaken with the group, so please spread the word to your colleagues that work on taxa beyond Orthoptera.  Please also note that while you can only give a single presentation at ICE you can be a coauthor on as many presentations


as you like. For general description of the symposium, please see our previous article at *Metaleptea* 39(2) pp. 13.

# A Guide to Crickets of Australia

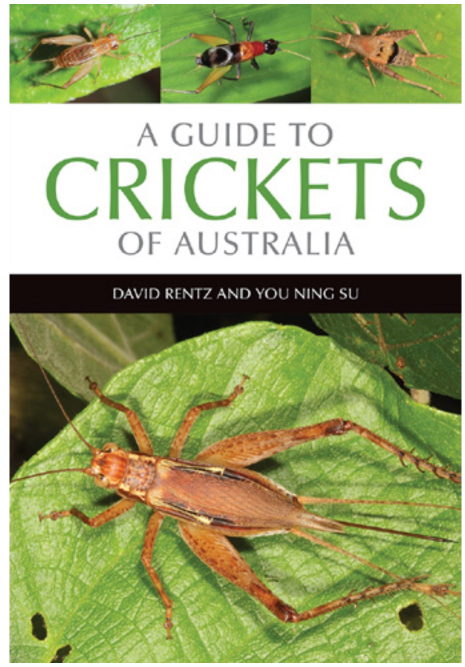
ISBN: 9781486305063 | 416 pages | 215 x 148 mm
Publisher: CSIRO Publishing

By DAVID RENTZ AND YOU NING SU

Cricket song is a sound of the Australian bush. Even in cities, the rasping calls signify Australia's remarkable cricket biodiversity. Crickets are notable for a variety of reasons. When their population booms, some of these species become agricultural pests and destroy crop pastures. Some introduced species are of biosecurity concern. Other crickets are important food sources for native birds, reptiles and mammals, as well as domestic pets. Soon you might even put them in your cake or stir-fry, as there is a rapidly growing industry for cricket products for human consumption.

Featuring keys, distribution maps, illustrations and detailed colour photographs from CSIRO's Australian National Insect Collection, A Guide to Crickets of Australia allows readers to reliably identify all 92 described genera and many species from the Grylloidea (true crickets) and Gryllotalpoidea (mole crickets and ant crickets) superfamilies. Not included are the Raspy Crickets (Gryllacrididae), King Crickets (Anostostomatidae) or the so-called 'Pygmy Mole Crickets' (Caelifera), which despite their common names are not related to true crickets. Natural history enthusiasts and professionals will find this an essential guide.

Available at https://www.publish.csiro.au/book/7490/




# Grasshoppers & Crickets of Italy

ISBN: 978-88-903323-9-5 | 578 pages | 15 x 21 cm
Publisher: WBA Handbooks

By C. IORIO, R. SCHERINI, P. FONTANA, F.M. BUZZETTI, R. KLEUKERS, B. ODÈ, & B. MASSA

Orthoptera is one of the most important and interesting Orders of the Class Insecta. They include grasshoppers and crickets that have a fundamental role in many terrestrial ecosystems. In this complete and updated publication all the 382 taxa (species and subspecies) of Orthoptera nowadays known from Italy are treated; 162 of these are endemic!

Unfortunately, as well as for other groups of organisms, also orthopterans have many species suffering from maximum degree of threat, according to the Red List of Threatened Species compiled by the International Union for Conservation of Nature (IUCN).

Therefore, Grasshoppers & Crickets of Italy is very important also from a conservation point of view; it allows to recognize the endangered species for planning interventions to safeguard them.

This new volume is an absolutely innovative tool in the field of nature handbooks. The authors have succeeded in realizing a text with a new and appealing graphic design, easy to consult, full of photos of morphological details useful to identify the species also by non-experts. Furthermore, very useful for the field work are the maps of the distribution areas, detailed at provincial level, for each species.

This book will be useful not only for orthopterists, but also for young entomologists who will be able to measure their ability in identifying species, for agricultural technicians and for all nature and entomology lovers. A book like this should not be missed from their libraries!

# In Memoriam: Carlos S. Carbonell
## (December 22, 1917 to August 15, 2019)

By MARÍA MARTA CIGLIANO[1], ESTRELLITA LORIER[2] & MARCOS GONÇALVES LHANO[3]
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The Orthopterists´ Society lost one of its most prominent members recently. Carlos S. Carbonell passed away on August 15, 2019, leaving behind a lifetime of dedication to Orthoptera research. Professor Carbonell was born in Montevideo, Uruguay, and graduated in Agricultural Engineering from the "Universidad de la República," Montevideo in 1945. In 1947, he obtained a Master of Science (Entomology) degree from the University of Maryland, U.S.A. under the supervision of Robert E. Snodgrass. Results from his Master degree were published under the title "The thoracic muscles of the cockroach *Periplaneta americana* (L.)," where his solid knowledge of anatomy and morphology of insects, in addition to his excellent scientific drawing skills, were revealed. His first publications dealt mostly with agricultural entomology, but in 1956/1957 he started publishing on different topics of grasshopper biology. His first paper on the systematics of grasshoppers, his major subject of research, was published in 1967 in collaboration with Ricardo A. Ronderos (from the Museo de La Plata, Argentina) and Alejo Mesa (from UNESP, Río Claro, Brazil), with whom he continued collaborating for much of his entire lifetime. Particularly, with Ronderos, he not only collaborated on several papers but also had a profound friendship. Prof. Carbonell also published several collaborating papers with Radcliff Roberts, Hugh Rowell, Marius Descamps, and Christiane Amédégnato, among others.

Professor Carbonell taking a photo during the post conference tour after the 10th International Congress of Orthopterology in Turkey in 2009 (Photo credit: M.M. Cigliano)

In 1969, he was awarded with a Guggenheim Fellowship in the field of organismic biology and ecology of Orthoptera, which made it possible for him to carefully study and photograph many types deposited in entomological collections from the USA and Europe. He published over 70 papers and books that stand out for their scientific rigor. His systematic revisions are not only characterized by their detailed descriptions, excellent illustrations, but also for the comprehensive information on the biogeography, biology, and ecology of the taxa involved. He also had outstanding aptitude as a field naturalist conducting countless field trips within Argentina, Uruguay, Chile, Brazil, Bolivia, and Paraguay that resulted in an excellent reference collection on Neotropical grasshoppers and in the books titled "*A naturalist in Amazon*" (vol I and II) where he described his daily field trips. In total, he described 95 valid species, 30 genera, a tribe and 2 subfamilies for Acridoidea. However, his major contributions to the field of Neotropical grasshopper systematics are his taxonomic revisions: subfamily Leptysminae, tribes Scyllinini and Phaeopariini, and Romaleidae genera (*Chromacris*, *Titanacris*, *Tropidacris*, *Xyleus*, etc.). The scientific work he did on the South American grasshopper fauna shaping its present systematics is certainly notable.

As a Professor from "Facultad de Humanidades y Ciencias, Universidad de la República, Uruguay" Carbonell taught several undergraduate and graduate courses on Entomology, Morphology and Anatomy of Insects, and Arthropods and Biogeography. He also acted as the Director of the Entomology Department from 1958 to 1975. Because of some personal issues and the political situation of his country he moved to Brazil and had a Research position (1981-1986) at the "Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq)" working at the "Museu Nacional, da Universidade Federal do Rio de Janeiro." During that time he also taught several courses for graduate students on morphology and anatomy of insects, with emphasis on Orthoptera, and directed several graduate students, including three Ph.D. students. In 2014, he was designated Emeritus Researcher of the Programme for the Development of Basic Sciences (PEDECIBA), Universidad de la República.

Many Society members are undoubtedly familiar with Carbonell´s scientific legacy so rather than writing about it we thought we would share some of our personal memories of him.

**Estrellita Lorier** remembers him: I met Prof. Carbonell shortly after his return to Uruguay in 1987 in his role as the Director of the Department of Entomology of the Faculty of Sciences, and later as the Director of my Postgraduate Thesis under PEDECIBA. It was a privilege to have been a student of the Biogeography course conducted by him. We were inspired by the content addressed in his classes and the focus placed on the history of the sciences and their various disciplines, which gave us a new and inclusive vision of synthesis. Prof. Carbonell placed his trust in my ability to participate in projects linked to his line of research. I always remember, with immense pleasure, his daily gatherings with teachers and students of the Department. These meetings took place in the afternoons, over a cup of tea, enjoying camaraderie, anecdotes of his travels, dreams and inspiring talks, always accompanied by his characteristic sense of humor.

All of us enjoyed the most the opportunities to participate with Prof. Carbonell of several field-collecting trips in our country. When in the field, he was a tireless walker full of inexhaustible energy. He devoted himself to not only collecting grasshoppers but also all kinds of insects, which he deposited in the Entomology Collection. Today, these materials provide the basis for young researchers to develop their undergraduate and postgraduate studies, and contribute to the knowledge of the entomological diversity of our region. Both on field trips and on his return from travel abroad, Prof. Carbonell conveyed to us his fondness for photography, not only that of scientific interest in insects but also those of Nature's artistry, such as plants, lichens, and tree barks among others.

We shared long hours of work and friendly company, he was always willing to collaborate with my studies, and to assist me in such things as identifying the collecting site location by reviewing his field diary or searching his privileged memory. There was no shortage of a cup of tea or an ice cream from his wife "Chichita" when I visited his place. Prof. Carbonell always accompanied these little pleasures with comments on literature or art, as he was a great reader of deep sensitivity. I met his children, grandchildren, and great-grandchildren during these visits. He was so generous that he made me feel like his friend and part of his family. It is appropriate to state that Prof. Carbonell was always committed to the just causes of Uruguayan society. Together with his wife, he accompanied, until not long ago, the "March of Silence" convened annually by the group "Mothers and Relatives of Uruguayans Detained Missing." This organization brings together relatives of detainees who disappeared during the last dictatorship civic-military in Uruguay.

**Marcos Lhano** remembers him: During my undergraduate studies, I started to have interest in grasshopper studies, so I joined the study group conducted by Prof. Alejo Mesa in Río Claro, Brazil. During the discussions of the group, the name of "Professor Carbonell" was always in the trending topics and, thus, I became familiarized with his publications. In addition, as a very close friend of Carbonell, Alejo used to tell us the stories and adventures they spent together around their passions, the orthopteran insects. During my Master's Degree, I decided to send a message to Prof. Carbonell asking him about the possibility of being the advisor for my PhD. and, after some days, I received a pleasing acceptance letter! Therefore, in 2001, I traveled to Montevideo to meet him for the first time and all the kindness demonstrated in the letter was personified in reality. That was Prof. Carbonell, a kind, polite, and subtly funny person. During the time I had the opportunity to study under his advice, he was always very helpful and attentive all the time in sharing his knowledge. We had wonderful conversations and I learned from him how to become a "Professor." We used to meet in his office at his house where he would tell me stories about his travels, fieldworks, and I would completely forgot to ask him about the doubts I had on my thesis…and, at the end, we often drank a delicious tea with his wife, Albina. Prof. Carbonell was also an excellent handmaker of all his fieldwork and laboratory equipment. He precisely made nets, pinning blocks, display cases, etc. He was an active member of the Orthopterists' Society and many of you may remember his presence at the OS Congress in Turkey and participation in the post-conference tour at the age of almost 90 years old! He was one of the kindest people that I have ever met and I always will be very grateful to have had the opportunity to spend a part of my life as his student.

**María Marta Cigliano** remembers him: The first time I met Professor Carbonell was when I went to Montevideo to teach the first of several courses on Phylogenetic Systematics at "Facultad de Ciencias de la Universidad de la República," Uruguay in 1991. From that time onwards, I visited him countless times at his home in Montevideo, where he had his laboratory, and we also shared a couple of post-conference tours of the OS. He was certainly a unique person, because of not only his general knowledge and interest in entomology and botany in general, and his dedication to the study of grasshoppers, but also for his kindness and willingness to help anybody who was interested in grasshoppers. He was extremely generous with his time and scientific knowledge. He never evaluated the time that he would spend in helping others identifying grasshoppers, providing literature, photos, specimen materials, revising manuscripts, and collaborating in many ways with the work of others. It was a privilege for me that he opened his home and I was able to spend hours talking about grasshoppers and listening his extraordinary stories about his field trips and anecdotes about several orthopterists that I only knew from the literature but with whom Prof. Carbonell had interacted with, such as Ashley B. Gurney, James A.G. Rehn, R. H. Roberts, Harold Grant, T. H. Hubbell, I. Cantrall, L. Chopard, M. Descamps, Boris P. Uvarov, and V. M. Dirsh. I very much treasure the numerous times that I spent with him and his lovely wife, ¨Chichita,¨ at lunchtime or teatime, sharing our other common interests in art and literature.

In synthesis, we all share our best impressions of Professor Carbonell. His legacy in systematics of Neotropical grasshoppers will remain forever. We will always be enormously grateful for his generous dedication. Those who had the privilege to interact with him know that somebody who cannot be replaced is no longer with us. We are going to miss our dear "Profe" very much, but he will continue to accompany us as we will remember his spirit and essence that made him a unique person.

# Regional Reports - What's happening around the world?

## Japan

By HARUKI TATSUTA
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I have to announce that the Orthopterological Society of Japan will be dissolved in 2019. This is very sad news, especially for the members of the society, but I feel this is the flow of the times. The average age of the members is increasing year by year and people who can manage the society are decreasing. Probably every other society meets this sort of problem eventually. On the other hand, young students and researchers have joined our society recently – this is truly good news! Here I would like to introduce a research topic that was conducted by Tatsuru Kuga. He is a new member of the Orthopterists' Society and joined the International Congress in Morocco, so some of you already known him and his research. I really expect that other young (and brilliant) students such as Tatsuru will join us in the nearest future.

**Self-introduction and my research interests:**

By Tatsuru Kuga
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I am a Ph.D. student studying behavioral ecology, particularly escape behaviors of grasshoppers. Here, I explain my research topics on two grasshopper species (Orthoptera: Acrididae; Fig. 1) as a self-introduction.

The first topic is on the decision of locomotion modes during the escaping of *Oxya yezoensis*, which formed the material of my bachelor thesis. They live in paddy fields and are cooked in soy sauce as a food in some regions in Japan (Nonaka, 2009). When a human approaches *O. yezoensis*, it escapes by either flying or jumping. I wondered whether the grasshopper decides its locomotion mode during the escape based on some factors. In addition, I wondered whether the grasshopper shifts its locomotion modes during consecutive escape attempts because previous studies on escape behaviors indicate that prey animals shift their escape tactics to increase unpredictability (Bateman & Fleming, 2014).

**Figure 1.** Adults of males (top) and females (bottom) of *Oxya yezoensis* (left) and *Acrida cinerea* (right) at the same scale. (Photo credit: T. Kuga)

To test these questions, I approached *O. yezoensis* three times in a row in the field. The results showed that environmental conditions, and the sex and the morphological traits of the grasshopper affected the decision of the locomotion mode during escaping. In contrast to the prediction, the grasshopper preferred the same locomotion mode as the mode in the previous escaping during the persistent pursuit (Kuga & Kasuya, 2019). Most studies on escape behaviors have focused on flight initiation distance, the prey-predator distance when the escape begins, and the distance fled, the distance that the prey escapes. In contrast, few studies have focused on the locomotion modes during escaping. To fill the gap of knowledge on escape behaviors, I am analyzing my data on the locomotion modes further and preparing the paper of the above results.

The second topic is the significance of a sound during escaping of *Acrida cinerea*, which was part of my master's thesis. When a human approaches *A. cinerea*, it escapes while making a clapping sound, called crepitation. The grasshopper is often observed in Japan and the occurrence of the sound is also well-known, even by non-specialists in entomology. The conspicuous sound during escaping seems to attract predators and to make the escape difficult. I am searching for the function of the crepitation, which brings benefits over the predation cost. Although the function has not been revealed yet, our results suggested that the sound was not a courtship signal to the conspecifics, and the occurrence of the sound was relevant to the decision of other escape tactics, including the distance fled. I hope to reveal the function by the next International Congress of Orthopterology.

**Acknowledgements**

I appreciate my supervisor, Dr. Eiiti Kasuya for correcting my draft. I thank Prof. Haruki Tatsuta for giving me the opportunity to write this report.

**Reference**

Bateman, P. W., & Fleming, P. A. (2014). Switching to Plan B: changes in the escape tactics of two grasshopper species (Acrididae: Orthoptera) in response to repeated predatory approaches. Behavioral Ecology and Sociobiology, 68: 457–465.

Kuga, T., & Kasuya, E. (2019). Repeated predatory approaches cause the rice grasshopper to repeat the same locomotion mode during escape: flying or jumping. Abstract Book of the 13th International Congress of Orthopterology, 258.

Nonaka, K. (2009). Feasting on insects. Entomological Research, 39: 304–312.

# Central & South America

By MARTINA E. POCCO
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I would like to express my gratitude to Marcos Lhano for suggesting my name to replace him in the role of Regional Representative for Central & South America, as well as to the OS Board for accepting me to be involved in this important role. Of course, it is my great pleasure to participate in this nice activity and I will try to do my best representing our region.

Currently, I am a Scientific Researcher at CONICET ("Consejo Nacional de Investigaciones Científicas y Técnicas"), and a Lab Teaching Assistant in a course of Taxonomy at "Universidad Nacional de La Plata" (UNLP), La Plata, Argentina. Under the advisory of Dr. María Marta Cigliano and Dr. Carlos Lange, I did a Ph.D. and a postdoc at UNLP on systematics, phylogenetic and biogeographic studies on the neotropical Romaleini (Acridoidea, Romaleidae), with a particular emphasis on the genus *Diponthus*. I am still working on the phylogeny of the romaleids, and my major research interests focus on the evolutionary study of biological traits (aposematic coloration and gregarious behavior at nymphal stages) that are common in this group of grasshoppers. In addition, I have recently started working in collaboration with Dr. Hojun Song on the study of phenotypic plasticity in the South American locust (*Schistocerca cancellata*), which has reemerged as a serious plague in the past recent years in northern Argentina and neighboring countries.

At this moment, the Society counts around 40 members from Latin America, 13 of them as student members. I would like to invite you all to contact me if you have information or any announcements involving our region (events, scientific meetings, new contributions, field trips, etc.) that you would like to share with the other members of the Society. Also, please do not hesitate to contact me if you have any questions regarding your membership status or payment dues. I would also like to invite all those who are not yet members and are interested in the field of orthopterology to join the Society. As a member for about 10 years, I am very grateful for all the opportunities that the Society has given to me, and to other students and young professionals supporting our research. Personally, I have received research grants for field trips, awards, funds to assist with international meetings of the Society and Orthoptera symposia, and grants for visiting museum collections. Therefore, I encourage anyone interested in orthopteroid insects all over the region to become a member and share information on Orthoptera.

**News coming from our region:**

I report, sadly, the news regarding Prof. Carlos S. Carbonell, who passed away on August 15, 2019. He was an outstanding orthopterologist from Uruguay who devoted his life to the knowledge and research of the Acridoidea fauna from the Neotropical region. The legacy of Prof. Carbonell is invaluable and his contributions certainly constitute a major reference in the study of Neotropical acridiology.

There is a state of emergency regarding the South American locust. Héctor Medina from SENASA (Argentina) informed me that the declaration of phytosanitary emergency in Argentina has been extended until 2021 due to the current situation of the plague. This year, outbreaks of *S. cancellata* were reported in Paraguay, followed by swarms detected in several provinces of northern Argentina (mainly Formosa, Chaco, and Santiago del Estero). Argentina, together with Bolivia and Paraguay, continues working on a Regional Management Plan, and an Inter-American coordinating group in plant protection (GICSV) has been recently created for locust plagues (Coordinator: H. Medina). More information available at http://apps.iica.int/GICSV/programas/SanidadVegetal/pages/langosta.aspx

Orthoptera Symposium: The "VIII Simpósio de Orthoptera e I Simpósio de insetos orthopteroides" organized by Pedro G. B. Souza Dias (UFRJ – Museu Nacional) will be held as part of the "XXXIII Congresso Brasileiro de Zoologia" (http://www.cbzoo.com.br/br/) in Águas de Lindoia, Sao Paulo, Brazil, during 02 - 06 March, 2020.

# China

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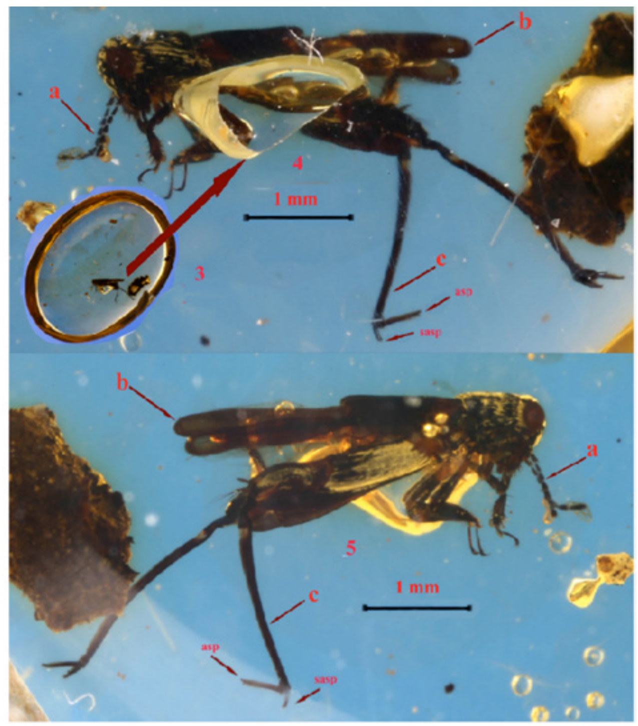
## A Symposium on Orthopteroidea Was Held in Annual Conference of Chinese Entomological Society

A symposium on Orthopteroidea was held on August 27-30, 2019 in Guilin, China. A total of 12 speakers gave talks in this symposium and over 80 members attended this symposium. Professor Long Zhang from China Agricultural University gave an oral presentation, "Biological Control of Locust in Different Ecosystems." He suggested that Antonospora locustae could be effectively used to control locusts of different ecosystems, including grassland, crop fields, and bamboo forest. Dr. Wei Jianing from the Institute of Zoology, Chinese Academy of Sciences gave an oral presentation, "Olfactory aposematism and antipredator defense in locusts". He showed that a volatile phenylacetonitrile (PAN) acted as an aposematic olfactory signal and as a precursor of highly toxic hydrogen cyanide (HCN), facilitating antipredator defense in gregarious locusts. Other talks mainly focused on orthoperan insect evolution and taxonomy. And the symposium greatly facilitated the academic exchange among researchers of Orthopteroidea.

### Advances in the taxonomy and behavior study of pygmy mole cricket (Orthoptera: Tridactyloidea)

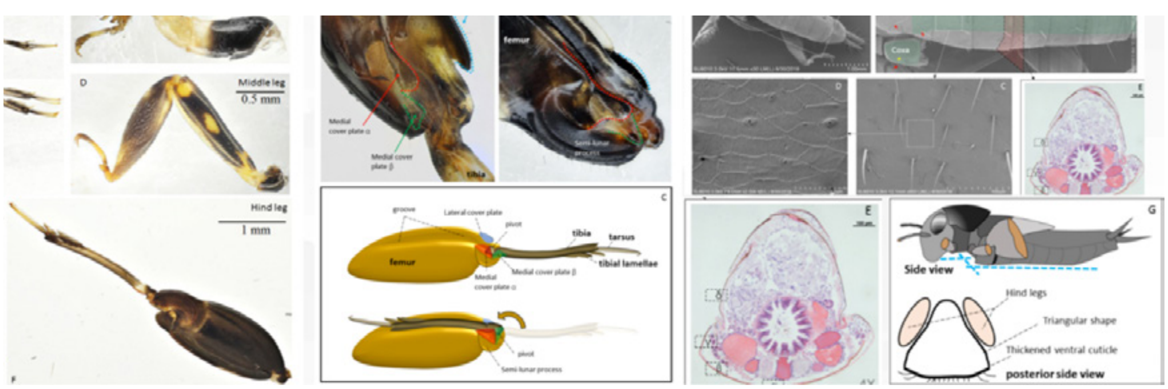
(from Professor CAO Chengquan of Leshan Normal University in China and his collaborators)

**Taxonomy:** After publishing the first new Tridactyloidea species from China by CAO, his group have published the first new genus of Tridactyloidea amber from Burma discovered by the Chinese.




*Paraxya hui* sp. nov., the first new genus of Tridactyloidea amber from Burma discovered by the Chinese.

Also, a new amber family and several new species will be published in the future. Many new classification features, sexual dimorphism, and intraspecific variation were studied. The whole genome sequencing and other




The "fore and mid four-legs" walking pattern of Tridactyloidea.

molecular studies of some species were carried out.

**Behavior:** The first discovery of Tridactyloidea may be used to predict earthquakes. The "fore and mid four-legs" walking pattern was firstly found in Tridactyloidea. The relationship between the body surface structure, and the jumping ability and their bionics application was studied. Other interesting behaviors, such as diving, nesting, mating, parasitism by mites, polarized light on body surface, and so on were also found.

### Progress on the study of Tettigoniidae of China

In 2017-2018, the Katydids Laboratory of Hebei University published 3 new species of Conocephalinae; 1 new genus, 3 new subgenera, and 18 new species of Meconematinae in Tettigoniidae; 11 new species, 1 new subspecies and 2 newly recorded species of Rhaphidophoridae from China; one newly recorded genus and one new species of Anabropsinae, and one new species of Gryllacrididae in Stenopelmatoidea. In molecular systematics, using COI-5P barcode sequences to estimate Chinese katydid biodiversity with six species delimitation methods revealed high cryptic/undescribed diversity for Chinese katydids. Using mitogenome sequences to construct higher-level Ensifera phylogeny, all analyses divided Tettigonioidea into Phaneropteridae and Tettigoniidae. Based on phylogenetic relationships and phylogeography, the results reveal speciation processes of the genus *Sinocyrtaspis* (Orthoptera: Meconematinae) related to climate change.

#### Publications List

**Taxonomy**

Bian, X. & Shi, F.M. (2018) New taxa of the genus *Phlugiolopsis* (Orthoptera: Tettigoniidae: Meconematinae) from Yunnan, China, with comments on the importance to taxonomy of the left tegmen. Zootaxa. 4532(3):341–366.

Bian, X. & Shi, F.M. (2019) First record the genus *Paterdecolyus* of Anabropsinae (Orthoptera: Anostostomatidae) from China. Zootaxa. 4564 (1): 283–288.

Chen, L.X., Mao, S.L. & Chang, Y.L. (2019) One new species of the genus *Xizicus* Gorochov, 1993 (Orthoptera: Tettigoniidae: Meconematinae) from Guangxi, China. Zootaxa. 4652(1):196–200.

Cui, P., Liu, Y.H. & Shi, F.M. (2019) Notes on the genus *Kuzicus* Gorochov, 1993 (Tettigoniidae: Meconematinae: Meconematini) in China with description of one new species. Zootaxa. 4651(3):555–564.

Dou, Y.J. & Shi, F.M. (2018) One new genus of the tribe Meconematini (Orthoptera: Tettigoniidae: Meconematinae) from China. Zootaxa. 4429(3):569–571.

Li, Y.Q. & Shi, F.M. (2018) Notes on the genus *Conocephalus* Thunberg, 1815 (Orthoptera: Tettigoniidae: Conocephalinae) in Southwest China with description of one new species. Zootaxa. 4438(1):148–158.

Li, Y.Q., Dou, Y.J. & Shi, F.M. (2019) A supplement of the genus *Homogryllacris* Liu, 2007 (Orthoptera: Gryllacrididae: Gryllacridinae) from China. Zootaxa. 4623(3):577–582.

Li, Y.Q., Zhang, T., Xin, Y.R. & Shi, F.M. (2019) The genus *Conocephalus* (Orthoptera: Tettigoniidae: Conocephalinae) from Guangdong and Nanling region, China with description of two new species. Zootaxa. 4565(4):590–600.

Liu, J., Chen, P.W., Wang, T. & Chang, Y.L. (2019) Three new species of the genus *Xizicus* (Orthoptera: Tettigoniidae: Meconematinae) from Taiwan. Zootaxa. 4550(3):439–443.

Shi, F.M. & Zhao, L.J. (2018) A new species of the genus *Pseudocosmetura* Liu, Zhou & Bi, 2010 (Orthoptera: Tettigoniidae: Meconematinae) from Sichuan Wanglang National Nature Reserve, China. Zootaxa. 4455(3):582–584.

Wang, P., Zhu, Q.D. & Shi, F.M. (2019) Supplement of the genus *Diestramima* Storozhenko, 1990 (Orthoptera: Rhaphidophoridae: Aemodogryllinae) from China. Zootaxa. 4615 (3): 577–584.

Wang, T. & Shi, F.M. (2018) First discovery of the male of *Teratura (Stenoteratura) kryzhanovskii* (Bey-Bienko, 1957) (Orthoptera: Tettigoniidae: Meconematinae). Far Eastern Entomologist. 358:19-23.

Wang, T., Chen, P.W. & Shi, F.M. (2019) Two new species of the tribe Meconematini (Orthoptera: Tettigoniidae: Meconematinae) from Taiwan. Zootaxa. 4564(1):295–300.

Wang, T., Shi, F.M. & Chang, Y.L. (2019) Revision of the genus *Sinocyrtaspis* Liu, 2000 (Orthoptera: Tettigoniidae: Meconematinae). Zootaxa. 4609(1):127–138.

Wang, T., Shi, F.M. & Wang, H.J. (2018) One new species of the genus *Acosmetura* and supplement of *Acosmetura emeica* Liu & Zhou, 2007 (Tettigoniidae: Meconematinae) from Sichuan, China. Zootaxa. 4462(1):134–138.

Xin, Y.R. & Shi, F.M. (2019) Three new species of the genus *Alloteratura* Hebard, 1922 (Orthoptera: Tettigoniidae: Meconematinae: Meconematini) from China. Zootaxa. 4651(3):289–296.

Zhu, Q.D. & Shi, F.M. 2018. Review of the genus *Diestramima* Storozhenko, 1990 (Orthoptera: Rhaphidophoridae: Aemodogryllinae) from China. Zootaxa. 4450(2):249–274.

Zhu, Q.D., Bian, X. & Shi, F.M. (2018) Remarks of the genus *Tamdaotettix* Gorochov, 1998 (Orthoptera: Rhaphidophoridae: Aemodogryllinae) from China. Zootaxa. 4378(2):294-300.

Zhu, Q.D., Wu, Y.X. & Shi, F.M. (2018) The genus *Mimadiestra* Storozhenko & Dawwrueng, 2014 (Orthoptera: Rhaphidophoridae) from China, with description of two new species. Zootaxa. 4531(2):295–300.

**Molecular evolution and systematics**

Wang, T., Zhu, Q.D., Heller, K.-G., Zhou, Z.J. & Shi, F.M. (2019) Phylogenetic relationships and phylogeography of the genus *Sinocyrtaspis* Liu, 2000 (Orthoptera: Tettigoniidae: Meconematinae) reveal speciation processes related to climate change. Systematic Entomology, DOI: 10.1111/syen.12384.

Zhou, Z.J., Guo, H.F., Han, L., Chai, J.Y., Che, X.T. & Shi, F.M. (2019) Singleton molecular species delimitation based on COI-5P barcode sequences revealed high cryptic/undescribed diversity for Chinese katydids (Orthoptera: Tettigoniidae). BMC Evolutionary Biology, 19: 79.

Zhou, Z.J., Zhao, L., Liu, N., Guo, H.F., Guan, B., Di, J.X. & Shi, F.M. (2017) Towards a higher-level Ensifera phylogeny inferred from mitogenome sequences. Molecular Phylogenetics and Evolution, 108, 22–33.

### Research progress in taxonomy of Tetrigoidea from China

(From Professor Weian Deng of School of Chemistry and Bioengineering, Hechi University, Yizhou 546300, Guangxi, China)

The taxonomy of Tetrigoidea is under review and deals with 7 subfamilies, 57 genera, and 780 species of Tetrigoidea occurring in China, with the morphological characteristics of each genus in re-described in this present work. Fifty-one new species are described, nine taxa are regarded as synonyms, six species are new combinations, and four taxa are replacement names. Based on the molecular data, phylogenetic relationships of Scelimeninae, Metrodorinae, Tetriginae, and Cladonotinae are reconstructed, clarifying differentiation and revising the system of these subfamilies. Phylogeography of *Tetrix japonica* was studied, and the ecological adaptability of *Tetrix japonica* and *Eucriotettix oculatus* were studied. Phylogenetic relationships and ecological adaptability of antennae and cercus receptors of tetrigids were analyzed by scanning electron microscope (SEM). Intestine microflora composition and distribution characteristics in tetrigids were also studied.

# Australasia (Australia, New Zealand, & Pacific Islands)

By MICHAEL KEARNEY
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Over breakfast at the International Congress Orthopterology in Morocco this year, Dave Hunter asked if I'd be the regional representative for Australasia. As you can see, I agreed to the task. I'm an ecologist with interests in understanding distribution and abundance from first principles (mechanistic niche modelling) and have also worked on evolutionary questions (especially parthenogenesis). My taxonomic focus in the past has been mainly on reptiles, but I have worked on grasshoppers since 2003 and am now making them a primary empirical focus. So, I hope this role helps me transition from an "outsider" to an "insider" of orthopterist circles.

Australia is "Grasshopper Country" as David Rentz's book says, but the community working on them in Australasia is not very large at present. That being said, a little revival appears to be starting. This December, at the Australasian Entomological Society meeting, we will have a symposium on Orthoptera as Model Systems in Ecology and Evolution. This aims to bring together those in the Australasian community working on Orthoptera to build and strengthen the research network. Hojun Song will be presenting a keynote and it is very exciting for us that he's coming to Australia next year on a Fulbright to start tackling the Catantopines – our most diverse grasshopper group.

Some recent news on Orthoptera research in the region relates to wingless grasshoppers, of two very different kinds. The "wingless grasshopper," *Phaulacridium vittatum*, is an acridid that in fact has wings but is polymorphic for wing size, most populations being brachypterous. It is a significant pest of southeastern Australia, having benefited from the conversion of native grasslands via grazing pressure. In May this year, Sonu Yadav and colleagues published a fascinating study of their genetic variation using single nucleotide polymorphisms (SNPs) and related this to environmental and morphological variation. Despite the high gene flow between populations of this highly abundant species, they found significant environmental associations of 242 SNPs (2% of the loci surveyed) with latitude, air temperature, and body size. Their work suggests that this species has high capacity to adapt to environmental change. You can read more about it at https://onlinelibrary.wiley.com/doi/abs/10.1111/mec.15146 and https://molecularecologyblog.com/2019/08/22/summary-from-the-authors-detection-of-environmental-and-morphological-adaptation-despite-high-landscape-genetic-connectivity-in-a-pest-grasshopper/.

The second wingless grasshopper of note is Key's matchstick grasshopper, *Keyacris scurra*. This species is truly wingless and is a member of the entirely wingless family Morabidae, a group of ~250 species unique to Australia. The genus is named after Ken Key, a giant of Australasian orthopterology. *Keyacris scurra* was made famous in evolutionary biology by MJD White and RC Lewontin, who studied polymorphisms in its chro-

Key's Matchstick Grasshopper, adult female (Photo credit: M. Kearney)

mosomes in the light of fundamental evolutionary theories. It occurs in southeastern Australia in grasslands and grassy woodlands dominated by kangaroo grass (Themeda triandra) where it feeds on native daisies. Sadly, the spread of *P. vittatum* has been at the expense of *K. scurra*, which has suffered such a dramatic range contraction with the advent of grazing in Australia that it is currently listed as threatened in the state of Victoria and is being considered for a national listing as endangered at present. In Victoria, Ken Key was the last person to observe the species, back in 1967. However, my colleague Ary Hoffmann and I found some populations hanging on in an isolated valley in the Australian high country, near the town of Omeo. A concerted effort has now begun to try and restore the species and we hope that this becomes a conservation success story in the near future. You can read more about it here: Rediscovering a 'Lost' Species

# Theodore J. Cohn Research Grant Reports

## Integrative taxonomy of the endemic Karoo agile grasshoppers, the Euryphyminae (Acrididae)

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Euryphyminae (Karoo agile grasshoppers) is an endemic grasshopper subfamily in sub-Saharan Africa. They are extremely agile and difficult to either catch or spot (Bazelet and Naskrecki 2014). Morphologically, they are adapted to arid regions: they are relatively robust, small to medium-sized (body length: 15–28 mm) compared to other grasshoppers. Both sexes either have wings which surpass the end of the abdomen in length, or short wings which just cover the tympanum (Bazelet and Naskrecki 2014). In most species, internal hind femora of both sexes are coloured black when mature and many species also have colourful hind wings and tibiae. When at rest, they camouflage with their environment because their bodies are either spotted or darkly coloured (Bazelet and Naskrecki 2014). It has been suggested that Euryphyminae use their colourful body characters for intraspecific communication, most likely as a sexual display, as all colourful body parts are hidden while at rest but can be displayed strategically during flight or movement (Bazelet and Naskrecki 2014).

The subfamily was erected by Dirsh (1956) based on its distinct ephiphallus and unusual male cerci. Euryphyminae are superficially similar in appearance to Calliptaminae, which also have ornate ephiphallus and male cerci, strategically colourful morphological characters, and also occur throughout the Old World. In South Africa, 54 species of Euryphyminae have been recorded vs. only six species of Calliptaminae, indicating that the Calliptaminae center of endemism and diversity is farther to the north than that of Euryphyminae (Cigliano et al. 2019). Catantopinae and Eyprepocnemidinae, too, have similar ornate male reproductive structures, colourful characters, and also occur throughout the Old World, but Catantopinae extend into Polynesia and Australia as well. A recent analysis of all Orthoptera for which complete mitochondrial genomes have been sequenced found that Catantopinae, Calliptaminae, and Eyprepocnemidinae, together with Cyrtacanthacridinae (which includes large-bodied grasshopper and locust species, including the desert locust, *Schistocerca gregaria*), form a distinct clade (Song et al. 2015). On the basis of morphology and distribution, Euryphyminae would most likely also belong to this clade, but it was not included in that study because its mitochondrial genome had not been sequenced at the time.

Dirsh (1956) did most of the taxonomic work on this subfamily, including extensive revision of the genera that were erected by Uvarov (1922). Naskrecki (1992; 1995) reviewed the Namibian Euryphyminae and revised the *Rhachitopis* genus. Bazelet and Naskrecki (2014) revised the genus *Pachyphymus*, and Rowell (2015) added two new species to the genus *Phymeurus* from Tanzania. Only three specimens of Euryphyminae have previously had DNA sequenced, and these sequences did not include any mitochondrial genes because the purpose of the study was to elucidate higher taxon relationships within the Orthoptera, so only two ribosomal RNA genes and two nuclear markers were targeted (Song et al. 2015).

The subfamily is restricted to sub-Saharan Africa and have rarely been studied. Species have high levels of intraspecific variation and low levels of interspecific variation, and available taxonomic keys are insufficient for distinguishing between species and sometimes even genera (Bazelet and Naskrecki 2014). Therefore, the aim of this study was to use an integrative taxonomic approach to fill gaps in knowledge relating to Euryphyminae taxonomy and diversity in the Karoo biome. I collected all Euryphyminae information from literature and digitized 626 museum specimens that had been positively identified. I also conducted two months-long sampling trips and collected 624 specimens of Euryphyminae in 30 sites across the southern Karoo biome. Utilizing all data at my disposal, I conducted the first taxonomic review of South African Euryphyminae and investigated morphological and molecular variation within one speciose genus, Euryphymus.

Due to uncertainties in taxonomy, I investigated the relationships among Euryphyminae genera by comparing morphological characters and molecular markers from three genes (cytochrome *c* oxidase 1 (COI) mitochondrial gene, 12S ribosomal RNA (12S), and Histone 3A nuclear gene (H3A)). What I found is that while most Euryphyminae genera are monophyletic and well-resolved, the evolutionary history does not comply with easily visible morphological traits. Something very intriguing is that I collected a lot of *Euryphymus* specimens from almost all 30 sites and the specimens looked very similar, so I started wondering if it's actually just one species or several. To find out, I first classified various individuals of genus *Euryphymus* on the basis of their morphology. I then used DNA barcoding to determine the relationship between individuals with various polymorphisms. Results showed that individuals group into five valid species using the 3% species divergence threshold acommonly used for insect phylogenetics. Of these five species, some are new to science and require species description. This study shows that variation among and within Euryphyminae subfamily is very high and that morphology alone may not be sufficient to differentiate among species.

**Acknowledgments**

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# Signal loss and compensation in Pacific field cricket *Teleogryllus oceanicus*

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Sexual signals are important for mating success (Darwin 1871, Andersson 1994), yet are often lost over evolutionary time (Wiens 2001). Despite the decreased mating opportunities associated with the lack of a sexual signal, signal loss is both common and taxonomically widespread (Wiens 2001). Oftentimes, animals have multiple sexual signals in different sensory modalities (Hebets and Papaj 2005), suggesting that in the absence of one signal, animals can still attract mates by compensating with another. We looked at the case of signal loss in the Pacific field cricket *Teleogryllus oceanicus* to see if male crickets compensate for the lack of an acoustic sexual signal by investing more in an olfactory signal. In the Hawaiian Islands, where *T. oceanicus* was introduced, males face significant predation pressure from the acoustically orienting parasitoid fly, *Ormia ochracea*. Female flies track male songs to find hosts for their larvae, which feast on and kill the male cricket (Zuk et al. 1993). Seemingly in response to this deadly pressure, a wing mutation arose that rid males of the structures necessary to produce song, rendering these males obligately silent (Zuk et al. 2006). Males with this wing mutation ("flatwings") and males without it ("normal-wings") coexist across three Hawaiian populations (Zuk et al. 2018).

Flatwings are hidden from the parasitoid, but cannot attract mates due to the lack of song (Zuk et al. 2006). Despite this barrier to mating, flatwing populations have remained steady in Hawaii (Zuk et al. 2018); silent males are obviously finding a way to mate. Flatwings engage more frequently in satellite behavior, wherein they exploit proximity to normal-wings and intercept females that are attracted to this male's song (Zuk et al. 2006). Females also demonstrate some behavioral flexibility in mate choice; though they prefer normal-wings, they do mate with flatwings, especially when reared in song-less incubators that mimic an environment with a high density of silent males (Bailey and Zuk 2008, Bailey and Zuk 2012).

Another hypothesis for flatwing success is that males compensate for the lack of song by investing more into another form of sexual signal. In

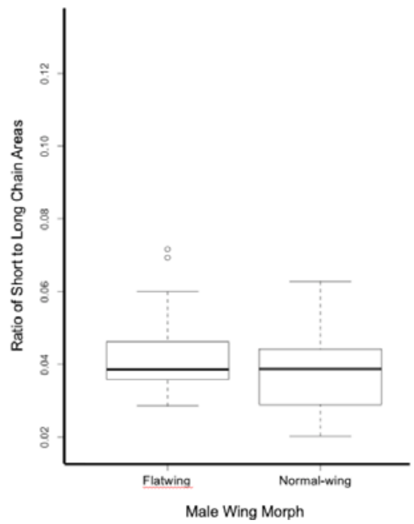


**Figure 1.** Comparison of cuticular hydrocarbon property between normal-wing and flatwing males

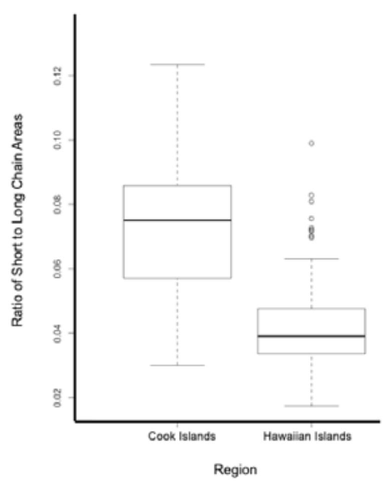


**Figure 2.** Comparison of cuticular hydrocarbon property between Cook Islands and Hawaiian males

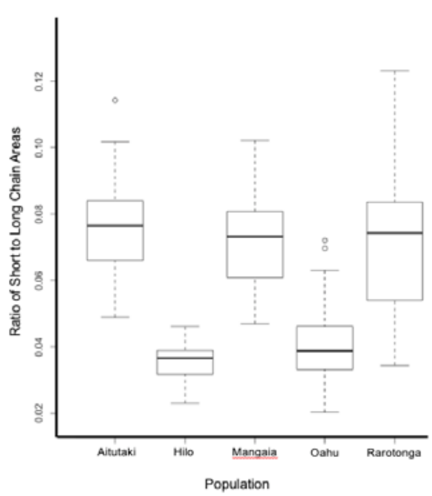


**Figure 3.** Comparison of cuticular hydrocarbon property among different populations

**Table 1.** P-values from a Fisher's LSD test on population-level CHC differences.

| | Aitutaki | Hilo | Mangaia | Oahu |
|---|---|---|---|---|
| Hilo | $2.0 \times 10^{-8}$ | - | - | - |
| Mangaia | 0.57 | $3.5 \times 10^{-7}$ | - | - |
| Oahu | $1.0 \times 10^{-7}$ | 0.19 | $2.6 \times 10^{-6}$ | - |
| Rarotonga | 0.82 | $5.7 \times 10^{-8}$ | 0.73 | $3.3 \times 10^{-7}$ |

many insect systems, cuticular hydrocabons (long-chain fatty acid lipids on the insect exoskeleton), or CHCs, are used in sexual communication (Singer 1998). Crickets can discern CHC profiles with their antennae and use them as short-range odor cues (Thomas and Simmons 2009a). In *T. oceanicus*, female crickets prefer short-chain cuticular hydrocarbons, the production of which is costly for males (Simmons et al. 2014). We hypothesized that the obligately silent flatwings compensate for the lack of song by investing more in attractive chemical signals. Consequently, we expected to see that flatwings would have more attractive chemical profiles than normal-wings. We also predicted that males from the parasitized Hawaiian Islands would have more attractive chemical profiles than their counterparts from the non-parasitized Cook Islands, the crickets' native range.

## Methods

We collected and freeze-killed crickets from the field in Hawaii (n = 20 NW Hilo, n = 20 NW Oahu, n = 20 FW Oahu) and the Cook Islands (n = 20 Aitutaki, n = 20 Mangaia, n = 20 Rarotonga). We then immersed each cricket in 5 mL of n-hexane for 5 minutes; this solvent extracts the CHCs from the insect exoskeleton. A subsample of 950 μL was extracted from each vial and stored in a 4°C freezer. To comparatively analyze the CHC profile, we added a C23:1 standard into the hexane. We then ran each 950 μL sample through an Agilent Gas Chromatography Mass Spectrometry (GCMS) fitted with a DB wax column. We identified individual compounds in GCMS chromatogram output by retention time and the NIST library database. To analyze the data, we calculated the areas of each peak in the chromatogram and generated proportions of short to long chains. Any chain with 31 carbons or less was considered short, and 32 to 36 carbons were considered long (Simmons et al. 2014). We used an arc sin square root transformation on the proportions to normalize the data. Lower proportions were considered less attractive profiles, as they indicate a high presence of long chain CHCs, while higher proportions were considered more attractive, as they indicate a high presence of short chain CHCs (Simmons et al. 2014).

## Results

The proportion of short to long chain areas did not differ between normal- and flatwing males (t-test, p = 0.26, t = 1.15, df = 55.58) (Fig. 1). Cook Island males had higher short to long chain ratios than Hawaiian males (t-test, p = 2.2 x 10-16, t = 12.36, df = 228.89) (Fig. 2). However, the proportions of short to long chain areas do not differ within the Hawaiian or Cook Islands (ANOVA, p = 2.2 x 10-16, F4,129 = 37.6; Table 1) (Fig. 3).

## Discussion

While we expected flatwings to have more attractive CHCs to compensate for their inability to sing, normal- and flatwing males do not have different chemical profiles (Fig. 1). However, both wing types had relatively low proportions (~0.04), meaning that both have an abundance of long chain CHCs. Long-chained CHCs have higher melting points, preventing melting of the insect cuticle and subsequent desiccation. Short-chained CHCs have lower melting points, increasing volatility and detectability by females at the expense of desiccation prevention (Gibbs and Pomonis 1995, Gibbs 2002). Though Oahu and Hilo experience high precipitation and humidity levels (unpublished data), the concurrent high temperatures may present a desiccation risk to the crickets. Hawaiian males may need to invest in desiccation prevention over sexual signaling in these populations.

In contrast to our expectations that the non-parasitized Cook Island males would have less attractive profiles than the parasitized Hawaiian males, males in the Cook Islands have almost twice than those of the Hawaiian populations, suggesting more attractive chemical profiles (Fig. 2). However, males do not differ in attractiveness between the islands in each region (Fig. 3). Though Cook Island males have more comparatively attractive chemical profiles, their average proportion (~0.075) still suggests an abundance of long chain CHCs over short chains, implying that males in the Cook Islands also need to prioritize the use of CHCs in desiccation prevention over sexual signaling.

Although a wealth of literature demonstrates that insects, and *T. oceanicus* specifically, use CHCs as sexual signals, most of these studies take place in a lab. Environmental conditions, such as the different humidity, temperature, and predation regimes that differ between the lab and field play a major role in the development and expression of cuticular hydrocarbons. Our work presents a novel examination of signal tradeoffs in the wild. It is possible that use of CHCs as sexual signals is different in the field, where environmental conditions are far more variable than in artificially constructed lab conditions. Unlike song, which is first and foremost a sexual signal, CHCs have a primary biological function in desiccation prevention. It may logically follow that under variable selection pressures, CHCs are less likely to be sexual signals, even in the absence of the primary sexual signal.

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# Are the phallic complexes of pygmy grasshoppers (Orthoptera: Caelifera: Tetrigidae) useful in taxonomy? Preliminary results

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Tetrigids are small orthopterans, whose morphology is one of the most peculiar among orthopterans. The pronotum is prolonged, covering part or the whole abdomen; prosternum specialized in a collar–like shape around the mouthparts (sternomentum); elytra shortened and laterally arranged in the body, wings developed and anal area with expansion (there are some species without one or both characters); tympanal organ absent; anterior and middle tarsis with two segments and hind tarsis with three segments; arolia absent (Hancock 1902, Dirsh 1961).

The male genital organs are composed of two layers (Amédégnato 1976) with organs membranous and concealed under paired chitinous

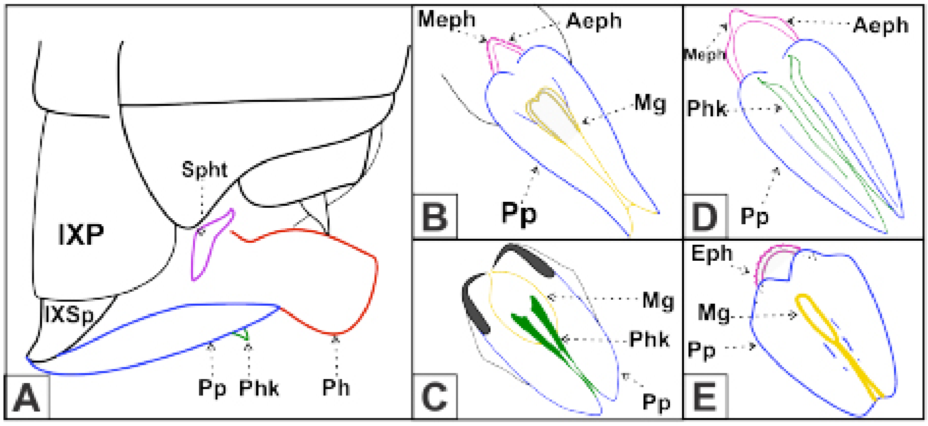


**Figure 1.** Terminalia in male terminalia in dorsal-lateral view of (A) *Tetrix bipunctata* (Linnaeus, 1758); male terminalia in dorsal view of (B) *Criotettix miliarius* Hancock, 1904; (C) *Paratettix meridionalis* (Rambur, 1838); (D) *Afrocriotettix nigellus* (Bolívar, 1887) and (E) *Pterotettix andrei* Bolívar, 1887. The drawings are adapted from Chopard (1920) with the correspondent terminology of structures and color in Table 1. Legends. Aeph: arms of epiphallus; Eph: epiphallus; Meph: median process of epiphallus; Mg: medial groove; Ph: phallic organ; Phk: pallial hooks; Pp: pallial plates; Spht: sclerites of phallotreme; IXP: 9th sternum proximal part and IXSP: subgenital plate.

plates (Flook & Rowell 1997), and directed to the anterior ends of the body (Dirsh 1961); cerci short and unsegmented (Rentz 1991); and egg as wine-bottle-shaped, cylindrical with acutely pointed extremity, such as horn of the egg (Hancock 1902, Nabour 1929, Hartley 1962). Among all these attributes, the genital organs are the only morphological characteristic not used in the description of Tetrigidae species, since genitalia has been considered a poorly specialized structure in this group. However, my preliminary studies point to the phallic complex presenting different degrees in complexity. Thus, the question arises: are the phallic complexes of Tetrigidae useful in taxonomy? Thus, the objective of this study was figure out if the genital organs of tetrigids have a limited use as taxonomic characters, or if they could be at least used to improve the descriptions and taxonomic studies of the Tetrigidae.

## Material and Methods

A systematic review of studies related to genital organs of tetrigids was carried out and searches were performed in bibliographic databases and searching in the morphology and taxonomy papers of Orthoptera. Also, one specimen was dissected to exemplify the results of the literature review and the genitals cleaned by treating them with a KOH solution at room temperature.

## Results and Discussion

Our results indicate that phallic complexes of pygmy grasshoppers are useful in taxonomy since there are different degrees of complexity, which has been indicated in the literature. We found a lot of studies that mentioned the genital organs without a standardization of the terms or comparison of the morphological data between species. Among these researchers, I highlight Chopard (1920), Hinton (1940) and Harz (1975):

Lucien Chopard was one of the first taxonomists to compare male and female genitalia of orthopteroids. In 1920, in the "Recherches sur la conformation et le dévelopement des demiers segments abdominaux chez les Orthopteres," using some species, such as *Tetrix bipunctata* (Linnaeus, 1758) (Fig. 1A); *Criotettix miliarius* Hancock, 1904 (Fig. 1B); *Paratettix meridionalis* (Rambur, 1838) (Fig. 1C); *Afrocriotettix nigellus* (Bolívar, 1887) (Fig. 1D); and *Pterotettix andrei* Bolívar, 1887 (Fig. 1E), he verified that terminalia region of tetrigids were totally different from other grasshoppers.

According to Chopard (1920), the

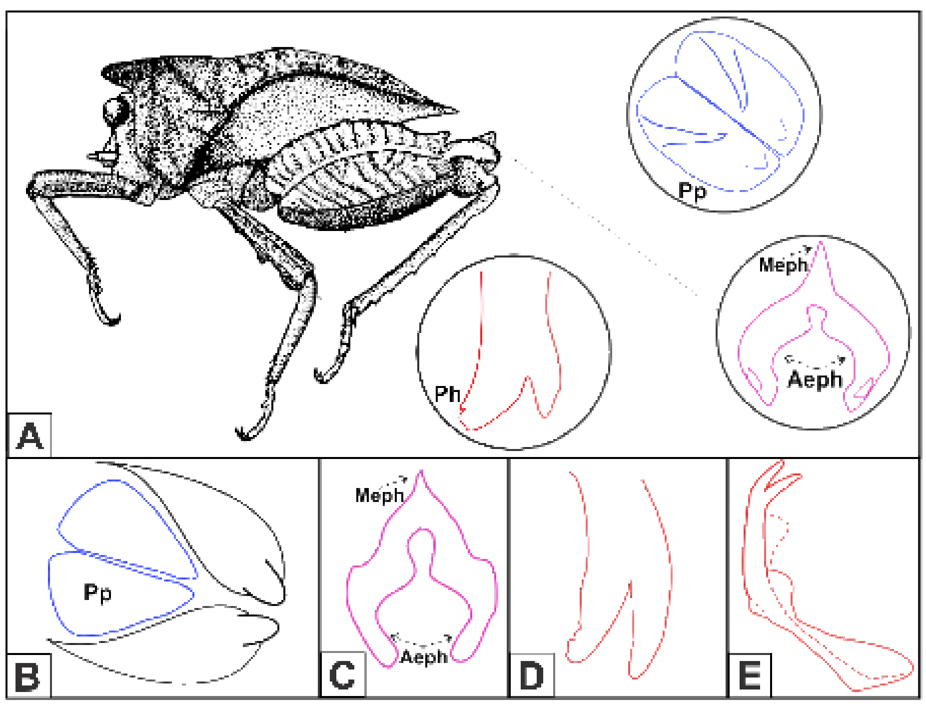


**Figure 2.** Phallic complex of (A) *Bufonides sellatus* Hinton, 1940 highlighting the pallial plates, epiphallus, and phallic organ; *Bufonides antennatus* Bolívar, 1898 with terminalia in dorsal view (B), (C) epiphallus and (D-E) phallic organ with a cylindrical internal sclerotization. The drawings are adapted from Hinton (1940) with the correspondent terminology of structures and color in Table 1. Legends. Aeph: arms of epiphallus; Meph: median process of epiphallus; Ph: phallic organ Pp: pallial plates.

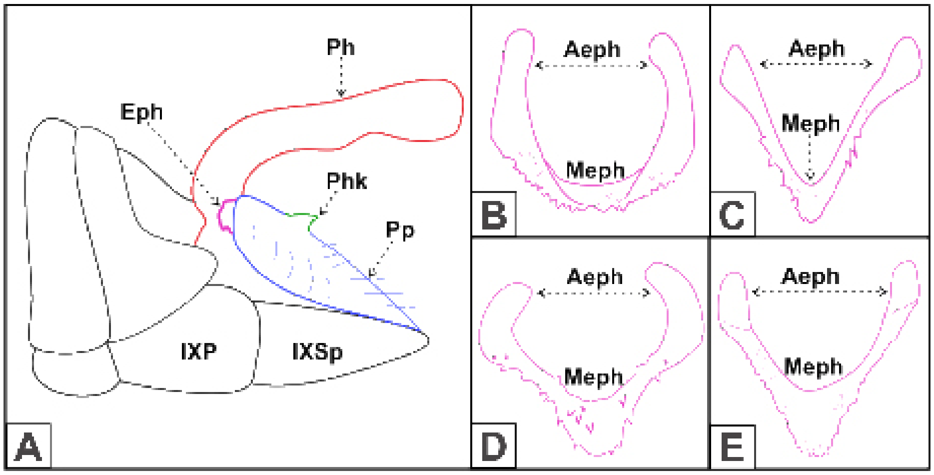


**Figure 3.** Terminalia in lateral view with phallic organ everted of (A) *T. subulata* and epiphallus on different species of *Tetrix* Latreille, 1802. The drawings are adapted from Harz (1975) with the correspondent terminology of structures and color in Table 1. Legends. Aeph: arms of epiphallus; Eph: epiphallus; Meph: median process of epiphallus; Ph: phallic organ; Pp: pallial plates; IXP: 9th sternum proximal part and IXSP: subgenital plate.

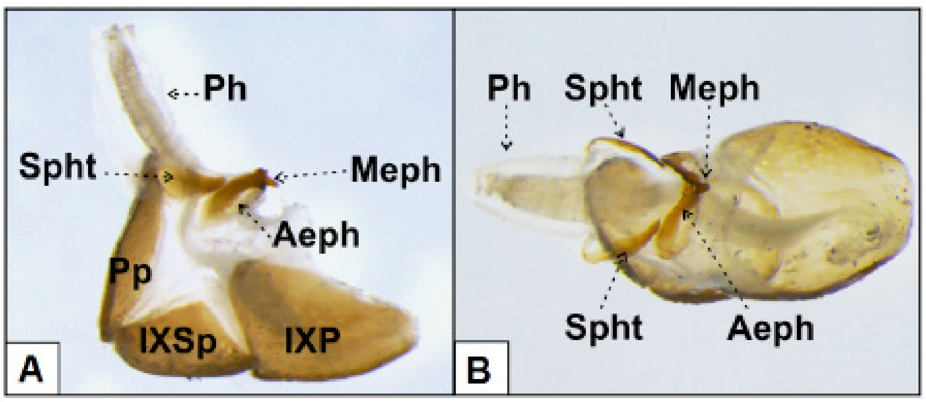


**Figure 4.** Terminalia structures of *Tettigidea* sp. (A) in lateral and (B) dorsal view. Legends. Aeph: arms of epiphallus; Cer: cercus; Eph: epiphallus; Meph: median process of epiphallus; Mg: medial groove; Ph: phallic organ; Pp: pallial plates; Spht: sclerites of phallotreme; IXP: 9th sternum proximal part and IXSp: subgenital plate.

subgenital plate is divided in two parts, with the apical part flexible, forming a triangular projection, and the penis is completely welded in the subgenital plate. The genital organs are composed by two large valves that fit into the apical part of the subgenital plate. They are separated by a deep median sulci, limited on each side by a chitinous piece. These structures (valves, chitinous pieces and median sulci) on the terminalia formed the genital pieces (Fig. 1).

Hinton (1940), in a revision of *Bufonides* Bolívar, 1898 made schematics of what he called "genitalia and associated sclerites" for *Bufonides antennatus* Bolívar, 1898 and *Bufonides uvarovi* Hinton, 1940 (Fig. 2). Kurt Harz (1975), in an extensive work on the fauna of Orthoptera in Europe, used the term phallic complex to indicate all structures laying above the subgenital plate, including the penis (Fig. 3A). He gave special attention to the epiphallus, the term used to describe the U-shaped sclerite and indicated that this structure is different in several species of *Tetrix* (Fig. 3B-E).

Although apparently without this objective, Hinton (1940) and Harz (1975) indicated through their drawings significant differences between the epiphallus to base comparisons of species of *Bufonides* and *Tetrix*, respectively. The epiphallus shape, angulation of arms, ornamentation of median process and surface of this structure presents morphological differences that allow this structure to be used as a taxonomic character to compare different species. My previous studies about the genital morphology of tetrigids showed a variation of forms, which are more easily noted in two structures: the phallic organ and epiphallus. The phallic organ has sclerotized portions as indicated by Hinton (1940) (Fig.2) and the specimen here dissected (*Tettigidea* sp.), that has a cylindrical internal sclerotization inside the phallic organ in which it was not necessary to apply coloration to better visualize the internal morphology of this organ (Fig.4).

More studies are needed to improve the understanding of the phallic complex functions, origin, and evolution in Tetrigidae. For this purpose, we should sample more specimens as much as possible and conserve some of them in alcohol for genitalia extraction of fresh material. This study is still ongoing (Silva et al. in press) and soon we will provide more information on the use of terminalia and genitalia in this group.

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# Studying locust phase polyphenism of the Central American locust: tales from the field

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Within the order Orthoptera, locusts are among the most enigmatic species. They form large migratory swarms or hopper bands, and exhibit density-dependent phase polyphenism. This polyphenism entails the existence of two distinct phases: a solitarious and a gregarious phase that are found at low and high population densities, respectively. They differ in several traits, including, but not limited to, behavior, morphology, nymphal coloration, physiology, and reproduction (Pener and Simpson, 2009; Cullen et al., 2017). Upon increasing population densities, solitarious locusts will turn into gregarious individuals, while the opposite process occurs when population densities become very low. This process of gregarization and solitarization has been studied in the lab for two different locust species: the desert locust, *Schistocerca gregaria* (Roessingh et al., 1994) and the migratory locust, *Locusta migratoria* (Guo et al., 2011). These studies show clear differences between the different species, possibly due to differences in their biology. For instance, in *S. gregaria*, solitarious nymphs gregarize within a few hours, while it takes several days for gregarious nymphs to become solitarious. As opposed to *L. migratoria*, in which it takes much longer for solitarious nymphs to gregarize, while gregarious nymphs quickly lose their gregarious characteristics. At the moment, it is unclear whether these differences in gregarization and solitarization are due to differences in their respective biology; for instance, both locust species differ significantly in habitat.

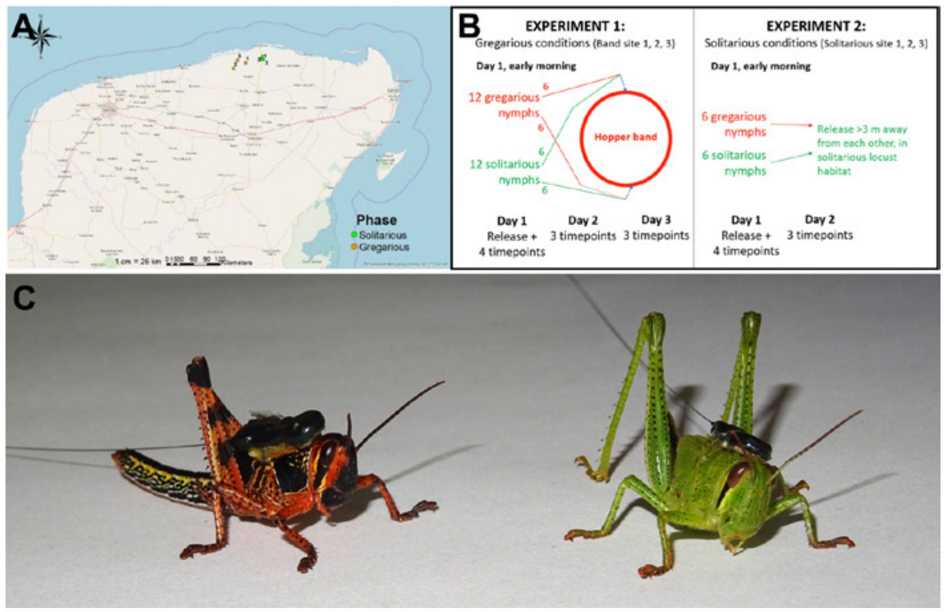


**Figure 1.** (A) Locations of the six field sites used in the study; (B) experimental set-up of the study; (C) gregarious (left) and solitarious (right) locusts with transmitters glued on abdomen. The picture was taken after the experiment was performed.

The relation between biology and solitarization/gregarization is hard to study in the lab, as the surroundings for locusts in the field are many times more complex. Field research on locusts is often hindered by a combination of factors, including the fact that swarms usually are few and far apart, the lack of accessibility to field sites (locusts often swarm in politically unstable regions), and a lack of good connections, or even a disconnect between locust control teams and scientists. However, the Central American locust *S. piceifrons* is a very suitable alternative to the regular, well-studied locust species. Not only does this locust swarm every 3-4 years in its main gregarious zone in Yucatan in Mexico, it is also well-controlled, and the local locust control team has an excellent knowledge of the whereabouts of the locust at any time. Our lab started a colony of this species a few years ago, giving us the perfect opportunity to compare lab-generated and field-generated data.

Our lab started by studying the time course of gregarization and solitarization in the lab (results not shown). This data shows that our species reacts similar to *S. gregaria* in a


**Figure 2.** (A) a hopper band in the early morning, right before they start marching; (B) and (C) marching locusts; (D) locusts clustering together again in the late afternoon, ready to roost at night.

laboratory setting: solitarious nymphs quickly gregarize (fast change after 2 hours, after which no further change occurs), while gregarious nymphs only slightly solitarize in the first hours, but even after 48 hours about half of the assayed individuals still behave like gregarious nymphs. Now it was time to travel to Yucatan, where hopper bands were currently roaming the countryside (Fig. 1). I stayed in Tizimin, Yucatan from November 12-31, 2018 and met up with Mario Poot-Pech and the rest of the locust control team of CESVY-SENASICA. We decided to do a translocation experiment, moving gregarious nymphs to a solitarious site and moving solitarious nymphs into a hopper band (Fig. 2B). We glued a PicoPip Ag337-transmitter glued on the pronotum of every experimental animal with floral glue (Fig. 2C), so that they could be tracked using a Yagi 148-152 MHz antenna with a Biotracker Receiver (Fig. 3B).

Finding three locations with hopper bands that I could use in my experiment was quite easy (Fig. 2A), at least for the locust control team. Time after time we would be driving for an hour when suddenly the driver suddenly stopped, retraced their tracks for several meters, and said that we were getting out. And sure enough, after crossing the barbed wire and walking for another 500 meters into tropical farmland with waist-high tropical vegetation, we would find ourselves surrounded by thousands of gregarious nymphs. Even though they said they used clues like the color and the stature of the vegetation to detect locust swarms, it always left me with a sense of wonder of how they were able to perform this feat time after time again. Finding locations with solitarious nymphs proved to be harder: there seemed to be just one large area where densities were low enough for locusts to still be in their solitarious phase (Fig. 2A). And, of course, densities were so low here that by the end of the trip, we were struggling to find last instar nymphs that would not turn into adults in the middle of our experiment.

We performed a total of three replications of each translocation experiment. For the "solitarious to gregarious" experiment, 12 solitarious and 12 gregarious nymphs were released in a hopper band and tracked for three consecutive days (Fig. 2B). For the "gregarious to solitarious" experiment, 6 solitarious and 6 gregarious individuals were followed for two days. Even though I would have liked to increase both sample size and time of every trial, there was a very clear time limitation to this experiment. There is only a three-week time window during which last instar nymphs are present, and there is only a certain amount of individuals you can track each day. With the next opportunity to study swarming locusts in Yucatan possibly not appearing for another four years, we had to make the most of it.

Before starting the experiments, we carefully designed them so that I would get the most out of every day, while at the same time not overloading myself. Let's say this was a partial success: I definitely succeeded in getting the most out of every day. Fieldwork has the tendency to be more complicated when you are actually doing it then when you're designing experiments on a whiteboard from the comforts of an air-conditioned room. Experiments were scheduled to start at 8:00 AM every day and finish at 6 PM. Of course, the field sites were consistently over one hour of driving from Tizimin, so that I woke up every day around 6:30 AM. Breakfast quickly became a luxury that I did not have time for half of the time (Fig. 3A). Halfway during the trip, daylight saving time ended and time was moved an hour forward. As you might expect, the locusts could not have cared less and did not change their daily schedule, so I finished off my last experiments waking up at 5:30 every morning.

Conditions in the field were harsh. Temperatures started off around 26°C in the early morning and rose to high thirties during the day. During the first week thunderstorms would come and go, and the open terrain did not offer a lot of cover (Fig. 3C&D). My constantly soaked feet quickly felt like some kind of painful pudding. When the rains finally stopped I realized the ever-present sun was burning my hands and face so badly that sunscreen didn't really help, and again I cursed the open terrain that would not offer a lot of cover. Moreover, I was getting more and more sleep-deprived: every evening I still had to get dinner, finish my field notebook, and discuss what I needed for following experiments. As the locust control team was eager to kill off all the locusts, their job after all, we had to decide which bands were not much of a threat for agriculture, so that I could still use them. However, I was a happy man! Seeing wild locusts with my own eyes has been a dream for me for a long time, but these feelings only became stronger once I started studying them for my PhD. After 4 years of studying these intriguing animals in the lab, these hardships were definitely worth it.

But then the hardships got worse. Our (not-so-cheap) transmitters lasted for 11 days while every experiment only took 2-3 days. You guessed it, we re-used the same transmitters for several experiments. As a result, we had to recapture the locusts at the end of every trial. When designing the experiment, this part was thought to be easy, and to not take very long. But it quickly became the most frustrating part of the whole expedition. Finding a scared locust in waist-high vegetation is not easy. It usually involved two people mowing down the vegetation while I used the antenna and receiver to guide them in the right direction. Sometimes, the presence of other vegetation would make me misjudge the exact location by 20-50 cm, making us lose more valuable time. Finding all the tracked locusts often took us until long after nightfall, which made it even more fun to find the transmitters of locust that had died or been eaten. Just imagine your search image is a bright green or orange locust, but instead you are actually looking for a black transmitter, at night, on black soil, between dead plant material that, you guessed it, had turned black.

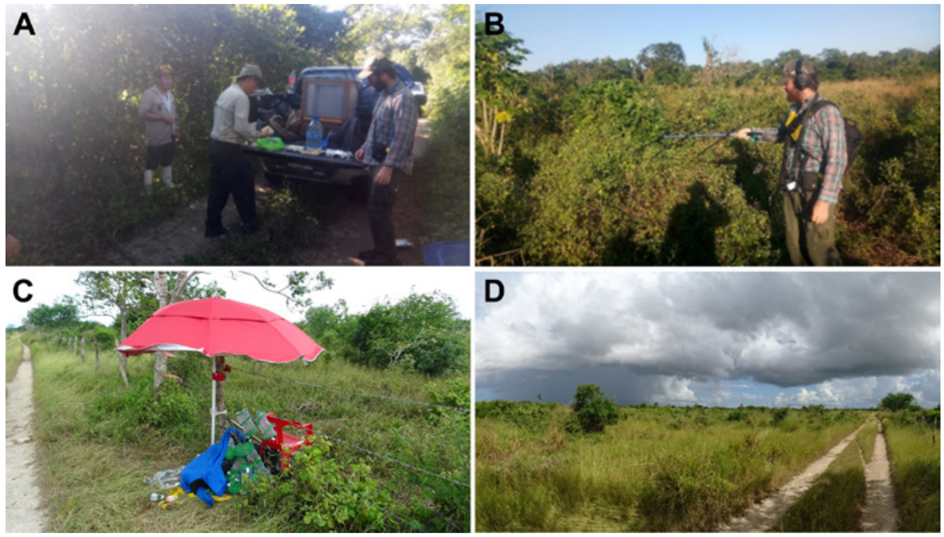


**Figure 3.** (A) what I would call an excellent breakfast!; (B) Me tracking locusts using a Yagi 148-152 MHz antenna with a Biotracker Receiver. Locations of tracked locusts were marked with a GPS; (C) My awesome encampment, and also my only cover from rain and sun; (D) habitat at field site 1. In the background, dark clouds are lurking, bringing not only rain but also painful feet.

On a positive note, these were excellent opportunities to improve my Spanish. It usually took us between 15 and 45 minutes to find a single transmitter, so you cannot imagine the extreme happiness when we saw a locust with transmitter sitting in plain sight on the top of a plant!! I especially remember one evening that stood out above all others: two of the tracked locusts had decided to die in the middle of 2 square meters of head-high vegetation right under a small wasp nest. Great. I will never forget Carlos Mora, who told me not to worry about it and happily started cutting into the vegetation with his machete. Soon enough, the wasps woke up, and angrily charged his headlamp. Two quick swings with his machete and the first two attackers were cleaved into two pieces in flight. Over 10 unappreciative wasps died that night, while the only casualties on our side were two stings (Carlos also hit one of the other Mexicans with the flat of his machete, but in doing so killed the wasp that would have stung him).

If at this point you are wondering how I could possibly survive three weeks of such hardships: the secrets are Belgian chocolate and the awesome people from the locust control team that always have a smile on their face. But even so, two weeks of only sleeping 2-6 hours a night, working in the humid and hot Yucatan sun, was apparently too much for me. The first two hours of an especially hot day (32°C right after the sun got up) managed to knock me out into a heatstroke. Against my will, I decided that it was best to leave the experiment as it was and go back home. The hours after this were an interesting combination of good and bad luck. Good luck: I was not alone that day, as Jorge Humberto Medina Durán was with me, so that I did not have to drive. Bad luck: we got involved in a car accident with a motorcycle and we were using our collaborator's car. Luckily, it resulted in no human damage, but it did result in me having to sit in the car, in the still-hot sun, for an extra hour. For those of you who have not experienced heatstroke before, sitting

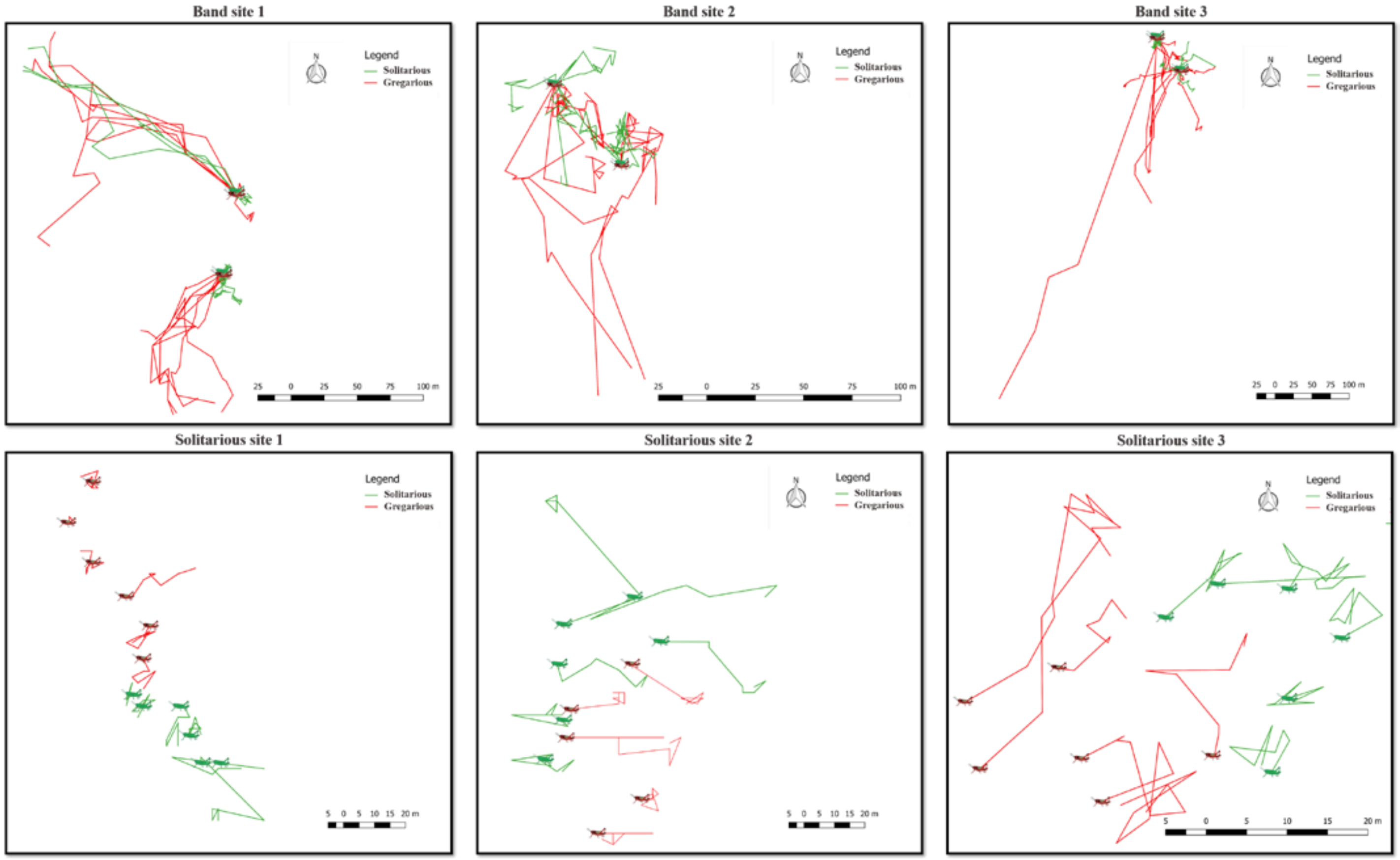


**Figure 4.** Results of tracking locusts in Yucatan. Top panels show data of band (gregarious) sites, bottom panels show data of solitarious locations. On band sites, 12 gregarious and 12 solitarious locusts were released equally on opposite sides of one band and tracked for three days. Each of the three maps shows a total of 11 timepoints where the coordinate of the locust was marked (release and 4 timepoints on day 1, and three timepoints each on the following days). Band site 1 shows how the band split in two, with half of the tracked individuals going one way, while the other half goes the other way. Three solitarious individuals join the band. On band site 2, the band moves in circles for the first two days, making the tracks very confusing. None of the solitarious nymphs join the band. On band site 3, only one gregarious nymph joins the band while four others move in the same direction with a reduced speed. No solitarious nymphs join the band. On solitarious sites, 6 gregarious and 6 solitarious last instar nymphs were released in similar habitat with at least 2 meters between individuals, and were tracked for two days. Each map shows 8 timepoints (release and 4 timepoints on day 1, and three timepoints on day 2). On all three panels, it is evident that gregarious and solitarious nymphs move similar distances.

in a hot car for an hour is not the best way to get better. In the end, we got to our room where I passed out and almost slept for two days! Completely refreshed, I was ready for another 5 days of field work!!

After all experiments were performed, it was already clear that our field data did not fully support the conclusions drawn from our lab results (Fig. 4). For instance, we found no difference between the distance moved when either gregarious or solitarious nymphs were released into the solitarious zone. On the other hand, only three solitarious nymphs out of a total of 36 tested individuals joined the hopper band, suggesting that, not surprisingly, gregarization in the field might be much more complex than in a laboratory setting. For a full description and analysis of the results, I will refer you to the paper that will be written up about these results, hopefully within the next year.

**Acknowledgements**

I would like to thank the Orthopterists' Society for kindly making this awesome field expedition possible with the Ted Cohn grant for young researchers. This trip gave me the experience of a lifetime studying one of my most favorite organisms in the field. During this trip, we also reused part of the material funded by an earlier Ted Cohn grant to Ryan Selking (Selking, 2018).

I would especially like to thank Dr. Mario Poot-Pech, head of the locust control team in Yucatan, without whose help this trip would have been a formidable disaster. Carlos Mora, Gonzalo Chi, and Carlos Llano all took me to the field, helped me recapture locusts at the end of the experiment until really late in the evening, offered me food, captured solitarious locusts when I didn't have time, and, most importantly, they did all of that without ever complaining and with a smile on their face. I don't think I would have survived past day two without them. Further, I would also like to thank Trinidad Canul, Daniel Piste, Luis Tun and any other members of the locust control team that I forgot to mention. Last, I owe a special thanks to Ricardo Munguia, the manager of CESVY-SENASCA in Mexico, and apologize for any discomfort caused by the car accident. I had a great time working together with you guys and I hope I'll be able to visit again!

I would further like to thank Jorge Humberto Medina Durán for assisting me during my last week of field work, even though I'm not sure whether I ever want to be ever in a car with you again. Thanks also to my brother, Ruben Foquet, for being more skilled in IGIS than I am and spending several hours to make the movement maps presented here, Dr. Greg Sword and Dr. Ricardo Mariño-Pérez for aiding in the development of ideas for field work and Toan Hoang for assisting me during the first two days of field work. Last, I owe a great deal to my advisor Dr. Hojun Song, who allowed me to go on this trip, helped a lot in designing all the experiments and visited two times during my stay in Yucatan to aid in the experiments.

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# Orthoptera Species File Grant Reports

## Digitization of the world's largest collection of Rhaphidophoridae at the ZIN, St. Petersburg

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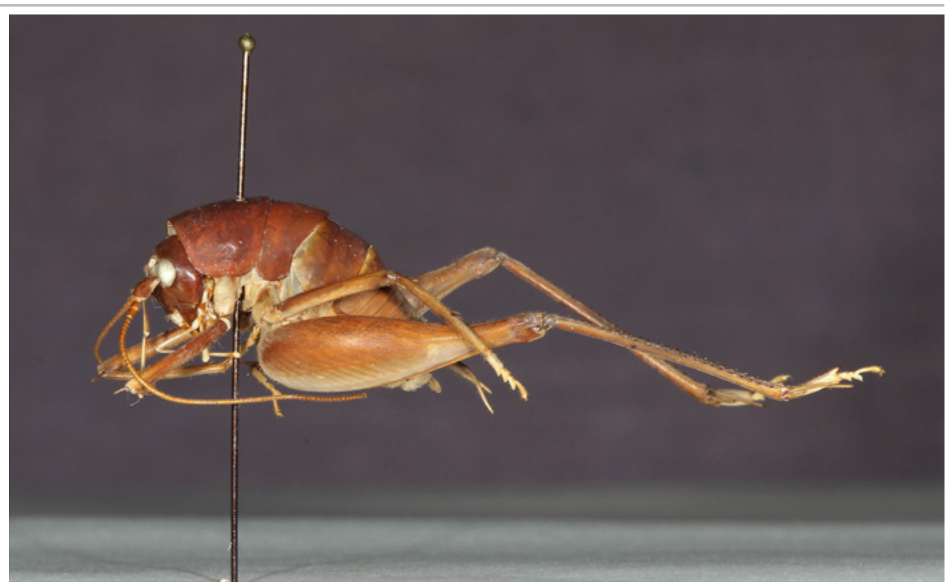
For many centuries, museum collections served as reference sources for a small community of researchers worldwide. Access to these collections was, and remains, difficult both spatially and temporally. The digitization of such collections provides the possibility of democratization of access and, moreover, a temporal flexibilization.

A photo certainly does not offer the same possibilities of comparison, but they can provide initial clues when determining a species and may thus be the starting point for further measures.

That was also the aim of this project: to provide access to such an insect collection, at least virtually.

During the data collection for population size estimations of the nocturnal cave cricket *Phalangacris alluaudi* (Mahé, Seychelles), another, yet unidentified species was found. This species seemed to belong to family of Rhaphidophoridae, but the morphological comparison with family members was impossible because the OSF database lacked photographs of the collection material stored mainly in the cabinets of ZIN St. Petersburg.



Male of *Rhaphidophora collina* in lateral view; Image by F. Billmaier, online at http://orthoptera.speciesfile.org/Common/basic/ShowImage.aspx?TaxonNameID=1217627&ImageID=233893.

This lead to the idea of digitizing this collection and making it accessable to a broader research community.

The collection consists of 10 boxes containing dry preparates in very mixed condition. The majority of the collection is quite well-preserved, but unforuntately, about 20-30 % of the specimens are in worse condition. According to Mr. Gorochov, additional alcohol preparations are non-existent.

The boxes contain specimens from these genera:

- *Rhaphidophora*
- *Stonychophora*
- *Eurhaphidophora*
- *Neorhaphidophora*

**Table 1.** List of specimens imaged during this project.

| Species name | Holotypus | Paratypus | Species name | Holotypus | Paratypus |
|---|---|---|---|---|---|
| *Rhaphidophora abramovi* | X | X | *Rhaphidophora thaiensis* | X | X |
| *Rhaphidophora arsentiji* | X | - | *Rhaphidophora trat* | X | X |
| *Rhaphidophora banarensis* | X | X | *Rhaphidophora vanghena* | X | - |
| *Rhaphidophora bidoup* | X | X | *Rhaphidophora vasiliji* | X | X |
| *Rhaphidophora bokor* | X | X | *Rhaphidophora vietensis* | X | X |
| *Rhaphidophora cambodia* | X | X | *Rhaphidophora vietensis nigrivertex* | X | X |
| *Rhaphidophora collina* | X | - | *Rhaphidophora wasile* | X | X |
| *Rhaphidophora curup* | X | X | *Rhaphidophora wuasa* | X | - |
| *Rhaphidophora curta* | X | X | *Rhaphidophora xishuang* | X | - |
| *Rhaphidophora dammermani* Karny- det. Gor | - | - | *Stonychophora angulata* | X | X |
| *Rhaphidophora dehaani* Karny- det. Gor | - | - | *Stonychophora? biaki* | - | - |
| *Rhaphidophora deluduo* | X | X | *Stonychophora cattien* | X | X |
| *Stonychophora denticulata* | X | X | *Stonychophora? cultrifer*- det. Gor | - | - |
| *Rhaphidophora exigua* | X | - | *Stonychophora fulva*- det. Gor | - | - |
| *Rhaphidophora fedorenkoi* | X | X | *Stonychophora furca* | X | X |
| *Rhaphidophora furcifera* | X | X | *Stonychophora halmatera* | X | X |
| *Rhaphidophora fusca* | X | X | *Stonychophora khmerica* | X | X |
| *Rhaphidophora iliai* | X | - | *Stonychophora maculata* | X | X |
| *Rhaphidophora indica* | X | - | *Stonychophora manokwani* | X | X |
| *Rhaphidophora insularis* | X | - | *Stonychophora minahassa* | X | X |
| *Rhaphidophora invalida* | X | - | *Stonychophora parafurca* | X | X |
| *Rhaphidophora ivani* | X | X | *Stonychophora parafulva* | X | X |
| *Rhaphidophora jambi* | X | - | *Stonychophora sulawesi* | X | X |
| *Rhaphidophora khmerica* | X | - | *Stonychophora supriori* | X | - |
| *Rhaphidophora lampung* | X | X | *Stonychophora? sylvestris* | X | - |
| *Rhaphidophora lao* | X | X | *Stonychophora tatianae* | X | X |
| *Rhaphidophora lobulata* | X | - | *Eurhaphidophora tarasovi* | X | X |
| *Rhaphidophora longa* | X | X | *Stonychophora tatianae falsa* | X | X |
| *Rhaphidophora lorelindu* | X | X | *Stonychophora tioman* | X | X |
| *Rhaphidophora magna* | X | X | *Stonychophora trilobata* | X | X |
| *Rhaphidophora malayensis* | X | X | *Stonychophora trusmadi* | X | X |
| *Rhaphidophora mariae* | X | X | *Eurhaphidophora ampla* | X | X |
| *Rhaphidophora mindoro* | X | - | *Eurhaphidophora angusta* | X | X |
| *Rhaphidophora minicanda* | X | X | *Eurhaphidophora bispina* | X | X |
| *Rhaphidophora negarensis* | - | - | *Eurhaphidophora bona* | X | X |
| *Rhaphidophora pahangensis* | X | X | *Minirhaphidophora kerinci* | X | - |
| *Rhaphidophora pangrango* | X | - | *Eurhaphidophora laosi* | X | X |
| *Rhaphidophora parvicanda* | X | - | *Eurhaphidophora nataliae* | X | X |
| *Rhaphidophora phusoy* | X | X | *Eurhaphidophora orlovi* | X | X |
| *Rhaphidophora raoan* | X | X | *Eurhaphidophora rotundata* | X | - |
| *Rhaphidophora recta* | X | X | *Eurhaphidophora visibilis* | X | - |
| *Rhaphidophora rombica* | X | X | *Pararhaphidophora anatolijiv* | X | X |
| *Rhaphidophora rombifera* | X | - | *Neorhaphidophora grata* | X | X |
| *Rhaphidophora simillima* | X | X | *Neorhaphidophora steineri* | - | X |
| *Rhaphidophora simulata* | X | X | *Neorhaphidophora valentinae* | X | X |
| *Rhaphidophora sinica* | X | - | *Neorhaphidophora valentinae proxima* | X | X |
| *Rhaphidophora songbaensis* | X | X | *Diarhaphidophora mira* | X | X |
| *Rhaphidophora spinifera* | X | X | *Diarhaphidophora sympatrica* | X | X |
| *Rhaphidophora tamarensis* | X | - | | | |

- *Pararhaphidophora*
- *Minirhaphidophora*
- *Diarhaphidophora*

**Digitization**

Photos were taken with a Canon EOS 60D, upgraded with an external flash. Specimens were photographed lateral, dorsal, ventral, frontal, and distal view. Over two weeks, the following species were photographed: see Table 1.

**Upload**

Pictures were rotated, cropped, and partially improved by FastStone Image Viewer. The following specimens were in very poor conditions, so photographs were therefore not added to the OSF database:

- *Neorhaphidophora valentinae proxima*
- *Neorhaphidophora steineri*
- *Neorhaphidophora valentinae*
- *Stonychophora cultrifera*
- *Stonychophora cultrifer*
- *Stonychophora fulva*
- *Rhaphidophora dehaani*
- *Rhaphidophora loricata*
- *Rhaphidophora dammermani*

# Contribution of distributional and taxonomical data of Mantodea species and photos of live individuals from West Central Africa

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The number of Mantodea species in the world is nearly 2,500 valid species (Wieland & Svenson 2018). This remains a small order of insects next to the Hymenoptera, Coleoptera, Lepidoptera, etc. The knowledge about Mantodea that we have is growing day by day. For several years, a craze has grown, which has led to many publications that review the Mantodea taxonomy, from subgenus all the way to the order level.

Mantodea Species File (MSF) (Otte et al. 2019), developed from the publication of R. Ehrmann (2002) and that of D. Otte & L. Spearman (2005), established the online foundations for Mantodea. These two last authors, assisted by Martin B.D. Stiewe (editor) and David C. Eades (Database Developer), have done a remarkable job. Almost all the citations known during the creation of MSF are recorded. Today, a very large amount of data are missing concerning each of the recorded species: description of the types, their location, their distribution. Thanks to the regular work of Martin B.D. Stiewe, in recent publications, species are recorded in detail in MSF. The updates to be made are on the data recorded from the beginning.

Since 2010, I have participated in many scientific missions in Central Africa (Cameroon, Central African Republic, Gabon). These different missions allowed me to photograph many species in their natural environment. They also allowed me to meet colleagues who could bring me their contributions in photographs. As a Mantodea specialist for decades, I have also accumulated almost all the bibliography concerning these insects. Finally, as a volunteer of the Mantodea collection at the Muséum national d'Histoire naturelle (MNHN) in Paris, I have access to the data of one of the largest collections of the world of this order of insects; in particular, data on Mantodea from West and Central Africa. Indeed, France has set up scientific research stations in the Congo Basin. The French presence brought a lot of data to the MNHN. Roger Roy, my mentor, is no stranger to all this data accumulated at the MNHN. The Mantodea types preserved in Paris were digitized for four years and are viewable at https://science.mnhn.fr. Many types are also digitized on https://mantodearesearch.com/images/, one of G. Svenson's Mantodea projects, along with his collaborators.

**Figure 1.** *Pseudocreobotra ocellata* female adult at the top of Mt Brazza, Lope NP, Gabon, III-2013.

Thus, thanks to the support of Orthopterists' Society, I contributed to the knowledge of the Mantodea of Central Africa. A list of 137 species, whose data have been updated, is based on several major publications that record these insects in Congo Basin countries (Roy 1968, Moulin et al. 2017, Moulin 2018, Roy 2018). The locality of the types has been indicated. The species distribution has been updated. The place of conservation of the types was recorded, as well as the kind of type studied and the category of the specimen. A link to the photos of types produced by the MNHN has been added (46 species conserved at MNHN). 71 photos taken by myself, in natura, were added (Figs. 1 and 2) as well as 29 photos from several authors whom I thank here: Thibaud Decaëns, Guilhem Duvot, Serge Obounou Menie, and Nil Rahola. Recent citations have also been added. Nominative descriptions of many species have been considered; thus, names of authors and dates have been able to find parentheses as the international nomenclature requires.

Work on Mantodea continues. I collaborate regularly with Martin B.D. Stiewe in order to improve MSF as soon as the opportunity arises during a work of taxonomy or synthesis of knowledge. I hope that the work done

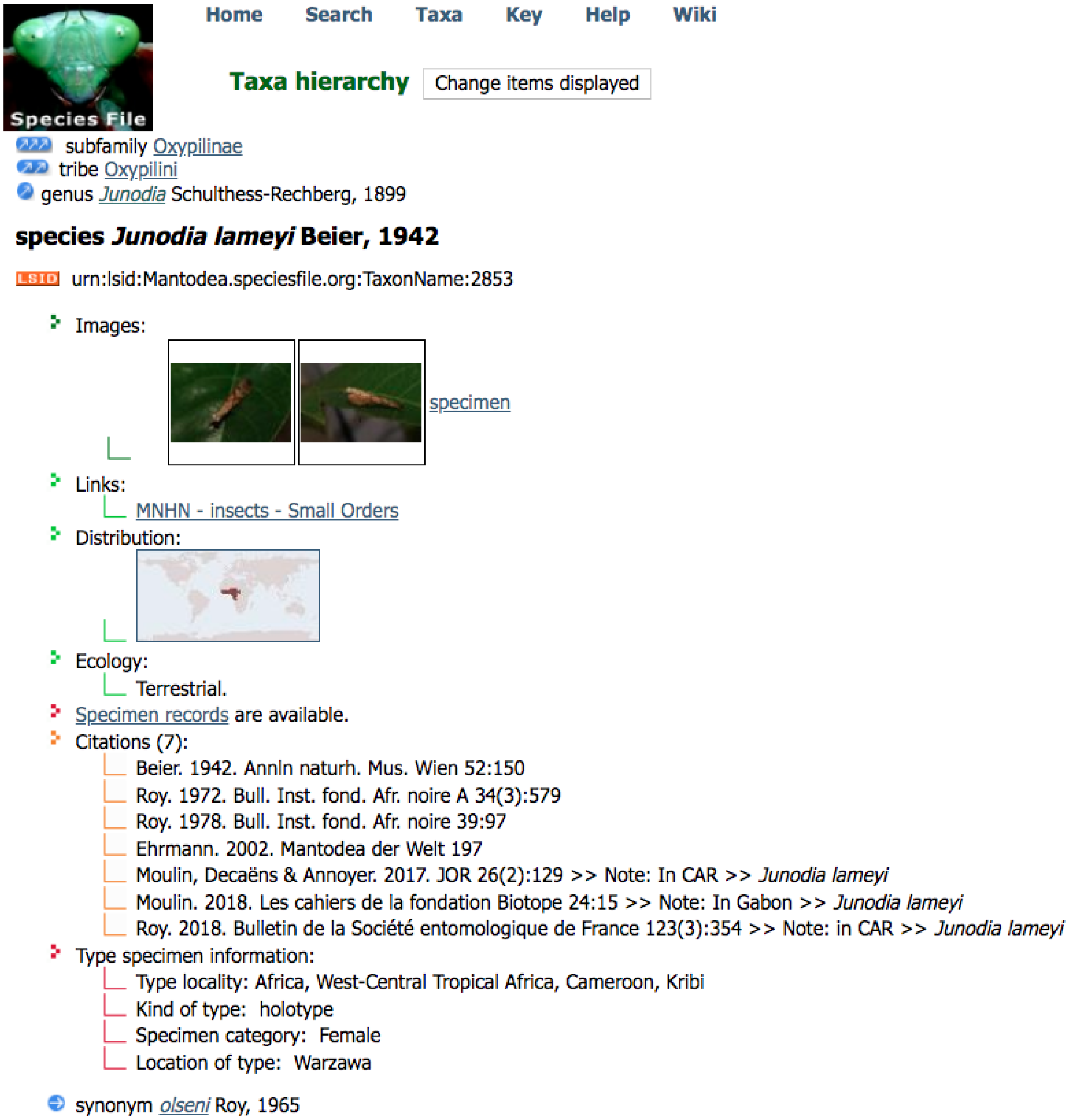


**Figure 2.** Example of a species updated on MSF.

can be useful. The Mantodea taxonomy has undergone major changes recently (Schwarz & Roy 2019) and rhere is still some work necessary for updating MSF.

I would like to thank the Orthopterists' Society for supporting my project, María Marta Cigliano for giving me extra time, Philippe Grandcolas for access to the Mantodea collections of MNHN, and Roger Roy for all the knowledge he gives me each day.

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# Editorial

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The very first issue of *Metaleptea* that I put together as the Editor was issue 29(2), which was published in September 2009, exactly 10 years ago. At that time, I was a postdoc at Brigham Young University looking for a faculty position. That issue prominently featured our 10th ICO in Antalya, Turkey, which was a marvelous meeting. During that meeting Michel Lecoq stepped down as Past President, and welcomed María Marta Cigliano as the incoming President. In page 4 of that issue, there was a photo of the late Ted Cohn with Battal Ciplak who organized the congress, and another photo of the late Carlos Carbonell sitting together with Dave Rentz. On page 12, there was an article about a Dan Otte Symposium honoring his achievements, which included a group picture in which I was standing between Kerry Shaw and Bill Cade, and Dan Otte right in the center, and the late Dick Alexander, who was Dan's Ph.D. advisor, in the middle of the first row. Looking at the past issues of *Metaleptea* is like walking down memory lane full of amazing mentors, friends, and colleagues who all share the love of Orthoptera. Reading the recollections of those who personally knew the late Carlos Carbonell in this issue confirms that my sentiment is not just my own, but shared among all of us orthopterists.

I tell my students that being involved in scientific societies is a great way of increasing their networks. It is probably true of any scientific societies, but I think there is something special about our society. Maybe it has to do with our shared passion about grasshoppers, katydids, and crickets (and, of course, other orthopterans). Maybe it has to do with some unexplainable, but fantastic qualities of people who are drawn to Orthoptera. It might be because our leadership is just terrific (which is true) and truly care about the members. Or, perhaps it may be because of the particular size of the order Orthoptera that we study (not so big enough to cause any division, but not so small enough to cause in-fighting). In any rate, I can confidently say that orthopterists are wonderful people and this society is the family you need to belong to if you are young students.

This is another fine issue of *Metaleptea* featuring how vibrant our society is. It is truly sad that we have lost one of the giants in the field, but his legacy lives on through the numerous people that were positively influenced by him. I am thankful to all of the contributors, including regional representative and past awardees. I would also like to thank our Associate Editor, Derek A. Woller, for his continued assistance in the editorial process, especially during his new fatherhood (his son was born July 9, 2019).

To publish in *Metaleptea*, please send your contribution 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 January of 2020, so please send me content promptly. I look forward to hearing from you soon!