ISSN 2372-2517 (Online), ISSN 2372-2479 (Print)

METALEPTEA

THE NEWSLETTER OF THE ORTHOPTERISTS' SOCIETY

President's Message

By **AXEL HOCHKIRCH**
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Dear Society members,

A very happy New Year to everyone! I hope you had an enjoyable holiday break.

I guess for most of you, the last weeks of the year are usually as busy as for me. Deadlines are approaching, papers or proposals need to be submitted or resubmitted, students and colleagues need some urgent help, and accounting needs to be finalized before the holiday break. Finally, you shut down your computer to relax for a few days with your family. But obviously sorting Orthoptera photos, validating Orthoptera observations, and responding to enthusiastic orthopterists is a passion, and, therefore, such breaks are not free of orthopterology. Many of our members see orthopterology as a passion rather than a work obligation. This is well-shown by some of our members, like our former president, Daniel Otte, who is still actively working on Orthoptera taxonomy, particularly on South African taxa. Such long-term engagement beyond the end of the service is quite typical for members of our Society.

In September 2024, I was able to visit the collection of the Academy of Natural Sciences of Drexel University in Philadelphia, which Daniel Otte used to curate. I attended a meeting of the advisory board to the Mohamed bin Zayed Species Conservation Fund, which was held at the museum. Many of you probably know the

museum as it holds one of the largest Orthoptera collections. While Daniel was traveling when I was visiting Philadelphia, I met Jason Weintraub, the current curator of the entomological collection. Jason showed me through the collection and I was able to see a specimen of the Rocky Mountain Locust, a species which once formed the largest insect swarms on the planet before it went extinct. He also showed me specimens of the Lord Howe Island Stick Insect which were collected before the species went extinct on Lord Howe Island (it was later rediscovered on Balls Pyramid). I have heard that Lord Howe Island has been successfully cleared of rats, so that a reintroduction of this species is now feasible. Such stories are the result of the engagement of numerous

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Figure 1. (Top) Jason Weintraub at ANSP; (Bottom) A specimen of the Rocky Mountain Locust

people, who have rediscovered and bred the species and initiated the rat eradication work. It is great to hear such success stories as they provide some hope that we still can save species from extinction.

Museum collections are a priceless resource for research, as they represent unique global heritages acquired from places and time periods that cannot be resampled. They provide an irreplaceable resource for understanding biodiversity and document how species and biotic communities respond to environmental change. However, many museums are underfunded and not all collections are well-maintained or curated. This is caused by the general public decrease of interest in taxonomy and the low citation rates of taxonomic articles. Nevertheless, we shall not forget that taxonomy is an important basis of virtually all other biological disciplines. Misidentification of species can lead to vast misinterpretations of research results. The importance of taxonomy was evident also for some of the most renowned orthopterists, such as Sir Boris P. Uvarov, who developed the phase theory of locusts when he understood that the different phases represent different morphs of the same species.

Our Societies' research grants (the Theodore J. Cohn Research Fund and the Orthoptera Species File (OSF) Grants) provide some modest financial support to foster orthopterological research and also facilitate the work in museum collections. Our Society is in the lucky position to benefit from the high generosity of our former president Ted Cohn, another enthusiastic and passionate orthopterist, who I was happy to meet at the 2001 International Congress on Orthopterology in Montpellier, France. The next deadline for the Theodore J. Cohn Research Fund is March 31st (see announcement in this issue). Besides our internal funding mechanisms, Jason Weintraub informed me that the Academy of Natural Sciences Philadelphia also provides grants for researchers who want to visit and work in the museum collection. So, there are numerous opportunities to get small taxonomic research projects funded.

In October 2024, I attended the IUCN SSC Leaders Meeting in Abu Dhabi. These meetings are always very intense and productive. One of the key outcomes of this meeting was that we need to engage stronger in building capacity for insect conservation in developing countries. The lack of entomological capacity in developing countries is also valid for Orthoptera. Some countries, even some mega-diverse ones, have very few or even no orthopterists at all. It will, therefore, be crucial to link experienced orthopterists or labs with young students and researchers from such countries. In most of these countries, there are also no large Orthoptera collections and there is a lack of resources and capacity to maintain insect collections in a good condition. Field guides or other identification resources are also missing. This is the reason why our Society has always supported the development of identification literature, if our financial situation permitted it. With our OSF, we are in a good position to facilitate Orthoptera identification, by providing links to taxonomic literature, photos, song recordings, and distribution data. Finally, our international congress is always a great opportunity to meet other orthopterists and start joint research projects. It is, therefore, my great pleasure to see the good progress towards our 15th International Congress of Orthopterology, which will be held in San Martín de los Andes, Neuquén, Argentina, from March 8-12, 2026.

I wish everyone success in their work for the coming year - all the best for 2025.

The Theodore J. Cohn Research Fund: Call for Applications for 2025

(Application Deadline: March 31, 2025)

By MICHEL LECOQ
Chair, Theodore J. Cohn Research Fund Committee
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Dear fellow Orthopterists,

I am pleased to announce a new call for applications for the Theodore J. Cohn Research Fund, which are due by Mach 31, 2025. This research grant is primarily intended to fund research projects on orthopteroids carried out by young researchers, often as part of a Master's or Ph.D. degree, although Postdoctorates may also be funded. A total of $15,000 U.S. dollars per year is available and it is possible to fund research grants of up to $1,500 dollars per beneficiary.

I remind you that the Orthopterists' Society aims to promote research on "orthopteroids" *sensu lato*, and proposals may concern any of the following orders: Orthoptera (grasshoppers, crickets, katydids, and more!), Blattodea (+Isoptera), Dermaptera, Embioptera, Grylloblattodea, Mantodea, Mantophasmatodea, Phasmida, Plecoptera, and Zoraptera.

I strongly encourage students and young researchers from all over the world, and particularly Africa and Asia, to submit a project. The committee will examine all applications with the same care and attention. The intrinsic quality and originality of the research project will be the only criteria considered.

Full details are available on the **Orthopterists' Society website's dedicated research fund page**. Proposals must be submitted in the suggested format and limited to the number of pages indicated. As usual, they should be submitted to the following address:

Michel Lecoq, Manager of the Ted Cohn Research Fund;
e-mail: **mlecoq34@gmail.com**

An important point: those whose projects are selected will be asked to submit an article presenting their main results for our **tri-annual *Metaleptea* newsletter**.

Remember… you can't get one if you don't apply!!!

I wish all of you the best for the year 2025!

Grants supporting the Orthoptera Species File (OSF)

By MARIA MARTA CIGLIANO
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The Orthopterists' Society, in cooperation with the Illinois Natural History Survey, provides grants for work supporting the OSF. Since 2013, this program has facilitated 90 projects of researchers from over 30 countries. It has become an instrumental force in advancing the database. The grants usually provide photo series of type specimens, images of live insects with geo-referenced localities, as well as sound recordings. This year, the OSF Governance Committee received and evaluated 14 proposals by applicants from 10 countries: Bhutan, Brazil, Cameroon, Germany, India, Mexico, Pakistan, Sri Lanka, Taiwan, and the U.S.A. The 10 proposals listed below will be funded. These have been selected based on the amount of data (images, specimen records, and sounds) expected to be added to the OSF. Also considered was the candidate's expertise, if the proposal was related to a taxonomic research project, and an adequate budget.

OSF Projects funded for 2025

1) Bhutan - Nawang Yonten and Pema Yangdon (Thimphu): FIRST RECORDS OF TETRIGIDAE OF BHUTAN

2) Brazil - Fianco Marcos (Federal University of Paraná): THE ORTHOPTERA FROM CAATINGA REGION IN BRAZIL, AND A DICHOTOMOUS KEY FOR PHYLLOPTERINI AND XENICOLA (ORTHOPTERA: PHANEROPTERINAE)

3) Brazil - Souza-Dias Pedro (Museu Federal, Univ. Federale Rio de Janeiro): THE ORTHOPTERA COLLECTION AT THE MUSEU NACIONAL, RIO DE JANEIRO (MNRJ). RECONSTRUCTION – STAGE 2: DATA SHARING

4) Germany - Yetchom Fondjo Jeanne Agrippine (Natural History Museum Karlsruhe): TAXONOMY, DIGITIZATION

AND PHOTOGRAPHIC DATABASE OF THE WEST-CENTRAL TROPICAL AFRICAN EUMASTACOIDEA BURR, 1899 (ORTHOPTERA: ACRIDOMORPHA) DEPOSITED IN THE NATIONAL MUSEUM OF NATURAL HISTORY PARIS (MNHN PARIS), FRANCE

5) Mexico - Jorge Gutierrez (UNAM): PHOTOGRAPHIC AND ACOUSTIC DATABASE OF MEXICAN KATYDIDS AND RELATED SPECIES

6) Pakistan - Panhwar Waheed Ali (University of Sindh Jamshoro): PHOTOGRAPHIC DOCUMENTATION OF THE GRASSHOPPERS (ORTHOPTERA: ACRIDIDAE) OF THE UNEXPLORED NARA DESERT OF SINDH, PAKISTAN

7) Pakistan - Zahid Sundus (Post Graduate College, Mansehra. KPK.): HIDDEN INSECT TREASURES: DIGITIZATION OF ORTHOPTERA TYPES AND NON-TYPE SPECIMENS FROM KEY ENTOMOLOGICAL COLLECTIONS IN CANADA

8) Sri Lanka - Goonatilake Manori (Colombo Museum) and Dhaneesh Bhaskar: EXPANDING THE MONOGRAPH OF ORTHOPTERA IN SRI LANKA – EXPLORING NEW REGIONS AND SPECIES DOCUMENTATION

9) Taiwan - Po-Wei Chen (New Taipei City): EXPEDITION ON THE UNDER-EXPLORED ORTHOPTERA FROM TAIWAN

10) U.S.A. - Francisco Rivas (Purdue University): DEVELOPING AN ACOUSTIC AND PHOTOGRAPHIC CATALOG OF ORTHOPTERA IN CHILE FOR OSF

Join Our Monthly Meetings via Google Meet

In August 2023, OSF transitioned to TaxonWorks, our new software infrastructure, while the original OSF has been archived for reference. TaxonWorks is an open-source, integrated platform that provides tools for data curation, filtering, and database reporting. The public interface, powered by TaxonPages, can be accessed at https://orthoptera.speciesfile.org.

If you are interested in learning more about this new infrastructure, we invite you to join our monthly virtual meetings. These sessions will provide an overview of the TaxonWorks platform and offer opportunities to discuss any topics of interest related to TaxonWorks suggested by participants.

If you have any questions or would like to attend these meetings, please contact me at my email address.

Updates from the Global Locust Initiative

By MIRA RIES[1] & RICK OVERSON[2]
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For millennia, Orthoptera have shaped ecosystems, influenced human livelihoods, and challenged agriculture and conservation efforts. With nearly 30,000 described species spanning diverse habitats, they play crucial ecological roles as herbivores, prey, and bioindicators of environmental change. Despite their significance, access to comprehensive, up-to-date information about these insects remains fragmented. Taxonomic references, ecological studies, management strategies, and conservation resources are scattered across institutions, journals, and unpublished reports—many locked behind paywalls or hidden in archives.

The **Global Locust Initiative** (GLI) at Arizona State University is addressing this challenge through **HopperWiki**, a new open-access, community-driven platform designed to serve as a global knowledge repository for Orthoptera. Inspired by AntWiki.org and built on the taxonomic framework of the Orthoptera Species File, HopperWiki aims to enhance visibility and accessibility for the global community by centralizing access to species profiles, management guides, identification tools, ecological findings, conservation resources, and more.

Beyond biology, HopperWiki bridges disciplinary divides by compiling outbreak bulletins, pest management strategies, standard operating procedures, and socio-economic perspectives on Orthoptera.

It fosters collaboration by connecting stakeholders—researchers, conservationists, policymakers, and industry professionals—through a directory of organizations and expert profiles.

Though still in its early stages, HopperWiki already offers an expanding **collection of species descriptions**, identification guides, technical reports, training manuals, media articles, and more. Special topic pages showcase interdisciplinary contributions, and expert profiles highlight research, publications, and professional work, incorporating the **GLI Network** to amplify visibility and collaboration. HopperWiki complements GLI's private, professional network, HopperLink, which provides an online space for researchers, practitioners, and other stakeholders to share and discuss their work, events, news, and more.

We hope the project will grow in usefulness to a diverse range of stakeholders—including researchers, non-profits, farmers, industry professionals, policymakers, and the general public—by facilitating informed decision-making, enhancing transparency, and preserving institutional knowledge.

We invite experts (you!) to contribute expertise, refine content, and share resources. Your involvement is critical to making HopperWiki a lasting and authoritative resource for the global Orthoptera community. Join us in shaping a more accessible, comprehensive, and collaborative future for Orthoptera research and management! Please reach out to **MiraRies@asu.edu** or **RickOverson@asu.edu.**

HopperWiki has been supported with feedback or funding from partners like the **Orthoptera Species File** (**OSF**), the Food and Agriculture Organization of the United Nations (**FAO**), the United States Department of Agriculture (**USDA**), the United States Agency for International Development (**USAID**), and the **NSF Behavioral Plasticity Research Institute** (**BPRI**).

Update on the Singing Insects of North America (SINA) Website

By **TERESA YAWN**
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A new katydid species, *Odontoxiphidium apalachicolae* Woo 2024 (Apalachicola Meadow Katydid), has been added to the **Singing Insects of North America (SINA) website**. In 2022, while doing field research in the Central Panhandle in Florida, Brandon Woo found a population of katydids that he easily identified as belonging to the genus *Odontoxiphidium*. Upon investigation, he realized that the katydids were not *O. apterum*, the only known species in the genus *Odontoxiphidium* at the time. *Odontoxiphidium apalachicolae* differs from *O. apterum* in habitat, coloration, male calling song, and female ovipositor. *Odontoxiphidium apalachicolae* inhabits seasonally flooded savannahs with pitcher plants (Fig. 1) while *O. apterum* is found in a wide range of habitats excluding the savannahs. Both species, when living, have variable coloration, but their color variations are distinctly different (Fig. 2). *Odontoxiphidium apalachicolae*'s song has a series of one to four short, high-pitched buzzes separated by three seconds (Fig. 3) and the males

Figure 1. Seasonally flooded savannah habitat at the type locality (Liberty County, FL). [Extracted from Fig. 2 in Woo 2024.]

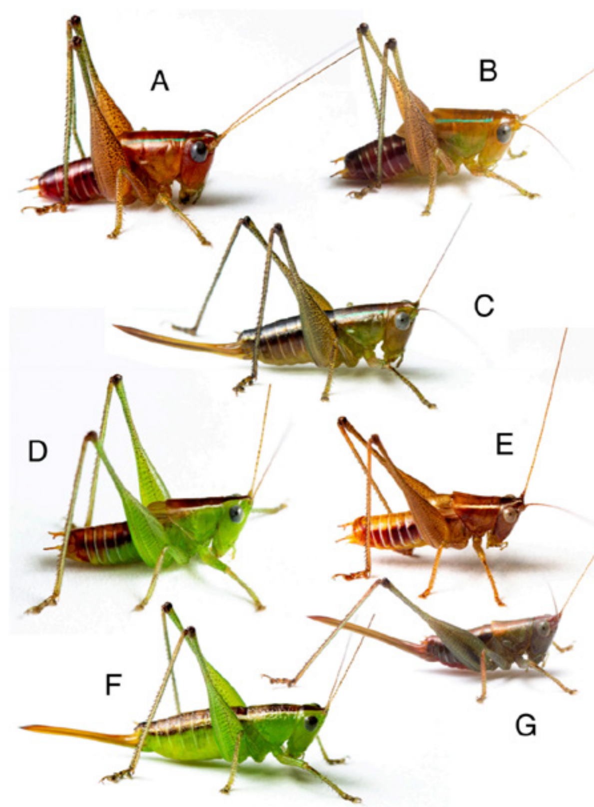

Figure 2. Habitus images of live adult individuals of *Odontoxiphidium* spp. A-C, *O. apalachicolae*. A) and B), color variations of male; C) female. D-G, *O. apterum*. D and E, color variations of male; F and G, color variations of female. [Fig. 1 in Woo 2024.]

sing during the daytime. *Odontoxiphidium apterum*'s song is made up of a series of high-pitched buzzes of variable length and the males sing during the day and night. Female *O. apalachicolae* have ovipositors that curve upwards while *O. apterum* females have ovipositors that curve downwards (Fig. 4). *Odontoxiphidium apterum* has a wide range throughout the Southwest Region of the U.S., but *O. apalachicolae* appears to be restricted to the Central Panhandle. All specimens collected by Woo were within the Apalachicola National Park and Tate's Hell State Forest. You can read more about this new species on SINA (**https://orthsoc.org/sina/240a.htm**), the Orthoptera Species File (**https://orthoptera.speciesfile.org/otus/1060275/overview**), and the paper published by Brandon Woo describing *O. apalachicolae* (**https://orthsoc.org/sina/literature/woo2024.pdf**). Figures and captions were taken from Woo 2024.

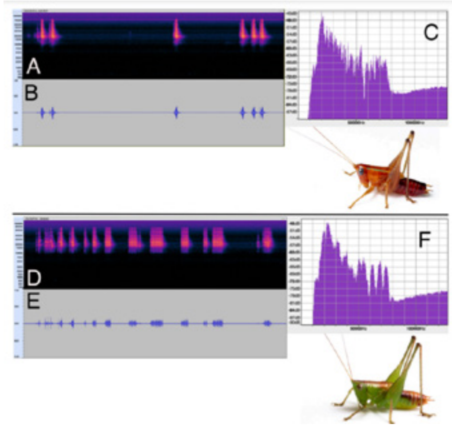

Figure 3. Calling songs of *Odontoxiphidium*. A-C, *O. apalachicolae*. A) Spectrogram of an echeme sequence. B) Waveform of same. C) Power spectrum. D-F, *O. apterum*. D) Spectrogram of an echeme sequence. E) Waveform of same. F) Power spectrum. [Fig. 6 in Woo 2024.]

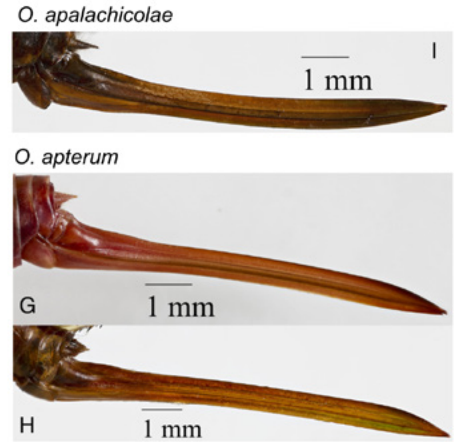

Figure 4. I) Ovipositor [*O. apalachicolae*]. G) Ovipositor (Oscar Scherer SP, Sarasota Co.) [*O. apterum*]. H) Ovipositor (Disney Wilderness Preserve, Osceola Co.) [*O. apterum*]. [Ovipositor for *O. apalachicolae* was extracted from Fig. 4 in Woo 2024; ovipositors for *O. apterum* were extracted from Fig. 5.]

THE CRICKET COURSE 2025

Soltis Center, Costa Rica, June 29 - July 7, 2025

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(Photo credit: Piotr Naskrecki)

We are excited to offer the second iteration of the CRICKET COURSE on June 29-July 7, 2025, at the **Soltis Center for Research and Education** in Costa Rica!

Rationale for the course: Although katydids, crickets, and allies represent an excellent model system for ecology, behavior, physiology, bioacoustics, and evolutionary biology, there is currently no platform in North America to provide structured training on these insects. As part of the National Science Foundation grant titled "NSFDEB-NERC: Multidisciplinary approach to bioacoustics: Integrating phylogenomics, biophysics, and functional genomics to unravel the evolution of hearing and singing in katydids, crickets, and allies" (**DEB-1937815**), we have assembled a team of currently active specialists to create and offer a unique workshop called "THE CRICKET COURSE." We offered the **first iteration of this course in 2023 at Archbold Biological Station in Florida**, and we are excited to offer the second iteration of this course in beautiful and biodiverse Costa Rica. This **7-day workshop** is targeted towards students, amateur naturalists, museum scientists, ecologists, and evolutionary biologists in order to provide hands-on training in identification, ecology, behavior, and bioacoustics of these amazing insects. The course will include lectures on taxonomy, phylogeny, biology, bioacoustics, and ecology of Ensifera, instructor-led collecting expeditions taking advantage of the diverse habitats found in Costa Rica, exercises on taxonomic identification, specimen preservation, field observation, and sound recording and analysis.

Instructors: Dr. Hojun Song (Texas A&M University), Dr. Fernando Montealegre-Z (University of Lincoln, U.K.), Dr. Nathan Bailey (University of St. Andrews, U.K.), Dr. Piotr Naskrecki (E.O. Wilson Biodiversity Laboratory at Gorongosa National Park, Mozambique), and Mr. Brandon Woo (Texas A&M University)

Venue: THE CRICKET COURSE will take place at the Soltis Center for Research and Education in Costa Rica, which is a biological field station owned and operated by Texas A&M University. It is in the Central Volcanic Range of Costa Rica and is part of the well-known Monteverde Cloud Forests located toward the northwestern part of the range. The forests at the Soltis Center are classified as a tropical mid-elevation rain forest (450 to 700 meters above sea level). It is part of the biological corridor Las Nubes, that connects most of the cloud forests along the Tilaran and Central Volcanic Range. Of course, it is home to numerous orthopterans, which makes the Soltis Center a perfect place to learn about crickets and katydids.

Participant Acceptance Criteria: THE CRICKET COURSE is open to all interested individuals (professionals, motivated amateurs, such as citizen/community scientists, undergraduate and graduate students, postdocs, and professors). Priority is given to applicants currently researching crickets, katydids, or other orthopterans and to those biologists for whom the course will have a significant impact on their research and/or teaching. An entomological background is not required. We aim to include students with interests and experiences in biology, including systematics, evolution, ecology, bioacoustics, and conservation. THE CRICKET COURSE is presented in English and is limited to 15 participants.

Cost: The CRICKET COURSE in Costa Rica is supported by the U.S. National Science Foundation grant, which will cover meals, lodging, station fees, and local transportation for field trips for all accepted participants (U.S. citizens or permanent residents only). For foreign (non-U.S.) participants, the cost is $650 per person. All participants are responsible for their own transportation costs between their homes and San Jose Juan Santamaría International Airport (SJO). We will provide transportation from the airport to the Soltis Center.

For more information about the course and instructors, please visit: **https://schistocerca.org/SongLab/index.php?page=the-cricket-course**

To apply: Please use this **Google Form**. The deadline for application is **March 31, 2025.**

Regional Reports - What's happening around the world?

North America

By **KATHLEEN KING**
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Robert (Bob) Srygley and David Branson of the United Stated Department of Agriculture (USDA) Agricultural Research Service (ARS) in Montana recently published a research article titled "Power Bars: Mormon Crickets Get Immunity Boost from Eating Grasshoppers" in *Insects*. The study considered when some grasshoppers co-occur with Mormon crickets and feed on the same host plants, but little is known about their interactions. ARS hypothesized that if Mormon crickets feed on grasshoppers, then the Mormon crickets' needs for alternative protein sources would decline when grasshoppers were more numerous. In addition, because Mormon crickets with less dietary protein had less immunity, ARS hypothesized that greater grasshopper density would enhance Mormon cricket immunity. In a field setting, ARS varied the numbers of Mormon crickets from 0 to 20 and the numbers of the grasshopper, *Melanoplus borealis*, from 0 to 45 m^2 in 68 1-m^2 cages.

After one month, ARS measured Mormon cricket dietary preferences and immune activity. As predicted, ARS found that protein consumption from the alternative source declined as grasshopper density increased, and immunocompetence increased with grasshopper availability. In addition, plant nitrogen declined with increasing insect density, reinforcing the importance of predation by Mormon crickets to meet their protein needs. Potentially influencing management decisions, Mormon crickets affect grasshopper populations, and grasshopper abundance might be an indicator of Mormon cricket immunity. More details can be found in the article here: Srygley, R.B.; Branson, D.H. Power Bars: Mormon Crickets Get Immunity Boost from Eating Grasshoppers. *Insects* 2023, 14, 868. **https://doi.org/10.3390/insects14110868**

Bob Srygley also published "Prolonged Diapause in Mormon Crickets: Embryonic Responses to Three Measures of Time" in the *Journal of Insect Physiology*. Since Mormon cricket eggs can remain diapausing in soil for multiple years without forming an embryo, Srygley investigated whether embryonic development was dependent on the number of annual cycles since the egg was laid, duration of the summer period (forcing), or duration of the winter period (chilling). Male and female Mormon crickets collected in Arizona and Wyoming were paired in the lab. For each mating pair, sibling eggs were incubated 12 weeks, fully developed embryos were removed, and the remaining eggs were split evenly among three treatments: a long cold period and a long warm period; a short cold period and a long warm period; and a short cold period and a short warm period, which respectively completed 2 annual cycles, 3 cycles, and 4 cycles in 60 calendar weeks. In each cycle, developed eggs and eggs that appeared inviable were counted and removed. For each mating pair, Srygley used survival analyses to test for differences in 1) the number of annual cycles, 2) the warm period duration, and 3) the cold period duration required for the embryos to develop.

Srygley also measured the median proportion of embryos developing in each cycle and population to see if development was greatest in prime numbered cycles. For nine of 13 mating pairs, one of the three factors was not excluded as a determinant of the phenology of embryonic development. Duration of the growing season was not rejected in eight of 13 cases. Duration of the growing season required for 50% of the eggs to develop ranged from 84 to 144 weeks. In one case from Arizona, the duration of the cold period was the only factor not rejected. Median chill time was 60 weeks, which is also more than one year. Despite this exception, Srygley concluded that duration of the growing season is typically the factor that determines timing of embryonic development for Mormon crickets. For these two high elevation populations, median forcing or chilling exceeded one year. More details can be found in the article here: Srygley, R.B. 2024. Prolonged diapause in Mormon crickets: Embryonic responses to three measures of time. *Journal of Insect Physiology*. 155. Article 104634. **https://doi.org/10.1016/j.jinsphys.2024.104634**

Other exciting news is the upcoming annual meeting for The National Grasshopper Management Board in Denver, Colorado this February 5 & 6. This is a great opportunity for private, state, tribal, and federal stakeholders in North America to come together and discuss grasshopper and Mormon cricket management topics. If you are interested in learning more about The National Grasshopper Management Board, please check out their webpage at: **https://sites.google.com/site/ngmborg/**

The Entomological Society of America (ESA) is currently calling for Symposia and Workshops for their annual fall meeting to be held in Portland, Oregon from November 9-12. The theme for this annual meeting is "Bridging Generations with Innovation, Legacy, and Passion." ESA Branch meetings are up-and-coming this spring. Please see below for locations and specific dates. For more details, check out their webpage at **https://entsoc.org/.**

Branch	Dates	Location	Program
Eastern	March 15-18	Harrisburg, PA	Website
International	April 7-9	Virtual	Website
North Central	April 13-16	Lincoln, NE	Website
Pacific	March 30-April 2	Salt Lake City, UT	Website
Southeastern	March 9-12	Baton Rouge, LA	Website
Southwestern	March 23-26	Round Rock, TX	Website

Central and South America

By MARTINA E. POCCO
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The X Brazilian Symposium of Orthoptera was held from November 18 to 22, 2024. The Orthoptera symposium is held every two years in Brazil, together with, since 2020, the Symposium of Orthopteroid Insects of Brazil, including presentations from orders of Polyneoptera group. In this opportunity, the event "X Simpósio de Orthoptera & III Simpósio de Insetos Ortopteroides: Um Olhar Sobre as Pesquisas Amazônicas, Unindo as Regiões do País" took place in the northern region of Brazil, in Manaus, Amazonas. It was hosted at the Federal University of Amazonas (UFAM), with the support and participation of the Postgraduate Program in Zoology (Ppg-Zoo), and with the participation of students and post-docs from the Postgraduate Program in Entomology at INPA (Instituto Nacional de Pesquisas da Amazônia). This event brings together experts and enthusiasts of orthopteroid insects, with the aim of discussing the scientific production and promoting the integration of this scientific community in Brazil. This meeting was organized by Larissa de Lima Queiroz (INPA) and Raphael Aquino Heleodoro (UFAM) and included 31 presentations (talks, mini-courses and posters) within nine thematic areas.

Another exciting news coming from our region was the announcement of the next ICO meeting, which will commemorate the Golden Jubilee of the founding of the Orthopterists' Society!

The **15th International Congress of Orthopterology** (**https://ico2026.com.ar/**) will be held in Patagonia, Argentina, from **8 to 12 March 2026** to celebrate “50 Years Advancing Orthoptera Research and Collaboration.” The meeting will take place at the birthplace of the Orthopterists’ Society (formerly the Pan American Acridological Society, PAAS) that was held in 1976, in the beautiful town of **San Martín de Los Andes, Neuquén Province, Argentina**. It will constitute an excellent opportunity to reflect on the progress made in Orthoptera research and management over the past five decades and to envision the future of this discipline. Students, researchers, agricultural extension officers, and their companions from around the world are invited to participate in this important event. The Organizing Committee is headed by María Marta Cigliano (CONICET, UNLP) and Héctor Medina (SENASA), and is composed of researchers and professionals from these institutions. The Advisory Board is integrated by the members of The Orthopterists’ Society Board.

The **website** of the event currently contains details on the congress, place, venues, organizing committees, travel information, and an image gallery. Information on registration, calls, deadlines and other details will be added as they become available. The contact email is **icorthopterology2026@gmail.com.**

East Asia

By LONG ZHANG
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International Conference on New Tech and Concept for Sustainable Management of Locusts was held on June 2-7, 2024 in Jinan, China. More than 100 experts and officers from 17 countries, the Food and Agriculture Organization of the United Nations, and the International Orthopterists’ Society attended the congress. They presented 31 oral presentations in outbreak and population dynamics of locusts and grasshoppers, monitoring and forecasting for locusts and grasshoppers, strategies and tactics of locust management, natural enemies and biological control, semio-chemicals as regulators for locust behavior, and new facilities for highly efficient management of locusts. During the conference, the participants visited reforming locust breeding regions into the crop field-fishing ponds in Jining city, Shandon province. All participants believed that this conference was fruitful and promoted the progress in locust control toward sustainable management.

Theodore J. Cohn Research Fund Reports

Male-male aggression in a genus of neotropical katydid that possess mandibular weaponry and employs mate guarding from the montane cloud forests of Colombia

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Weaponry and mate-guarding are rarely seen sexually dimorphic characters within Orthoptera, with only a handful taxa displaying them (Field and Deans, 2001; Kirby, 1899; Péringuey, 1916; Trewick and Morgan-Richards, 2004; Heller and Helb, 2021). One such genus is *Satizabalus* from the montane cloud forests of Colombia, which was described by myself last year (Holmes et al., 2024) (Fig. 1). Males of this genus possess weaponry in the form of enlarged mandibles and have been observed, in the field and in captivity, guarding the entrance to a burrow containing a female (Montealegre and Morris, 1999). Through preliminary observations, I hypothesised that these mandibles are used in male-male combat when competing for or defending a harem of females (Holmes et al., 2024), similar to the behaviours observed in Wellington tree wētās (Kelly, 2004; Kelly, 2006).

In the field, species of *Satizabalus* have been observed hiding in and singing from pre-existing burrows made from dead plant material (De Souza et al., 2011), the male will reside at the entrance of these burrows blocking them off with their enlarged head and mandibles (Holmes et al., 2024; Montealegre and Morris, 1999). Often at the base of these burrows there will be a small group of females, however it is unknown how long the male will defend these females for and what effect an approaching rival male would have. Whilst the use of tremulation to convey male size in this species has been described (De Souza et al., 2011), there is a gap in the literature that documents physical male competition or mate guarding in Tettigoniidae, and *Satizabalus* spp. are not an exception.

Two species in *Satizabalus* are common to find in the field in Colombia: *S. sodalis* (Fig. 1A) can be found in the Western Cordillera cloud forests and *S. jorgevargasi* (Fig. 1B) in the Central Cordillera cloud forests. I hypothesise that defending males will aggressively stridulate towards a wandering male that approaches their burrow. If this fails to deter the wandering male, I predict the defender will attack the approaching male utilising its enlarged mandibles coupled with defensive stridulation. With the help of the Theodore J. Cohn Research Fund, I was able to travel to the field to document and describe male-male combat and mate guarding in this sexually dimorphic genus of sylvan katydid.

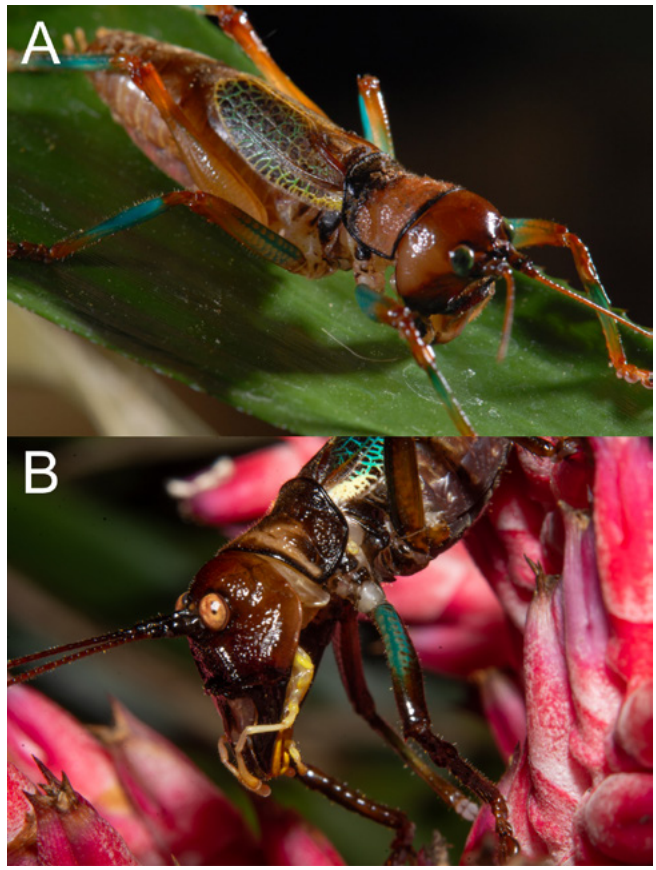

Figure 1. Habitus of species in the genus *Satizabalus*. (A) A male *S. sodalis* resting on a leaf. (B) A male *S. jorgevargasi* resting on a Bromeliaceae flower.

Upon arriving in Colombia, we travelled first to the Central Cordillera in search of *S. jorgevargasi*. Five nights of field work were spent here in Valle del Cauca, Costa Rica, Puente Rojo community (Fig. 2A). On the first night we walked a transect line and used an Echo Meter Touch 2 to localise the singing males. Some males were found singing in the open whilst others were found singing from or near a burrow. In most cases, where a male was singing, a female was found close by. The locations of the males were marked, and we revisited these locations over the next four nights. Since *Satizabalus* is brachypterous, it was expected that they would remain in the same location and they did, allowing us to revisit them each night.

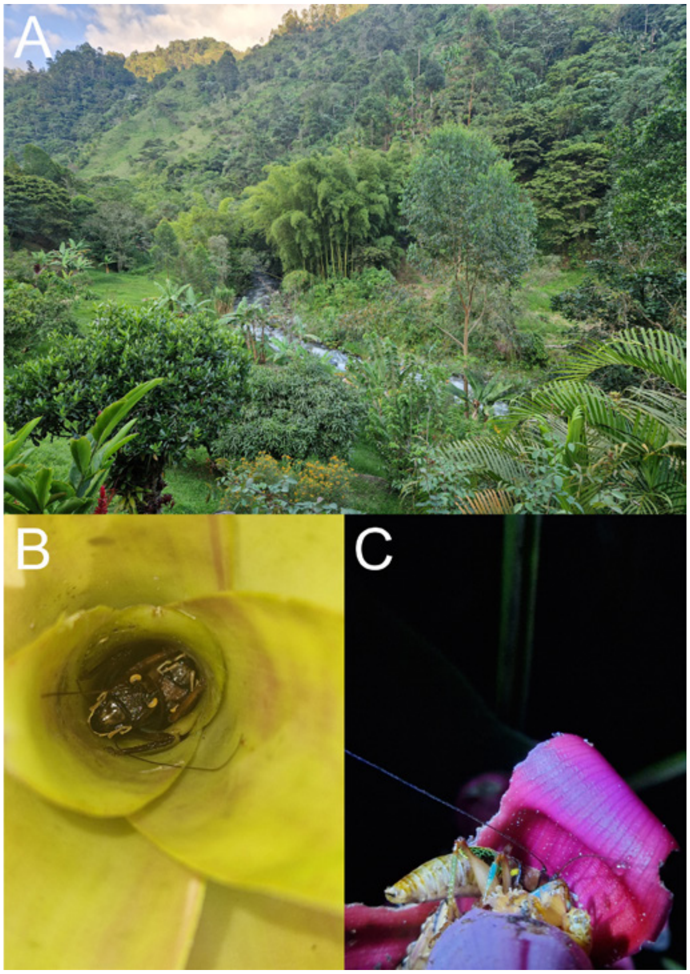

Figure 2. Images taken whilst in the field. (A) The habitat of *Satizabalus*, Costa Rica, Puente Rojo. (B) A male *S. jorgevargasi* guarding a female inside of a Bromeliaceae. (C) A female *Satizabalus sodalis* feeding on the flower of a Heliconiaceae.

We observed males guarding females (Fig. 2B), however attempts to introduce a rival male to the burrow to encourage an aggressive response were unsuccessful in the field.

We then travelled to the Western Cordillera and spent four nights here staying in the Bitaco reserve, located in the Chicoral community of La Cumbre, looking for *S. sodalis*. We once again set a transect line and used the Echo Meter Touch 2 to detect singing males. Their behaviour was no different to their congenerics in the Central Cordillera. We commonly found females feeding on the flowers of Heliconiaceae (Fig. 2C). We then collected several specimens from each species under official permits and brought them to the UK.

In the lab, a suitable habitat was made for the specimens we brought back. Males were housed separately, misted daily, and fed a diet of cut apple, bee pollen and dried mealworms. After a month had passed to allow them to habituate, an arena was created to study the male-male aggressive behaviours. Two males were placed into the arena with a divider placed between them. After 10 minutes had passed, the divider was lifted and the interaction between the two males was recorded. A series of behaviours ensued, including antennal fencing, mandible flaring, aggressive stridulation, and grappling. These behaviours are consistent with previous literature regarding male-male aggression in Gryllidae (Alexander, 1961; Rillich and Stevenson, 2011). Acoustic recordings were also done simultaneously via ultrasound sensitive equipment. I have made a preliminary recording of this male-male aggressive behaviour available to view online at **https://doi.org/10.6084/m9.figshare.28248089**. I am currently in the process of organising and analysing the collected data and I aim to publish the results in the near future. This study is a good step towards understanding male-male aggressive behaviours using weaponry in Tettigoniidae.

Acknowledgements

I would like to thank Jorge Vargas for providing us with accommodation in Costa Rica, Puente Rojo and allowing us to carry out field work on his property. I would further like to thank Sebastian Ulloa and the staff at the recinto de los suenos ecolodge for their hospitality and for granting us permission to carry out field work on their property in the Chicoral community. I greatly appreciate the Orthopterists' Society's Theodore J. Cohn Research Fund. As my Masters is self-funded, I would not have been able to carry out this field work without the help of this research grant. The costs for food and accommodation used during field work were funded by my supervisor Prof. Fernando Montealegre-Z under an Leverhulme grant.

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Taxonomy and phylogeography of *Poecilimon zonatus* group (Phaneropterinae, Orthoptera): A story linked to the Taurus Way

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The genus *Poecilimon* ranks as the second most diverse lineage in the Palearctic region and the most diverse in Anatolia in terms of species and subspecies numbers. It comprises over 170 taxa, mainly distributed in Anatolia, Greece, the Balkans, and the Caucasus, with fewer taxa occurring in other parts of the Palearctic (Çıplak 2004; Borissov et al. 2023; Cigliano et al. 2025). Studies on the genus have focused mainly on its taxonomy, particularly its species groups, with a traditional approach.

One of 22 recognized species groups, the *Poecilimon zonatus* group, comprises 11 species and subspecies (Cigliano et al. 2025). This group is predominantly found along the highlands of the Taurus Way (a mountain chain extending from the Caucasus to the Levant and continuing into the southern Taurus Mountains, Çıplak 2008), with two notable exceptions: *P. vodnensis*, in the Balkans, and *P. varicornis*, known only from its type localities, in Lebanon and Syria (Fig. 1). The majority of the information on this group comes from two recent studies that were published almost simultaneously. Sevgili et al. (2018), published in May, provided detailed morphological and bioacoustics data and described several new taxa within the group. On the other hand, Kaya (2018), published in April, utilized single-gene molecular data to perform phylogenetic and automated species delimitation analyses, resulting in the identification of additional new taxa in the group. While these studies have significantly expanded our understanding of the group, they have also introduced numerous new questions and challenges for further investigation. These two studies were in conflict in several aspects, including overlapping type localities that suggest synonymy among their newly described taxa, disagreements on ranges of species and populations, and disputes in morphological, bioacoustics, and phylogenetic descriptions and statements.

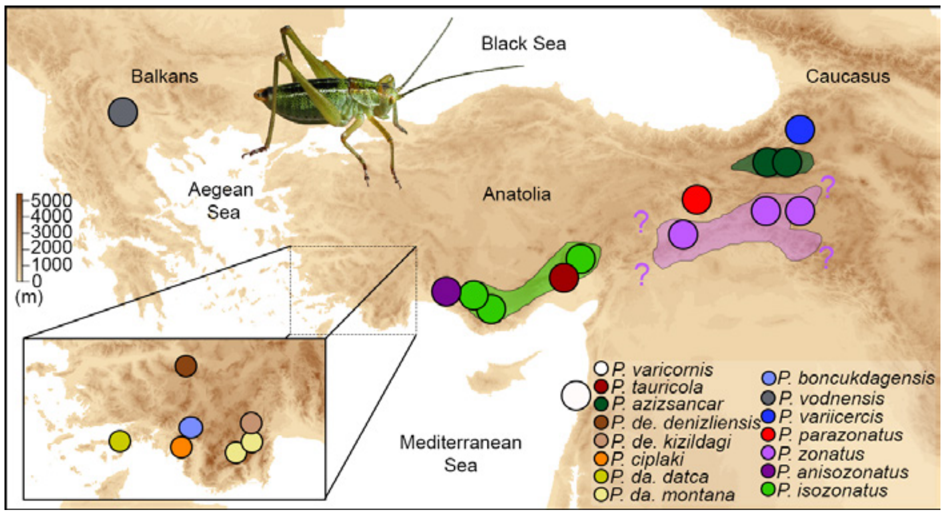

Figure 1. Distribution of the members of *P. zonatus* species group (modified from Uluar et al. 2025).

Therefore, this study aimed to resolve these conflicts by increasing the molecular data available for existing taxa in databases, as well as for newly described taxa within the genus. Primary analyses were conducted for phylogeny and phylogeography, species delimitation tests, and ancestral area reconstructions. These efforts were further supported by phenotypic data from morphology and bioacoustics, enabling a holistic taxonomic re-assessment of the group. We produced sequences from mitochondrial (Cytochrome c oxidase subunit I (COI), NADH dehydrogenase subunit 2 (ND2), and 16S rDNA + tRNAval + 12S rDNA (VAL)) and nuclear (Internal transcribed spacer 1- 5.8S rDNA- Internal transcribed spacer 2, ITS) gene regions from 20 populations representing all species in the group except *P. varicornis*. The newly generated sequences were combined with published sequences downloaded from the GenBank database. Each gene matrix was aligned, and unique haplotypes were identified. The unique haplotypes were then concatenated for subsequent analyses. Phylogenetic trees were constructed using Maximum likelihood (ML) and Bayesian Inference (BI) approaches, employing appropriate algorithms and softwares. Species delimitation tests such as ASAP (Puillandre et al.

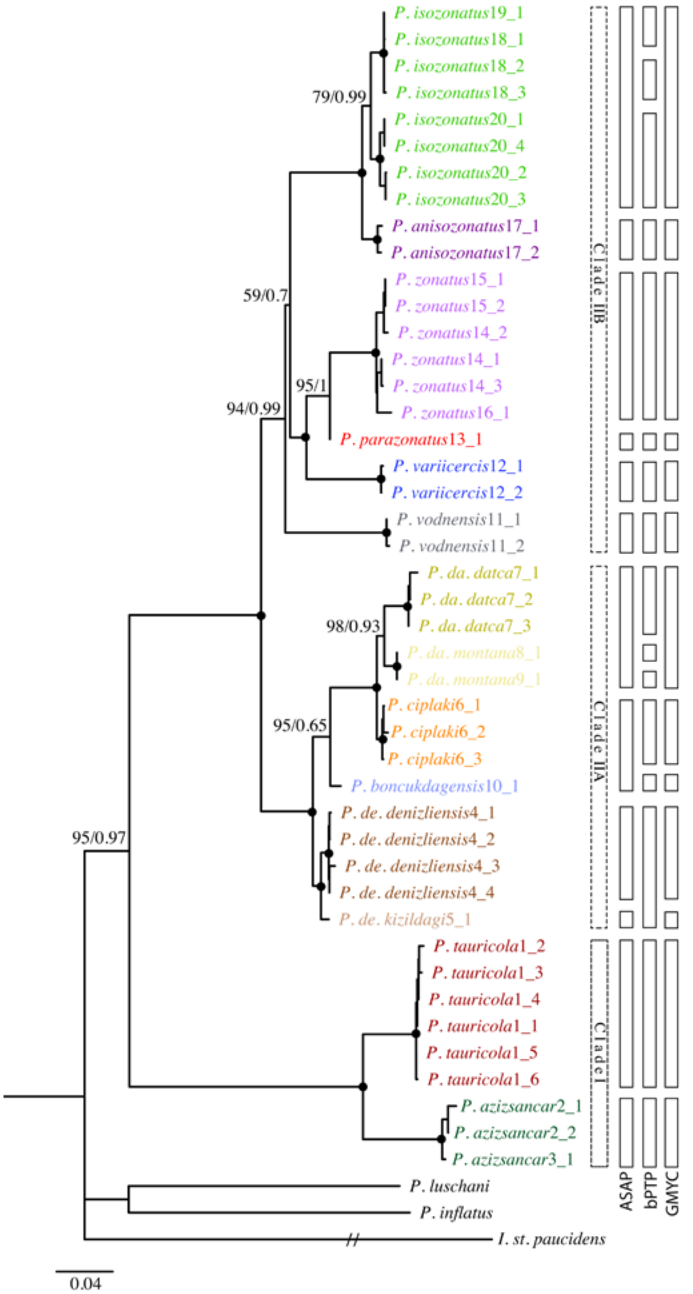

Figure 2. Phylogenetic tree (with ML/BI node support values) and species delimitation test suggestions (obtained from Uluar et al. 2025).

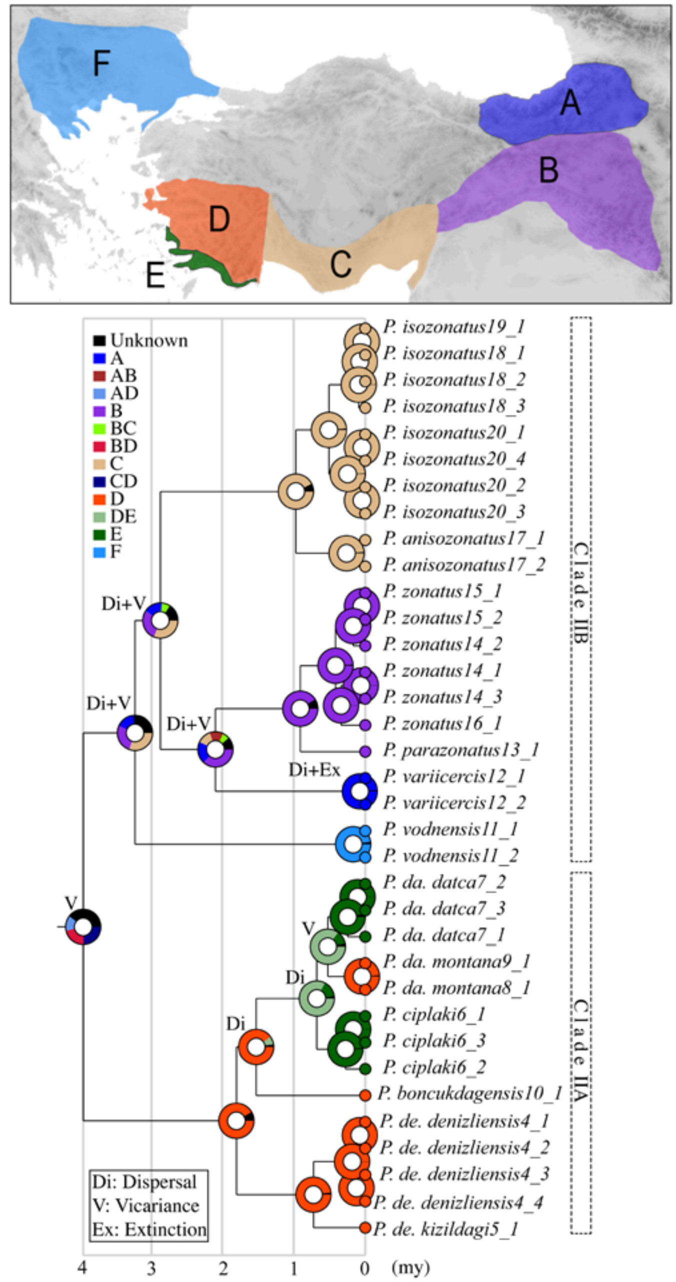

Figure 3. Ancestral area reconstruction for the members of Clade II (modified from Uluar et al. 2025).

2021), bPTP and GMYC (Zhang et al. 2013) were performed to determine the exact number of species and subspecies. The pairwise differences were calculated to assess the genetic distance between units suggested by species delimitation tests. Additionally, Discriminant Analysis of Principal Components (DAPC) was applied to identify clusters within the species group. Morphological and bioacoustic data from all available individuals were thoroughly examined, providing a comprehensive approach to resolving taxonomic and phylogenetic uncertainties. Molecular clock and ancestral area reconstruction analyses were conducted to understand the phylogeographical patterns within the species group.

By integrating traditional taxonomic approaches with modern systematics, the taxonomy, phylogeny, and phylogeography of the *Poecilimon zonatus* species group were extensively reassessed. This effort led to the redefinition of most species and subspecies, resulting in the description of three new species (*P. anisozonatus*, *P. parazonatus*, and *P. boncukdagensis*) and two new subspecies (*P. denizliensis kizildagi* and *P. datca montana*), the synonymization of *P. salmani* with *P. ciplaki*, and the elevation of two subspecies (*P. denizliensis* and *P. datca*) to species rank (Fig. 2.). The unified species concept (De Queiroz 2007), which prioritizes phylogenetic uniqueness, proved to be more effective than phenotypic diagnoses based on single character, such as structure of cerci or certain bioacoustic traits, for delineating species within the group.

The common ancestor of the *P. zonatus* group dates to approximately 7 million years ago during the Miocene, which is older than the previously reported estimate (Borissov et al. 2023). About 3 million years later, the species group splitted into two distinct lineages (Clade I and Clade II), suggesting either limited diversification until the Pliocene or the extinctions occurred during this period. Significant diversification, shaping the current diversity of the group occurred during the Pleistocene, likely driven by habitat changes due to Pleistocene climatic cycles. These findings also suggest that members of the species group dispersed into new areas or remained in refugia with suitable habitats along the high-altitude "Taurus Way," influenced by historical climate events (Fig. 3.).

Despite some unresolved aspects, the study highlights the critical role of integrating molecular systematics with traditional taxonomy and emphasizes the importance of comprehensive sampling to achieve a more accurate understanding of biodiversity.

This project was supported by the Orthopterist' Society's Theodore J. Cohn Research Fund on April 10, 2023 and conducted in MEVBIL (Molecular Evolution and Biogeography Laboratory, Akdeniz University, Antalya, Turkey, PI: Prof. Dr. Battal Çıplak) during 2023-2024. This text summarizes an article that is currently in press in *Arthropod Systematics and Phylogeny*:
Uluar, O., Chobanov, D. P., & Çıplak, B. (2025). Merging taxonomy with systematics: A holistic approach to understanding the *Poecilimon zonatus* group (Orthoptera, Phaneropterinae). More detailed information about the article can be found following its publication. Stay tuned and feel free to reach out.

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On the evolution of the association between *Romalea* grasshoppers (Romaleidae) and their gregarine parasites (Apicomplexa)

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Lubber grasshoppers have always amazed me. I was only 5 or 6 years old when I saw my first one in my hometown in Mexico. I was wandering around in the town's *campo santo* (cemetery) when one of these giant grasshoppers crossed my path. To be fair, I saw it as a giant critter because I was just a small kid, but these grasshoppers are indeed pretty large. I remember being both intimidated by how enormous it looked and curious enough to poke it, causing it to flash its bright red hind wings. Ever since that day, I've been fascinated by these grasshoppers.

At the time, I didn't know what I was looking at, but now I know it was the species *Taeniopoda centurio*, or, excuse me, *Romalea centurio*[1], which lives in the northeastern mountain ranges of the Sierra Madre Oriental of Mexico. Fast forward many years, and I am still studying these grasshoppers. However, now I am also intrigued by the association that they

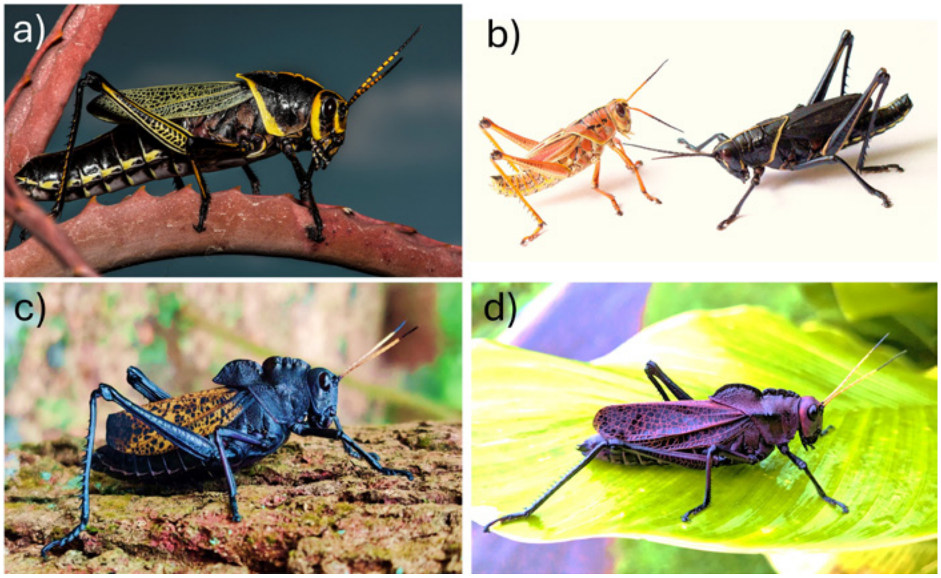

Figure 1. Photographs of *Romalea* species. a) *R. eques* © Jerry Kirkhart (CC BY 2.0); b) *R. microptera* (by Brandon Woo); *R. centurio*; *R. microptera*.

form with an obscure group of gut--dwelling unicellular protist parasites known as gregarines (Fig. 1). My interest in gregarines began during my undergraduate studies, while I was reading about parasite diversity. In the book "The protozoan phylum Apicomplexa"[2], published in 1988, Norman D. Levine wrote: "insects are by far the most numerous of invertebrate species, with about 686,000 named species; gregarines have been reported from only 0.32% of them… if we assume that there is one species of apicomplexan parasite for every species of host, there are still perhaps 860,000 species to be named … The great majority would be gregarines." This idea, along with the fact that they are the closest relatives of parasites such as *Plasmodium, Toxoplasma*, and *Cryptosporidium*, which are the agents causing severe disease and economical loss, sparked my interest in this group.

We know that gregarines are extremely diverse. We know it because of their broad host range, which includes multiple groups of invertebrates, including arthropods, and from environmental DNA surveys that have identified gregarines as dominant parasites in both marine and terrestrial environments[3,4]. As Levine (1988) suggested, the diversity of gregarines, like most parasitic taxa, is often thought to match that of their hosts. This is because parasites and their hosts are expected to coevolve due to the high level of adaptation parasites develop toward their hosts. Thus, the evolution of the interaction should result in cospeciation, resulting in a pattern of mirroring phylogenies between the two interacting groups[5,6]. This idea also implies that parasites rarely colonize new hosts because their evolution is strictly bound to that of their hosts. What better way to test these predictions than by studying gregarines in my beloved lubber grasshoppers!

Lubber grasshoppers (Fig. 2) are actually great models for studying gregarine associations. They are now classified within the genus *Romalea* and include a moderate diversity with 12 recognized species distributed from Central America to the southeastern U.S.[7] These grasshoppers are flightless, exhibit clustered distributions, and behave clumsily, making them relatively easy to collect once you find the sweet spot in which they aggregate. Furthermore, their large size makes them easy to dissect. Besides these characteristics, lubber grasshoppers are commonly parasitized by gregarines; in general, more-so than any other orthopteran species I have dissected to date, especially those from moist habitats. Although I don't know exactly why lubbers are so heavily parasitized by gregarines, this characteristic makes them ideal to gather gregarine samples, which are frequently hard to obtain. Here, I share an overview of my progress on this research. I will skip most of the technical details for now since I plan to publish this research soon, I hope.

In 2023, I was fortunate to receive the Theodore J. Cohn Research Fund from the Orthopterists' Society to study the evolution of the association between the lubber grasshoppers and their gregarine parasites. My proposed objective was relatively straightforward: to infer the phylogenies of both the grasshoppers and their gregarine parasites to compare them. If gregarines have cospeciated with lubber grasshoppers, then their phylogenies should match. Although the idea of cospeciation between gregarines and their hosts is appealing[4,8,9], back in 2020, I published the description of two gregarine species from *R. centurio*[10] (actually from the same spot where I first observed this species as a kid). An interesting insight of this work was that *R. centurio* was coinfected by two distantly

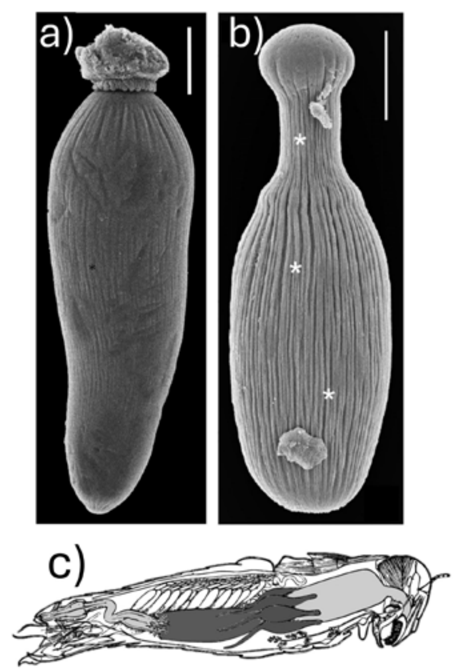

Figure 2. a-b) Scanning electron pictures of the unicellular gregarine gamont life-stage (modified from Medina-Duran et al.[10]). c) transverse section diagram of grasshopper. Midgut colored in dark gray to highlight the location where gamonts live.

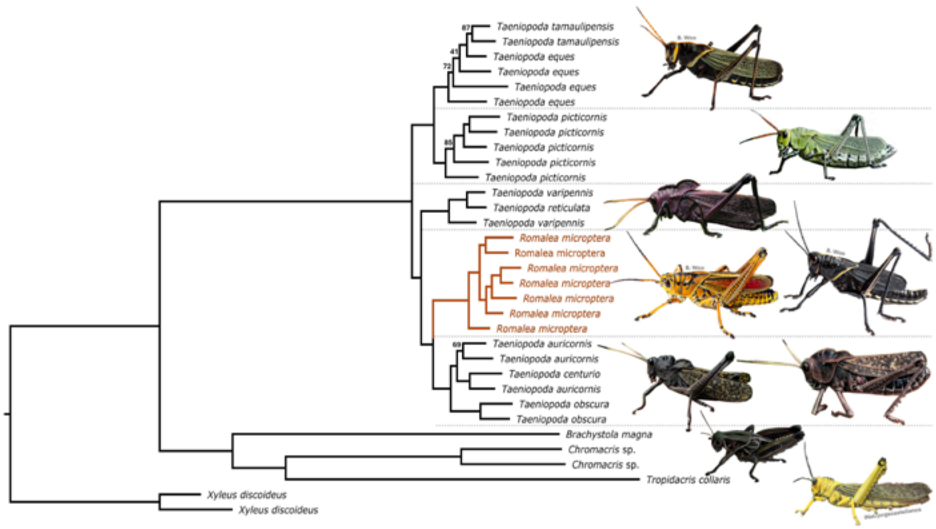

Figure 3. The phylogeny of *Romalea*. For clarity in the main text explanation, I use the genus *Romalea* to refer only to *R. microptera* (highlighted in orange), while for the remaining species I use the former genus *Taeniopoda*.

related gregarine species. While this does not necessarily conflict with the idea of cospeciation, it suggests that colonization events may play a more important role in shaping gregarine associations as previously thought. Having this insight in mind, I further investigated the diversity of gregarines across the species diversity of the genus *Romalea*.

I collected nine out of the 12 recognized species within *Romalea*, representing the main genus subgroups. Armed with a field dissection microscope, pipettes and dissection tools, and after countless hours at night dissecting the grasshoppers I had collected during the day, I gathered gregarine samples for each lubber species that I sampled. I used the host and gregrine samples for further molecular phylogenetic analyses.

Using Orthoptera-specific target enrichment[11], I inferred the phylogeny of the lubber grasshoppers (Fig. 3). The results confirmed the paraphyly of *Taeniopoda* with respect to *R. microptera*, as previously proposed by De Jesus Bonilla et al. (2019)[12]. However, the clade formed by the species *R. reticulata* and *R. varipennis*, found in the southernmost range of the genus distribution, does not represent the basal group, as it was proposed by the same authors. Although the evolutionary implications on the origin and biogeography of this genus is part of another story yet to be told, the phylogenetic structure challenges the view of a south-to-north dispersion and diversification of the Romaleidae diversity[13,14].

For gregarines, I identified four gamont morphospecies (*Amoebogregarina, Gregarina, Boliviana* and *Coronoepimeritus*) (Fig. 4a-d) infecting different *Romalea* species. Phylogenetic analyses based on 18S sequences revealed that these morphospecies belong to four distinct clades (Fig 4e). Further analyses of the relationships of these lineages with respect to the overall gregarine diversity showed that each genera represents an independent clade (Fig. 4f). These results showed that at least four independent colonizations have shaped the association between gregarines and *Romalea* grasshoppers. Morover, these colonizations were not random. For example, *Boliviana* was exclusive to *R. microptera*, which is exclusively distributed in the southeastern U.S. On the other hand, *Amoebogregarina* was found only in *Romalea* species previously classified within the genus *Taeniopoda*, which are distributed in Mexico and Central America. *Gregarina* was restricted to two divergent *Taeniopoda* clades, and *Coronoepimeritus* was found across the host diversity. An overview of the association between gregarines and the grasshopper hosts is found in Figure 5.

These findings demonstrate that gregarine diversity is shaped by more than just cospeciation as has been previously proposed. Instead, these results highlight that the association between gregarines and their hosts is much more dynamic with recurrent colonizations playing a significant role in their evolution. At least two gregarine lineages (*Amoebogregarina* and *Boliviana*) show clear geographic structure, indicating that host dispersal has influenced colonization patterns. For example, *R. microptera*

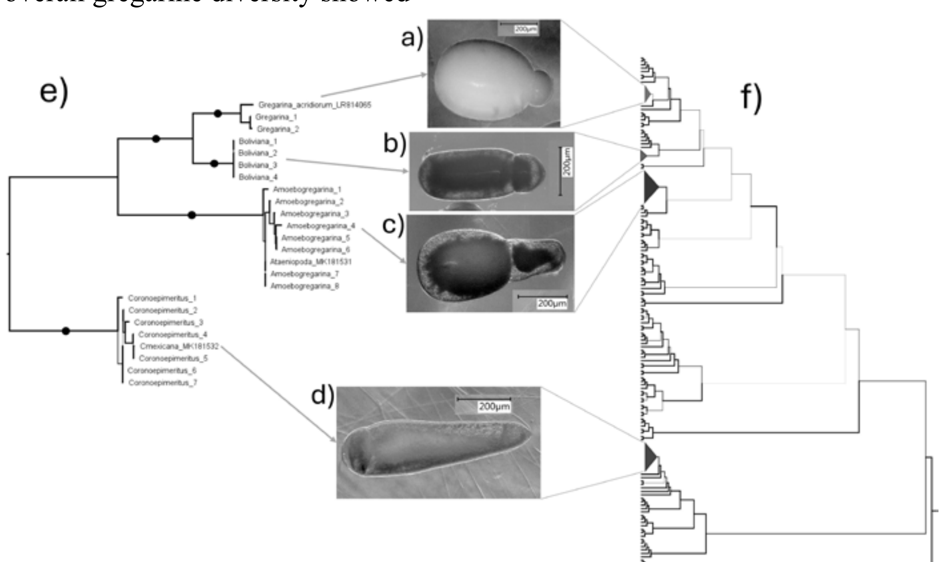

Figure 4. a-e) Gregarine genera found in *Romalea*. a) *Gregarina*; b) *Boliviana*; c) *Amoebogregarina*; d) *Coronoepimeritus*; e) phylogeny of unique 18S haplotypes. f) 18S phylogeny of the overall gregarine diversity showing that the gregarine genera found in *Romalea* belongs to four independent clades.

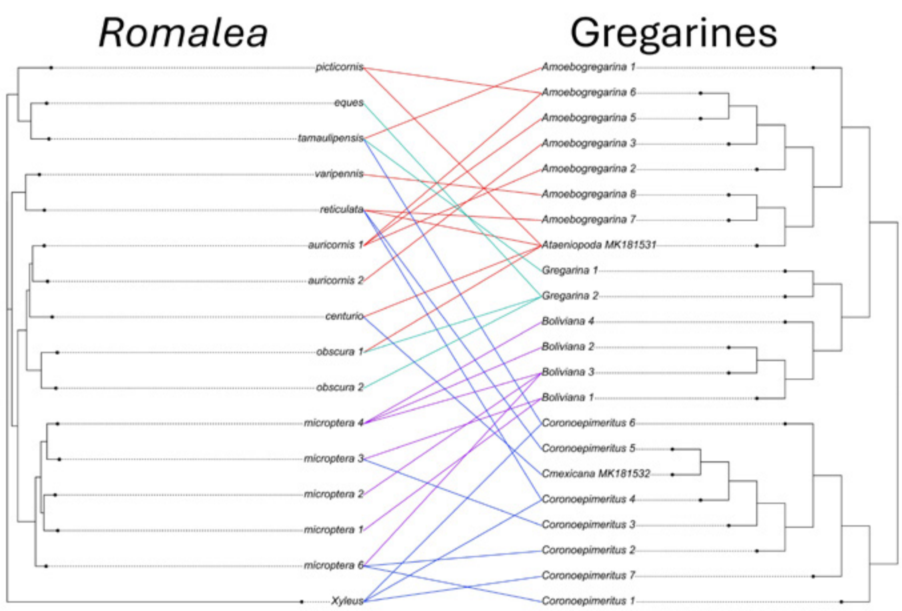

Figure 5. Tanglegram of pruned phylogenies showing the association between *Romalea* species and their gregarine parasites.

may have either escaped infection by ancestral gregarines during its dispersal or introduced its own gregarine lineage, which was later replaced by the locally resident *Boliviana*. These colonization events likely occurred at different times, as *Romalea* species diverged and spread. This is a possibility because it can be observed that while the species of the genus *Coronoepimeritus* are found throughout the host diversity, *Amoebogregarina* is exclusively found in *Taeniopoda* species, and *Boliviana* is exclusively found in *R. microptera*. Further time--calibrated phylogenetic analyses are needed to test these hypotheses.

In summary, our findings revealed a dynamic evolutionary history between *Romalea* grasshoppers and their gregarine parasites. Four independent colonizations by distinct gregarine lineages, possibly at different times, have shaped these associations. While cospeciation may have still occurred after colonization, geographic structure in two lineages (*Amoebogregarina* and *Boliviana*) highlights the role of host dispersal and ecological dynamics in shaping gregarine associations. Further questions include whether a broader sampling of the species and populations of the grasshoppers will change the current patterns, and how the cospeciation pattern looks after each colonization event. Future analyses using new sequencing technologies for gregarines, as well as a deeper sampling of the species and populations of the grasshoppers will help to answer these questions. For now, I will keep poking lubbers around.

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Orthoptera Species File Grant Reports

Study of Melanoplinae (Acrididae), Mecopodinae, and Hexacentrinae (Tettigoniidae) of high Andean forests and páramos of Colombia - Extension of the project to areas not covered, mainly in the south of the eastern range, and the central range of the Colombian Andes

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The Andes comprise a significant mountain chain that extends across South America, from the south in Argentina and Chile, running parallel to the Pacific Coast of the subcontinent, reaching Colombia, where it divides into three ranges (eastern, central, and western). The eastern range further splits to the north, entering Venezuela, where this important mountain chain ends (Stern, 2004; Graham, 2009). The landscapes and cultural dynamics along the range, which crosses several countries, are diverse, influencing the region's ecosystems and economy (Harden & Hyman, 2007). Additionally, the Andes, with their variations in elevation, became a series of islands among the clouds, as their mountains isolate populations (Fiedler & Strutzenberger, 2013; Mahecha *et al.*, 2019), resulting in a considerable diversity of taxa for many biological groups, including orthopterans. The groups studied in this research are grasshoppers of the subfamily Melanoplinae (Acrididae) and katydids of the subfamilies Mecopodinae and Hexacentrinae (Tettigoniidae), which have a preference for these high altitude environments and endure the low temperatures of the high Andean forests, páramos, and the edges of the snow-capped peaks (Braun *et al.*, 2009; Braun 2016; Scattolini *et al.*, 2020).

Colombia is not only one of the most biodiverse countries on the planet, but also harbors the highest concentration of areas in high Andean forests and páramos worldwide. These ecosystems are of the utmost value since they are considered "water factories" because large and small rivers are born in these places. In these areas, a large number of plant species, endemic and native (among them many shrubs, lichens, and mosses, organized vertically in at least four layers of vegetation), as well as many animal species, are distributed, especially insects (Flantua *et al.*, 2019; Mahecha *et al.*, 2019). However, the diversity of insects in these regions has not been studied and Orthoptera is especially poorly known.

I actively collected in different locations on the eastern and central slopes of the Colombian Andes (see Map 1). In these areas, the specimens were photographed in the field, and representatives of several new species and genera were collected, in addition to the known species with distribution in the study area, including samples in 96% alcohol for molecular analysis. During the development of this project, I was instructed by Maria Marta Cigliano and Holger Braun on how to digitize and upload data to the new OSF. The photographs of the specimens were taken with a Canon RP camera and a Canon 100 mm macro lens. The photographs were edited and resized using Adobe Photoshop CS6. Photographs of the already described species were uploaded (Fig. 1), while data and photographs of new taxa are

Map 1. Localities collected during the project.

pending until their formal descriptions are published.

In the studied area, 12 species of Melanoplinae were found, primarily from the tribe Dichroplini, two species of Mecopodinae (*Tabaria opilioides* Walker, 1870 and *Encentra longipes* Redtenbacher, 1892), and one species of Hexacentrinae (*Ecuaneduba gambitaensis* Chamorro-Rengifo, 2009) (Braun *et al.*, 2009; Chamorro-Rengifo, 2009; Chamorro-Rengifo *et al.*, 2011; Cadena-Castañeda & Cardona-Granda, 2015; Cigliano *et al.*, 2024). Specimens of most species were collected, except for *Chibchacris sturmi* Ronderos, 1981 (Melanoplinae), which lives in a protected area where the indigenous people do

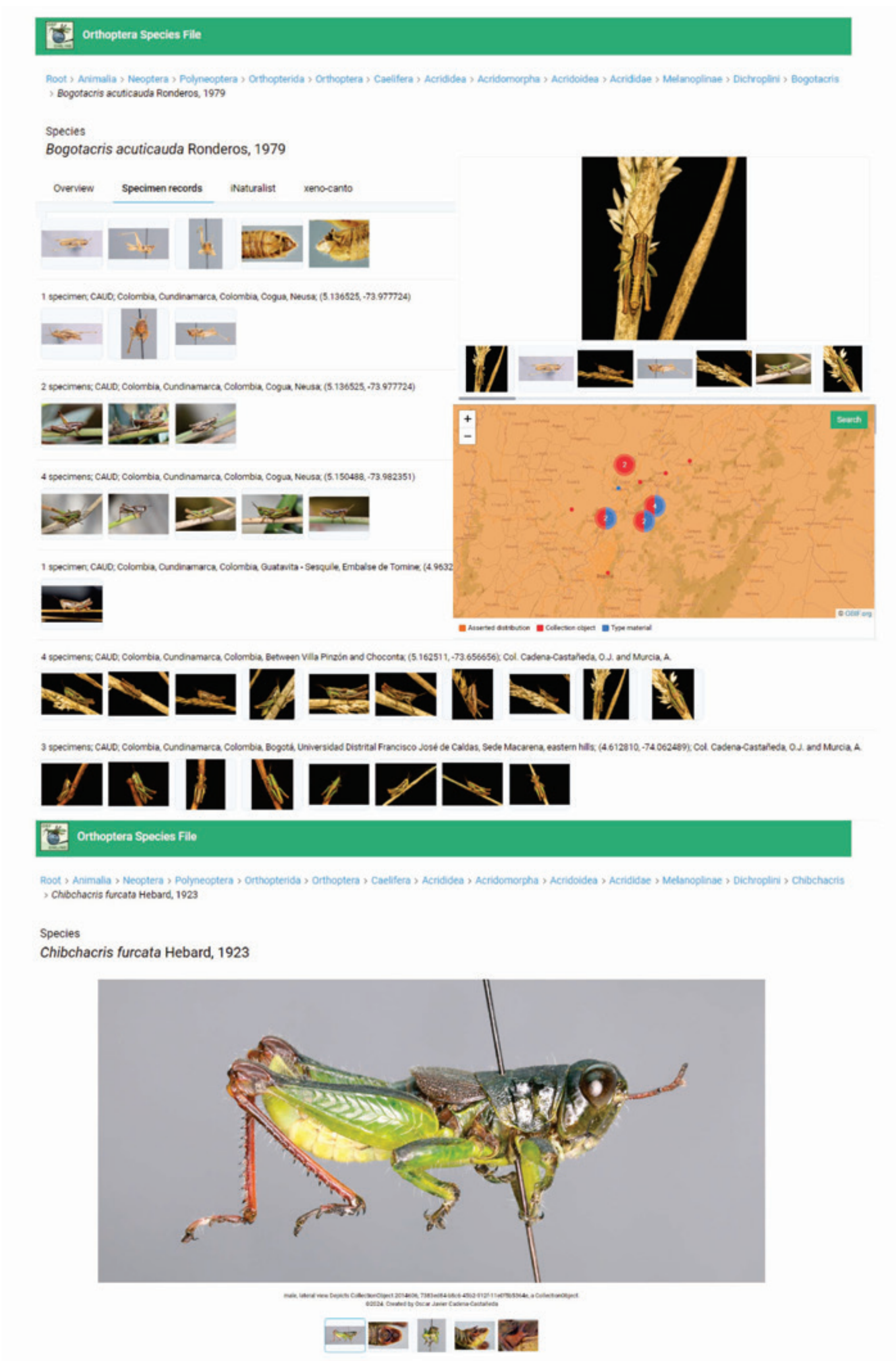

Figure 1. Example of *Bogotacris acuticauda* Ronderos, 1979 and *Chibchacris furcata* Hebard, 1923, with updated data.

not permit collection.

During the exploration and collection in those majestic forests, grasslands, and páramos, several new taxa to science were discovered, doubling the number of high mountain species and genera of Melanoplinae recorded for the area. Several species of Melanoplinae had no records since their original description. Some curiosities were observed during the collections and reviews of collections. For example, the type locality of *Chibchacris furcata* Hebard, 1923, and *Chibchacris digitifera* Hebard, 1923 is La Pica, Santander (Hebard, 1923). However, upon visiting the site, no species of *Chibchacris* Hebard, 1923 were found. Instead, a possible new species of *Agesander* Stål, 1878 (Acrididae: Ommatolampidinae) was discovered among the grasslands and frailejones. The two *Chibchacris* species were not found in sympatry and were collected more than seven hours by car from their type locality. *Ch. furcata* was found between Cocuy and Güicán (above 3000 m), in the northern part of the Boyacá department, and *Ch. digitifera* in another distant locality, in the municipality of Tona, in the Santander department (above 2000 m). A similar case occurred with *Bogotacris casanare* (Hebard, 1923), originally recorded in Palmar del Río Casanare, Boyacá, a low elevation locality, not exceeding 500 m, with different conditions than those common for high mountain species, but additional specimens were found in entomological collections, with localities close to 2000 m. The collectors of these species probably confused the localities, and projects such as this contribute significantly to clarifying these situations, which have not been detected until now.

The eastern slope of the Colombian Andes was the most diverse for Melanoplinae, but the least diverse for Mecopodinae. In contrast, the opposite occured in the central Andean range: the diversity of Melanoplinae was lower, while that of Mecopodinae was higher. For example, *Bogotacris pausifrons* Ronderos, 1979 was found in the northern part of the central slope, but in the other high Andean forests and páramos, the spaces usually occupied by Melanoplinae on the eastern slope were replaced by grasshoppers of the subfamilies Ommatolampidinae (Aspidophymini) and Gomphocerinae (a couple of taxa yet to be described) on the central slope. In the mid and lowlands of the central Andean slope, it was common to find *Aidemona azteca* (Saussure, 1861) and occasionally *Baeacris bogotensis* (Carbonell & Ronderos, 1973).
A surprising find was the northernmost point for *Jivarus* Giglio-Tos, 1898. This genus diversifies to the south of the Colombian Andes, primarily in the area where the mountain range has not yet divided, continuing its distribution between Ecuador and

Figure 2. Some examples of specimens collected during the project. **A.** *Chibchacris furcata* Hebard, 1923. **B.** New genus close to *Chibchacris* n. sp. 1, **C.** *Bogotacris pausifrons* Ronderos, 1979. **D.** *Jivarus* n. sp. **E.** *Bogotacris acuticauda* Ronderos, 1979. **F.** *Bogotacris varicolor* (Stål, 1878). **G.** *Tabaria* n. sp. **H.** *Tabaria opilioides*.

the northern Peruvian Andes (Cigliano & Amédégnato, 2010). The new species was collected in the municipality of Salento, in the Cocorá Park (Quindío), 130 km in a straight line from the locality of *Jivarus marginalis* Ronderos, 1979 (Tenerife, Valle del Cauca), the northernmost species known to date for the genus, and also the closest to this new species. This suggests that additional species of *Jivarus* are still waiting to be discovered in this Andean region of Colombia, and it highlights the distributional gap between the reported localities for the seven known species of the genus in Colombia, which contrasts with the 21 species recorded for the genus in Ecuador (Cigliano *et al*., 2024).
Mecopodinae and Hexacentrinae are subfamilies that have diversified in the Old World, whereas in the Neotropics, only a few species are found in the Andes between Peru and Colombia (Braun *et al*., 2009). Currently, only *E. gambitensis* and *T. opilioides* are known in the eastern range (Chamorro *et al*., 2011), along with an additional *Tabaria* species that has yet to be described. On the central range, only *E. longipes* is known, along with five additional new species that prefer humid areas covered by bryophytes, where they hide. For *E. longipes*, only the female holotype was known. In this project, additional males and females were collected and identified, with more precise locality records compared to the original description. Several additional species of Mecopodinae and Hexacentrinae are likely to await discovery in the south of Colombia and on the western slope.
The collections were a blessing to me, as they provided the opportunity to study and contribute to the knowledge of high mountain orthopterans in Colombia. But it was also a blessing and opportunity to be in spectacular places with beautiful landscapes where the sound of nature was predominant. These are places where people rarely visit due to their remoteness from major urban centers, where only a few farmers live, and sometimes no human settlements are visible for miles. These areas are covered with frailejones and grasslands as far as the eye can see, giving the feeling of being in the midst of a sea of frailejones. Ascending further into these areas, I had the chance to witness the snowy mountains, the Nevado del Cocuy (Boyacá) and the Nevado del Ruiz (between Caldas and Tolima), which are imposing in their silent splendor, and to think that they are at imminent risk of disappearing. Colombia holds half of the planet's páramos and several glaciers crucial for supplying water to more than half of the Colombian population. However, due to various factors, their extent is steadily decreasing. The new collections are important not only for understanding our favorite insects, but also for reflecting on the imminent loss of these ecosystems. Fortunately, projects like this help document part of their diversity before they disappear.

Acknowledgments
I especially thank Holger Braun, Maria

Figure 3. Some examples of localities visited in this project. **A.** Páramo del Almorzadero (Norte de Santander department at 3600 m.) with my little helper sons. **B.** High Andean Forest from Tona (Santander department at 2300 m.). **C.** Los Nevados National Natural Park (Road between Caldas and Tolima departments at 5000 m.). **D.** Nevado del Ruíz volcano seen from the municipality of Murillo (Tolima department at 3000 m.). **E.** High zone of Cocorá Valley (Quindío department at 2400 m.). Large Sierra lagoon, near the snow line, El Cocuy National Natural Park (border Boyacá and Arauca departments at 4550 m.). **E.** El Cocuy National Natural Park (Boyacá department at 4000 m.)

Marta Cigliano, who had the patience not only to instruct me with the operation of OSF, but to teach me the basics in the studies of Tettigoniidae and Acrididae, to always be willing to listen to my doubts, provide photographs, and help to solve my difficulties in the advancement of several of my projects. I thank the Orthopterists' Society for the support in this project, which actually became a fundamental support to all my future projects. I will always be grateful and willing to keep collaborating on whatever is necessary in the OSF and will continue contributing to photographs and recordings in the future.

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Photographic database of Phaneropterinae and Pseudophyllinae katydids (Ensifera, Tettigoniidae) in the Naturhistorisches Museum Wien (NMW, Vienna, Austria)

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The Naturhistorisches Museum Wien (NMW) (Fig. 1A), houses one of the most important insect collections in the world. Picturing only the Orthoptera, the collection houses over 2,050 type records, including more than 1,900 primary types. The importance of the Orthoptera collection stems mainly from the works of Carl Brunner von Wattenwyl (1823-1914), who described over 600 species with types deposited there; Heinrich Hugo Karny (1886-1939), who described over 220 species with types deposited there; Josef Redtenbacher (1856-1926), who described over 200 species; as well as Max Beier (1903-1979) and Henri de Saussure (1829-1905), each of whom described over 140 species with types deposited in the collection (Cigliano et al., 2024). Thus, the collection has invaluable significance, and within the Orthoptera, its importance is even greater when we consider the Tettigoniidae.

This initiative to create photographic records of the little-known (and illustrated) Orthoptera material was conceived and finally realized during my doctoral studies. In addition to the opportunity to photograph the material deposited in the Natural History Museum of Vienna, I was able to study the Tettigoniidae there, which were part of my thesis involving the morphological systematics of Phyllopterini, a Neotropical tribe of katydids. None of this would have been possible without the grant received from the Orthopterists' Society.

Figure 1. The visit at the Natural History Museum, Vienna. A: Natural History Museum, Vienna; B: Susanne Randolf, Harald Bruckner, and me at the Orthoptera Collection; C: photographic equipment.

At the collection, I was warmly welcomed by Dr. Susanne Randolf and Mag. Harald Bruckner, who provided me with access to the collection (Fig. 1B). They offered all the necessary support to enable me to work as effectively as possible, studying any desired Orthoptera material. Without them, this work would not have been possible.

In my project, I had planned to illustrate, through photographs, 97 species of Tettigoniidae, all from the subfamily Phaneropterinae. Unfortunately, not all intended species were found in the collection; as soon as I realized this, I contacted Dr. Maria M. Cigliano, who allowed me to work with other subfamilies of Tettigoniidae, enabling me to achieve my goal. During my stay at the collection, I was able to photograph 108 species, including 74 species of Phaneropterinae, with a total of 74 type specimen records corresponding to 68 species, and 34 species of Pseudophyllinae, with photos of 33 type specimen records corresponding to 29 species. The list of taxa can be found in Tables 1-2.

The specimens were photographed in dorsal, lateral (see Fig. 2A and G), and ventral views, focusing on certain regions such as the head and pronotum in dorsal and lateral views (Fig. 2B, C, H and I); the stridulatory area of males from a dorsal view (Fig. 2D and H); male and female terminalia

Table 1. List of the photographed species of Phaneropterinae and Pseudophyllinae housed at Naturhistorisches Museum Wien (NMW)

Genus	Species	Type material
Acripeza	*Az. reticulata*	No
Acrometopa	*Ap. syriaca*	Yes
Anaulacomera	*An. sulcata*	Yes
	An. sororcula	Yes
	An. recta	Yes
	An. maculata	Yes
	An. lanceolata	Yes
	An. inermis	Yes
	An. inconspicua	Yes
	An. harpago	Yes
	An. gracilis	Yes
	An. dentata	Yes
	An. concisa	Yes
	An. chelata	Yes
Angara	*Ag. albofasciata*	Yes
Anonistus	*As. scariosus*	Yes
Arethaea	*Ar. phalangium*	Yes
Caedicia	*Ca. acutifolia*	Yes
	Ca. concisa	Yes
	Ca. inermis	Yes
	Ca. longipennis	Yes
	Ca. marginata	Yes
	Ca. obtusifolia	Yes
	Ca. olivavea	Yes
	Ca. scalaris	Yes
	Ca. septentrionalis	Yes
	Ca. obtusifolia	No
Casigneta	*Cs. pellucida*	Yes
Dapanera	*Dp. falxcercata*	Yes
Diastella	*Dl. latifolia*	Yes
Elimaea	*El. curvicercata*	Yes
	El. longicercata	Yes
	El. marmorata	Yes
Engonia	*En. minor*	Yes
Hemielimaea	*Hl. chinensis*	Yes
Himerta	*Hi. marmorata*	Yes
Holochlora	*Ho. emarginata*	Yes
Holochlora	*Ho. forstenii*	Yes
	Ho. obtusa	Yes
	Ho. tumescens	Yes
	Ho. javanica	No
Isopsera	*Is. vaga*	Yes
Leptoderes	*Lp. flavipennis*	Yes
Letana	*Lt. atomifera*	Yes
	Lt. despecta	Yes
Microcentrum	*M. ligatum*	Yes
Odontura	*Od. algerica*	Yes
Odonturoides	*Os. plasoni*	Yes
Orpacanthophora	*Or. inermis*	Yes
Orthelimaea	*Ot. flavolineata*	Yes
Orthelimaea	*Ot. minor*	Yes
Paracosmophyllum	*Pa. atrodelineatum*	Yes
Paraducetia	*Pc. cruciata*	Yes
Petaloptera	*Pt. filia*	Yes
Phaulula	*Ph. compressa*	Yes
	Ph. gracilis	Yes
	Ph. phaneropteroides	Yes
	Ph. rugulosa	Yes
Phlaurocentrum	*Pl. maculatum*	Yes
Platycaedicia	*Pe. hospes*	Yes
Platycaedicia	*Pe. major*	Yes
Poecillimon	*Po. concinnus*	Yes
Poecillimon	*Po. neglectus*	Yes
Psyrana	*Ps. borneensis*	Yes
	Ps. longestylata	Yes
Satrophyllia	*Sa. arabica*	Yes
Scambophyllum	*Sc. sanguinolentum*	No
Steirodon	*St. rarospinulosum*	Yes
	St. striolatus	Yes
Symmachis	*Sy. lateipennis*	Yes
Tetana	*Te. grisea*	Yes
Torbia	*To. costulata*	Yes
	To. pruinosa	Yes
Tylopsis	*Ty. bilineolata*	No
Acauloplacella	*Ac. immunis*	Yes
	A. parvula	Yes
Chloracris	*Cl. brunneri*	Yes
Chondrodera	*Ch. ocellata*	Yes
Cocconotus	*Cc. meroncidioides*	Yes
Cratioma	*Ct. borneensis*	Yes
	Ct. elongatum	Yes
Desaulcya	*Ds. ampulla*	Yes
	Ds. congica	No
Gonyatopus	*G. lamellipes*	Yes
Hemigyrus	*Hg. tonkinensis*	Yes
Idiarthron	*Id. carinatum*	Yes
Incanotus	*In. atricoxatus*	Yes
Lichenochrus	*Li. servus*	Yes
Macrochiton	*Ma. adjutor*	Yes
Margarodera	*Mg. quadripunctata*	No
Paradeclus	*Pd. brasiliensis*	Yes
Paramorsimus	*Pr. confinis*	Yes
	Pr. fruhstorferi	Yes
Paraphractus	*Pp. abbreviatus*	Yes
Pedinothorax	*Px. venezuelanus*	Yes
Phricta	*Pi. spinosa*	Yes
Phyllominus	*Py. acutipennis*	Yes
	Py. ampullaceus	Yes
	Py. apterous	Yes
	Py. verruciferous	Yes
	Py. zebra	Yes
Pseudophyllus	*Ps. simplex*	Yes
Rhinodera	*Rh. spinifrons*	Yes
Sanaa	*Sn. regalis*	No
Zabalius	*Z. congicus*	Yes
	Z. robustus	Yes
	Z. major	No
	Z. verruculosos	No

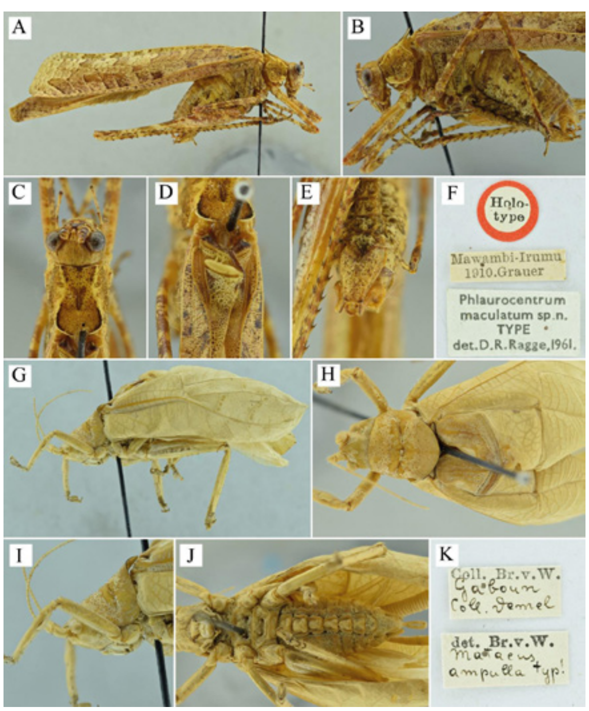

Figure 2. Example of photographed specimens. A-F: *Phlaurocentrum maculatum* Ragge, 1962 (Phaneropterinae); G-K: *Desaulcya ampulla* (Brunner von Wattenwyl, 1895) (Pseudophyllinae).

from lateral and ventral views, and dorsal when possible (Fig. 2 E and I); as well as the thorax and abdomen from a ventral view (Fig. 2I). Additionally, labels were photographed for all specimens (Fig. 2F and K). For the photographic records, I used my macro lens, a Sigma 105mm, which I obtained through a previous grant from the OSF, attached to a Nikon D5300 camera. The camera was mounted on a tripod, using a clear dome for lighting (Fig. 1C). Images were captured at multiple focal points, using Helicon Remote, and then processed using Helicon Focus for stacking. Over 12,000 photos were taken, totaling around 95 gigabytes of data. After stacking, a total of 796 photos were obtained and uploaded to the OSF database, using TaxonWorks.

Although this grant focused only on two subfamilies of katydids, Phaneropterinae and Pseudophyllinae, these represent the most diverse groups of Tettigoniidae. Furthermore, the photographed specimens are from various parts of the world, including Australia, Borneo, Brazil, Chile, Ivory Coast, Ecuador, the United States, the Philippines, Indonesia, Papua New Guinea, and Syria. I hope that these photographic records, with high-quality illustrations, will be of great utility for research in taxonomy and systematics of katydids. Additionally, I hope it will greatly assist researchers working with this group, allowing them to use the data generated here in their studies.

I would like to once again thank

the Orthopterists' Society for funding this project. I am eternally grateful for the opportunity that was given to me. I thank Dr. Maria M. Cigliano, Dr. Holger Braun, and everyone who assisted me during this project, as well as the curators of the collection for their warm reception and all the help I received in Vienna.

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Contributed Articles

Infection with *Aspergillus oryzae* XJ-1 reduces the long-range flight capacity of adult *Locusta migratoria*

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Aspergillus oryzae XJ-1 is an effective pathogenic biocontrol agent for at least 16 species of locusts, including adults and nymphs. The flight capacity of male and female adults of *Locusta migratoria* was evaluated using a flight mill after infection with 1×10^{7} conidia/ml of *A. oryzae* XJ-1 suspension. The maximum flight speed (0.45±0.05 m/s), average speed (0.02±0.01 m/s), flight distance (42.64±12.20 m), flight duration (1.85±0.36 min), and maximum flight duration (0.76±0.18 min) of males were significantly lower 4 days after inoculation with *A. oryzae* XJ-1 than in the uninoculated treatment (maximum flight speed: 0.74±0.10 m/s; average speed: 0.17±0.03 m/s; flight distance: 405.69±83.37 m; flight time: 14.66±4.24 min; and maximum flight duration: 5.44±2.04 min). Similarly, the average speed (0.01±0.004 m/s), flight distance (32.81±10.48 m), flight time (1.44±0.49 min), and maximum flight duration (0.67±0.20 min) were significantly less in females 4 days after inoculation with *A. oryzae* XJ-1 than in the uninoculated treatment (average speed: 0.21±0.08 m/s; flight distance: 498.56±200.66 m/s; flight time: 15.75±4.73 min; and maximum flight duration: 12.15±4.56 min). These results demonstrated that *A. oryzae* XJ-1 could significantly reduce the long-range flight capacity of male and female adult *L. migratoria*, to prevent locust swarms' migrating long distances and causing plagues in addition to killing locusts directly.

Keywords: *Aspergillus oryzae*; *Locusta migratoria*; flight capacity; reduction; adult

Introduction

Locusts are the world's most economically significant agricultural pests. Serious locust plagues have often caused famines, led to social unrest, and induced regime changes in China's feudal era. Large locust swarms can migrate thousands of kilometers, endanger millions of square kilometers of crops, and have globally significant economic, social, and environmental effects (Zhang et al., 2019; Zhang and Lecoq, 2021).

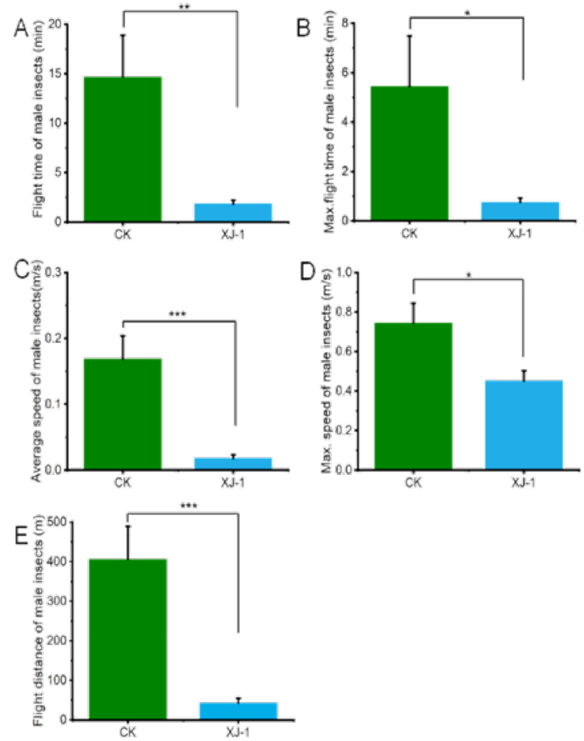

Figure 1. Effect of *Aspergillus oryzae* XJ-1 infection on the flight capacity of male adult *Locusta migratoria*. A–E, Comparison of the flight time, maximum flight time, average speed, maximum speed, and flight distance of male adults between the treated and control groups. n=8. *t*-test, *, p<0.05, **, p<0.01, ***, p<0.001.

Since the 1940s, chemical pesticides have been the main approach used for the control of locusts; however, chemical pesticides are not effective for eradicating locust plagues, and they can even have environmentally deleterious effects. Since the 1980s, various biocontrol agents for the control of locusts have been developed, including *Metarhizium* and *Nosema locustae*; these are effective on nymphs but are less effective on adults (Zhang et al., 2019; Zhang and Lecoq, 2021). Our lab previously reported a new fungal pathogen of locusts, *Aspergillus oryzae* XJ-1, that was highly virulent not only to locust nymphs but also to locust adults through bioassays, field-cage experiments, and large-scale experiments (Zhang et al., 2015; You et al., 2023; Fu et al., 2024). When we performed bioassays in the laboratory, we found

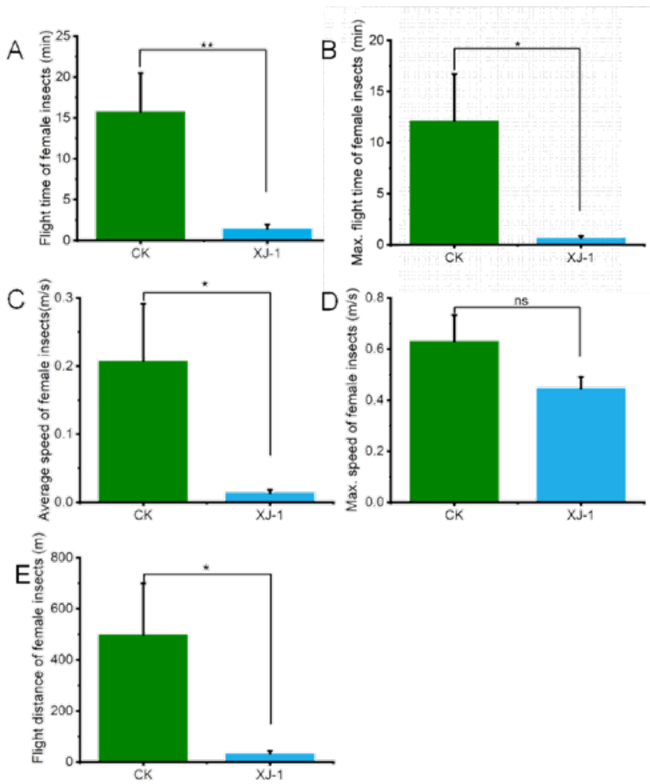

Figure 2. Effect of *Aspergillus oryzae* XJ-1 infection on the flight capacity of female adult *Locusta migratoria*. A–E, Comparison of the flight time, maximum flight time, average speed, maximum speed, and flight distance of female adults between treated and control groups. n=8. *t*-test, ns, p>0.05, *, p<0.05, **, p<0.01.

that adult *Locusta migratoria* became slow after they were inoculated with *A. oryzae* XJ-1. We thus speculated that *A. oryzae* XJ-1 may affect locust activity and reduce the flight capacity of locusts after infection. The flight capacity is very important for locust migration.

Flight mills are commonly used to determine the flight capacity of insects (Chambers et al., 1976). These can be used to determine the maximum flight speed, average speed, flight distance, flight time, and maximum flight duration according to analysis of videos of insect flight. Flight mills have been used to study the flight behavior of European corn borers (*Ostrinia nubilalis*) infected with *Nosema pyrausta* and the flight ability of the Asian longhorned beetle (*Anoplophora glabripennis*) infected with *Metarhizium fuscus* F52 (Chambers et al., 1976; Dorhout et al., 2011; Clifton et al., 2019). In this paper, we used flight mills to evaluate the effect of *A. oryzae* XJ-1 on flight capacity of male and female adult *L. migratoria* after infection.

Materials and methods

Locust rearing

L. migratoria nymphs and adults were reared in the Biocontrol Laboratory of the Institute of Plant Protection at the Shandong Academy of Agricultural Sciences. Locusts were fed fresh wheat seedlings daily at 28–30 °C and 60% relative humidity and under an 18 h/6 h light/dark photoperiod. Feces were regularly removed from the locust enclosures.

Inoculation of Aspergillus oryzae XJ-1

A. oryzae XJ-1 preserved in our laboratory was inoculated on a PDA plate and cultured at 30.0 ± 2.0 °C for 7 days; they were then diluted into a suspension of 1×10^7 conidia/ml with 0.3% (vol/vol) Tween-80 for further use. Male and female adult locusts on the 5th day after eclosion were individually inoculated by immersion in 1×10^7 conidia/ml of *A. oryzae* XJ-1 suspension with 0.3% (vol/vol) Tween-80 solution for no more than 1 s; immersion in 0.3% (vol/vol) Tween-80 solution was used as a control. The treated adults and control adults were dried and individually reared in plastic boxes with a round top (diameter, 14 cm), round bottom (diameter, 9 cm), and height of 14 cm until the 9th day after eclosion. The flight capacity of these locusts was evaluated using a flight mill. The flight time and flight laps were recorded using videos.

Flight capability measurements and analysis

The flight mill used in this experiment was produced by Hebi Jiaduo Science Industry and Trade Co., Ltd. Individual insects of similar size and weight were used for testing. A glass fiber tube with a diameter of 0.8 mm and length of 20 cm was used as the flight mill arm. The treated and control adult locusts were fixed at both ends of the flight mill arm separately with glue. The vertical position of the locust was carefully adjusted so that it was tangent to the cantilever and parallel to the ground. The flight mill arm was placed back on the flight mill; it was rotated around the central axis, and videos were recorded for 40 min. The locust's flight time, maximum flight time, and number of revolutions were recorded by analyzing the video. The total flight distance was determined by the radius (10 cm) of the flight mill arm and total revolutions. The maximum flight distance was determined when the revolution of one flight bout was highest in one flight experiment. The average flight speed was calculated according to the total flight distance and the total flight time. The flight speed of all flight bouts was calculated to determine the maximum flight speed.

To ensure that the treated insects were infected by *A. oryzae* and that the control was not infected, we performed an infection experiment as described in An et al. (2023) and Fu et al. (2024). After flight experiments, the treated and control insects were taken down and killed by placing them in a freezer at -20 °C. In the laboratory, each dead locust was placed on a sterilized glass slide on sterilized filter paper in a sterilized Petri dish, and 200 µl of sterile water was added to soak the filter paper. The Petri dish was placed in an incubator at 28 °C for 7 days. Every two days, the growth of *A. oryzae* XJ-1 on the locusts was observed and recorded.

Statistical analysis

All analyses were performed in Ori-

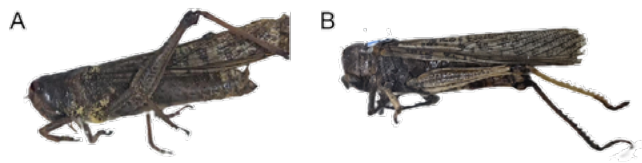

Figure 3. Identification of locusts infected with *Aspergillus oryzae* XJ-1. A. treated locusts; B. control locusts.

gin 2021 software (OriginLab, USA). Student's *t*-tests were used to analyze differences in flight time, maximum flight time, average speed, maximum speed, and flight distance between the treatment and control.

Results

The maximum flight speed (0.45±0.05 m/s), average speed (0.02±0.01 m/s), flight distance (42.64±12.20 m), flight time (1.85±0.36 min), and maximum flight duration (0.76±0.18 min) of males were significantly lower 4 days after inoculation with *A. oryzae* XJ-1 than in the uninoculated group (maximum flight speed: 0.74±0.10 m/s; average speed: 0.17±0.03 m/s; flight distance, 405.69±83.37 m; flight time, 14.66±4.24 min; and maximum flight duration: 5.44±2.04 min) (Fig. 1).

Similarly, the average speed (0.01±0.004 m/s), flight distance (32.81±10.48 m), flight time (1.44±0.49 min), and maximum flight duration (0.67±0.20 min) of females were significantly lower 4 days after inoculation with *A. oryzae* XJ-1 than in the uninoculated group (average speed: 0.21±0.08 m/s; flight distance: 498.56±200.66 m/s; flight time: 15.75±4.73 min; and maximum flight duration; 12.15±4.56 min) (Fig. 2).

Aspergillus oryzae XJ-1 conidia grew from all the bodies of treated insects, but not from all control insects (Fig. 3).

Discussion

The flight capacity of insect hosts can be reduced by pathogens after infection. Infection of *L. migratoria* with *Nosema locustae* resulted in a significant reduction in their average total flight distance, average flight speed, and average flight time compared with healthy adult locusts, indicating that there was a marked decline in their flight capability (Zhang et al., 1995). The flight distance and duration of 1-day-old male and female European corn borer (*O. nubilalis*) were significantly reduced compared with that of control insects after infection with *N. nubilalis* (Dorhout et al., 2011). The total flight distance and duration of adult male *A. glabripennis* significantly decreased at 7 days after infection with *M. brunneum* F52; the total flight distance and duration of both male and female adults significantly decreased at 10 days after infection (Clifton et al., 2019).

In this study, the flight time, maximum flight time, average speed, maximum speed, and flight distance were all significantly lower in female and male locust adults infected with *A. oryzae* XJ-1 than in control individuals uninfected with *A. oryzae* XJ-1; however, there was no significant difference in the maximum speed of female adults between the treatment and control groups. These results indicate that *A. oryzae* XJ-1 could significantly reduce the long-distance flight ability of *L. migratoria* and potentially prevent the long-distance migration of locusts to form locust plagues in addition to directly killing the pest.

Acknowledgments

This work was supported by the National Natural Science Foundation of China (No. 32472640), Agricultural scientific and technological innovation project of Shandong Academy of Agricultural Sciences (CXGC2024F05).

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The active compounds from male sex gland of *Locusta migratoria*

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Locusta migratoria is an important migratory pest worldwide. There are few reports on the function of the extract of sex glands of adult *L. migratoria*. In this paper, we demonstrated that the extract of male sex glands of adult *L. migratoria* at proper dilution could attract female adults. Furthermore, electroantennographic detection (EAD) showed that two compounds could elicit electrophysiological responses of female antennae.

Keywords: *Locusta migratoria*; active compound; sex gland; behavioral experiment; electrophysiological response

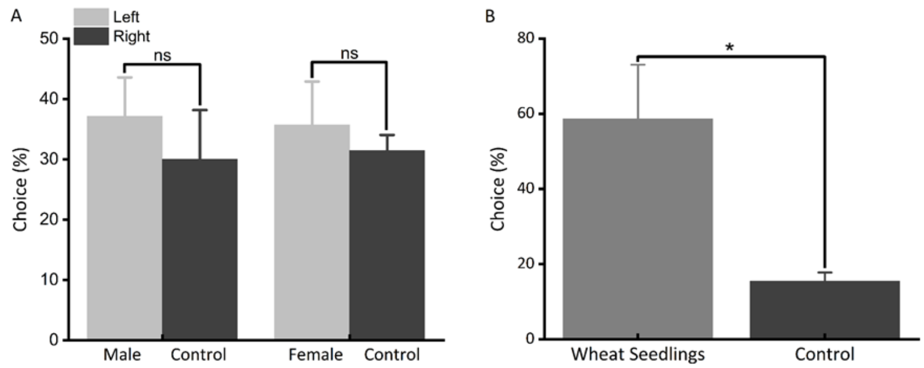

Figure 1. The determination of T-maze setup for locust behavior induced by odor. A, Negative control experiment, n=7; B, Positive control experiment, n=4. Bar, S.E.M. *t*-test. ns, no significant difference. *, P<0.05.

Introduction

Locusta migratoria is one of the important migratory locusts in China and it has strong reproductive ability (Zhang et al., 2019; Zhang and Lecoq, 2021). The courtship ritual of desert locusts (*Schistocerca gregaria*) consists of a series of typical elements just like *Drosophila* (Sokolowski, 2001; Golov et al., 2018). Two isomers of candidate pheromone, naphthyl and propionitrile, were identified from the male reproductive organs of *L. migratoria*, and showed significant affinity to CSP91, a protein reported in the testis (Ban et al., 2013). But there are no behavioral and electrophysiological data to support the conclusion that naphthyl and propionitrile are sex pheromone components. To date, no sex pheromone has been convincingly identified from *L. migratoria*. In this paper, we combined electroantennographic detection (EAD) and behavioral experiments to demonstrate that two compounds in the extract of male sex glands of adult *L. migratoria* may be active semiochemicals to female adult locusts.

Materials and methods

Locust rearing

Locusta migratoria nymphs were reared in the Biocontrol Laboratory of the Institute of Plant Protection at the Shandong Academy of Agricultural Sciences. Locusts were fed fresh wheat seedlings daily at 28–30 °C and 60% relative humidity and under an 18 h/6 h light/dark photoperiod. Feces were regularly removed from the locust enclosures. According to days after eclosion, male and female adults were collected into different insect cages (diameter 20 cm, length 50 cm) for the following experiments after 7-15 days.

Male sex gland extraction

The crude extracts from the sex glands of male adults were extracted by solvent extraction. The sex glands of mature male adults were dissected and collected in the 2 ml centrifuge tube and each of which contained 250 µl hexane with 10 glands. The collected glands were thoroughly ground with the handheld grinder (Shanghai Jingxin, China) and left at room temperature for 4 hours. After 20 min of centrifuge at 10,000 rpm, the supernatant was transferred to the chromatographic bottle as the gland extracts (100%) and stored at -80 °C for behavioral experiment and EAD experiment.

EAD experiment with the extract

A 10×universal EAG amplifier (Syntech, Netherlands), and an Intelligent Data Acquisition Controller (IDAC-4, Syntech, the Netherlands) were used to detect the electrophysiological activities of the volatile compounds in the sex gland extracts of mature male adults with female antennae.

Behavioral experiment

Behavioral experiments were performed in a T-maze olfactometer (with an arm length of 50 cm, a diameter of 4.5 cm) in a uniform illumination. Temperature was maintained at 28±2 °C, 60% relative humidity, the airflow speed at 100 ml/min. Turn on the vacuum pump for 30 min to remove impurities from the air in the T-maze setup, then place 10 µl extract into one glass arm as the treatment arm and 10 µl hexane into another glass arm as the control arm.

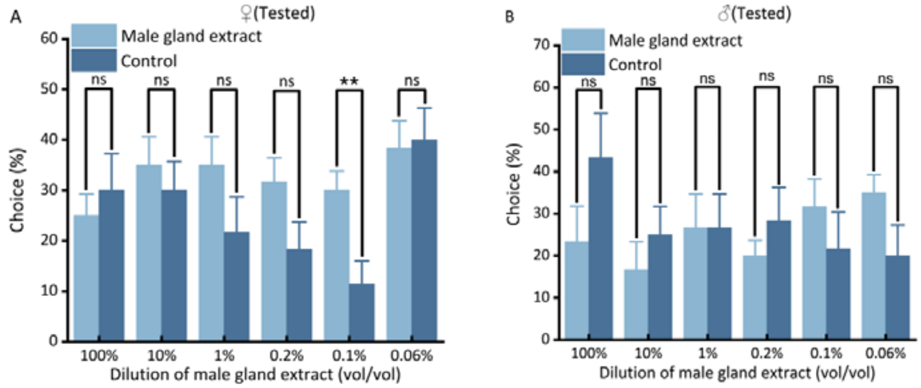

Figure 2. Effect of locust male gland extract on the selection behavior of male and female adult locusts. A-B, Effect of male gland extract on female and male, respectively. n=6. Bar, S.E.M. *t*-test. ns, no significant difference. **, P<0.01.

Locusts were released into the olfactometer individually. The preference of each locust was observed and recorded within 5 min. When the locust enters one side of the glass arm with its whole body and stays for at least 10 s, it is considered to make a choice, otherwise no choice. All tests were replicated at least six times, and each time with 10 individuals. After completing one repeat, the setup was cleaned, and the direction of the olfactometer was switched to prevent system errors.

Statistical Analysis

All analyses were done in Origin 2024 software (OriginLab, USA). Student's *t*-tests were used to analyze differences in the choice between the treatment and the control.

Results

T-maze olfactometer

We used a negative control experiment and a positive control experiment to test if this T-maze behavioral setup was suitable for the determination of locust selection behavior induced by odor. The negative experiment (14 replicas, a total of 140 individuals) showed that there was no significant difference in the choice of two sides for male and female adults when no odors were placed in both sides (Fig. 1A). Then, wheat seedling was used as a stimulus to test locust selection between the wheat seedling side and the blank side as the positive control (Four replicas, a total of 40 individuals). Choice of the tested locusts of the wheat seedling were significantly higher than that of the control side (Fig. 1B). These results indicated that this T-maze setup was suitable.

The male gland extract at a proper dilution significantly attracted female adult locusts, but not males

The male gland extracts were diluted with hexane to 10%, 1%, 0.2%, 0.1%, 0.06% (vol/vol), respectively. Choice of both female and male adults to these serial concentrations of extracts were conducted in the T-maze olfactometer. Among these concentrations, only the concentration of 0.1% male gland extract significantly attracted females, but not males (Fig. 2A and 2B), indicating that some active components may exist in the extract of male glands.

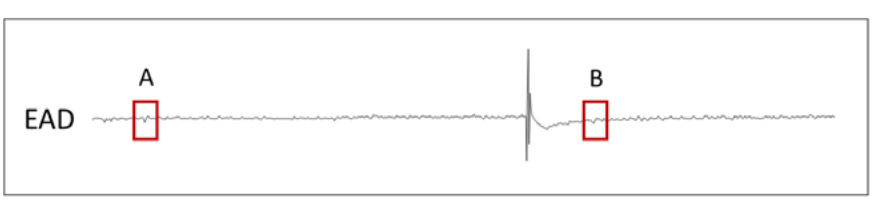

Figure 3. EAG responses of female antennae to male adult gland extract.

Electroantennographic detection of two active compounds from male gland extract

An EAD experiment was conducted to analyze the male adult gland extract. Two compounds (A and B) in the extract could elicit obvious electrophysiological responses of female adult locust antennae (Fig. 3).

Discussion

Using pheromone to regulate agricultural pest behavior, such as mass trapping and killing, or mating disruption, and monitoring population have been developed in many pests (Cork, 2016; Evenden, 2016). However, these methods have not been developed for locust adults due to few semiochemicals identified from locust adults. Here, we found two active compounds from male sex gland extract of adult *L. migratoria* through an EAD experiment. Moreover, male sex gland extract could significantly attract female adults only at a specific concentration, but not male adults, indicating candidate semiochemicals may exist in male sex gland extract. This will open a new window for further study on locust semiochemicals and developing new monitoring and control methods based on the semiochemicals in integrated locust management.

Acknowledgments

This work was supported by the National Natural Science Foundation of China (No. 32472640), Agricultural scientific and technological innovation project of Shandong Academy of Agricultural Sciences (CXGC2024F05).

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The 2024 Malawi Expedition

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Malawi, earlier known as Nyasaland, is a Sub-Saharan landlocked country located in Southeast Africa along the western part of the African Great Rift Valley bordered by Mozambique, Tanzania, and Zambia. Approximately half of Malawi's territory is categorized as forested or wooded area, similar to Tanzania, home to a wide variety of flora and fauna that makes it one of the top countries in tropical Africa for its diverse natural areas and unique species. Malawi's flora and fauna is little known, presenting an untapped opportunity. While some research on insects in Malawi has primarily focused on Lepidoptera, Coleoptera, and Hymenoptera, Orthoptera remains understudied in comparison to other insect groups, despite its significant importance. The lack of comprehensive research hinders our understanding of the diversity, distribution, behavior, and ecological roles of Orthoptera.

In an effort to bridge this gap, I, Jireh Mwamukonda, a Malawian master's student at Mississippi State University in the Entomology Department under the supervision of Dr. JoVonn G. Hill, who inspired the research, collaborated with two other entomologists from the Department of Entomology at the Academy of Natural Sciences of Drexel University in Philadelphia, Pennsylvania, U.S.A., Dr. Daniel Otte and Gregory Cowper, to organize an expedition to Malawi.

Figure 1. Group photo of the expedition team. Left to right. Dan Otte, Jireh Mwamukonda, Greg Cowper, and Mary Mervis Mwalukuwo.

May 9, 2024 was no ordinary day, it was the much-anticipated arrival date for the field trip in Lilongwe, the capital city of Malawi at Kamuzu International Airport. I arrived a few hours before Dan and Greg. I was welcomed by Mary Mervis Mwalukuwo who would be accompanying the team on this trip. Dan and Greg faced a two-hour delay sorting out their car rental upon arrival. Our journey to New Dawn Lodge was marked by chaotic road construction and renovations, which were happening across the country. The reckless and negligent driving typical of minibus and taxi drivers, which I'm accustomed to, but which was unfamiliar to Dan and Greg, added to the challenge of reaching our accommodation. Despite these challenges, we eventually arrived at the lodge.

On May 10, 2024, we drove to Dedza Pottery Lodge, where we were lodging for the next two nights. The Dedza Kirk mountain range provided majestic views as we drove through. Our first collecting site would have been at the peak of the Dedza mountain, but the roads to get to the top were too rocky, so it was impossible to get there. Instead, we collected in three different sites around the mountain. At one of the sites, we were joined by the locals, and it was the first site where we encountered *Phymateus viridipes*, among other grasshopper species. This species, commonly known as the green milkweed locust, belongs to the family of Pyrgomorphidae and is well- known for its striking coloration.

Figure 2. *Phymateus viridipes* commonly known as the green milkweed locust found in Dedza.

On the 12th of May, we started off for Zomba. Dan had made a previous expedition to Malawi in 1983 and found some lentulids, which we were hoping to find more of during this trip. Getting on Zomba mountain was not easy as the roads seemed to have constant maintenance. We managed to collect at the Emperors View, William Water Falls, and Queens View. The stunning sight of Zomba town from an elevation of 1,785 meters was absolutely magnificent.

On the 14th of May, we started off for Mulanje and drove through Blantyre, the second largest city in Malawi, and made a tea stop at Thyolo Sports Club. We collected at this unplanned site as well and one thing we collected was a big green playing mantis that Greg enjoyed taking pictures with. We continued our journey to Mulanje with a scenic view of the tea plantations and an overlook of Mulanje Mountain, the largest in South Central Africa. We lodged at KaraOmula resorts, a luxurious accommodation that's located at the base of Mulanje mountain. Just like Dedza mountain, we failed to get to the top because the end access of the road was further from the top of the mountain which would need us to hike for two days, so we collected within the base and a few kilometers away. Unfortunately, continuous rains impacted our collection at this site.

On the 17th of May, we started off for Cape Maclear, Mangochi, a district along the shores of Lake Malawi, that covers up 25% of the total land and is the 9th largest lake in the world and 3rd in Africa, spanning a length of 568 km and a width of between 16 and 80 km, and which supports significant aquatic biodiversity. Specifically, this lakeshore drive is never an easy one due to the road conditions, such as potholes that are not noticeable from a distance. Thankfully, we had large SUVs that reduced the impact of feeling how deep some of these potholes were. On our way, we spotted a giant African lizard that suddenly ran across the road. We lodged at Tranquilo Resorts by the beach and collected in this area. On the 19th of May, we drove 30 kilometers down to Monkeybay where we lodged at Mogfords Resort, another luxurious resort along the beach, and then collected for a day.

We believed the trip from Mulanje to Mangochi was difficult until we drove to Nkhotakota. The potholes and broken roads made us slow down significantly, and in some trading centers, pedestrians seemed indifferent to the fast-moving traffic along the highway. Dan and Greg were amazed by this, which wasn't really that strange to me since I know how busy trading centers along the highway can be. Due to the condition of the road, it took longer than we had hoped for and we ended up making it after sunset to our place of lodging at Nkhotakota Safari Lodge along the beach. No one enjoyed the experience of driving at night on a bad road, so we therefore agreed to always add an hour or two to our estimated arrival time. The heavy waves from the lake came with a fresh breeze that calmed our souls and we enjoyed our dinner of a traditional cuisine: the famous tilapia, nsima, mixed vegetables, and beans. At this site I was interested mostly in getting some tsetseflies from Nkhotakota Game Reserve, which was a success and some grasshoppers were collected too. By this time almost everyone's energy in the team was getting low. It'd been a good 2 weeks since we started our expedition and we only had a week more to go. Finding new species that we didn't get from other places or new species that haven't been identified yet helped boost up our energy.

Our final beach lodging was at Makuzi lodge in Nkhatabay. The drive wasn't as bad as the previous one. Rains at this site hindered collecting, so I decided to drive by myself 70 km Northwest to Mzuzu where I was able to collect at Mpamba. I then returned to the lodge to rest for another long rough drive. On the 24th of May, we started off for Nyika National Park. We stopped by Mzuzu to get some food supplies since the lodge only offered chef services and almost everything else is more than 170 kilometers away on this dusty, rocky, and rough road that only lets one drive about 30-40 km/hour. The drive to Mzuzu from Nkhatabay was the best, the roads were in good condition, and the forest and mountains on one side of the ride and the lake on the other side provided a very good view. About 20km to get to Mzuzu the roads are so winding because of the mountains, which made it even more amazing. We left Mzuzu around 11:30am and by 3:45pm we were at the entrance of

Figure 3. Sampling site at Zomba Mountain with Jireh and Dan conversing over a beautiful view of Zomba town.

Figure 4. Jireh pinning specimens that were sampled in Mangochi.

the park. Google showed we could get to Chelinda Camps where we were lodging in the next 2 hours. However, that 2 hours turned into 4 hours. Seeing antelopes and zebras on the way to the camp brought back the excitement and we were so eager to see more mammals that we did not feel how long it took us to get to the camp. We were welcomed by the manager and the chef was waiting for us. They gave out the guidelines of the place and asked us to always use caution since there were a lot of wild animals, including leopards, plus a lion was heard and spotted a few weeks ago.

Having Nyika as one of the last sites was a good choice and we were both excited to catch grasshoppers and see other animals as it was different from all the places we had been to. This site is made up of rolling hills that offer beautiful views, valleys filled with Miombo woodland, and dense evergreen forest. The montane vegetation makes it preferable for animals like zebras and antelopes. We managed to also see some bush hyrax, elands, roan antelopes, kudu reedbucks, bushbucks, duikers, and a leopard. In the short bushes as we were collecting grasshoppers, we saw three different species of birds, one of which was the harlequin quail. That rough drive was slowly paying off because we had some very shiny, tiny grasshoppers that we didn't get from any other place and Dan was certain that they were new species that haven't been described yet, just what a new entomologist would hope for. The three-day collecting trip at this site was finally over and, as much as I do not want to name favorites, Nyika National Park was my best site.

Ealy on the 27th of May, we started off for Kasungu. Due to the nature of the drive we decided to spend a night in Mzuzu at Umunthu Space and Lodge where we had a good rest. In the morning, we started off for Kasungu. We had two stops in Mzimba in Chikangawa where we collected more new species. When we got to Chikho Lodge in Kasungu everyone was ready to finalize their samples. Dan identified some of the specimens to family, subfamily, and genus level. The ones we thought were new species were packed in a different shipping box, so we could work on them at the Academy of Natural Sciences. Data on each collected specimen, including species name and location were recorded. Photographs were taken to document the physical characteristics of each species. **The key Findings for this expedition were**: Species Diversity: The field trip yielded a diverse array of grasshopper species which comprised the families of Acrididae and Tetrigidae, of which 11 species and one subfamily were identified right from the field: *Chrotogonus burri*, *Morphacris fasciata*, *Catantopsis basalis*, *Humbe tenuicornis*, *Catantops melanostictus*, *Tmetonota abrupta*, *Acanthacris ruficornis*, *Phymateus karschi*, *Phaeocatantops solitarius*, *Tylotropidius gracilipes*, *Phaeocatantops decorates*, and Eyprepocnemidinae. 3 other subfamilies were also identified: Acridinae, Gomphocerinae, and Oedipodinae.
19 genera were also observed: *Morphacris*, *Acrida*, *Chrotogonus*, *Machaeridia*, *Comacris*, *Duronia*, *Taphronota*, *Acrotylus*, *Calliptanus*, *Gastrimargus*, *Comacris*, *Spathosternum*, *Parepistaurus*, *Aeolopus*, *Oxya*, *Phymurus*, *Phymateus*, *Humbe*, *Afrosphaena*. The identification of two species remains uncertain and could be *Oedaleus* and *Comacris* or Acridinae.

Grasshopper species composition varied across different habitats, with certain species displaying habitat preferences like the *Afrosphaena*, which like short grasses and the *Gastrimargus*, which like areas with trees and field crops. This Orthoptera expedition provided valuable insights into the rich diversity of grasshoppers of Malawi. Among the grasshoppers identified to genus and subfamily, some remain unknown and may represent new species. Further studies will employ molecular techniques, such as DNA analyses, to infer the biogeography of genera of interest, resolve challenging identification cases, and construct phylogenetic trees to examine species relationships.

Meeting Reports

Symposium on "New Discoveries Through Consilience in Orthopteran Systematics" at ICE2024

By MARIA MARTA CIGLIANO
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The 27th International Congress of Entomology (ICE2024) took place from August 25-30, 2024, in Kyoto, Japan. A total of 4,041 participants (4,278 including members of the public) from 82 countries and regions gathered at the Kyoto International Conference Center. During the Congress, I had the privilege of chairing a symposium titled "New Discoveries Through Consilience in Orthopteran Systematics," featuring several members of the Orthopterists' Society (Fig. 1).

Figure 1. Participants of the symposium

The symposium brought together a diverse group of graduate students and researchers, offering fresh perspectives and advancements in the diversity, taxonomy, phylogeny, ecology, and evolutionary studies of Orthoptera. It was a great opportunity to meet and engage with the seven speakers, and the talks were scientifically inspiring, offering new insights in Orthoptera research. The discussions that followed were stimulating and fostered a spirit of collaboration.

These summaries highlight the diverse topics and significant contributions made during the symposium, emphasizing the integration of taxonomic, phylogenetic, ecological, and conservation-focused research.

1. "Taxonomy and Natural History are Needed to Study Evolutionary Research Questions: The Case Study of Eneopterinae Crickets" - Tony Robillard

Tony Robillard from ISYEB, Muséum national d'Histoire naturelle, Paris, France, highlighted the essential role of taxonomic research in evolutionary studies. Using Eneopterinae crickets as a case study, he demonstrated how species traits, including behavior and ecology, enrich our understanding of phylogeny and biodiversity. He emphasized the complementarity between taxonomy and phylogenetic studies in revealing the evolution of communication in crickets and their biogeographic patterns.

2. "Ixalidiidae – A New Family of Acridoidea (Orthoptera) from Africa" – Claudia Hemp, Mark Ritchie, Maria Marta Cigliano, Klaus-Gerhard Heller, Jackson Linde, Onur Uluar, and Hojun Song

Claudia Hemp from the University of Bayreuth, Germany, introduced Ixalidiidae, a newly described family within Acridoidea, revealed through molecular phylogenetic studies. This small, flightless grasshopper family from East and Central Africa shows unique characteristics and behaviors, such as courtship drumming. The study also linked the family to the South American Tristiridae, suggesting a Gondwanan origin.

3. "The Phylogeny of Pygmy Mole Crickets (Orthoptera: Tridactylidae) Using Phylogenomic Data" – Brandon Woo, Jackson Linde, Julianne Allred, Katie Puperi, and Hojun Song

Brandon Woo from Texas A&M University, U.S.A., presented the first phylogeny of pygmy mole crickets, revealing monophyly of Tridactyloidea and resolving familial relationships. His findings highlighted inconsistencies between molecular and morphological classifications, providing a foundation for future biogeographic studies of this ancient Orthoptera group.

4. "Unlocking an Evolutionary Chorus: A Comprehensive Phylogeny of Tettigoniidae (Insecta: Orthoptera)" - Jackson B. Linde, Austin J. Baker, Seunggwan Shin, Duane D. McKenna, Michael F. Whiting, Fernando Montealegre-Z, and Hojun Song

Jackson Linde, from Texas A&M University, U.S.A., discussed advancements in the phylogenetics of Tettigoniidae (katydids), focusing on their acoustic communication. Using extensive taxon sampling and phylogenomic methods, the study clarified previously unresolved relationships within this diverse family, shedding light on their evolutionary history.

5. **"Orthopteran Studies in Mexico: Consilience Among Museum Specimens, Old Field Notes, Recent Fieldwork, iNaturalist, and Local Communities' Engagement" – Ricardo Mariño-Pérez**

Ricardo Mariño-Pérez from the University of Michigan, U.S.A., traced the history of Orthoptera studies in Mexico, highlighting a shift towards local involvement and collaboration in the 21st century. He emphasized the role of community engagement, museum collections, and platforms like iNaturalist in driving new research and fostering public participation.

6. **"Food Plant and Olfactory Perceptions in the Three Sympatric Species of New Zealand Alpine Grasshoppers" – Mari Nakano, Steven Alexander Trewick, Kye Chung Park, and Mary Morgan-Richards**

Mari Nakano from Massey University, New Zealand, investigated the dietary and olfactory preferences of three coexisting alpine grasshopper species in New Zealand. Her study found that these species are polyphagous, with no distinct plant preferences, and share heightened sensitivity to green leaf volatiles, suggesting similarities in their feeding habits despite differing microhabitat use.

7. **"Global Diversity Patterns in Orthoptera" – Maria Marta Cigliano, Maria Celeste Scattolini, Maria Belen Cabrera, Hernan Lucas Pereira**

In the final presentation, I shared the work of my research team, presenting our preliminary results from a macroecological study of Orthoptera, highlighting global biodiversity patterns. Using advanced modeling techniques, we identified richness peaks in tropical regions and revealed important "rich-rare" areas where species richness is high but range sizes are small, underscoring the significance of these patterns for conservation planning.

Proceedings of X Brazilian Orthoptera Symposium and III Orthopteroid Insects Symposium

By RAPHAEL AQUINO HELEODORO[1], LARISSA LIMA DE QUEIROZ[1*], DANIELA SANTOS MARTINS SILVA[2*]

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One of the most significant meetings for Brazilian Polyneoptera researchers is the Orthoptera Symposium, which has been held every two years since 2006. The event has already taken place in Recife (2006), Uberlândia (2008), Natal (2010), Botucatu (2012), Porto Alegre (2014), Cuiabá (2016), Foz do Iguaçu (2018), Águas de Lindóia (2020), and Viçosa (2022). The X Symposium of Orthoptera and III Symposium of Orthopteroid Insects took place in the city of Manaus, state of Amazonas, Brazil, between November 18 - 22, 2024.

The symposium's target was to spread the news about ecology, evolution, systematics, and other relevant points on Orthoptera and orthopteroid (Polyneoptera) studies. Likewise, we also wanted to draw attention to Brazil's crucial northern area and provide a space in which the researchers feel embraced and share their experiences and the hardships of becoming a scientist in the North. For those who are not familiarized with the socioeconomic reality of Brazil, the Northern region is the poorest, with lower rates of educational indexes, thus making a harder pathway to college in comparison to other regions of Brazil. In contrast, the North also has two of the main institutions of entomology research in Brazil: The National Institute for Amazonian Research (INPA) and the Paraense Museum Emilio Goeldi (MPEG).

Traditionally, the symposium attendants come from Brazi'sl South and Southeast regions, with some occasional participation from the North and Northeast. But this time, the symposium provided an opportunity for researchers from the North region to be integrated into this scientific community. This symposium edition was hosted at Amazonas Federal University (UFAM), one of the most significant public universities in Brazil, placed in the biggest urban forest fragment in the world (Fig. 1).

Figure 1. Federal University of Amazonas, photographed from above. Image from: realtime1.com.br/

The symposium was entirely free to

Figure 2. Organizing staff and attendees of the X Symposium of Orthoptera and III Symposium of Polyneoptera from Brazil.

Figure 3. Lectures from November 18. A) Dr. José Albertino Rafael; B) MSc. Leonardo Lanna and Lucas Fiat.

attract academics and students who couldn't afford the registration costs for pricey events. Thus, 85 attendants took part in every activity, which were conducted by 31 speakers, all of whom are specialists on different Polyneoptera orders (Fig. 2). The symposium had four different activities. First, speakers had the opportunity to share their knowledge in lectures of 30 minutes, followed by approximately 15 minutes of questions from the public. Twenty speakers gave 18 lectures during the conference. Second, the symposium had three roundtables, each with three speakers that had 20-minute presentations (60 minutes total), followed by one hour of discussions with those in attendance. Third, during the afternoon's coffee breaks, a total of 29 poster presenters shared their studies with the community for about an hour. Fourth, at the end of each day (starting from the second), the symposium had three conferences of training where the attendees had the opportunity to learn and develop practical skills on orthopteroid taxonomy and tools to study them. The complete schedule can be seen below:

<u>18 November 2024</u> (Fig. 3)

i. Lecture: 30 Years of training researchers in Polyneoptera in Northern Brazil, by Dr. José Albertino Rafael (INPA).
ii. Lecture: Science and imagination: Revealing the Amazon Rainforest in the search for praying mantis, by MSc. Leonardo Lanna and Lucas Fiat (Mantis project).

<u>19 November 2024</u> (Fig. 4)

i. Lecture: Project "Grasshoppers from Brazil", by Dr. Daniela Santos Martins Silva (Miami University).
ii. Lecture: From field to laboratory: how faunal inventories can contribute to the study of crickets, by MSc. Maria Vitória Alves Borille (National Museum of Rio de Janeiro).
iii. Lecture: Diversity of Acrididae: Leptismini /Caelifera, by Dr. Ana Lúcia Nunes Gutjahr (State University of Pará).
iv. Lecture: Predatory katydids in the Amazon: discoveries and surprises over the leaves, by Dr. Diego Matheus de Mello Mendes (Mamirauá Institute for Sustainable Development).
v. Roundtable discussions: Hardships and challenges of graduating in Brazilian northern region – Dr. Amanda Batista (Federal University of Amazonas), Dr. Larissa de Lima Queiroz, MSc. Rayssa Almeida de Azevedo, and Dr. Renato Almeida de Azevedo.
vi. Conference training: Phasmatodea Identification – MSc. Victor Ghirotto and Philip W. Engelking (Phasma project).

<u>20 November 2024</u> (Fig. 5)

i. Lecture: Value of training new taxonomists in Embioptera, by MSc. Paula Jéssica Costa Pinto (Federal University of Paraná).
ii. Lecture: Diversity of Zoraptera in Brazil, MSc. Sheila Pereira de Lima (INPA).
iii. Lecture: The "forgotten" Orthopteroids in Polyneoptera: Rediscovering the diversity of Plecoptera, by Dr. Tácio Vitor Duarte Simões (Centro de Investigación Esquel de Montaña y Estepa Patagónica).
iv. Lecture: Spectroscopy as a tool to support Taxonomic decision, by MSc. Rayssa Almeida de Azevedo.
v. Lecture: Roundtable discussions: The importance of the male genitalia in Polyneoptera – Dr. Fernando Campos De Domenico (Zoology Museum of São Paulo University), Dr. Lucas Denadai de Campos (University of São Paulo), and Dr. Raphael Aquino Heleodoro (INPA).

Figure 4. Photos from November 19. A) Dr. Diego M. M. Mendes at Roundtable 1; B) Dr. Daniela S. M. Silva at her lecture on "Project Grasshoppers from Brazil"; C) Dr. Amanda Batista at Roundtable 1; D) Attendees during coffee break and posters presentation; E) Attendees at the conference training of Phasmatodea Identification.

Figure 5. Photos from November 20. A) MSc. Sheila P. Lima at her Lecture on Zoraptera; B) Dr. Tácio Duarte on his Lecture on Plecoptera; C) Roundtable 2, from left to right: Dr. João Rafael Oliveira, Dr. Renato Azevedo and Dr. Neucir Szinwelski; D) Attendees during coffee break and posters presentation; E) Attendees at the conference training of Grasshoppers Identification.

vi. Lecture: Conference training: Grasshoppers Identification – Dr. Daniela Santos Martins Silva, and MSc. Larissa de Lima Queiroz (project "Grasshoppers from Brazil").

<u>21 November 2024</u> (Fig. 6)

i. Lecture: Mapping the gap in the knowledge of Orthoptera biodiversity, by Dr. Rodrigo Antônio Castro Souza (Mato Grosso Federal University)

ii. Lecture: Proscopiidae as a forest pest in Brazil, by MSc. Maicon dos Santos da Silva (Paulista State University).

iii. Community ecology and morphological variation of leaf litter crickets, MSc. Nádia Kroth (Viçosa Federal University)

iv. Lecture: The importance of systematics for biological classification: identifying and solving taxonomic inconsistencies in katydids (Orthoptera: Tettigoniidae), Dr. Marcos Fianco (Paraná Federal University).

v. Roundtable discussions: Polyneoptera Ecology in Brazil: Past, Present, and Future – Dr. Neucir Szinwelski (West of Paraná State University), MSc. Nádia Kroth (Viçosa Federal University), Dr. Raphael Aquino Heleodoro (INPA), and Dr. Renato Almeida de Azevedo (INPA).

vi. Conference training: Spectroscopy in Taxonomy – MSc. Rayssa Almeida de Azevedo (INPA) and Dr. Renato Almeida de Azevedo (INPA).

<u>22 November 2024</u> (Fig. 7)

i. Lecture: Mantodea: A brief approach to this fascinating order, MSc. César Augusto Chaves Favacho (MPEG)

ii. Lecture: When was the last time you heard about Dermaptera?, by Dr. Raphael Aquino Heleodoro (INPA)

iii. Lecture: Vertical stratification and taxonomy of Blaberidae Burmeister, 1829 (Blattodea) in a tower in

Figure 6. Photos from November 21. A) MSc. Maicon Silva at his Lecture on Proscopiidae; B) Dr. Nadia Kroth on her Lecture on Orthoptera Ecology; C) Dr. Marcos Fianco on his Lecture on Tettigoniidae; D) Roundtable 3, from left to right: Dr. Fernando Domenico, Dr. Lucas Denadai, Dr. Raphael A. Heleodoro; E) Attendees at the conference training of Spectroscopy in Taxonomy.

the Central Amazon, by Walterley Vilhena Pereira Filho

iv. Lecture: The Global Phasmatodea research: Status and perspectives, by Phillip W. Engelking and MSc. Victor Ghirotto (Phasma project)

v. Conference training: How to use Helicon Remote to photograph large insects, Dr. Gustavo Costa Tavares (Federal University of Pará)

In summary, the X Brazilian Orthoptera Symposium and III Orthopteroid Insects Symposium established themselves as fundamental events for the integration and strengthening of the scientific community dedicated to the study of Polyneoptera in Brazil. For the first time, the event featured specialists from all Polyneoptera orders occurring in Brazil, including Zoraptera, Embioptera, and Dermaptera. This edition, held in the Amazon, highlighted the biological richness and scientific potential of the Northern region while addressing challenges related to regional inequalities. With a diverse and accessible program, the Symposium fostered knowledge exchange, encouraged the formation of new partnerships, and provided an inclusive space for researchers and students, especially for those from Northern Brazil. The event reaffirmed its commitment to science, education, and the appreciation of biodiversity, leaving an inspiring legacy for future generations of entomologists. Our deepest gratitude to The Orthopterists' Society for financial support, The Zoology Postgraduation Program of the UFAM, INPA, and the Grasshoppers from Brazil project for providing logistical support.

Figure 7 (below). Photos from November 22. A) Philip W. Engelking and MSc. Victor M. Ghirotto on their Lecture on Phasmatodea; B) MSc. César Favacho on his Lecture on Mantodea; C) Orthoptera researchers from Brazil, from left to right: Dr. Fernando Domenico, Dr. Diego M. M. Mendes, Dr. Marcos Fianco, Dr. Pedro S. Dias, Dr. Carlos Elias and Dr. Ana Lúcia N. Gutjahr; D) Dr. Pedro S. Dias discussing the future of the Symposium with the attenders; E) Attenders and organizing staff at the end of the event.

Treasurer's Report

By PAMELA MIHM
Treasurer
p.mihm@regency-multifamily.com

The Statement of Assets as of December 31, 2024 and the 2024 Summary of Cash Receipts and Expenditures are shown below. The Orthoptera Species File (funded by an endowment from the University of Illinois) and publishing the *Journal of Orthoptera Research (JOR)* are the two largest uses of resources. The Society's total assets increased from $1.7 million at the end of 2023 to $1.8 million at the end of 2024. We have $50,000 set aside in an interest-bearing certificate of deposit for the 2026 Congress, which will be held in Argentina. We continually evaluate the Society's investments to ensure we have diversification that produces healthy income and growth in value. If you have any questions, please contact me at at **p.mihm@regency-multifamily.com**.

Orthopterists' Society
Statement of Cash Receipts and Expenditures
(1/1/24 through 12/31/24)

Cash Receipts	
Dues	$4,595.00
Publications	2,590.00
Community Foundation endowment	11,864.13
Royalty and revenue sharing	4,572.12
Book reimbursements	40.00
Transfer cash from Vanguard & Wells Fargo	33,600.00
Proceeds from sale of investments	92,500.00
University of Illinois allocation	253,000.00
Total Cash Receipts	$402,761.25
Cash Expenditures	
Publisher JOR	$6,213.73
Pensoft Publishers	17,007.06
JOR assistance	12,000.00
Research grants (Ted Cohn)	15,000.00
Executive director remuneration	1,500.00
Ed. Metaleptea remuneration	1,500.00
Assistant Ed. Metaleptea remuneration	1,000.00
Assistant Finance remuneration	1,500.00
Webmaster remuneration	500.00
JOR editor remuneration	3,000.00
Maintenance of Orthoptera Species File	205,000.00
Grants-Orthoptera Species File	48,489.00
Professional fees (income tax preparation and audit)	6,573.00
Webmaster SINA site support	3,600.00
AAIS-support for Congress	1,000.00
Accounting	12,000.00
Congress 2026 set aside CD	50,000.00
Airtable database consulting & software	2,740.00
ICE registration reimbursement	1,299.05
Contribution for publishing book	5,440.10
Orthoptera and Orthopteroid symposiums	5,000.00
Other	2,028.28
Total Cash Expenditures	$402,390.22
Cash Receipts over Cash Expenditures	$371.03
Beginning Cash Balance	10,715.09
Ending Cash Balance	**$11,086.12**

Orthopterists' Society
Statement of Assets
(As of December 31, 2024)

Cash		
Paypal cash balance	$151.24	
Chase Bank	10,934.88	
		$11,086.12
Investments at market value		
Vanguard:		
Grants (Note 1)	$479,866.84	
Operating (Note 2)	788,636.21	
		$1,268,503.05
Wells Fargo:		
AAAI (Note 3)	$18,754.26	
Endowment (Note 4)	50,560.21	
Operating (Note 2)	392,972.03	
Grants (Note 1)	105,751.34	
		$568,037.84
Total assets		**$1,847,627.01**

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

Editorial

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

Sometimes, people ask me how I became interested in grasshoppers. Ever since I was little, I have always been fascinated with insects. My childhood dream was to become an entomologist and I am one of the lucky ones who made my dream come true. I remember that I enjoyed catching grasshoppers as a kid in the 80's. I did not know the scientific names of the species I was catching then, but now I know that *Oedaleus infernalis* and *Acrida cinerea* were some of the common species that I used to catch a lot. This childhood memory is not why I decided to study grasshoppers and the actual turning point came later.

When I was an undergraduate student at Cornell, I happened to read a book titled "*Locust Handbook*" by A. Steedman. It's a classic book on locust management, published by the Natural Resources Institute in London. I don't remember how I ended up borrowing that book from the library, but I remember reading that book from cover to cover because the biology of the desert locust was so fascinating. The book showed a picture of a desert locust swarm from northern Africa. Somehow that picture made a profound impression on me, which prompted me to learn more about locusts.

When I started as a graduate student, I wanted to study the evolution of swarming behavior in locusts, which introduced me to the wonderful genus *Schistocerca* to which the desert locust belongs. I remember the late Ted Cohn jokingly telling me not to work on the genus because he told me it was difficult. Well, Ted was not wrong in saying that. *Schistocerca* is a taxonomically challenging group to work with, but it has opened so many doors for me, and I don't regret working on this group at all.

The study of grasshoppers (which has eventually expanded to all orthopterans) is not only my academic pursuit, but also somewhat of a personal obsession. Orthopteran insects are just amazing and I am so glad to see that we now have many young orthopterists from around the world studying these wonderful creatures. I will continue to do my part to support the community.

This issue of *Metaleptea* is a monster issue with many articles and contributions. Our society is vibrant and strong. Although the political climate is depressing for us scientists, I am hopeful that we will persevere. I am also very excited about the upcoming ICO in Patagonia. It will be an opportunity to look back and see how much we have grown as a society, and I look forward to meeting many young orthopterists in person!

I want to thank our Associate Editor, Derek A. Woller, for his continued assistance in the editorial process during his busy schedule.

To publish in Metaleptea, please send your contribution to **hsong@tamu.edu** with a subject line starting with **[Metaleptea]**. The next issue of *Metaleptea* will be published in May of 2025, so please send me the content promptly. I look forward to hearing from you soon!

Officers of the Orthopterists' Society