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METALEPTEA

THE NEWSLETTER OF THE ORTHOPTERISTS' SOCIETY

President's Message

By DAVID HUNTER
President
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Dear Society Members,

A Happy New Year 2022 to everyone – wishing you every success in what continues to be trying circumstances. While there is a great deal of uncertainty, we are making plans for the next Congress at Mérida in the Yucatán Peninsula of México. One of our local members, Mario Poot Pech, has been looking into venues that are at a very reasonable price and has received a lot of support from national organisations that are keen to send about 50 delegates to the Congress, which will give us a good basis for overall attendance. The plans are for both on-site and virtual presentations as part of the congress, but the ratio between on-site and virtual is difficult to determine at this stage, so plans will be made for various levels. I continue to believe that COVID-19 will be at a much lower level by the time of the Congress due to increasing vaccinations and the current Omicron variant spreading so rapidly giving us a form of herd immunity. I know planning ahead is difficult for all of us, including planning for the Congress itself, but to help us with the overall planning, think about what you can do regarding either coming to the Congress in person or taking part virtually. The plan is to ask you about your attendance preferences when we send out membership renewal reminders in March.

I also bring to your attention our annual call for applications for the Theodore J. Cohn Research Fund. If you are a student or Postdoctorate member of our Society or have members in your research group who are, we encourage applications ahead of the March 31st deadline. Reports on the work of past successful applicants are regularly included in *Metaleptea*. Application details are in this issue and on the Orthopterists' Society website.

Of course, all of us are continuing our work in ways that work for our circumstances and once again I present another excellent *Metaleptea*, thanks to Hojun Song and Derek A. Woller. Wishing everyone a very prosperous 2022!

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The Theodore J. Cohn Research Fund: A new call for applications for 2022
(Application Deadline: March 31, 2022)

By MICHEL LECOQ
Chair, Theodore J. Cohn Research Fund Committee
mlecoq34@gmail.com

Dear fellow Orthopterists,

I have the pleasure to announce a new call for applications for The Theodore J. Cohn Research Fund. This research grant is primarily to fund research projects in Orthoptera (*sensu lato*) by young researchers, often as part of a master's or Ph.D., though Postdoctorates may also be funded. A total amount of $15K per year is available and it is possible to fund research grants for up to $1,500 per grantee.

I particularly encourage students and young researchers from 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.

Full detailed information can be found on the Orthopterists' Society website, on the "Grants & Awards" page:
http://orthsoc.org/resources/grants-awards/the-theodore-j-cohn-research-fund/

Proposals should be submitted in the suggested format and limited to the number of pages indicated. As usual, proposals should be submitted at the following address:
Michel Lecoq, Manager, The Ted Cohn Research Fund
e-mail: mlecoq34@gmail.com

As a reminder, those whose projects have been selected are required to submit an article presenting their main results in a future issue of *Metaleptea*.

I wish all of you the best for the year 2022!

The 2022 OSF Grants Funded

By MARIA MARTA CIGLIANO
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Dear members of the Orthopterists' Society,

As you might have noticed, the number of OSF grant reports published in the recent issues of *Metaleptea* has been gradually reduced since several projects needed to be postponed due to COVID-19 travel restrictions. Only a few projects could be carried out during the past two years.

By the end of 2021 the OSF grants committee received and evaluated 13 proposals by applicants from eight countries: Austria, Brazil, Croatia, India, Nepal, Pakistan, Philippines, and the U.S.A. The eight proposals listed below from four countries were funded and were selected based on the amount of data (images, specimen records, and sounds) expected to be added to the Orthoptera Species File. Also considered were the candidates' expertise, if the proposal was related to a research project, and the adequacy of the budget.

Projects funded for 2022

Austria

1) Ivković Slobodan (Trier University, Germany) and **Horvat Laslo** (Austria)
Taxonomy, bioacoustics and distribution of Orthoptera in the Western Balkans (Montenegro and North Macedonia)

Brazil

2) Riuler Corrêa Acosta (Universidade Federal Do Rio Grande Do Sul - Brazil)
Singers Orthopterans: bioacoustics of southern species Rio Grande do Sul, Brazil

3) Gustavo Costa Tavares (Universidade Federal do Para, Brazil)
The Ensifera fauna awaiting indoors: a study on the Ensifera housed in the Laboratory of Invertebrates of Universidade Federal do Pará (UFPA), Brazil

4) Phillip Engelking (Universidade Estadual Paulista Júlio de Mesquita Filho, UNESP, Brazil)
Species of Tettigoniidae without photos in the Orthoptera Species File of two collections of USA

5) Marcos Fianco (Federal University of Paraná, Brazil)
The poorly illustrated Phaneropterinae (Orthoptera: Tettigoniidae) de-

posited in the Naturhistorisches Museum Wien (NMW), Wien, Austria

6) Victor M. Ghirotto (Museu de Zoologia da Universidade de São Paulo, São Paulo - São Paulo, Brazil)
Documenting the types of poorly known Ensifera: Orthoptera in European museums

India

7) Dhaneesh Bhaskar (Regional Vice-Chair for Asia IUCN SSC Grasshopper Specialist Group, India)
Orthoptera diversity, distribution and ecology in Nigriri Biosphere reserve, India and Field visit to Sri Lankan type localities covering the Orthoptera Types in the National Museum (CNMS) Colombo, Sri Lanka

Philippines

8) Jewel Anne G. Salvador (College of Biological Sciences Mindanao State University-Iligan Institute of Technology, Philippines)
Delineating Species Boundaries of Ensifera (Orthoptera) in Agusan del Sur, Eastern Mindanao, Philippines through Bioacoustics and Morphological Analysis

Announcement: Creation of the Feraki Fund

Facilitating Orthoptera Research in Greece, the Balkans, and Turkey

By LUC WILLEMSE
Senior Collection Manager Orthopteroids
Chair CETAF Collections Group
Naturalis, Leiden, NETHERLANDS
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On December 1, 2021, the Feraki Fund was formally created by the signing of a memorandum of understanding (MoU) by representatives of the Hellenic Zoological Society, the Grasshopper Specialist Group, and the Willemse family. The fund is named after Fer Willemse, who devoted his life to the systematics of Orthoptera with a special focus on Greece. During his many collecting trips across Greece, spanning a period of almost 40 years, he not only discovered a large number of species not previously known to occur in Greece, but also more than 50 taxa new to science. With his zeal and dedication in mind the "Feraki Fund" is meant to assist and, hopefully, stimulate young, enthusiastic researchers with their studies on Orthoptera in Greece, the Balkans, and Turkey.

Research eligible for funding

The Feraki Fund supports research aimed first and foremost at the Orthoptera fauna of Greece, but funding proposals for research taking place in the Balkans or Turkey will also be taken into account. As to the type of research that is eligible for funding, this mostly includes studies involving or being the result of fieldwork of some kind: taxonomy, systematics, and phylogeny of Orthoptera, faunistics (including studies on species distribution), conservation (including studies on endangered Orthoptera and their threats), and ecology (including studies on habitat preferences or population modelling). Although the main aim of the Feraki Fund is to stimulate research on the order of Orthoptera itself, applications for other orthopteroid orders, like Blattodea, Mantodea, Phasmatodea, and Dermaptera will be considered as well. Overall priority will be given to studies focusing on the conservation of endemic species and species that globally or nationally have been assessed as critically endangered, endangered, or vulnerable.

Costs covered by the Feraki Fund

The total amount available for funding each year is at least € 2,000. Depending on (extra) donations and/or available funds not being fully utilized, the amount may be raised. Depending on proposals submitted and budgets requested, the total yearly amount will normally be allocated to a single proposal, but, on an exceptional basis, may also be divided over several proposals. The Feraki Fund can be used as a scholarship or to cover travel expenses (fuel, car rental), subsistence expenses (accommodation and food), field and lab equipment, and consumables for research. Other expenses, such as congress attendance, are eligible, but only in the context of other costs applied for as part of an ongoing research project. The above costs refer to the applicant and potential volunteers involved in the fieldwork and should be spent in the period indicated in the application, but within two years after having received confirmation of the funding.

Who may apply

The Feraki Fund does not impose

any restrictions on applicants, like age, educational level, or nationality, but especially targets undergraduate and post-graduate students, young researchers, and early career scientists.

Applications

Applications can be submitted throughout the year, but are only reviewed once each year. Deadline for submission is 15th of December. Results are announced by 15th of February each year. An application form can be downloaded via this website: https://www.hzoos.gr/en/orthoptera-grant; once filled in, it should be sent to FerakiFund@gmail.com.

Postdoctoral scholar position in Oedipodinae biogeography

By TEREZA JEZKOVA
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An NSF-funded postdoctoral position is available in the Jezkova Lab at Miami University to investigate spatial patterns and mechanisms driving diversification of Oedipodinae grasshoppers.

Duties/Physical Demands:

- Collect specimens of Oedipodinae grasshoppers across the US and Mexico
- Prepare voucher specimens and curate tissue collection
- Generate and analyze genomic data
- Present data and write manuscripts
- Provide guidance and mentoring for graduate and undergraduate students in the lab
- Participate in yearly Bioinformatics Workshop and First Year Research Experience (FYRE) Program

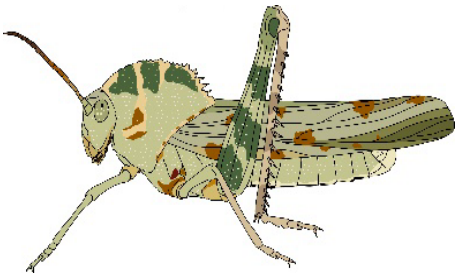
Minimum Qualifications:

Ph.D. in biology with focus on insect ecology or evolution. The candidate must have the ability to engage in rigorous field work, must have a driver's license, and be able to travel between the U.S. and Mexico. The candidate must be highly motivated.

Desired Qualifications:

Favorable consideration may be given to candidates who have experience with insect collecting and curation, systematics, and phylogenetics. Strong computational skills and experience with genomic approaches are preferred but not required. The candidate should be able to work both independently and collaboratively within a multidisciplinary research environment and have excellent written and oral communication skills.

Preferred Start Date:
May 1st 2022



Salary: $50,000/year + benefits

To apply, please send **(1)** a cover letter that explains your research interests and experiences, **(2)** your current Curriculum Vitae, and **(3)** contact information for three references as a single PDF file to Dr. Tereza Jezkova (jezkovt@miamioh.edu). Please include "Postdoc application plus name" in the subject line when you apply for this position. Screening of applications will begin on **February 18th** and will remain open until filled. Initial appointment will be one year, renewable up to three years based on performance.

Updates from the Global Locust Initiative

By MIRA WORD[1] & RICK OVERSON[2]
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[2]Co-director, GLI, roverso@asu.edu
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Hello, fellow orthopterists!

As many of you know, we launched a new online home for the Global Locust Initiative (GLI) Network. As HopperLink turns a year old, the community has grown to 170 members from 35 different countries and 78 distinct areas of expertise. We are encouraged to see the dynamic discussions, virtual networking, and exchanges of resources taking place between researchers, students, and practitioners across continents. Thank you to everyone who has helped make the community a success. We encourage everyone with an interest in Orthoptera and surrounding research and management topics to join us by tak-

Figure 1. Filming "Deep Look". (Photo by Mira Word)

Figure 2. Students engaging with the experiments on the biomechanics of wing expansion in locusts. (Photo by Mira Word)

ing a moment to create a profile.

Researchers in the GLI Laboratory and partners continue to make strides on projects at the intersection of ecology, physiology, governance, and livelihoods. For more details on our active NSF CAREER and BPRI biology projects, as well as our community-based USAID project, check out the GLI website. A recap of the South American locust governance workshop supported by FFAR and ASU's Swette Center and led by Dr. Clara Therville (Postdoctoral Research Associate) and Dr. Marty Anderies (ASU Professor, Sustainable Food Systems) is now available on our website in English and Spanish. This project is studying complex feedbacks within social-ecological-technological systems and comparing locust governance across species and countries.

Recently, the GLI Lab had the opportunity to host several notable visitors, including scholars, teams of undergraduate researchers, and documentary filmmakers. In September, we hosted the filming of a PBS Digital Studios, "Deep Look" documentary on locust biology in the GLI Lab facilities (Fig. 1). In October, Drs. Mary Salcedo & Jake Socha from Virginia Tech engaged a large team of undergraduate students in an intensive, week-long experiment to understand the biomechanics of wing expansion in locusts (Fig. 2). GLI Lab was also excited to host Drs. Lucile Marescot and Shawn Wilder this December who presented research, respectively, on population dynamics and management of the Senegalese grasshopper, and predator biology and nutritional ecology.

Regional Reports - What's happening around the world?

West Europe

By GERLIND U.C. LEHMANN
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The global situation is as restrictive in Europe as elsewhere in the world, hindering scientific cooperation and exchange. Field work, especially, is harder to organize these days and travel difficulties are a general threat for ongoing research. Laboratory work is equally affected by restrictions and shortage of laboratory material. Several congresses have been postponed in the region. With great hope we are looking forward to the third European Congress on Orthoptera Conservation (ECOCIII) combined with the 16th biannual meeting of the DGfO (German Society of Orthopterology) to be scheduled for 1-2 April 2022 at the Naturalis Biodiversity Center in Leiden, Netherlands. We hope for a successful meeting in April after two attempts and you are warmly invited by the Organizers at Naturalis.

Also, from Naturalis, Roy Kleukers and colleagues were visiting eastern Germany last autumn to inspect one of the last remaining populations of the groundhopper ***Tetrix bipunctata*** in the mainland of Central Europe. The Orthoptera working group of Brandenburg used this visit for a joint excursion at the former military training ground Trampe (Fig. 1).

CaBOL – Caucasus Barcode of Life

A new multinational project has evolved in the Caucasus region funded by the Germany Research Ministry BMBF, aiming to catalogue numerous animal and plant species of the Caucasus. Based on previous projects, the Caucasus Barcode of Life (CaBOL) research initiative makes use of barcodes for applied biodiversity research. Likewise, it is structured to support and expand the educational

Figure 1. The Orthoptera working group of Brandenburg visiting eastern Germany to collect *Tetrix bipunctata* (Photos by Gerlind Lehmann).

Figure 2. The southeastern part of Georgia is covered by a steppe-like vegetation, inhabited by a variety of grassland grasshoppers, Acrididae and Oedipodinae species. (Photo by Gerlind Lehmann).

Figure 3. In the north of Georgia the Caucasus mountains are a massive barrier spanning from the Black Sea in the West towards the Caspian Sea in the East. The typical high mountain vegetation is heavily grazed by cows, like in other high-altitude habitats. Together with some widespread species, subendemics, like the tiny *Chorthippus demokidovi*, inhabit this region. (Photo by Gerlind Lehmann).

Figure 4. The *Chorthippus biguttulus* group still needs a serious revision in the Caucasus area. This dark and colorful representative is found on mountainous gravel in the Kazbek-area at an altitude of 2200 m, nearly topotypical to material taken by Ramme on his ground-breaking expedition nearly a century ago (see Ramme 1951 Mitt. Zool. Mus. Berlin on his expedition to the Caucasus and Persia). (Photo by Arne Lehmann).

Figure 5. Photo documentation of one sampled specimen, showing a male *Oedipoda miniata* placed on a grid for size comparison along with its CaBOL accession number. (Photo taken by Eka Arsenashvili).

infrastructure in the Caucasus region. CaBOL is a collaborative project by partners from Armenia (Scientific Center of Zoology and Hydroecology, Yerevan; Yerevan State University), Georgia (Agricultural University of Georgia, Tbilisi; Ilia State University, Tbilisi), and Germany (Georg-August-University Göttingen; University of Koblenz-Landau) under the organizational leadership of the Zoological Research Museum Alexander Koenig, Bonn, Germany. The infrastructure created through CaBOL ensures scientific training regarding modern methods in the Caucasus and, thus, strengthens social and economic development in a region with a very high and, at the same time, threatened biodiversity. Last autumn we started an Orthoptera working group within CaBOL with the cooperation of the ZFMK, the Museum Hamburg, the two Georgian Universities, and independent experts. A field trip in September 2021 was the starting point for this collaboration. We managed to sample in most major geographic regions of Georgia (Figs. 2 and 3) resulting in material from approximately 20% of the known species (Fig. 4).

The collected material is now managed by the Ilia State University, Tbilisi, organizing the samples along with a photographic documentation for further studies (Fig. 5). The specimens will later be sequenced for the barcode reference library.

Existing samples will be incorporated into the workflow and new collections will increase the number of available species. Further collection trips to Georgia and Armenia are planned for 2022. However, the Caucasus region is still under-explored and any help is highly welcomed. We warmly invite our colleagues to help with records and material, and encourage you to visit this biogeographically interesting region. Don't hesitate to contact me for further correspondence.

Middle East - Caucasus

By BATTAL ÇIPLAK
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As with the whole world, the communities in the Middle East and Caucasus suffered from the COVID-19 pandemic and the conditions still have not returned to normal life yet. Several times people were housebound, travelling and meetings have been forbidden, and orthopterists could not go for field studies. Also, an online life, from regular courses to shopping, has been imposed on people. Sometimes, COVID-19 was an excuse to impose some unexpected rules. These conditions have become tough because of the conflicts and wars in the region as always.

Although orthopterists in the region lived under these conditions, they still continued to produce data on Orthoptera. We encountered 13 publications on Orthoptera of the region when we searched the electronic mediums for 19 countries in the regions by the keywords "Orthoptera, country, 2021". Content of the publications was diverse. Four publications were with taxonomic/faunistic content, three with pest management content, three with phylogenetic content, two with anatomical content, and one with parasites of Orthoptera. Regarding the conditions in the region, we consider this a significant number.

Orthoptera conservation activities have also been conducted. The

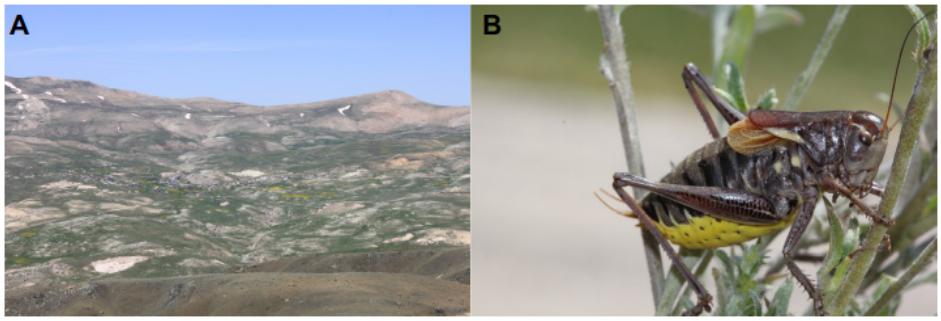

Figure 1. The male of *Psorodonotus ebneri* and a view of its "Noah's Ark," the Beydağları Mts.

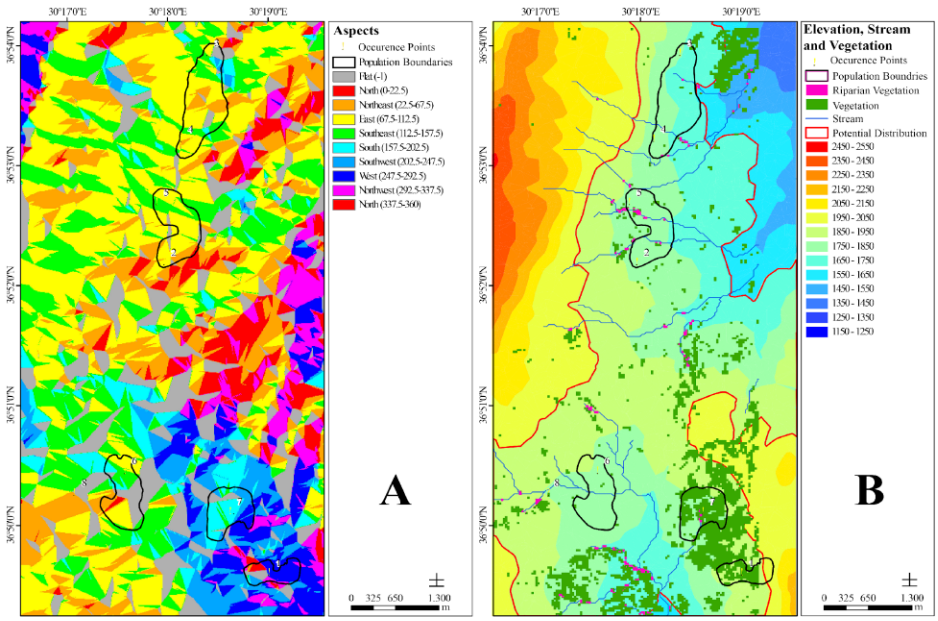

Figure 2. Map showing the characteristics of the range area of *Psorodonotus ebneri.*

Middle East and Caucasus consist of many glacial refugia, such as Anatolia, Caucasus, and Caspian Sea Depression, and the highlands in these refugia harbour many endemic cold-adapted species. Regarding the mythology of the region, we named the summits in the region as "Noah's Ark." An example of one such species that we have monitored/studied is the Beydağları bush cricket *Psorodonotus ebneri* (Fig. 1), with assistance from The Mohamed bin Zayed Species Conservation Fund (https://www.speciesconservation.org/). The project has just been finalized and we arrived at the following conclusions, in summary. From the obtained data the main ecological conditions determining the range limits of *P. ebneri* were determined to be as follows (Fig. 2): (i) 1750- 1950 m elevation; (ii) the high grass meadows of mountains in forest opening, (iii) the east and southeast facing, (iv) the terra rosa Mediterranean soil, (v) the 0-10 °C temperature for egg period and 15-20 °C for live period, and (vi) the humidity of %RH 90-100. The live forms (nymphs + adults) were observed during early-May to late June. Therefore, their hatching, molting, and egg-laying periods in total last about 60 days. This altogether demonstrates that the Beydağları bush cricket is a stenobiont insect demanding very narrow ecological conditions. Under these conditions we classify it as "critically endangered" and the main threat to the species is global warming. Based on this conclusion, cold-adapted species restricted to summits in the refugia of Middle East/Caucasus, and those in other glacial refugia as well, should be considered doomed species.

North America

By KATHLEEN KING
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Despite winter weather and complicated COVID-19 situations, Orthoptera research activities are prevailing. The Global Locust Initiative (GLI) has been quite active and a detailed update can be found in this issue in the article entitled "Updates from the Global Locust Initiative." Other exciting Orthoptera news comes from the United States Department of Agriculture (USDA). The USDA's Rangeland Grasshopper and Mormon Cricket Management Team was in New Mexico for two months (May and June) for its annual summer field season. During this period, grasshopper populations were monitored across several large acreage experiments to assess the effects of different aircraft nozzles, varying insecticide rates, and different types of adjuvants when deployed via piloted fixed-wing aircraft and unmanned aircraft systems. Two cage experiments were completed that focused on assessing the effects of biopesticide baits that incorporated fungal pathogens (Fig. 1). Data analyses from these experiments are ongoing and results will be presented at February's annual National Grasshopper Management Board meeting, during which many people involved with grasshopper management in the U.S. and Canada meet to discuss current research and topics of interest. In other USDA grasshopper-related news, Chris Reuter (Fig. 2) retired at the end of 2021 after 43 years with the Team. Nelson Foster (recipient of the 2013 Sir Boris Uvarov Award in Applied Orthopterology) hired Chris not long after he started his own career with the USDA and Chris has arguably become one of the most proficient living identifiers of at least U.S.-based grasshopper species, focusing primarily on rangeland species of all life stages. Travis Hitchner (Fig. 2) has been hired as Chris's replacement and is doing his best to learn as much as he can as fast as he can.

Figure 1. The USDA's Rangeland Grasshopper and Mormon Cricket Management Team (left to right: K. Chris Reuter, Travis Hitchner, Lonnie R. Black, and Sage Nabity Stroh; not pictured: Derek A. Woller) hard at work on a New Mexico rangeland setting up a biopesticide bait cage experiment.

Some exciting Orthoptera activities are also happening at the University of Lethbridge in Alberta, Canada. Working under supervisor Dan Johnson, Sejer Meyhoff defended his MSc in Environmental Science at the University of Lethbridge (Alberta, Canada) on the important role of grasshoppers, especially *Melanoplus dawsoni*, in the later summer and fall diet of sharp-tailed grouse. Sejer not only determined the relative frequency in the diet, but used stable isotopic analysis to track the contributions in the growth of feathers over time. Nick Hassink who is working under Dan Johnson and Phil Bonnaventure has completed a two-year study of microclimate and soil temperature in the Rocky Mountains of Castle Provincial Park of Alberta with relevance to the distribution of arthropods, such as mountain Orthoptera, and grylloblattids. Microclimate recording stations and the results of pitfall traps and

Figure 2. The USDA's Rangeland Grasshopper and Mormon Cricket Management Team's K. Chris Reuter (left) passing on his identification skills to his successor, Travis Hitchner (right), and the Team's other intern during the summer field season, Sage Nabity Stroh (middle).

sweep nets show the pattern of distribution. The University of Lethbridge grasshopper development model (Lactin et al., 1995) is currently being mapped onto the mountains. Dan Johnson completed a compilation of 50 years of grasshopper survey data comprising 74,000 sites in collaboration with Alberta Agriculture and Forestry, and Agriculture and Agri-food Canada. The compiled data was then used to model the unusual two-year oscillations in northern counties versus smoother population trends in the south, and compare trends to broader weather patterns and molecular biology. Additionally, surveys of species and ages at key rangeland, natural, and cropland sites during 2019-2021 were used to compile the current drafts of photo guide books. Dan also worked towards completing a study of possible biocontrol of airfield grasshoppers for reducing bird strike risk to aircraft, in collaboration with military and commercial airports and the Bird Strike Association of Canada. Progress on this project during 2020-2021 was limited due to pandemic restrictions.

The Entomological Society of America Branch Meetings and International Branch Meeting are forthcoming. The Eastern Branch Meeting and Southeastern Branch Meeting are in person in March. The North Central Branch, Pacific Branch, and Southwestern Branch Meetings are in person in April. The International Meeting is virtual and will be held in April. More information on these meetings can be found here: https://entsoc.org/events/branch-meetings.

Orthoptera Species File Grant Reports

The Ensifera fauna from Guartelá State Park, Paraná State, Brazil

By MARCOS FIANCO
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Dear fellow orthopterists, I am pleased to report the results of the grant that I earned supporting the Orthoptera Species File (OSF) regarding the fauna of Ensifera from Guartelá State Park (GSP) in 2019. The GSP is inserted in the second Paraná plateau, in the municipality of Tibagi. GSP covers a small area of about 798 ha that is part of the Environmental Protection Area of the Devonian Escarpment. It is a highly important park due to the vegetation that it preserves, the Atlantic Forest and the Cerrado, the latter of which is the austral limit of its formation in Brazil, a remnant of the Pleistocene Period (2.5 m.y.a. – 11.7 kya) with semiarid characteristics, which has never been studied so far regarding the faunal composition of Ensifera. The GSP houses the greatest canyon in Brazil, the Guartelá Canyon, of about 30 km (Fig. 1A), and an important archaeological site, with rupestrian paintings that date back more than 8,000 years. Though relatively small, the GSP altitude ranges from 780 m to 1160 m, with the Cerrado formation occupying the higher altitudes and Atlantic Forest the lower altitudes, and advancing on dry areas through springs, slopes, rivers and streams (Fig. 1B and C). Given this scenario, an inventory of the ensiferans became quite important.

The collecting efforts took place from January 2020 to March 2021. I was able to make the first sampling effort from 20-23 January 2020. However, the COVID-19 pandemic started soon after and the GSP remained closed until October 2020. After the reopening of the park, I had the help of some colleagues to make six more collecting efforts at the GSP: Dr. Neucir Szinwelski, Hemanueli Preis (a young orthopterist), Phillip W. Engelking (a young orthopterist and phasmatologist), and Dr. Diego N. Barbosa (a hymenopterist from my lab). As the pandemic was at its worst in Brazil, we did COVID-19 tests at the university before the field trips to make sure we didn't have the virus

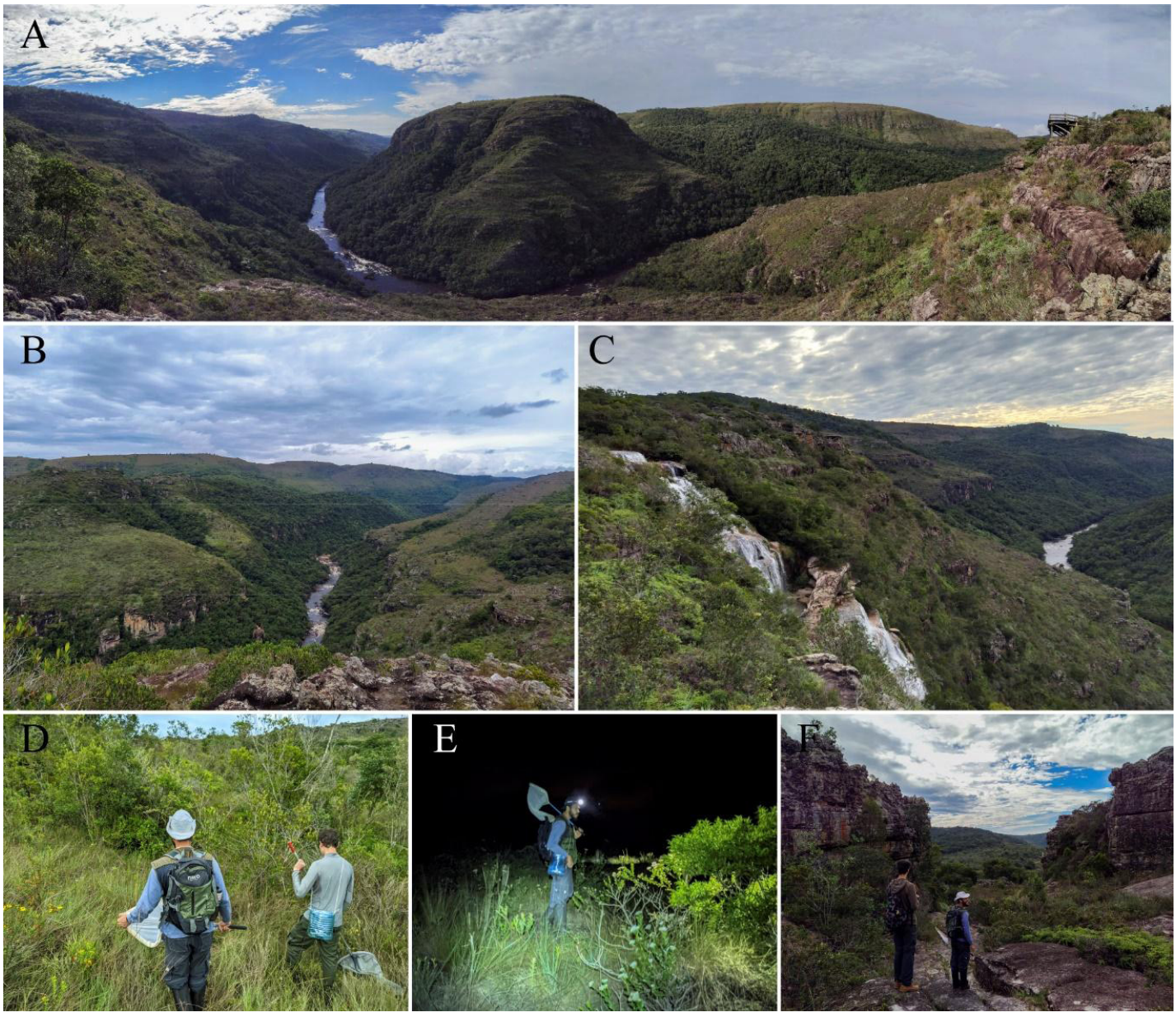

Figure 1. Guartelá State Park. **A+B:** Guartelá Canyon; **C:** Vegetal formations, notice the Atlantic Forest (lower altitudes) advancing on dry areas of Cerrado formations (higher altitudes); **D:** me and Dr. Diego N. Barbosa collecting during the day in the transition between Cerrado and Atlantic Forest; **E:** Dr. Diego Barbosa collecting at night; **F:** Dr. Diego Barbosa and Phillip W. Engelking collecting in the highest altitude of GSP - the two brothers mountain.

and would have little risk of transmitting the disease to the park staff. Each collecting effort was four days and three nights. With the help of entomological nets (Fig. 1D) we sampled the Poções and Hawk trails. Additionally, a light trap was installed near the GSP lodging that is inserted inside the park, in a transition of Cerrado to Atlantic Forest (Fig. 1E).

A total of 65 species were collected: 56 species of Tettigoniidae, 13 of them new to science, plus a new genus and one species that I was unable to identify due to a lack of a male (the sex with reliable characters); one species of Gryllacrididae; three species of Gryllidae, all new to science; two species of Trigonidiidae; and three species of Phalangopsidae, one new to science. I was able to take photographs of live individuals of 43 species, and record calling songs of 28 species (especially for the new species), and all these data have been uploaded to the OSF. All the collected data are summarized in Table 1.

After pinning, I took photographs of the individuals, especially the reliable characters to identify the species. At least four photos of the individuals were taken. To take these photos I used a Nikon D5300 camera attached to a Sigma 105mm macro lens and for each image I made a composition of 12-25 photos and then stacked them in Zerene software. This process was done in order to obtain high-quality images, with full depth of field, so that several parts of the individual are in focus. I have already uploaded images of the previously described species, so 46 taxa, for a total of 214 photos. After the formal description of the new species, I will upload at

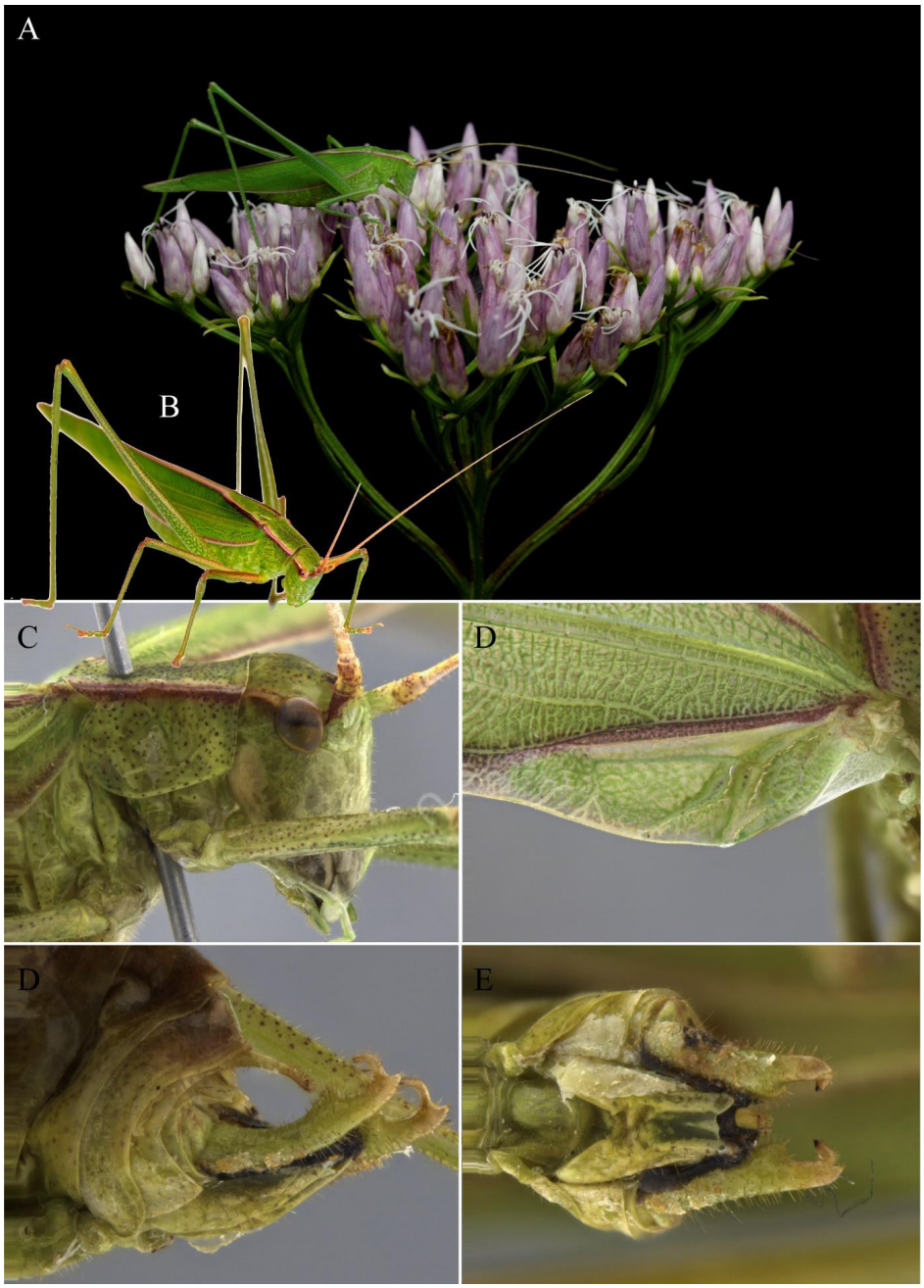

Figure 2. *Hyperophora minor*. **A:** male feeding on flowers; **B:** male lateral habitus; **C:** male head and pronotum, lateral view; **D:** male left stridulatory area, dorsal view; **E:** male terminalia, lateral view; E: male terminalia, ventral view.

least 5 images for each described species, resulting in 85 more images. In this way, the total data uploaded to OSF will be 298 images and 56 sound recordings. I provide in Figure 2 a sample of the photos and sound that have already been uploaded to OSF.

For some species I was able to make important observations, such as the relationship of *Hyperophora minor* (Phaneropterinae) with the plant *Symphyopappus* spp.(Asteraceae). This katydid species was one of the most abundant in the GSP, with individuals collected in flowers and leaves of the plant, feeding only on its flowers. Males and females were found copulating in the leaves and females were observed ovipositing in *Symphyopappus* stems and branches. The occupation of the environment by some *Conocephalus* (Conocephalinae) species was also observed. For example, at the GSP there are five species of the genus, with each one inhabiting different phytophysiognomies and related to different plants (e.g., *Conocephalus* (*Anisoptera*) *goianus* being related to *Hyparrhenia bracteata* (Poaceae) and *Sorghastrum scaberrimum* (Poaceae), and *Conocephalus* (*Anisoptera*) *saltator* being related to *Urochloa* (Poaceae)).

It is interesting to note that before this study only 14 species of Tettigoniidae were reported for the Paraná State and from the 46 species that I collected 43 are new records. The article describing the species of Tettigoniidae, and reporting the katydid fauna from the GSP is in the writing process and I hope to publish it by next year. As I collected live individuals, I was able to store a leg of at least one individual per species in 100% alcohol, which will be used for molecular studies, especially phylogenetics. Additionally, together with Dr. Diego N. Barbosa and my advisor Dr. Gabriel A.R. Melo, I am making a study of the ovipositor of Tettigoniidae, regarding the muscles, the sclerites, and the habit of oviposition, in a morpho-physiological approach.

I am grateful for the grant that I received, for all the help provided by Dr. Maria Marta Cigliano and Dr. Holger Braun during the development of this work. I acknowledge Dr. Neucir Szinwelski, Dr. Diego N. Barbosa, Hemanueli Preis and Phillip W. Engelking for all the help during the field trips, and my advisor Dr. Gabriel A.R. Melo for all the help during image acquisition. Besides all this, the grant that I earned provided the purchase of photographic equipment, collection equipment, such as lanterns and lamps, and recording devices, which I am using right now during my Ph.D. studies and that I will certainly use in the future, to study, collect, and provide high-quality photos and sounds of Brazilian orthopterans!

Table 1. Species of Ensifera collected at Guartelá State Park, Paraná, Brazil. *: new species, article of description already accepted; **: new species, article in writing process; ***: impossible identification to species level – taxonomy based on males, and I only collected females

Taxon	Number of individuals collected		Photos uploaded	Photos in vivo	Sounds
	Males	Females			
TETTIGONIIDAE	**133**	**78**			
Conocephalinae	**54**	**32**			
Conocephalini					
Conocephalus (*Anisoptera*) *goianus*	2	3	8	Yes	Yes
Conocephalus (*Anisoptera*) *guartela* **sp. n.** **	6	4	-	Yes	Yes
Conocephalus (*Anisoptera*) *saltator*	9	4	6	Yes	Yes
Conocephalus (*Anisoptera*) *truncatus*	1	0	5	Yes	Yes
Conocephalus (*Opeastylus*) *longipes*	5	2	4	Yes	Yes
Conocephalini gen. et sp. n. **	4	10		Yes	No
Copiphorini					
Lamniceps gigliotosi		1	4	No	No
Neoconocephalus exaltatus	2	1	5	Yes	Yes
Neoconocephalus flavirostris	1		6	No	No
Neoconocephalus rioclarensis	2		4	Yes	No
Neoconocephalus spiniger	2	1	5		Yes
Neoconocephalus testaceus	2		4	Yes	Yes
Neconocephalus vicinus	12	3	5	Yes	No
Neoconocephalus viridis	1		4	No	No
Neoconocephalus **sp. n.** 1 **		1			
Neoconocephalus **sp. n.** 2 **	1				
Neoconocephalus **sp. n.** 3 **	1				
Neoconocephalus **sp. n.** 4 **	1				
Oxyprora flavicornis	1	2	5	Yes	Yes
Meconematinae		**2**			
Phlugidini		2			
Phlugis sp. 1 ***				No	No
Phaneropterinae	**78**	**44**			
Aniarae genus group					
Aniarella minor	1		4	Yes	No
Aniarella proxima	1		4	Yes	No
Hyperophora brasiliensis	2	1	5	Yes	Yes
Hyperophora minor	16	14	4	Yes	Yes
Cosmophylla genus group					
Engonia kaingang **sp. n.** *	1			Yes	Yes
Engonia minor	2		4	Yes	Yes
Microcentrini					
Microcentrum lanceolatum	3		4	Yes	No
Odonturini					
Anisophya melanochloris	1			Yes	No
Anisophya **sp. n.** **	2	3		Yes	Yes
Xenicola **sp. n.** **	1	2		Yes	No
Xenicola xukrixi		2	5	Yes	No
Phaneropterini					
Anaulacomera **sp. n.*** (*incertae sedis*)	1		-	Yes	No

Table 1 (Cont'd). Species of Ensifera collected at Guartelá State Park, Paraná, Brazil. *: new species, article of description already accepted; **: new species, article in writing process; ***: impossible identification to species level – taxonomy based on males, and I only collected females

Anaulacomera trispinata	1		6	No	No
Anaulacomera (Anallomes) arlindoi **sp. n.***	1		-	Yes	No
Anaulacomera (Anallomes) sylviae	2		4	No	No
Anaulacomera (Anaulacomera) argentina	2	2	4	Yes	No
Anaulacomera (Anaulacomera) metropolitana	21	7	6	Yes	Yes
Anaulacomera (Anaulacomera) **sp. n. ****	3		-	Yes	Yes
Anaulacomera (Cervicercora) dama	3		5	Yes	No
Anaulacomera (Cervicercora) **sp. n. ****	1		-	No	No
Grammadera (Deragramma) albida	1	1	5	No	No
Grammadera (Deragramma) steinbachi	1	1	5	Yes	No
Grammadera (Grammadera) forcipata	1	2	6	Yes	Yes
Phaneropteroides longicercatus		1	4	No	No
Phyllopterini					
Phylloptera fosteri	2	1	4	Yes	Yes
Phylloptera sp. n.		2		Yes	No
Pycnopalpini					
Pycnopalpa bicordata	1		4	Yes	Yes
Topana sp.	1		4	Yes	No
Scaphurae genus group					
Scaphura elegans	1		6	Yes	Yes
Scuderiini					
Ceraia cornutoides	1	1	4	No	No
Ceraia liebermanni	1		4	No	No
Homotoicha similis	1	4	5	Yes	Yes
Theudoria melanocnemis	2		5	Yes	Yes
Steirodontini					
Stilpnochlora marginoides	1		4	No	No
Incertae sedis					
Enthephippion olivaceum	1	1	5	Yes	Yes
Pseudophyllinae	**1**				
Cocconotini					
Dasyscelus intermedius	1		4	Yes	Yes
GRYLLACRIDIDAE		**1**			
Neoeremus rivimeridionalis		1	5	No	Yes
GRYLLIDAE					
Anurogryllus **sp. n. ****	2	2		Yes	
Gryllus **sp. n. ****	2	3		Yes	
Oecanthus **sp. n. ****	5	4		Yes	Yes
TRIGONIDIIDAE					
Cranistus colliurides	1	3	4	No	No
Phylloscirtus amoenus		2	5	Yes	No
PHALANGOPSIDAE					
Adelosgryllus rubricephalus	1		5		
Eidmanacris suassunai	2	3	5	Yes	No
Endecous **sp. n. ****	2	2		Yes	Yes

Taxonomy and distribution of Scelimeninae Bolívar, 1887 & Cladonotinae Bolívar, 1887 from southern India and digitization of Tetrigidae types stored in the MHNG Geneva (Switzerland)

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The pygmy grasshoppers exhibit great diversity in India and Sri Lanka. Still, there are not many publications on their systematics and biology, as they have been neglected since the departure of colonial researchers. The taxonomy was never revised after the active description era during the 19th and 20th century. It is essential to stress that a few years ago, it was virtually impossible to identify Indian Orthoptera based upon photos. The taxonomic repositories, such as Orthoptera Species File (OSF), only had drawings and links to the old descriptions for Indian species during 2016. All taxonomic sources were textual descriptions and, sometimes, but not regularly, with some scarce black and white drawings. This is one of the major causes (together with the high traveling expenses for Indian researchers to the European museums where the type material was deposited) for the lack of scientific expertise on Orthoptera in India. The availability of type specimens of Indian Orthoptera in OSF is now much better since we have started contributing since mid-2016 (with the aid of Orthoptera Species File research grants).

Our 2018-2020 project was focused on reviewing two subfamilies of Indian tetrigidae (Scelimeninae and Cladonotinae) along with the distribution data of the accompanying species. The two Tetrigidae subfamilies have a rather peculiar morphology, making them charismatic taxa. The project reviewed only the core Scelimeninae (i.e., the tribe Scelimenini). The major contributions to Indian tetrigidae research were previously published by Walker (1871), Bolivar (1887, 1902, 1909, 1918), Brunner Von Wattenwyl (1893), Hancock (1904, 1907, 1909, 1910, 1913, 1915), Kirby (1914), Hebard (1929, 1932), Günther (1938, 1939), and Blackith (1988, 1992). These subfamilies (Cladonotinae Bolivar, 1887 and Scelimeninae Bolivar, 1887) and their more-than-a-century-old taxonomy is very complex. Fauna

Deltonotus subcucullatus (Walker, 1871)

Deltonotus gibbiceps (Bolívar, 1902)

Euscelimena harpago (Serville, 1838)

Tettilobus trishula Skejo, Bhaskar & Stermšek, 2020

Tettilobus prashadi Günther, 1938

Figure 1. Tetrigids from Western Ghats

of the pygmy grasshoppers of the Indian subcontinent consists of more than two hundred species of pygmy grasshoppers (Shishodia et al. 2010, Cigliano et al. 2020), 13 of which belong to the subfamily Cladonotinae and 58 belong to the Scelimeninae.

Papers published from 2018 to 2020 that relate to the project

We have published an annotated catalogue of Indian and Sri Lankan Cladonotinae and have presented an annotated distribution for all the species (Bhaskar et al. 2020). Pygmy grasshoppers were put into ecological context by studying the response of orthopterans to fire management practices in southern India (Bhaskar et al. 2019) (Fig. 1). The first male specimen of *Mopla guttata* was described and rediscovered from Western Ghats more than 70 years since its discovery (Bhaskar et al. 2020). Two new species were described: *Tettilobus trishula* from India (Bhaskar et al. 2020) and *Cladonotus bhaskari* from Sri Lanka (Tumbrinck et al. 2020). Taxonomy and distribution of Indian Scelimeninae has been investigated in the context of the worldwide Scelimeninae systematics (Muhammad et al. 2018) where new records and many misidentifications were addressed, as well as new combinations proposed, such as *Indoscelimena india*. The genus *Oxyphyllum* has been transferred from Cladonotinae to Tetriginae (Skejo et al. 2019) and was thus not studied within Indian Cladonotinae anymore (Bhaskar et al. 2020). Misidentifications of Scelimeninae nymphs for new species were discovered (Skejo et al. 2018) and corrected.

1. **Bhaskar D**, StermŠek S, Easa PS, Franjević D, **Skejo J** (2020) Wide-nosed pygmy grasshoppers (Cladonotinae: Cladonotini, Xerophyllini) of India and Sri Lanka: catalogue with an identification key and description of a new species of the genus *Tettilobus*. Zootaxa, 4894(3), 474-500.
2. **Bhaskar D**, Easa PS, Rowell CHF (2020) *Mopla guttata* (Acrididae: Catantopinae) rediscovered in the Western Ghats, Kerala, India. Journal of Orthoptera Research 29(1): 17–23. https://doi.org/10.3897/jor.29.35664
3. Tumbrinck J, Deranja M, Adžić K, Pavlović M, **Skejo J** (2020) Cockscomb-shaped twighopper, *Cladonotus bhaskari* sp. n., a new and rare pygmy grasshopper species from Sri Lanka (Orthoptera: Tetrigidae: Cladonotinae). Zootaxa, 4821(2), 333-342.
4. **Bhaskar D**, Easa PS, Sreejith KA, **Skejo J**, Hochkirch A (2019) Large scale burning for a threatened ungulate in a biodiversity hotspot is detrimental for grasshoppers (Orthoptera: Caelifera). Biodiversity and Conservation, 28(12), 3221-3237.
5. **Skejo J**, Gupta SK, Chandra K, Panhwar WA, Franjević D (2019) Oriental macropterous leaf-mimic pygmy grasshoppers—genera *Oxyphyllum* and *Paraphyllum* (Orthoptera: Tetrigidae) and their taxonomic assignment. Zootaxa, 4590(5), 546-560.
6. Muhammad AA, Tan MK, Ashikin AN, Azirun MS, **Bhaskar D**, **Skejo J** (2018) An annotated catalogue of the pygmy grasshoppers of the tribe Scelimenini Bolívar, 1887 (Orthoptera: Tetrigidae) with two new Scelimena species from the Malay Peninsula and Sumatra. Zootaxa, 4485(1), 70 pp.
7. **Skejo J**, Gupta SK, Tumbrinck J (2018) Nymph inadvertently described as new species for a fourth time? On the identity of *Euscelimena hardi* (Tetrigidae: Scelimeninae) with general remarks on the identification of pygmy grasshopper nymphs. Zootaxa, 4418(1), 93-97.

Checklist and brief distribution data of the Indian and Sri Lankan Cladonotinae and Scelimeninae

Altogether, 13 Cladonotinae and 11 species of Scelimenini inhabit India and Sri Lanka, and these 24 species are assigned to altogether 11 genera. Two Cladonotinae genera, *Cladonotus* and *Gignotettix*, are endemic to Sri Lanka, and two, *Hancockella* and *Yunnantettix*, are endemic to India, Kerala, and West Bengal, respectively. The highest diversity of the Indian Cladonotinae is reported from southern India, more specifically from the Western Ghats of Kerala (5 species), while Scelimeninae shows a different distribution pattern, where the north-easternmost part, such as Assam and Western Bengal of India has the largest diversity (7 species). The exception for this Scelimenin rule is genera *Gavialidium* and *Euscelimena*, endemic to southern India and Sri Lanka. Below, we present an annotated checklist of the Indian representatives of these two families.

Subfamily CLADONOTINAE Bolívar, 1887

Tribe CLADONOTINI Bolívar, 1887

Cladonotus bhaskari Tumbrinck, Deranja, Adžić, Pavlović et Skejo, 2020 [SRI LANKA]
C. humbertianus Saussure, 1862 [SRI LANKA]
C. latiramus Hancock, 1904 [SRI LANKA]
C. turrifer Walker, 1871 [SRI LANKA]
Deltonotus gibbiceps (Bolívar, 1902) [INDIA: Kerala, Tamil Nadu, SRI LANKA]
D. subcucullatus (Walker, 1871) [INDIA: Kerala, SRI LANKA]
Gignotettix burri Hancock, 1909 [SRI LANKA]
Hancockella portentosa (Kirby, 1914) [INDIA: Kerala]
Yunnantettix elytratus (Günther, 1939) [INDIA: West Bengal]

Tribe XEROPHYLLINI Günther 1979

Potua* (?) *sabulosa Hancock, 1915 [INDIA: Maharashtra]

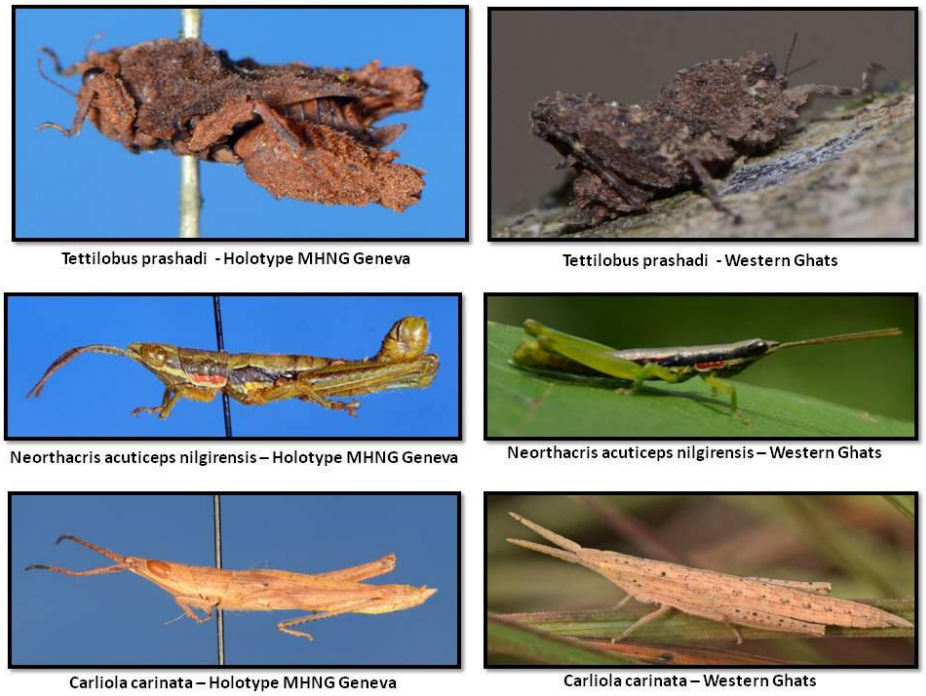

Figure 2. Type specimens and field images of grasshoppers

T. pelops (Walker, 1871) [SRI LANKA]
T. prashadi Günther, 1938 [INDIA: Kerala]
T. trishula Skejo, Bhaskar et Stermšek, 2020 [INDIA: Kerala]

Subfamily SCELIMENINAE Bolívar, 1887

Tribe SCELIMENINI Bolívar, 1887

Euscelimena gavialis (Saussure, 1862) [INDIA: Kerala, SRI LANKA]
Euscelimena harpago (Serville, 1838) [INDIA: widespread (Rajasthan, Gujarat, Maharashtra, Karnataka, Kerala, Chhattisgarh, Orissa, West Bengal)]
Euscelimena logani (Hancock, 1904) [SRI LANKA]
Gavialidium carli Hebard, 1930 [INDIA: Tamil Nadu]
Gavialidium crocodilum (Saussure, 1862) [SRI LANKA]
Indoscelimena angulata (Hancock, 1915) [INDIA: West Bengal]
Indoscelimena flavopicta (Bolívar, 1909) [INDIA: West Bengal, THAILAND]
Indoscelimena india (Hancock, 1907) [INDIA: Assam]
Indoscelimena saussurei (Hancock, 1915) [INDIA: West Bengal]
Scelimena discalis (Hancock, 1915) [INDIA: Assam, THAILAND]
Scelimena kempi (Hancock, 1915) [INDIA: Assam]

Digitization of Indian Orthoptera types in the MHNG Geneva (Switzerland)

Type specimens of 73 Indian species are deposited in MHNG. Among which only 17 of them had already appeared in OSF. A total of 60 type species were digitalized from the Geneva museum. 277 images (including 104 holotype, 141 syntype, 21 lectotype and 4 paratype) of dorsal, ventral, lateral and frontal view along with relevant taxonomic characteristics were uploaded to OSF (Fig. 2). The type specimen of *Bolivaritettix lativertex* (Brunner von Wattenwyl, 1893) was missing according the curator the specimen must be in MCSN Genova.

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The story of an unexpected collaboration – Bolívar & Ferrière (1912)

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Ignacio Bolívar y Urrutia (1850-1944) was known for encouraging young scientists (Gomis Blanco, 1988), but even so it seems surprising that he co-authored a study of Phasmida from the Seychelles, Bolívar & Ferrière (1912), with a new graduate who had no track record in taxonomy. Bolívar was by then director of the Museo Nacional de Ciencias Naturales in Madrid and an entomologist with a European reputation while this was Ferrière's first publication; an unlikely pairing, perhaps?

Charles Ferrière (1888-1979) was a Genevan entomologist who dedicated a career of over 50 years to the study of hymenopteran parasitoids. He worked in the Bern Natural History Museum, the Imperial Institute of Entomology in London, and the Geneva Natural History Museum (MHNG), ending his career as director of the International Centre for the Identification of Entomophagous Insects for the International Commission for Biological Control, hosted at the MHNG (Besuchet, 1980). His 150 scientific publications are virtually all about Hymenoptera or biological control, so the paper with Bolívar is something of an anomaly for him too.

Ferrière graduated from the University of Geneva in 1910. He then went on an expedition to Ceylon (Sri Lanka) as assistant to Professor Edouard Bugnion (1845-1939) of the University of Lausanne. The choice of Ferrière as assistant was probably not unrelated to the fact that Bugnion's daughter married Ferrière's brother in 1910. Bugnion was interested in termites and Ferrière acted as photographer (see Bugnion, 1913). He then travelled to Britain, where he studied forestry and agriculture at the University of Edinburgh, matriculating in 1912 before returning to Geneva.

On his way to Edinburgh, however, Ferrière stopped in Cambridge

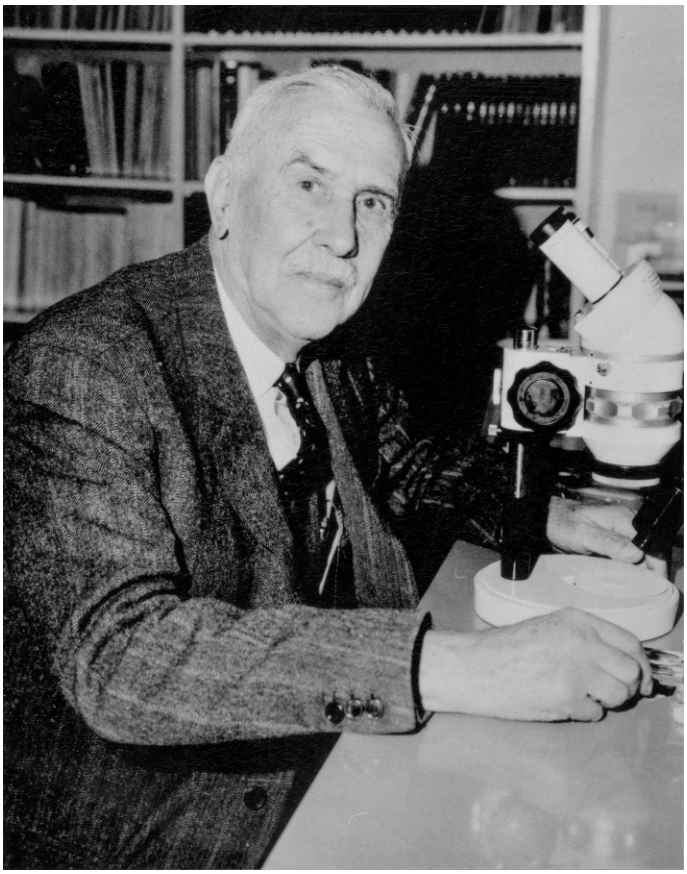

Figure 1. Charles Ferrière

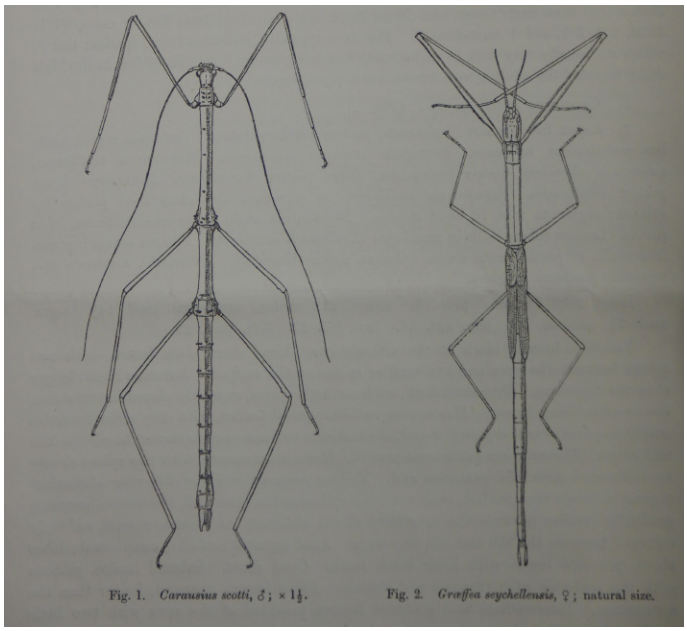

Figure 2. The text figures from Bolívar & Ferrière 1912

where he studied some specimens of Phasmida collected in the Seychelles deposited in the Cambridge University Zoological Museum. The then-professor of zoology at Cambridge, John Stanley Gardiner (1872-1946), had been leader of the Percy Sladen Trust *Sealark* Expedition in 1905 (Stanley Gardiner, 1905), and had sent Bolívar the Orthoptera material collected for study. Bolívar returned it with an article on the Orthoptera *sensu stricto* (Bolívar, 1912) and notes on the Phasmida.

Many more Phasmida had been collected in the Seychelles since then and that was the material Ferrière studied, but he also had Bolívar's notes on the earlier Phasmida collection (see note in Bolívar & Ferrière, 1912: 293). Stanley Gardiner encouraged Ferrière to finish the work Bolívar had started, but Ferrière appears to have left no trace in the Cambridge archives. It was probably Stanley Gardiner, who read both of the papers at the Linnean Society, who helped him complete the English text of the article (Bolívar wrote his 1912 article in Spanish) and who arranged for the joint publication with Bolívar.

Bolívar described one species in their joint article; Ferrière described two and produced both of the text figures. Perhaps the most striking feature of the article is Ferrière's explicit explanation that he chose not to accept Bolívar's notes about what he considered to be a new species, but Ferrière considered to be specimens of *Carausius sechellensis* (Bolívar, 1895), indicating considerable self-confidence in one so young. The type specimens of the Phasmida described are now in the Natural History Museum, London. That Bolívar would agree to this partnership may seem surprising, but besides a reputation for encouraging young scientists, he also had good relations with the MHNG, having been a regular correspondent of Henri de Saussure (1829-1905) and written about MHNG specimens (Bolívar, 1909) for Emil Frey-Gessner (1826-1917), with the result that the MHNG contains many Bolívar type specimens (Hollier, 2016).

Ferrière obtained a doctorate from the University of Geneva in 1913, then did an internship at the Paris Entomological Station under Paul Marchal in 1914, which introduced him to hymenopteran parasitoids and set the course of his subsequent career (Bovey 1979). In one respect, however, his work on Phasmida was typical of Ferrière: most unusually for an entomologist, Ferrière was not attracted by field work and nearly all the specimens he worked on were collected by other people.

Acknowledgements
Thanks are due to Philippe Wagneur and Juliette Oulevey of MHNG, Jacqueline Cox of Cambridge University, and Russell Stebbings of the Cambridge University Museum of Zoology for their help.

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An (un)expected journey: sampling Orthoptera in the intangible area of the Iguaçu National Park, Brazil

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Dear colleagues, we hope that our brief story about an (un)expected journey finds you well and healthy. Since 2002, orthopterists have carried out several surveys in the Iguaçu National Park (INP), the largest remnant of Inland Atlantic Forest of Brazil, located in the extreme west of Paraná, with a protected area of about 185,000 ha. This fragment is known worldwide for the iconic Iguassu waterfalls and for hosting rich biodiversity, with 335 species of birds, 48 species of reptiles, 1,100 species of plants, and more than 800 species of invertebrates being recorded, in addition to 110 species of mammals, highlighting the jaguar (*Panthera onca*), whose population has increased due to intense conservation actions.

The work with orthopterans in the Iguaçu National Park (INP) began with Dr. Edison Zefa, in 2002. Since then, four master's dissertations have been carried out with Orthoptera in this conservation unit. In 2009, Dr. Pedro G.B. Souza-Dias inventoried and described new taxa of Grylloidea and, in the same year, Dr. Neucir Szinwelski developed his master's thesis studying the responses of crickets to forest regeneration. Two years later, Dr. Szinwelski developed his doctoral thesis at INP, covering ecology and methodological studies with Grylloidea. In 2019, M.Sc. Marcos Fianco began his work on the inventory and description of new species of Tettigoniidae and, a year later, M.Sc. Victor M. Prasniewski, studied the effects of landscapes on the diversity of species of Caelifera. In addition, several scientific initiation works were carried out at the INP, especially after the appointment of Dr. Szinwelski at the Universidade Estadual do Oeste do Paraná (Unioeste), located about 15km from the INP.

Before giving numbers on the diversity of Orthoptera for the INP, it is worth mentioning the various partnerships with renowned orthotherists, such as Dr. Maria Katia Matiotti (PUC/RS), Dr. Carlos F. Sperber (UFV/MG), Dr. Francisco G. Mello (Unesp-Botucatu/SP), Dr. Edison Zefa (UFPel/RS), and Dr. Holger Braun (Museo de la Plata, Argentina), without whom many studies would not be possible. Also, partnerships with other researchers (Dr. Carlos Brocardo - UFOPA) and administrative agents of the INP (Rosane Naudarer, Ivan Baptiston, Adaildo Policena, Lucimara Frederico and Edilson Esteves) made the approval and execution of this project feasible.

The diversity of orthopterans seems to be astonishing given the area sampled so far (< 100 ha): at least 105 species of grasshoppers (Caelifera) have been found so far (da Costa et al. in preparation), with two new species described in the past four years. For Ensifera, at least 27 species of crickets are found in the region, with a new genus and five new species of crickets being described. For katydids, there were at least 87 species (Fianco et al. in preparation), with eight species being described in the last three years.

Figure 1. Photographic records of the "Projeto Floriano'' expedition. A) Dr. Neucir Szinwelski (left), M.Sc. Victor Prasniewski (center) and M.Sc. Marcos Fianco (rigth). B) Displacement by helicopter to the camp inside the forest. C) Floriano River. D) A 6 m long Malaise installed. E) Katydids on soap at camp.

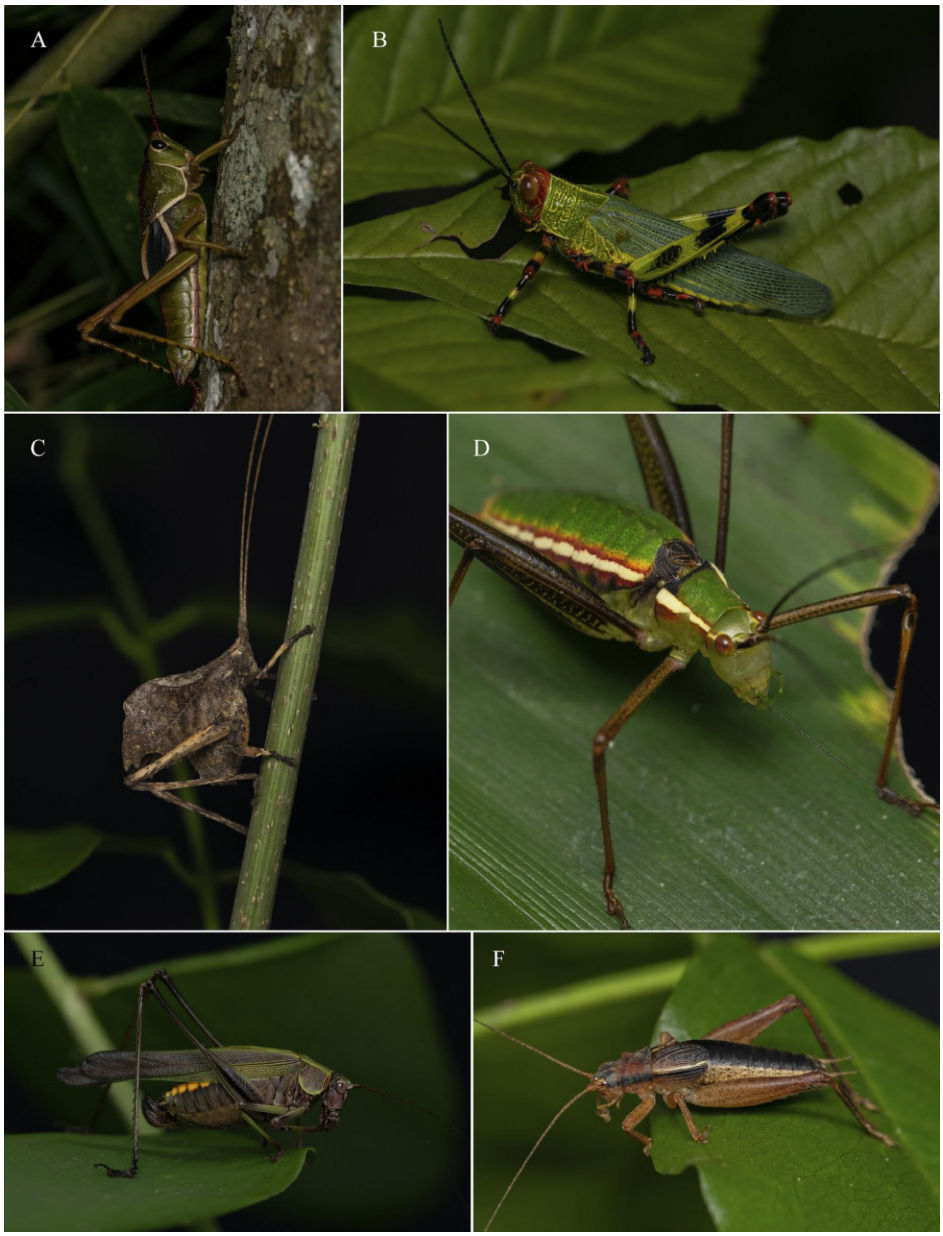

Figure 2. Photographic records of some specimens. A) *Staleochlora arcuata iguazuensis* Roberts & Carbonell 1992. B) *Zoniopoda tarsata* (Serville, 1831). C) *Typophyllum inflatum* Vignon, 1925. D) *Xenicola xukrixi* Fianco, Faria & Braun, 2019. E) *Enthephippion olivaceum* (Brunner von Wattenwyl, 1891). F) *Taroba elephantina* de Mello & Souza-Dias, 2010.

This number of species is surprising, especially because the inventories were carried out in only four INP sites, where there is a structure for housing researchers, however, nothing was known about the Orthoptera within the pristine area of this fragment.

Reaching these impressive numbers, even if restricted to easily accessible areas, was an unexpected journey. As a result of these works, Dr. Szinwelski was invited by the INP administration to head a research project with several groups of organisms, aiming at sampling in intangible areas, where very few researchers are able to visit. That was an unexpected journey. The project was called "Projeto Floriano: unveiling intangible biodiversity," and its name is related to the Floriano River, which rises in the INP's intangible area and flows into the Iguaçu River, which forms the Iguassu falls below. The intangible area is a core area of the INP, is located at least 7 km away from the nearest edge, and the only way to reach the area is by helicopter. With support from the INP (administration, administrative technicians, inspectors and assistants) we made our first expedition to these areas between the 6th and 8th of December 2021. When we arrived in the intangible area, we set up camp and began sampling the orthopterans both with active collection and with the aid of sweep nets, during the day and at night. Malaise traps, fall traps and light traps were also installed. At the same time, trap cameras were installed to record mammals and genetic material was also collected from a relictual population of the tree, Araucaria.

In the first expedition of the "Projeto Floriano" we were able to collect 44 species (11 grasshoppers, 8 crickets, and 25 katydids), and that number may increase once we analyze all the collected material. From the analyzed species, two species of katydids represent new records while one species of grasshopper, two crickets, and three katydids may be new to science. Photos of all species collected *in vivo* were taken by Marcos Fianco, with the equipment he bought with the OSF Grant that he earned, back in 2019/20. Some of the photos will be uploaded in the Orthoptera Species File as soon as possible.

Works like this are extremely important to reduce knowledge deficits, especially the Linnean and Wallacean (the first refers to the fact that many species have not yet been described, and the second that little is known about the distribution of taxa). These deficits can only be overcome with a commitment to natural history (especially taxonomy) as part of the science that is the basis for other studies in the most diverse areas of knowledge. Taxonomic inventories deserve special consideration in this context, given the central role of these studies in supporting really relevant ecological, evolutionary, and biogeographic patterns. Furthermore, our journey is important given (i) the general taxonomic impediment and, especially, the one existing for Orthoptera; (ii) there are only 11 researchers working with Orthoptera in Brazil; (iii) the

high probability that the INP presents a high richness of Orthoptera, considering the size of the sampled area and the results already found; (iv) the deficit in Orthoptera distribution data, which continues to rise over time; and (v) the possibility that, having overcome the taxonomic impediment, there is the possibility of using Orthoptera as a biological model in studies that test hypotheses in different areas of knowledge. In summary, Orthoptera are a favorable group for several types of studies given their ease of collection, relatively high abundance and diversity, and large size compared to other insects, which facilitates studies of their morphology and systematics. Orthopterans are abundant in forests, and easy to handle experimentally, which enhances their use for ecological experiments, however, it is necessary that the studied species have been identified, which depends on the work of taxonomists. This, my friends, is a brief account of an (un)expected journey. We know that "it's strange, but the good things and the pleasant days are quickly narrated." "The world is out there, waiting to be discovered" and we are looking forward to the next journey!

Filling the gaps: Melanoplinae in Western and Northwestern Mexico

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As part of our ongoing research on selected groups of Orthoptera in North America, we conducted an expedition in September 2021 to the states of Michoacán, Jalisco, Nayarit, Sinaloa and Baja California Sur (western and northwestern Mexico). The aim of this trip was to collect the great majority of Melanoplinae species in these regions to fill some gaps in our efforts to have recent representative samples of these grasshoppers in Mexican and USA collections. This is because these areas of Mexico in general have been neglected due to logistic reasons, although we have systematically collected in Mexico during the last 15 years. In the western and northwestern Mexico, as in other mountainous areas of the country, a complex overlap of Nearctic and Neotropical biotas exists and it is possible to explore different and contrasting habitats in a single day, such as xerophytic shrub, temperate, and tropical forests (Fig. 1) in a wide range of elevations (from the sea level up to ca. 2,500 masl). Even though Melanoplinae grasshoppers are less diverse in the western and northwestern Mexico than in the eastern and northeastern Mexico, the former regions still harbor a considerable diversity of endemic species

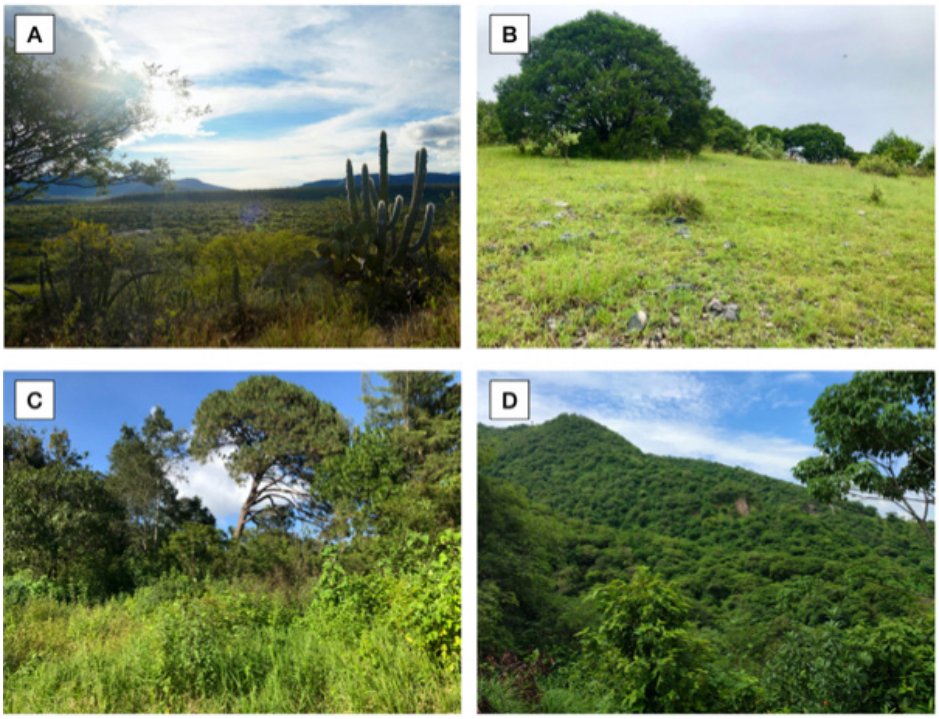

Figure 1. Collecting site in different habitats including: A) Xerophilous shrub in Sinaloa; B) Juniper forest in Jalisco, C) Pine-oak forest in Michoacán, and D) Tropical deciduous forest in Nayarit.

(Figs. 2-4), including some of the most atypical melanoplines, such as the species *Psilotettix obesus*.

We started our expedition in Mexico City as usual, from where we drove westbound to Tepic, Nayarit, crossing the highlands of the western portion of the Mexican Volcanic Belt Mountain Range. Along this area, we collected at different sites of pine-oak forests where we found various populations of some common melanoplines, such as *Aztecacris laevis* and *Melanoplus differentialis*. From there, we went towards Topolobampo, Sinaloa, driving northward on highway 15, which goes mainly along the Pacific Coast but also penetrates segments of the external versant of the Sierra Madre Occidental Mountain Range. Soon, after we moved from Tepic, tropical deciduous forests became the dominant vegetation and correspondingly we also observed

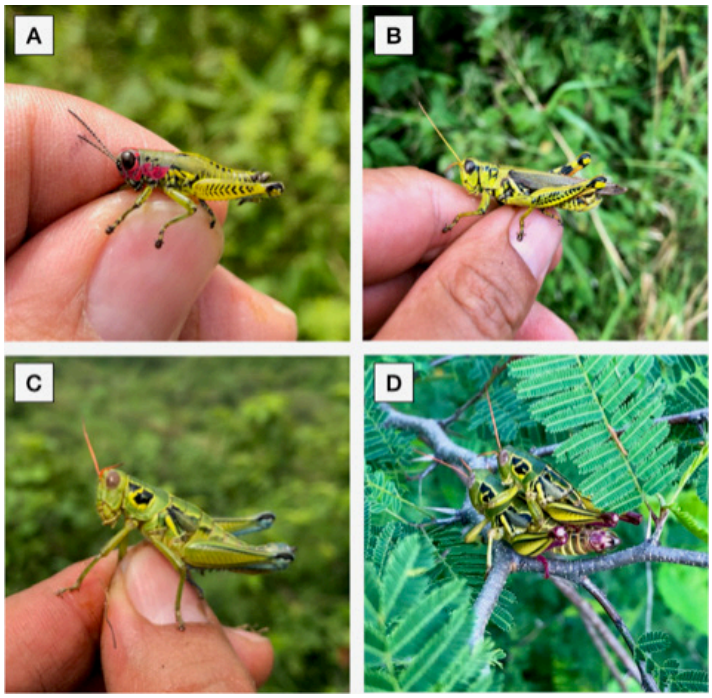

Figure 2. Melanoplinae species: A) *Aztecacris laevis* near Lagunillas, Michoacán; B) *Melanoplus differentialis* from Tequila, Jalisco; C) *Barytettix poecila* from Hostotipaquillo, Jalisco; and D) *B. paloviridis* near Culiacán, Sinaloa.

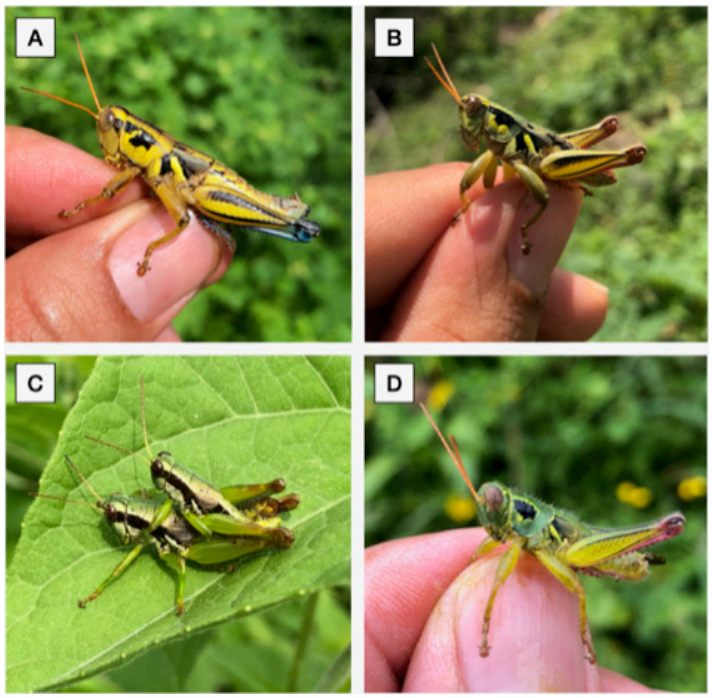

Figure 3. Melanoplinae species: A) *Barytettix psolus* from Salvador Alvarado, Sinaloa, B) *B. crassus* from La Paz, Baja California Sur; C) *Sinaloa sipuri* from Hostotipaquillo, Jalisco; and D) *S. nitida* from Tepic, Nayarit.

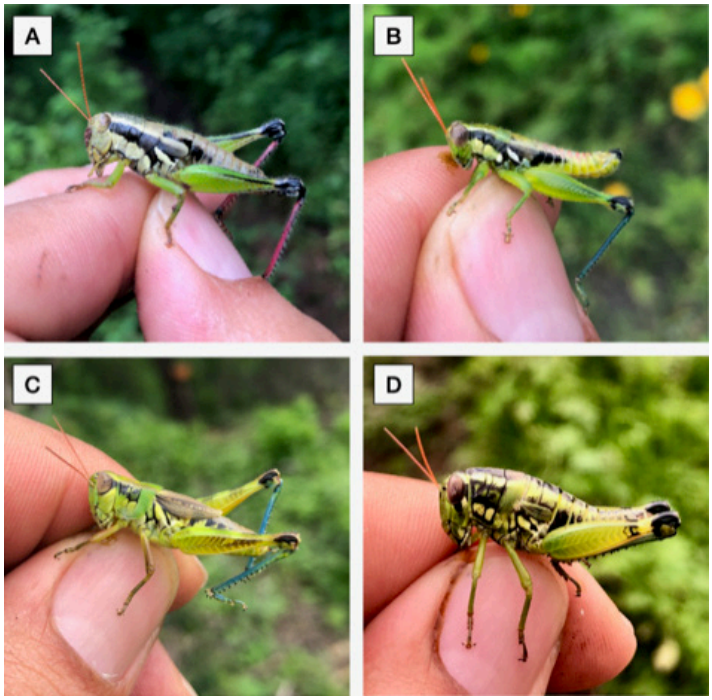

Figure 4. Melanoplinae species: A) *Sinaloa behrensii* from Concordia, Sinaloa, B) *S. pulchella* from Elota, Sinaloa; C) *Melanoplus cancri* from Sierra La Laguna, Baja California Sur; and D) *Philocleon cledon* from Cihuatlán, Jalisco.

changes in the orthopteran fauna. For instance, as we moved northward, we appreciated a succession of different species of *Barytettix* and *Sinaloa*, which also appeared to be the most common melanoplines in this region. Similarly, we also observed multiple species of *Brachystola*, and *Neobarrettia* along this transect (Fig. 5). From Topolobampo, we crossed the California Gulf to La Paz, Baja California Sur by ferry and then moved southward to the Sierra La Laguna Mountain Range at the tip of the Baja California peninsula. In this area, we were able to find some poorly known melanopline species, such as *Melanoplus cancri*, *M. complanatipes* and *Psilotettix obesa*. After our stay in Baja California Sur, we crossed back from La Paz to Mazatlán, Sinaloa (Fig. 6). On our way back to Mexico City, we visited additional localities across the northwestern portion of the Sierra Madre del Sur Mountain Range in the states Jalisco and Colima, where we found some species of *Philocleon* among other Orthoptera, such as the colorful *Chromacris colorata* (Fig. 5E). As in previous expeditions, we certainly collected new species of grasshoppers (in process of description) and we succeeded in collecting most of the species of Melanoplinae we were looking for.

Due to the nature of the trip, several of the visited places were type localities of different genera and species of Melanoplinae. Contrary to other regions in the world, these areas were well explored by great orthopterologists, such as Drs. Irving Cantrall, Ted Cohn, Dan Otte, among others, during the second half of the 20th century. Many localities were sampled during the past decades, which provided large series (with multiple specimens per collecting event) in some cases, while in other cases only a few specimens (most likely indicating the rarity of certain species rather than the lack of effort). From the museums, we can easily see a unit tray containing 20 specimens without noticing it must

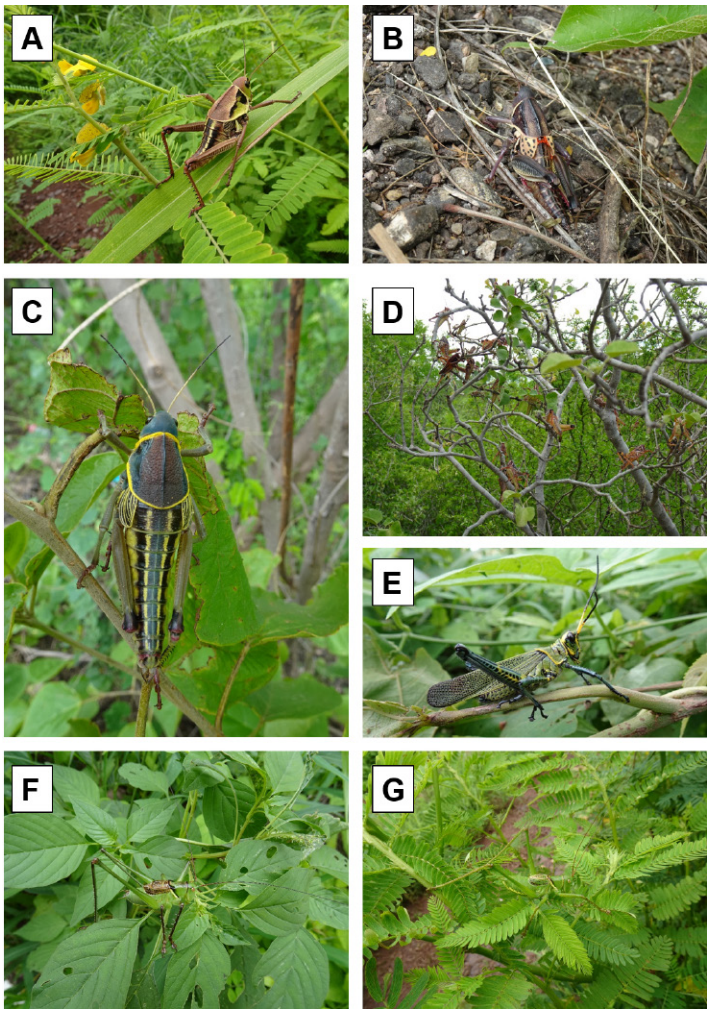

Figure 5. A) *Brachystola beherensii* near Acaponeta, Nayarit; B) *B. magna* with acari from Topora, Sinaloa; C) *B. beherensii* from Topora, Sinaloa; D) Nymphs of *B. beherensii* from Tosalibampo, Sinaloa; E) *Chromacris colorata* near Lázaro Cárdenas, Jalisco; F) *Neobarrettia* cf. *sinaloae* near Elota, Sinaloa; G) *Neobarrettia* cf. *sinaloae* near Acaponeta, Nayarit.

have taken 10 trips during 30 years to collect them. Nowadays, the amount of time, money, and effort to collect insects is frequently undervalued.

Without a doubt, we are standing on the shoulders of giants, and thanks to the efforts of the mentioned orthopterologists, who spent hours looking for good localities, we saved a lot of time locating collecting sites by just going to their original localities. Even though they collected before the use of GPS was popularized, the details recorded on their labels (usually indicating the distance to the nearest town, number of the highway and direction) regularly made it straightforward to find the exact localities. Of course, we did our part, and we also spent some time looking for potentially good and new localities (as usual, we succeed in many and failed in others). Nevertheless, we are happy to report that indeed, most of the species were there and even happier to find new records that will add to the knowledge of the geographic distribution of various poorly known Melanoplinae species. We are fortunate to be part of this generation and we are training the next generation of orthopterists as well.

Due to the fact this expedition was sponsored with funds and people from two institutions, the resulting material was divided between their respective collections, the University of Michigan Museum of Zoology (UMMZ) in the U.S. and the Colección de Artrópodos de la Facultad de Estudios Superiores, Iztacala (CAFESI) at UNAM, Mexico. RMP is currently working at the Insect Collection of the UMMZ. As many of you may know, the UMMZ is the second most important collection of Orthoptera of the Americas, second to Academy of Natural Sciences of Philadelphia of Drexel University (ANSP). On the other hand, SSU has been making great efforts during the last years in creating an Orthoptera Collection at CAFESI, which currently house 46 type specimens of the genera *Dasyscirtus, Liladownsia, Perixerus*, *Sphenarium* and *Reyesacris*.

Acknowledgements

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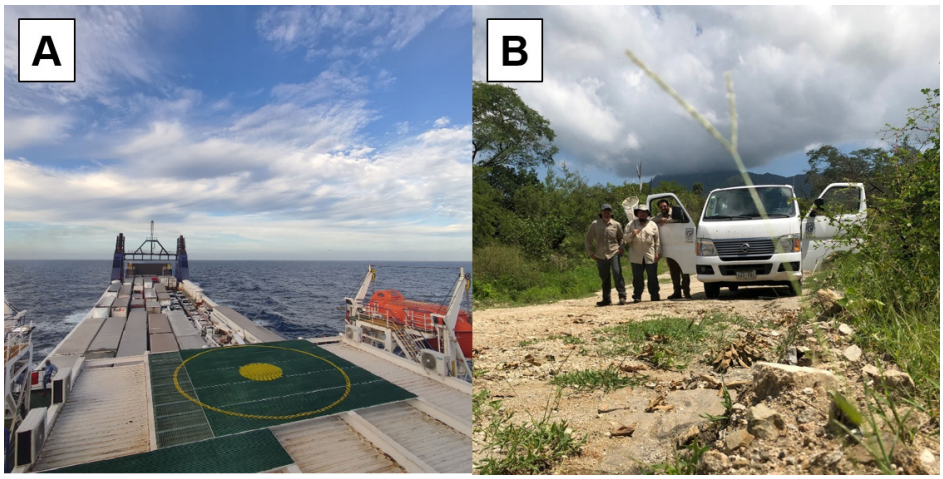

Figure 6. A) Ferry crossing the Gulf of California in the way back from Baja California (La Paz) to Sinaloa (Mazatlán), and B) Expedition team in Sierra La Laguna, Baja California Sur.

Proceedings of the 2021 ESA Organized Meeting, "Small Orders, Big Ideas (Polyneoptera)"

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Since 2014, a symposium or organized meeting (depending on the whim of the conference organizers) focused on Poyneoptera has been part of the annual Entomological Society of America (ESA) conference, containing presentations by a balanced ratio of younger researchers (often students) and seasoned ones, and covering interesting topics that focus on one or more of the 10 extant polyneopteran orders: Blattodea (+Isoptera), Dermaptera, Embiodea, Grylloblattodea, Mantodea, Mantophasmatodea, Orthoptera, Phasmatodea, Plecoptera, and Zoraptera. This event quickly became an annual tradition (2020 marks its 8th anniversary!) and will hopefully continue to be a mainstay at ESA conferences for years to come.

Over time, one of the event's goals has been to have the event co-organized with the assistance of a student, which has occurred successfully the last 3 times. Thus, Derek and Hojun's two main roles these days are to apply for the meeting and assist the student as needed when they are selecting and inviting speakers, and moderating the meeting, all of which gives students invaluable experience in organizing symposia. For 2021's event, Carter Wolf was our Ph.D. student co-organizer and he did a fantastic job overall despite the switch to a hybrid (in-person and virtual) meeting format (due to the ongoing SARS-CoV-2 pandemic), several unfortunate cancellations by speakers, and the fact that Hojun and I were unable to make it to the meeting in-person despite plans to do so. This was the first time that a student has moderated the event fully solo and, from all accounts, it went smoothly.

This year, we had six speakers participate at the event (three in-person, three virtual), all from the U.S.A. this time, and, as always, we attribute a majority of the event's success to the wonderful speakers and their engaging presentations. The speakers were: (in-person) Alexander J. Harman, Carter Wolf, David Zonana; (virtual) Derek A. Woller, Janice S. Edgerly (who entertained audiences of this event for the 7th time!), and our wonderful keynote speaker, Christina L. Kwapich. Jay Gallagher was unable to participate in the actual event, but his abstract is still included below. Together, these talks covered two of the Polyneoptera orders: Orthoptera (always!) and Embioptera and a diverse array of topics were discussed, ranging from updated distributions to biomimicry to deep neural networks to sonic weaponry. If you would like to learn more about the presentations, a brief abstract and figure for most are provided below.

Finally, we have a request for students working on polyneopteran insects. Assuming the symposia is approved yet again for the November 2022 ESA meeting, which will be in Vancouver, Canada, we'll need someone new to co-organize it with us. Not only is this a unique opportunity to learn about the organization of symposia, and even conferences, it also brings you in contact with some of the most interesting researchers out there who are focusing on Polyneoptera. Ideally, the student will have been a past presenter in the symposia, but it's not required. If you don't feel like you want to take up this responsibility in 2022 or beyond, but still want to present in our symposia next year or in the future, feel free to also contact Derek and Hojun. Either way, we're looking forward to your response!

Updated distributions of Oklahoma grasshoppers (Orthoptera: Acrididae) and notes on *Melanoplus macclungi*

Alexander J. Harman (aleharm@okstate.edu), Oklahoma State University

Grasshoppers collectively pose one of the greatest pest threats to grazing land in the Great Plains of the United States. It has been estimated that, annually, grasshoppers consume approximately 22% of available forage in the western United States. Despite the substantial damage that grasshoppers cause, the majority of research has been conducted on a handful of species that are considered the most

Figure 1. *Melanoplus macclungi* on eastern red cedar, *Juniperus virginiana.*

economically important. There are over 120 species of grasshoppers known to occur in Oklahoma, but there have been no comprehensive surveys undertaken since the early 1960s. Many of the earlier studies neglected tribal lands that make up a large portion of Oklahoma, leaving the grasshopper diversity poorly sampled in the eastern half of the state. I surveyed grasshopper diversity throughout Oklahoma to better understand the distributions of the species that occur in Oklahoma. Specimens were collected by combination of sweep and aerial netting at hundreds of sites throughout the state. New species reported for Oklahoma include *Trachyrhachys aspera*, *Trimerotropis melanoptera*, *Metaleptea brevicornis*, *Melanoplus macclungi*, and *Phrynotettix tshivavensis*. The highest number of species were found in the shortgrass prairie, at the far western end of the state, while the lowest numbers of species were found in the Ouachita mountain and tallgrass prairie ecoregions.

Melanoplus macclungi (Fig. 1) is a poorly known species previously reported from Barber County, Kansas. It was found to be associated with eastern red cedar, *Juniperus virginiana*, on which it feeds. Recognizing how little was known about this species, we conducted surveys targeting it throughout Oklahoma. Utilizing the data from misidentified historical specimens and citizen-science databases, we also found records of *M. macclungi* from Arkansas and Missouri. Many individuals were collected live, so that we could learn more about their host preferences, fecundity, and other aspects of life history.

Anthropogenic sound alters grasshopper diet

Carter L. Wolff (clw905@msstate.edu), Mississippi State University, with Jillian M. Kurtts and Brandon T. Barton

Ecosystems can be affected in many ways as human activity encroaches in natural environments. Sound pollution is one potential driver of community change. However, it is unclear if sound acts as a stressor in most species. When herbivores are stressed by other factors, they increase respiration rate, leading to a carbon deficit, facilitating a shift in diet to meet new nutritional needs. We asked if sound could stress grasshoppers, altering their diet choice. To do this, we conducted two experiments. The first experiment aimed to determine if sound affects grasshopper respiration rates. We measured grasshopper respiration at 21 different sound frequencies, ranging from 0.001 – 60 kHz. We found seven frequencies that affected grasshopper respiration rates. Four frequencies increased respiration rates, while three frequencies decreased respiration rates.

In the second experiment, we asked if grasshoppers altered their diet when exposed to frequencies of sound that either increased or decreased respiration rates from the first experiment. Grasshoppers were given two types of artificial diets (Fig. 2), which were weighed after a 48-hr feeding period to determine the diet type consumed. We found that when grasshoppers were exposed to the high sound treatment, they would switch their diet to eat significantly more carbohydrates. When grasshoppers were exposed to the low sound treatment, there was a shift towards eating more proteins. The results from these experiments demonstrate that sound can stress grasshoppers, thereby affecting their diet. Ultimately, this may impact plant communities if grasshoppers feed on different plants to meet new nutritional requirements under stressful conditions.

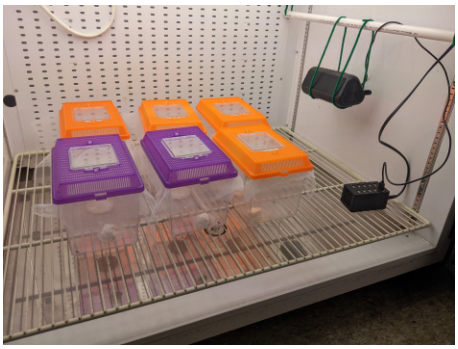

Figure 2. Plastic terraria containing a grasshopper with access to carbohydrate-rich and protein-rich artificial diets. A suspended Bluetooth speaker was used to administer sound treatments. (Photographed by C. Wolff).

Enhancing grasshopper population surveys with deep neural networks and unmanned aircraft systems

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Bi-annual surveys by USDA personnel across the 17 contiguous, western states of the United States are undertaken on rangeland habitats to: 1) assess population levels of grasshoppers for the purpose of determining where outbreaks may occur later in the season (spring/early summer survey) and 2) help inform a best guess on what populations might be like the following year (late summer/fall survey). Once a population "hot spot" has been identified in the spring/early summer, it may be a candidate for an insecticide treatment upon written request by the landowner/manager and further surveys will then be undertaken to confirm populations meet the USDA management program's economic threshold. For these reasons, surveys are very important to the program, but the process can often be hindered to some degree by limited financial and personnel resources. Therefore, our team has been working on developing novel methods that would enhance survey and population detection abilities at a lower cost.

One idea we have been exploring is the use of deep neural networks (DNN) coupled with the use of unmanned aircraft systems (UAS). In brief, a DNN is a framework for multiple machine learning algorithms and we trained one to recognize grasshopper shape using a very basic RGB

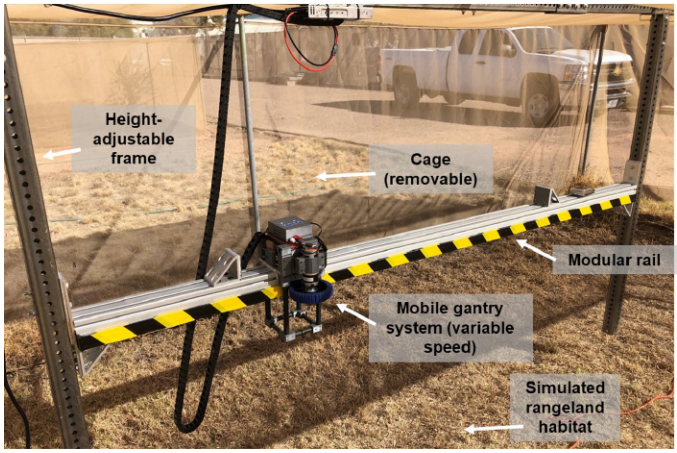

Figure 3. Unmanned aircraft system-simulation system set up on simulated rangeland habitat outside of the USDA lab in Phoenix, AZ.

camera and a lab-reared population of the migratory grasshopper, *Melanoplus sanguinipes*, the most damaging pest species of rangeland habitats. First, we trained the DNN to recognize live and pinned specimens across all life stages using static image data and then we added in data gathered from a UAS-simulation system (Fig. 1), which centers around a mobile gantry system that can move at four speeds to better-simulate the flying abilities of a UAS, on both a white background and simulated rangeland habitat. All target assessment metrics (false positive rate (30%) and false negative rate (20%)) for the DNN were met successfully for both static and moving images, but only at the three lowest speeds and mainly for 3rd instar to adults (especially). 1st and 2nd instars appeared to be too difficult to "see," particularly on rangeland habitat while the highest gantry speed most likely added too much motion blur for the DNN to identify grasshoppers correctly.

Next, we tested the DNN using a data set of images collected from a UAS (DJI Mavic Pro 2) while in New Mexico in an area with a mixed-population of grasshoppers at an average density of 12 per square meter. We flew at the lowest altitude possible (2 m) to match the training of the DNN as closely as possible. Despite this, the DNN was unable to detect any grasshoppers at all! Our current hypothesis for this is that the DNN may have been overtrained for the specific species, which was not present and does not generalize to the shape of other grasshoppers as expected. To rectify this, more training is planned using mixed species in more real-world habitats and at higher heights.

Macroecology and the evolution of complex maternal care in Embioptera

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Embiopterans are known for exhibiting maternal care. They are also remarkable for the neoteny of the adult females; they are juvenile in form, streamlined, and flexible. These traits give the order a look of homogeneity. No matter in which taxonomic family they sit or in which location they live, they resemble each other. Only with an adult male expressing secondary sexual traits can one determine the taxonomic name of an embiopteran. These characteristics have posed problems when one wishes to understand the diversification of this cosmopolitan order. One trait that seems to display diversity is a behavioral trait: how the mother treats and handles her eggs. A recent publication on the macroecology of parental care in arthropods prompted us to examine that diversity. The authors, Santos et al. (2017) (doi: 10.1111/brv.12303), tested the hypothesis that the closer an insect or arachnid is to the tropics, the more elaborate the parental behaviors will be, including egg-handling. Their study included one embiopteran because enough experimental data was available on that species for their analysis. In fact, that species is *Antipaluria urichi*, which I have studied since the early 1980s and the data in Santos et al. was based on my research. I realized that I had enough information from different genera and from different locations to test their hypothesis more broadly for Embioptera.

In essence, the hypothesis stems from E. O. Wilson's fundamental ideas about biodiversity; that is, tropical realms host more natural enemies than temperate regions. If natural threats are more intense, then one would expect more elaborate parental investment in the tropics. To test this hypothesis for Embioptera, I gathered photographic documentation for 28 species and scored egg handling techniques: (1) complexity of the individual egg treatment, (2) whether the eggs are affixed to the substrate, (3) the nature of the covering on the egg mass, (4) how the eggs are aligned or scattered (Fig. 4), and (5) if silk is added to the egg mass. These characteristics ranged from 2 to 5 different states reflecting fairly high diversity.

Figure 4. Examples of diversity of egg alignment for Embioptera: highly ordered (top), loosely clustered (middle), scattered (bottom).

For example, some species, like *A. urichi,* create egg masses where individual eggs are coated with a cement, stuck down to the substrate, aligned in neat rows, and covered with thick macerated materials and silk. Others place their eggs individually into silk with no extra accoutrements. The dataset included GPS coordinates as a marker of position for each species. Locations ranged from arid to tropical. My colleagues at the University of Calgary (John Soghigian and Gen Morinaga) and I tested how these traits correlated with annual evapotranspiration, a stand-in for biodiversity. The results aligned nicely with the findings presented in the "Macroecology" paper by Santos et al. (2017); that is, despite a modicum of phylogenetic signal, tropical embiopterans display the most complex egg handling behaviors.

Do parasitic ant crickets (Myrmecophilidae) mimic ant gasters?

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Ant crickets (Myrmecophilidae) are the only obligate parasites in the order Orthoptera. They live exclusively inside the nests of ants, where they pilfer stored food and brood, and solicit regurgitated liquid from their ant hosts. Many ant crickets are host-generalists that exploit numerous ant species from several size classes and subfamilies. The desert ant cricket, *Myrmecophilus manni,* parasitizes more than 41 ant species in the western United States, and varies tremendously in body-size depending on the identity of its host. When reared with small-bodied ants, *M. manni* grow into small adults, but when reared with large-bodied ants, *M. manni* grow into large adults (Fig. 5). The positive correlation between host size and cricket size is clear, but any function of host size-matching, if one exists, has remained elusive. One possibility is that crickets of "the right size" are better able to mimic the mechanical solicitations needed to initiate trophallaxis (mouth-to-mouth food exchange) with their ant hosts. If tactile mimicry is important to their survival, perhaps resembling a common morphological feature shared by ant nestmates also reduces ant aggression towards invading crickets. Adult ant crickets are apterous, and their smooth bulbous bodies are similar in size to the gasters of ant workers and queens (though this does not explain why tiny, juvenile crickets are able to survive in the same host nests).

Figure 5. A group anesthetized ant crickets awaiting measurement. Growth trajectories of *Myrmecophilus manni,* reared with various ant host species, were compared in a cross-fostering experiment (Photographed by C. Kwapich).

Possibly, the benefits of size-matching have little to do with adult crickets themselves, and more to do with their eggs, which are laid in the soil below the brood piles of their ant hosts. If cricket eggs evade detection by resembling ant brood, then the positive correlation between adult cricket size and ant gaster-size might exist so that female crickets can lay appropriately sized eggs. To test this idea, I compared egg size between large-bodied *M. manni* found with large ant hosts and small-bodied *M. manni* found with small ant hosts (Weber's length < 1.5 mm). Each female carried only 1 or 2 eggs. Yet, when compared to the eggs and larvae of host ants, there was no clear relationship suggesting that cricket eggs mimic a particular ant life stage. In fact, large-bodied crickets and small-bodied crickets laid eggs that consistently measured 1.2 mm in length, across a nearly 2-fold range in female body width, and a 2.5-fold difference in dorsal length between the largest and smallest adult female crickets in the study. The result is that crickets from differently sized mothers all hatch at approximately the same size, regardless of host ant identity. Why cricket size begins to diverge in subsequent instars remains a mystery. Perhaps adult size is just an epiphenomenon of host colony nutrition, which varies enormously between ant species. This possibility leads to another tantalizing set of questions.

Newly evolved rattling crickets use novel morphology to attract mates while evading

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Witnessing the evolution of novel traits in real time is exceptionally rare. The recent appearance of new sexual signals in Hawaiian populations of the Pacific field cricket (*Teleogryllus oceanicus*) provides an opportunity to ask how and why novel signals become successful. Male crickets have specialized structures on their wings that they use to produce songs to attract potential mates. Over the past two decades, males with changed wing morphology who are either silent or produce attenuated song have evolved multiple times independently. Their

reduced conspicuousness protects these males from a deadly, acoustically orienting parasitoid fly. More recently, we have observed a dramatic and widespread increase in morphological and song variation across Hawaii, suggesting an ongoing rapid phenotypic diversification event. In order to understand this early stage of signal diversification, we 1) characterized the acoustic and morphological variation of phenotypes across Hawaii, 2) determined the morphological reasons for song differences, and 3) tested how natural (flies) and sexual (female crickets) selection impacts these phenotypes.

Hierarchical clustering using morphological and acoustic measures revealed three distinct, prominent song-producing male morphs in addition to the silent type: ancestral, purring, and rattling, which were discovered in the context of this study. The three morphs have distinct song characteristics, and purring wings differ from rattling and ancestral wings. Rattling and ancestral wings do not differ from each other using traditional wing-landmarking methods, but an unusual characteristic of one structure on the underside of the wing is unique to rattling crickets and appears to be responsible for the stark difference in their songs. Rattling song, like purring, is attractive to female conspecifics yet protective against parasitism, serving as another private mode of communication amongst crickets. Our findings suggest that this system is currently experiencing a phenotypic diversification event where multiple evolutionary solutions to shared selective pressures have arisen and spread within a short period of time, providing a rare microcosm for observing the real-time evolution of complex sexual signals.

This is the work of the street-art artist **Arthur Bordalo (aka Bordalo II)**, discovered on a wall of a building in a street of Lyon, France. Bordalo is a Portuguese artist who transforms garbage and waste into three-dimensional animals. Submitted by Michel Lecoq (mlecoq34@gmail.com), photo by his daughter, Elphège Rollet.

Editorial

By HOJUN SONG
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Happy New Year to everybody! For those of you who are in Asia, 2022 is the Year of the Tiger, I wish you the best in all your endeavors!

While I start this editorial in a celebratory tone, the reality is that we are still battling the COVID-19 pandemic as well as several climate related disasters around the world. Particularly, the Omicron variant is now a dominant strain within just a few months after it was identified from South Africa. In many parts of the world, the infection rates are soaring due the strain's extraordinary ability to transmit. I know many of my colleagues, students, and friends have been affected by COVID, and now I regularly get notifications that someone in my class has been tested positive.

I remember that I was writing the editorial for *Metaleptea* from Canberra, Australia, where I went for my short-lived sabbatical, this time two years ago. At that time, I did not realize that this coronavirus would become a pandemic that would kill millions of people and drag on for this long. In just two years, the world has become a very different place in many ways. But, I am glad and relieved to know that the science of orthopterology has since rebounded, as evidenced by many contributions that are featured in this issue.

One thing that this particular issue of *Metaleptea* is missing is the Ted Cohn grant reports. I have received a number of emails from the grant recipients saying that their research has been seriously compromised by COVID-related restrictions, which have delayed their progress. I really hope that the students in our field do not get discouraged. The field of orthopterology has progressed since its inception despite numerous wars and natural disasters, and as long as we keep our keen interests in the insects that we love and care about, the future of our field is bright. I have noticed that the number of research labs studying various orthopterans is on the rise around the world, and I am doing my part in training the next generation of orthopterologists. The COVID-19 pandemic will eventually pass to some degree, but our science will go on.

I am particularly excited about the society's plan to organize the 14th International Congress of Orthopterology in Mérida, Yucatán, México in October, 2023. Our dear colleague Dr. Mario Poot Pech is spearheading this effort and I truly look forward to meeting all our friends and colleagues in person soon.

This issue of *Metaleptea* is filled with interesting reports and stories contributed by our members. I would also like to thank our Associate Editor, Derek A. Woller, for his continued assistance in the editorial process.

To publish in *Metaleptea*, please send your contribution to hsong@tamu.edu with a subject line starting with [**Metaleptea**]. As for the format, a MS Word document is preferred and images should be in JPEG or TIFF format with a resolution of at least 144 DPI. We welcome any content, such as personal essays, travelogues, stories, photos, or anything you want to share with fellow orthopterists. The next issue of *Metaleptea* will be published in May of 2022, so please send me content promptly. I look forward to hearing from you soon!

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