

METALEPTEA

THE NEWSLETTER OF THE



ORTHOPTERISTS' SOCIETY

President's Message

By **AXEL HOCHKIRCH**
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Dear Society members,

I have just returned from a 10-day trip to Costa Rica where I was attending a meeting of the advisory board to the Mohamed bin Zayed Species Conservation Fund. We meet three times each year to discuss proposals and allocate funds for conservation projects. Members of the Orthopterists' Society have benefited from the Fund several times and, since 2009, the Fund has spent ca. \$300,000 for Orthoptera conservation projects around the world. However, we have hardly received any proposals from the Neotropics and never from Costa Rica. In fact, our Society does not even have members from Costa Rica or the neighboring Central American countries. Those who have done research on Orthoptera in Costa Rica usually come from other regions, such as the United States or Europe. This is worrisome, as Costa Rica is a megadiverse country with more than 500 Orthoptera species listed in the Orthoptera Species File (OSF). There are probably still many undescribed species to be discovered in the rainforests of Costa Rica and it should be a priority of our society to build capacity in this beautiful country, as well as in many other countries with a lack of Orthoptera specialists. Indeed, a similar situation exists in many other countries, particularly throughout tropical Africa and southeast Asia.



For me, Costa Rica was a new experience in terms of Orthoptera, as my field research focus was in Europe and parts of Africa. The neotropical Orthoptera fauna is very different from the Old World and I was amazed to find some beautiful grasshoppers and bush-crickets. For example, I found the grasshopper *Copiocera specularis* (see photo) in the lowland tropical rainforests of the biological field station La Selva, a species that belongs to a unique subfamily (Copiocerinae), which contains 144 described species in the Neotropics. I probably would not have been able to identify this species without the Citizen Scientist platform iNaturalist, which has quite good coverage of Central American Orthoptera.

Costa Rica is a model country in

TABLE OF CONTENTS

(Clicking on an article's title will take you to the desired page)

[1] PRESIDENT'S MESSAGE

[2] SOCIETY NEWS

- [2] *The 2024 Theodore J. Cohn Research Fund Recipients* by M. LECOQ
- [3] *Updates from the Global Locust Initiative* by M. RIES & R. OVERSON
- [4] *Update on the Singing Insects of North America (SINA) Website* by T. YAWN

[5] REGIONAL REPORTS

- [5] *Australia, New Zealand & Pacific Islands* by M. KEARNEY
- [6] *West Europe* by G.U.C. LEHMANN

[8] T.J. COHN RESEARCH FUND REPORTS

- [8] *Apocalypse Now with Ice Cream?* by A. VAN DER MESCHT
- [10] *Light at Night Affects Cricket Behavior in a Semi-natural Environment* by K. LEVY
- [12] *Taxonomy, Phylogeny, and Biogeography of the Grasshopper Genus Pteropera Karsch, 1891 (Orthoptera: Acrididae: Catantopinae)* by J.A. YETCHOM FONDJO

[16] OSF GRANT REPORTS

- [16] *Photographing Blattodea Types in Australian Museums* by H. HOPKINS
- [20] *Photographic Database of Western Asia Acridomorpha (Orthoptera, Caelifera) Type Specimens Deposited at NHM London* by H. TLILI & A. MOUSSI

[22] CONTRIBUTED ARTICLES

- [22] *Seemingly Risky Feeding Behavior by an Adult Melanoplus confusus Scudder* by M.L. BRUST & J.G. HILL
- [25] *The Magic World of Akira Toriyama* by D. SANTOS MARTINS SILVA
- [26] *Royal Society Theo Murphy Meeting "Locust and bee plasticity in a changing world"* by H. SONG

[28] EDITORIAL



Capiocera specularis from Costa Rica.

terms of conservation. Until the early 1990s, deforestation was extremely high and the country had lost about 50% of its primary forests. However, since that time a lot of reforestation projects have started and native trees have been used to develop secondary forests, so that many primary forests have been reconnected by near-natural vegetation. During my stay in Costa Rica, we also visited a project by the Monteverde Institute, which grows native tree species for reforestation programs and donates them to community members who want to grow

them on their land or in their gardens. An excellent project as, all too often, reforestation programs are using non-native species, which do not have any value for native insects.

Since our last International Congress of Orthopterology in Mexico the planning for our next congress continues. We still plan to hold the 15th

Congress in San Martín de los Andes, Argentina, the place where the Pan American Acridological Society (the precursor of our Society) was founded in 1976 - 50 years before our next congress will take place. While the economic situation in Argentina is still critical, our society has enough financial strength to cover a potential budgetary shortfall. There is unequivocal support among the society's board members to support the 50th anniversary congress in Argentina.

During the last months, Mira Ries

from the Global Locust Initiative (GLI) has helped us to set up a new membership management system via a platform called Airtable, which will simplify the management of our members. We will soon replace the old PDF membership application forms on our website by an online form that directly corresponds with the database. We also aim to re-establish a public version of the database as we had on our website, but this will require consent of each member for the data to be published as we have to ensure compliance to the European General Data Protection Regulation (GDPR), which does not allow us to share personal data without such consent. We will inform you via email as soon as the new system is in place, so that you can update your information and agree to share data.

Being back in Europe, field cricket (*Gryllus campestris*) season has already started in my region. This species used to be very rare in my region, but has massively expanded in recent years as a consequence of the warming climate. I wish you a good field season and success for your projects.

The 2024 Theodore J. Cohn Research Fund Recipients

By **MICHEL LECOQ**

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Dear fellow orthopterists, The selection committee for the Theodore J. Cohn Research Fund, offered every year by our society, received 16 research proposals from the following countries: Australia, Cameroon (2), Mexico (2), India (3), Singapore, USA (4), and the UK (3).

As usual, the selection committee was faced with often-original and excellent projects, and the choice was a difficult one. Nevertheless, we quickly reached an agreement, and I am pleased to announce below the list of

the 10 projects selected for 2024. We have 5 candidates from developing countries, even if some are studying at a university in a country other than their own, and this high proportion is, of course, to be welcomed. Another highlight this year is the presence of a project dealing, for the first time, with Plecoptera. I would like to take this opportunity to remind you that our society is dedicated to the Polyneoptera ("orthopteroids") as a whole, as mentioned on the home page of our website and that the committee will examine with equal attention any project coming from these nine insect orders: Blattodea (+Isoptera),

Dermaptera, Embioptera, Grylloblattodea, Mantodea, Mantophasmatodea, Phasmida, Plecoptera, and Zoraptera.

For 2024, and in alphabetical order by surname, the lucky recipients of these funds are as follows:

- **Hiroimi Yagui Briones** from Peru (PhD student, University of Melbourne, Australia) - *Genetic insights into a translocated flightless grasshopper: An analysis two-year posttranslocation.*
- **Souradeep Dutta** from India (PhD student, National Institute of Science Education and Research, DAE, India) - *Impact of anthropogenic noise on the acoustically communicating*

- Ensiferan communities - A study from Eastern India.*
- **Anna Eichert** from USA (PhD student, American Museum of Natural History, New York, USA) - *The Systematics of Plecoptera.*
 - **Lewis Holmes** from UK (Master student, University of Lincoln, UK) - *Male-male aggression and combat in a species of sylvan katydid that employs mate guarding from the montane cloud forests of Colombia.*
 - **Swastik Padhy** from India (PhD student, University of Minnesota, MN, USA) - *Impact of sub-lethal level of insecticides on species isolation barriers in field crickets (Orthoptera: Gryllus).*
 - **Syeda Mehreen Tahir** from Pakistan (PhD student, Arizona State University, AZ, USA) - *Unraveling how protein-rich diets accelerate mortality in biopesticide-infected desert locusts (*Schistocerca gregaria*).*
 - **Sydney Szwed** from USA (PhD student, Illinois State University, IL, USA) - *The Link Between Male Aggression and Immunity: A Critical but Neglected Life-History Trade-Off.*
 - **Jose David Gomez Tapia** from Mexico (Master student, National Autonomous University of Mexico) - *Phylogeography of a recently discovered genus of Melanoplinae (Orthoptera: Acrididae).*
 - **Jasmine Walker** from New Zealand (PhD student, University of St Andrews, UK) - *When form met function: Determining the evolutionary developmental substrates of acoustic signal diversification.*
 - **Renjie Zhang** from China (PhD student, University of St Andrews, UK) - *Living Transitional Fossils: Testing the Biomechanics of Insect Song Evolution in Rapidly Diversifying Crickets.*

On behalf of the committee, I wish them all the best in their research and we're obviously looking forward to seeing their report published in *Metalepthea* in a few months' time.

Updates from the Global Locust Initiative

By **MIRA RIES¹** & **RICK OVERSON²**

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After years of global collaboration and co-writing, members from the Global Locust Initiative (GLI) Network have published a comprehensive review and synthesis paper in the *Journal of Orthoptera Research (JOR)*. The paper is titled *Global perspectives and transdisciplinary opportunities for locust and grasshopper pest management and research* (<http://doi.org/10.3897/jor.33.112803>), and brings together 38 coauthors from 12 different countries across 34 diverse organizations. This paper aims to be a foundational resource for the community, and a catalyst for transdisciplinary collaboration and growth of the field.

The paper originated from discussions at the 2018 GLI launch conference held at Arizona State University and evolved from collaborations among stakeholders over subsequent years. Participants were initially grouped by regional expertise and then by discipline. With this foundation, the paper explores the relationships, strengths, and weaknesses of the organizations responsible for the

management of major locust-affected regions and reviews recent advancements and challenges of the disciplinary topics related to locust and grasshopper management and research.

If you are just hearing about the Global Locust Initiative (GLI), check out our website www.locust.asu.edu. The GLI is an Arizona State University initiative whose mission

is to promote interdisciplinary locust research and management to improve the well-being of farming communities and global food system sustainability.

Upcoming events:

The GLI is looking forward to the 2024 Entomological Society of America (ESA) conference, which



Photo from the GLI launch event in 2018.

will be held in Phoenix, Arizona. Join us for our annual networking event on Tuesday, November 12th at 4 PM. This year, we will host a mixer alongside the [Behavioral Plasticity Research Institute](#) and the [Orthopterist's Society](#). Join us to connect with colleagues new and old, and hear updates on their projects and research. We invite anyone interested in any aspect of orthopteran biology, integrative pest management, sustainable agriculture, food security, or related fields to join the conversation. An informal gathering at a nearby restaurant will follow the event (location forthcoming).
Orthopterists' Society Membership

Database Update

We have made some exciting new updates to the Orthopterists' Society membership database system using a platform called Airtable that makes it easier for new members to sign up and existing members to renew. Online membership forms are now available on our [website](#). If you have any feedback or run into any issues please let us know by emailing miraries@asu.edu.

As part of our update, we would like to publish part of the database for public viewing on our website, which would enable members to search for and connect with each other more

easily. To publicly post such information (specifically, your full name, professional title, email, organization, country, species/areas of expertise/interests in Polyneoptera, and personal website) we need your consent. While you're at it, why not update your contact information? You can use this form to let us know what is new with you and if you would like your info to be displayed on the website: <https://bit.ly/OSMemberConsent>. If you are ready to renew your membership click here: <https://bit.ly/OSRenewingMember>.

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

By **TERESA YAWN**

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For the past few months, I have been updating and adding new records to the species' map pages on [SINA](#). Some map pages are relatively easy to update, such as Buckell's grig (*Cyphoderris buckelli*). There were only a handful of records, all from tblMain (Tom Walker's spreadsheet with SINA records from 2003 to 2008), which ranged from the northwest of the United States up into British Columbia. This was the first map page I updated that had records from Canada, which provided the opportunity to finalize how Canadian records would be listed: Provinces, Regions, and Localities. As a map of the United States Regions is provided on map pages with records in the U.S., a map showing the Canadian Provinces is also provided for those pages with Canadian records. I was able to place all data points on *C. buckelli*'s map except one: a locality for British Columbia was given as Squizax, but I could not find any place with this name in British Columbia, or anywhere else, for that matter. This was mentioned at the end of the List of Records under

Notes.

Other map pages are more complicated, such as those for *Oecanthus forbesi* and *O. nigricornis*, two species that are morphologically similar and can only be identified to species by song. [Nancy Collins](#) brought to my attention the need to update these maps. Nancy, [Lisa Rainsong](#), and [Carl Strang](#) helped update the maps by providing new records and information on the crickets' distributions. Both species are found in Ohio, but *O. forbesi* is only found west of Ohio and *O. nigricornis* is only found east of Ohio. The updated map includes records for both species and is used on both map pages. Records provided by Lisa, Carl, and Nancy were identified by song. Records from tblmain included records that were identified by song and those based on specimens or literature. Symbols on the map indicate whether records are for *O. forbesi*, *O. nigricornis*, or a location that includes both species, as well as if the record was based on song, specimen, or literature. A second map shows a closeup of the records in Ohio that were identified by song. The original SINA maps, created in 2003

and 2005, have been kept on the map pages for reference and continuity.

Frequently, I am contacted by persons who are interested in using songs, images, or videos from SINA for various projects. Here are a few interesting requests that I received over the last year:

- A retired United States Department of Agriculture (USDA) entomologist requested permission to use the photograph of a mating pair of [clicker round-winged katydids \(*Amblycorypha alexanderi*\)](#) in a paper he was writing on "the analysis of courtship behavior in orthopteran insects and its implications in understanding the main idea of one poem in *Odes of Shao and the South*."
- A student at Goldsmiths, University of London requested to use the song of the [broad-winged tree cricket \(*Oecanthus latipennis*\)](#) in the creation of a Soundscape Composition for his final project in his studies. His aim was to develop a composition to provide relief for individuals

- with tinnitus.
- A sound designer for video games requested to use various songs from SINA in a game she is helping to create. The game's purpose is to educate players about climate change, its impact on insects, and what we can do to reduce that impact.

When someone contacts me and requests to use songs, images, or videos from SINA, I am always happy to say that, yes, they are welcome to use the content they requested. SINA is licensed under the Creative Commons Attribution-ShareAlike (CC BY-SA) license and its contents are available for use with minimal restrictions. Es-

entially, anyone is free to use SINA content for various purposes, including commercial ones, as long as they credit SINA and license any new work they create based on it under the same terms. This information is provided on SINA's [copyright page](#).

Regional Reports - What's happening around the world?

Australia, New Zealand, & Pacific Islands

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K

en H.L. Key's field notes available online

Most of the Australian grasshopper specimens in the Australian National Insect Collection derive from the efforts of Ken Key and those working under his directive. Their 223 field notebooks were scanned by Dr. Md Anwar Hossain as part of his Ph.D. research and they are now available online for everyone to see at the [Biodiversity Heritage Library](#). Anwar published [a paper on these notebooks](#) and our efforts transcribing them, and [a paper on diversity patterns](#) in Western Australian grasshoppers based on the information in these field notes.

Grasshopper translocation studies

A couple of papers have come out on the practicalities of grasshopper translocation for conservation from the Kearney lab, one on [correlates of translocation success](#) led by Ph.D. student Hiromi Yagui and another on the (lack of) [impact on a source population](#) of collection for translocation.

David Hunter gives presentations at CLCPRO in Mauritania

Between 11-15 December, David Hunter took part in the 16th Meeting of the Executive Committee of CLCPRO (Committee for the Control of the Desert Locust in the Western Region) in Nouakchott, Mauritania. Various presentations summarised the minor desert locust outbreaks that have been managed in the past year and the latest in forecasting, monitoring, and control including important areas of research. David presented the latest results and information on the use of biopesticides against locusts in various parts of the world, including Australia, China, Mexico, and Central Asia.

The European Union is a key market for agricultural exports, but a number of the chemical pesticides that have been used against locusts in recent years are either banned or severely restricted in the EU. For exporting countries, the detection of such chemicals in shipments of agricultural products to Europe would lead to the rejection of shipments and a reduction in the marketability of their exports. Consequently, the use of any of the chemicals banned in the EU needs to be restricted to non-crop situations or to crops that are certain not to be exported. There needs to be a more judicious use of chemical pesticides that are still available for locust control and it is critically important to come up with ways to reduce chemical pesticide use including strip ("barrier") spraying and increased use of

biopesticides. That biopesticides can be a significant part of desert locust management has been demonstrated by the widespread use of the Novacrid *Metarhizium* biopesticide in Somalia during 2019-21 against both nymphal bands and adult swarms. The high (>80%) mortality seen in Somalia and in the other countries that use *Metarhizium* mean that biopesticides are a genuine alternative in many situations, particularly preventive management and when locusts are outside cropping areas. However, there are several major issues that have hindered the use of *Metarhizium* biopesticides. The first is higher price, but, while the cost of *Metarhizium* product is higher than chemical pesticides, when one considers the *total* cost of a treatment program (personnel, vehicles, equipment, aircraft), the price difference per hectare treated is not substantial, especially when *Metarhizium* is applied in strips. Furthermore, the selectivity of *Metarhizium* in working well only against locusts and grasshoppers means the market for the product is limited: the desert locust only has outbreaks from time-to-time and so broadening the use of biopesticides to a wide variety of locust and grasshopper pests, as has occurred in China, is an important way forward in ensuring a more regular market and continuing production.

West Europe

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Insects provide various vital functions in ecosystems, but in recent years a dramatic decline in their biomass has been observed. The landmark study by Hallmann et al. (2017) conducted in Germany received worldwide attention by showing a decline in insect biomass of 75 percent over the last three decades. Because of the dramatic impact on insects shown by this study the German Government supported multiple approaches to investigate possible drivers of this insect decline. A multimillion Euro study is the transdisciplinary research project DINA (Diversity of Insects in Nature Protected Areas). Similar in methodology to the original study, the biomass of flying insects from Malaise traps was recorded using identical traps by the Entomological Society of Krefeld (EVK). Malaise traps were in use in 21 representatively selected Nature Protected Areas across Germany. To cover spill-over effects from bordering arable land, transects of five traps were placed in each study area (Fig. 1). These transects spanned from the arable land into the Nature Protected Areas (Fig. 2, ex Lehmann et al. 2021). The project was conducted from May 2019 until late autumn 2023, while the traps were operated from summer 2019 until autumn 2022.

Although many Orthoptera species can fly, due to their comparable large size they are not a target group for malaise traps. However, at least accidentally, Orthoptera visited the traps (Fig. 3).

When assessing the whole species count initially by metabarcoding (Köthe et al. 2023) we found quite a number of Orthoptera species in our probes. It is currently unknown which percentage of Orthoptera are captured due to dispersal flights or as passive

sampling of walking individuals. Nonetheless, Orthoptera have an advantage of low species numbers (around 80 species in Germany), and decade-long use as indicator organisms for climate change and habitat loss. Therefore, we included them as one insect group especially for validation of the metabarcoding results.

To achieve this, selected probes (out of around 2500 in total) were manually sorted by insect order and counted, which is a labor-intensive task (Fig. 4).

Probes from Malaise traps with a two-week sampling interval contain several thousand individuals (Fig. 5).

Even if Diptera, Hymenoptera, and Lepidoptera dominate in individual numbers, Orthoptera adults are found in moderate numbers, covering at least a reasonable part of the local fauna (Fig. 6).

The full results from the Orthoptera assessment are underway and can be expected soon.

In general, the project showed negative impacts of agricultural practices in the surrounding of Nature Protected Areas on insects and their habitats (Köthe & Schneider et al. 2023). Contact with several pesticides (Brühl et al. 2021), impoverishment of vegetation by fertilisers on the edge of protected areas (Köthe et al. 2023a), and long common boundaries between protected areas and arable land (Eichler et al. 2022, 2023) contribute to the documented reduction of flying



Figure 1. Malaise traps along a transect in the nature protected area “Gesower Hügel” in the federal state of Brandenburg in Germany. Picture taken by Gerlind Lehmann.

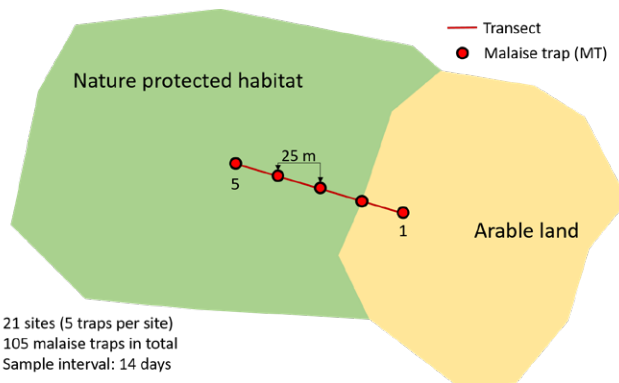


Figure 2. Schematic transect with traps reaching from arable land (MT1) into a nature protected habitat (MT2-5); from Lehmann et al. 2021, Biodiversity and Conservation 30:2605–2614. doi:10.1007/s10531-021-02209-4



Figure 3. Trap site with one of the largest German bushcrickets *Tettigonia viridissima*; picture taken by Michael Braune

insects (Mühlenthaler et al. 2024). Biomass and insect richness according to DNA metabarcoding strongly correlate (Köthe & Schneider et al. 2023), which suggests that biomass is a reliable indicator for the status of their diversity. The Ellenberg indicator value for nutrients turned out to be a reliable metric for the condition of vegetation and documented the loss of endangered species (Köthe et al. 2023a).



Figure 4. Manual sorting of Malaise trap samples by Dr. Roland Mühlethaler, strategic manager of the DINA-project; picture by Gerlind Lehmann.



Figure 5. Unsorted sample from a Malaise trap, showing the diversity of insects from a two-week interval.

However, the management of Nature Protected Areas also shows considerable deficiencies and does not address many problems or offers hardly any risk assessment, especially for insect conservation. Recommendations based on the results and expertise of the DINA project were derived to strengthen the protection of insects in Nature Protected Areas (Köthe et al. 2023b).

Relevant project information is compiled by the Leibniz-Institut für ökologische Raumentwicklung (IÖR) in story maps, accessible under: <https://storymaps.arcgis.com/stories/4e24dc33f079481385de-35b72587186e>.

The whole project was a collaboration of eight research institutions in Germany and supported by a gre-

at number of Citizen Scientists to check the Malaise traps; a warm thank you to all participants.

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Figure 6. Orthoptera from a Malaise trap sample in autumn, represented by adults of bushcrickets (*Phaneroptera falcata*, *Meconema meridionale*), crickets (*Oecanthus pellucens*), and grasshoppers (genus *Chorthippus*); picture taken by Gerlind Lehmann.

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Theodore J. Cohn Research Fund Reports

Apocalypse Now with Ice Cream?

By **AILEEN VAN DER MESCHT**
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The year was 2021. Contrary to popular belief, the desert was not dry and desolate. And yet zombies were stirring. Okay, fine, not zombies, but

they do have an affinity for munching on those both dead and living.

In late 2020 and early 2021, the southern Kalahari in South Africa received above-average rainfall ending a seven-year drought in the region. In turn, vegetation growth was facilitated, and both grass and forb species dominated what would have otherwise been bare sand dunes. It was in this green Kalahari that our story begins. I had proposed to investigate the distribution of orthopterans across this landscape, using both traditional methods, such as sweep netting and active searches, and acoustic monitoring of the Tettigoniidae community (a particular favorite group of mine). Upon arriving at Tswalu Kalahari Reserve, it quickly became apparent that the katydids had other ideas. The good rains had woken up all the millions of sleeping zombies in the soil. Throughout the austral summer from 2020 – 2021, landscape was characterized by a huge mass emergence of this species.

Acanthoplus discoidalis – a critter so zombie-like it becomes cute, but, as an orthopterist, perhaps my assessment of the species is biased. This species is a member of the Hetrodinae subfamily, and, as such, is a large flightless and generalist feeder. A further characteristic of this species is that the males really have a lot to say for themselves, producing a long and relatively low frequency buzzing call that carries for many meters and effectively masked all other calls in my recordings. Interestingly, under

the conditions of this mass emergence, calling activity would start at 10 AM, and reach an activity peak between 3 PM and midnight, and then decrease through the early hours until 10 AM when the cycle would start again. Somewhat contrary to the idea that katydids tend to dominate the nocturnal soundscape, here they most definitely dominated both the diurnal and nocturnal soundscapes.

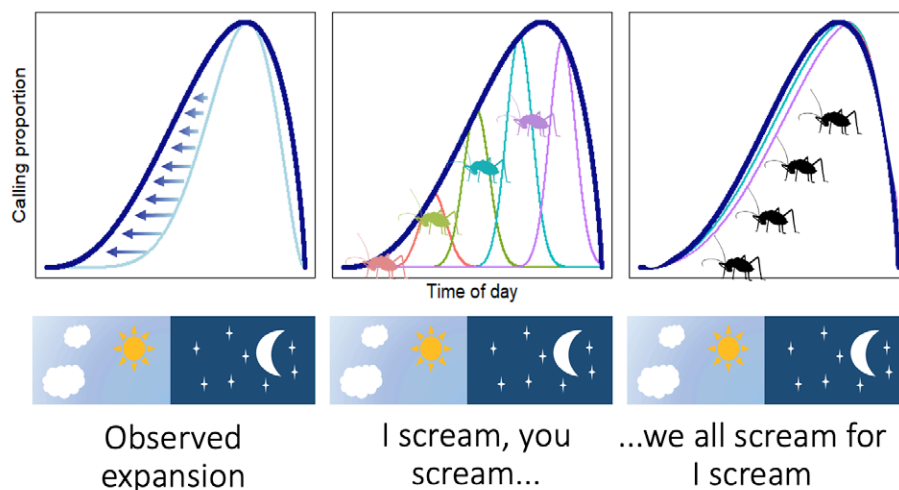
The seed of an idea was planted (also being the Kalahari in summer, ice cream was on my mind) and I started wondering, if there are so many males calling at the same time, how much acoustic intraspecific competition do males experience? And is this expanded diel activity period a direct result of males attempting to minimize intraspecific competition by altering their individual acoustic niches and thus following the principles of the ideal free distribution? Thus, the Ice Cream Hypothesis was postulated.



A zombie *Acanthoplus discoidalis*

As children, many of us learn the ditty “I scream, you scream, we all scream for ice cream.” This is an ideal way to describe the fundamental ecological question posed here: is the observed expansion of this species acoustic niche a result of males partitioning it between each other, and thus taking turns to “scream.” So, H_1 becomes “I scream, you scream.” Or do males simply all expand their diel acoustic niche at the same time as that is what their neighbors are doing, and thus H_2 becomes “We all scream for ice cream.”

With this in mind, another trip to the Kalahari was undertaken. this time in





Tswalu Kalahari Reserve, South Africa

April 2022. Individuals of both sexes were collected, and brought back to the laboratory in Bloemfontein, South Africa. “Freshly” mated females are easily identified in the field in the morning as the males provision their partners with a large gelatinous nuptial gift. An interesting side bar: the male’s refractory period post-mating is about 3 days long where they do not call and take the time to develop the next gift. Collected individuals were housed in separate containers with a thick sandy layer approximately 5cm deep and were provisioned with food and some foliage on which to climb. Females oviposition directly in the sand, and were observed ovipositioning a few hours post-mating. After a three-week collection period, all individuals were transported back to the laboratory in the department of Zoology and Entomology, University of the Free State, South Africa. Mating history of the individual females was noted, and those that were unmated upon collection, or who had laid eggs early in the season, were paired with a male as mating is easily induced between individuals overnight in the lab. Females were allowed to oviposition in the sand within each container.

This was all done in order to set up a laboratory colony of individuals that

I could manipulate densities and sex ratios in order to determine if there is indeed density-dependent intraspecific acoustic competition in this species. At this point, I learned a very good lesson in that all the greatest science plans can go splat. And splat indeed went my plans.

With very little in the literature on rearing hetrodinae eggs under laboratory conditions, I based my approach on other Tettigoniidae experiments. Seasonal temperature in the Kalahari can vary considerably, with summer days often reaching 45°C+, while winter nights with sub-zero conditions are common. Following this, *Acanthoplus* eggs in the sand enter a period of diapause during the cooler winter months before beginning development after the first spring rains. Eggs were left undisturbed during the winter months. When the spring rains were first noted in the Kalahari, the egg pods were retrieved from the sand, washed in distilled water, and the individual eggs placed in mesh-covered petri dishes in a rearing container in which humidity was maintained at 75% and a constant ambient temperature of 26 °C. After 4 months of lovingly checking on the eggs and tending to their every need, I realized that I failed to postulate H₃, which states that *A. discoidalis* are a stubborn spe-

cies and will only hatch under conditions that they feel are acceptable. So, what I thought were 5 star plus accommodations, likely scored a minus 5 star rating in their books!

Individual acoustic niche variation is still something that needs to be delved into. The acoustic niche and acoustic adaptation hypotheses focus on the species level. Very little, especially in the insect and Tettigoniidae literature looks at how individual variation contributes to the overall fitness of a species and how this variation can lead to an evolutionary stable population. Perhaps a field-based experiment is a better approach since *A. discoidalis* is an ideal study organism as it is large-bodied, slow, easy to find, and easy to identify acoustically. But perhaps, most importantly, this species occurs at both low and extremely high densities. If any specialist reading this has any ideas, please do reach out, all input will be greatly appreciated.

At least I can confidently say that there shall be no zombie-*Acanthoplus discoidalis*-apocalypse, and all our ice cream is safe.

And for those who don’t believe I can do serious science having read the above, or who would like to read more about orthopterans in the Kalahari here are two publications that have come out of my various galivants to this amazing part of the world:

- van der Mescht, AC. & Codron, D. (2023) Mountains and their ecotones increase landscape heterogeneity and maintain a unique assemblage of grasshoppers in the southern Kalahari. *Ecological Entomology*, 48, 226–239. Doi: 10.1111/een.13217
- van der Mescht AC, Lewis C, van der Merwe C & Daryl Codron (2023) Hurry up and sing: early onset of diel calling behaviour and ecological drivers of calling behaviour of *Acanthoplus discoidalis*, *Bioacoustics* 32, 284-300. Doi: 10.1080/09524622.2022.2112289

Light at Night Affects Cricket Behavior in a Semi-natural Environment

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The rhythmic changes of day and night serve as the most reliable signal for timekeeping in most organisms, forming the basis for circadian regulation and behavior synchronization¹. Exposure to artificial light at night (ALAN) disrupts the natural light cycle, negatively impacting animals' natural behavior as well as the entire ecosystem². ALAN has been reported to affect the length and quality of sleep, spatial and temporal orientation, predation risk and mortality in numerous insect species³. Furthermore, changes in the exposure to light have been shown to affect the daily activity patterns of insects, including crickets. Measurable changes are mostly manifested in circadian behavior, including locomotion, stridulation (sound produced by rubbing the cricket's wings against each other), sleep, foraging, and courtship, but also in circadian gene expression and hormonal regulation.

Adult males of the field cricket, *Gryllus bimaculatus*, stridulate just after sunset and during the night in order to attract females for reproduction⁴ and their stridulation behavior can be easily monitored by simple recording devices. Demonstrating a predominantly nocturnal lifestyle, crickets thus constitute a good model for studying the effects of ALAN (including low levels) on the circadian behavior of insects⁵. Indeed, various studies have reported changes in cricket circadian behavior following exposure to different light regimes⁶⁻⁸ including ALAN^{9,10}. However, practically all of these studies were conducted under laboratory settings.

Recently we have reported on a first attempt to understand how ALAN affects cricket stridulation behavior under almost natural conditions¹¹, while also comparing our findings to those obtained under laboratory settings⁹. I describe here these results in brief.

Methods

Thanks to The Orthopterists' Society's Theodore J. Cohn Research Fund, we purchased Swift outdoor recording devices¹² (Cornell Lab of Ornithology) and sound cards for building a semi-natural experimental set-up (Figure 1). This set-up allowed us to investigate the impact of ALAN on *G. bimaculatus* crickets. Each cricket was placed individually in an enclosure, under shaded outdoor conditions of up to 1500 lx, and was exposed to a specific ALAN treatment (Figure 1 A-B). A total of seven different night light intensities were investigated, including <0.01 lx as control, 2 lx, 5 lx, 100 lx, 400 lx, and a constant light of 1500 lx intensity. Each experiment lasted 14 days and nights (overall the experiments were conducted over a period of two years). The stridulation data of the individual crickets was evaluated manually and compared among treatments¹¹. During the experiments, temperature was monitored to ensure similar temperatures in all

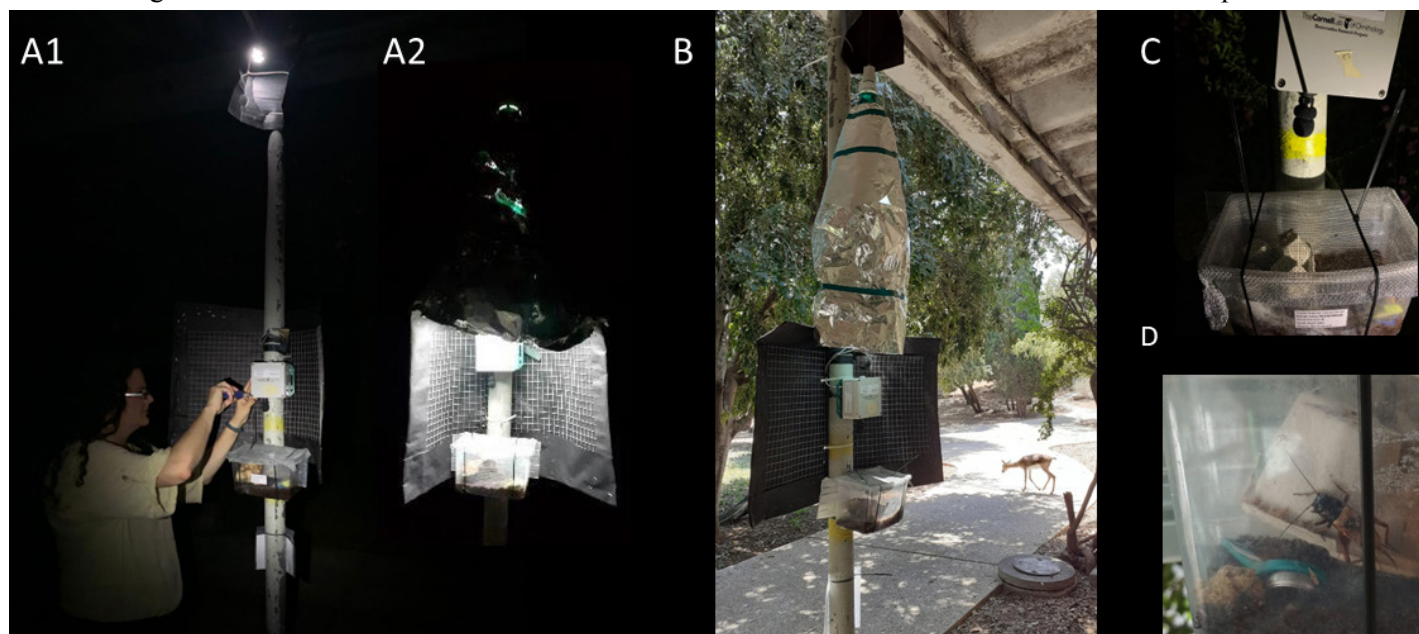


Figure 1. The set-up of the semi-natural, ALAN experiment: (A1) The experimental setup of the 15 lx treatment consisting of a shaded enclosure containing a cricket and the Swift autonomous recording device 15 cm above it. (A2) For comparison, the experimental setup of the 1500 lx treatment, showing the Aluminium foil wrapped CFL light bulb at night (B) and at daylight. (C) A close-up of the enclosure and the microphone and (D) the cricket in the enclosure, next to the temperature button (green).

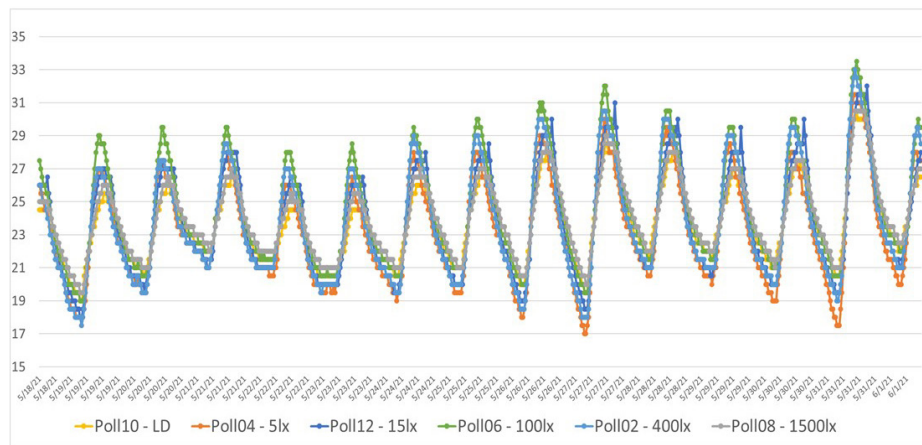


Figure 2. An example of a representative daily temperature rhythms during one experimental trial (18.5.–01.06.2021) of the semi-natural ALAN experiment. The shaded temperatures, temperature peaks, and rhythms are very similar for all six experimental poles, differing in less than 5°C from each other.

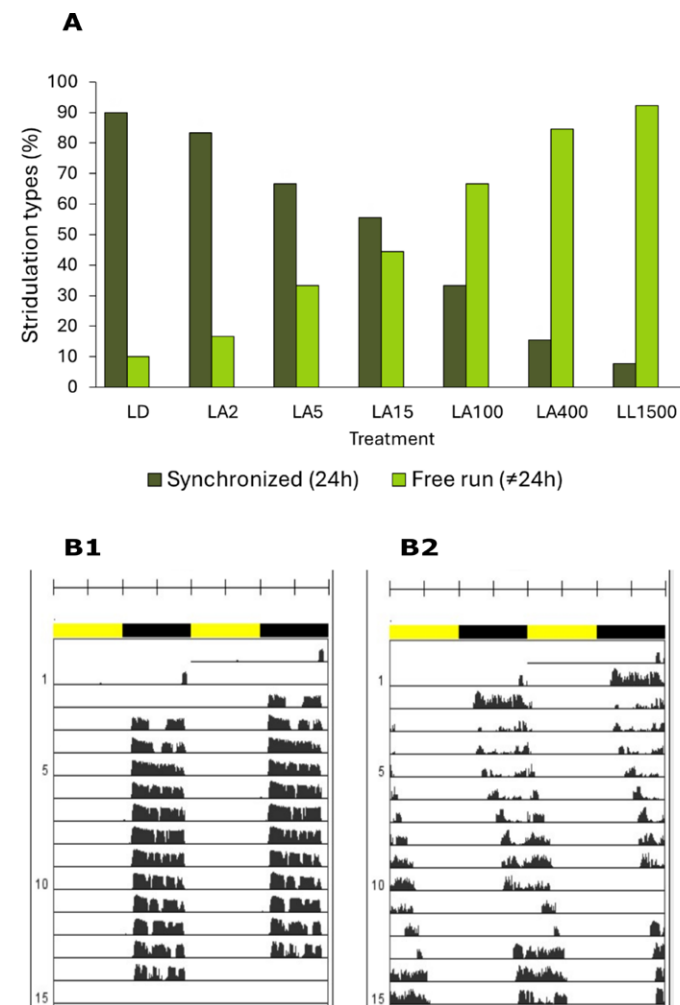


Figure 3. The relative proportion of daily stridulation activity rhythm types in adult male crickets exposed to different ALAN intensities under semi-natural conditions: (A) A light-intensity dependent decrease and increase in the percentage of synchronized (dark green), and free-run (light green) stridulation activity rhythms, respectively (ntot. = 98). Treatments as follows: LD (<0.01 lx, n = 30); LA2 (2 lx, n = 6); LA5 (5 lx, n = 15); LA15 (15 lx, n = 9); LA100 (100 lx, n = 12); LA400 (400 lx, n = 13); LL1,500 (1500 lx, n = 13). (B) Double-plotted actograms showing two different examples of rhythmic stridulation patterns: (B1) synchronized stridulation behavior, occurring in a 24 h cycle period; (A2) free-run stridulation behavior occurring in a cycle period longer than 24 h (namely 24.5 h for the cricket shown here). Yellow and black bars indicate diurnal and nocturnal phases, respectively. Adapted from ¹¹

the experimental enclosures (Figure 1D; Figure 2). See Levy et al.¹¹ for further details.

Results and Discussion

Overall, ALAN affected the timing of the crickets’ stridulation (Figure 3A), leading to a decrease in synchronized behavior and an increase in free-run behavior (Figure 3B). Free-run refers to a behavior which is not synchronized to the surrounding conditions but rather follows the individual’s internal clock. The proportion of crickets exhibiting free-run behavior increased with the light intensity (Figure 3A).

This was further demonstrated in a significant difference in the median activity period between the crickets under control conditions or

under a light intensity above 100 lx¹¹. Moreover, the variance of the median activity period differed between the control group and all treatments exposed to a light intensity higher than 100 lx¹¹. These results are in accord with our previously reported laboratory findings, where lifelong exposure of crickets to various intensities of ALAN evoked a light-intensity-dependent increase in free-run behavior⁹. However, the ALAN intensity required to disrupt the crickets’ natural behavior and induce free-run in 80% of the population was much higher under natural conditions compared to the laboratory settings. This difference may be attributed to the strong differences in diurnal illumination intensities between the two experimental settings.

Another noteworthy observation relates to the crickets’ overall stridulation behavior in the constant light treatment. Despite the natural temperature cycles, which have been suggested to synchronize behavior under laboratory settings^{13,14}, most crickets in our semi-natural experiment exhibited free-run behavior and were thus not synchronized by the temperature rhythm¹¹.

This study presents a novel experimental system, utilizing the cricket as a model for long-term monitoring of the effects of ALAN under almost natural conditions. Our findings demonstrate ALAN-induced changes in stridulation and subsequently in courtship behavior. Such alterations in timekeeping and acoustic signaling may adversely affect mating behavior, increase the crickets’ predation risk, and negatively impact the species fitness. This adds to the growing understanding of the threats of ALAN on insects and ecosystems. Further investigation is required to thoroughly understand the possible diverse and complex consequences of ALAN on insects’ behavior and fitness.

Acknowledgments

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Taxonomy, Phylogeny, and Biogeography of the Grasshopper Genus *Pteropera* Karsch, 1891 (Orthoptera: Acrididae: Catantopinae)

By **JEANNE AGRIPPINE YETCHOM FONDJO**

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P*teropera* Karsch, 1891 is a micropterous Afrotropical grasshopper genus belonging to the subfamily Catantopinae. Species of this genus are common in forests, forest edges, and agrosystems, and most of them have restricted distribution ranges. *Pteropera* was first described for a single species, *P. verrucigena*. This genus was monotypic until *P. pictipes* I. Bolívar, 1908 was described. At the same time, *P. karschi* (I. Bolívar, 1905) previously included in the genus *Aresceutica* Karsch, 1896 was also included in the genus *Pteropera* (Donskoff, 1981). After 12 years, *P. uniformis* L. Bruner 1920 was described. Shortly thereafter, Ramme (1929) revised the genus based on external morphology and described two other species (*P. carnapi* and *P. zenkeri*), and transferred *P. spleniata* (Karsch, 1896) and *P. femorata* (Giglio-Tos, 1907), originally

placed in the genus *Serpusia*, into the genus *Pteropera*. At the same time, Ramme (1929) proposed two keys to *Pteropera* species (one on males and one on females), that included a total of 8 species distinguished on the basis of external morphological features and coloration. Then, Ramme (1929) noted *P. pictipes* and *P. femorata* to be synonyms. 52 years later, Donskoff (1981) conducted a complete revision of the genus based on external morphology, coloration, and genitalia

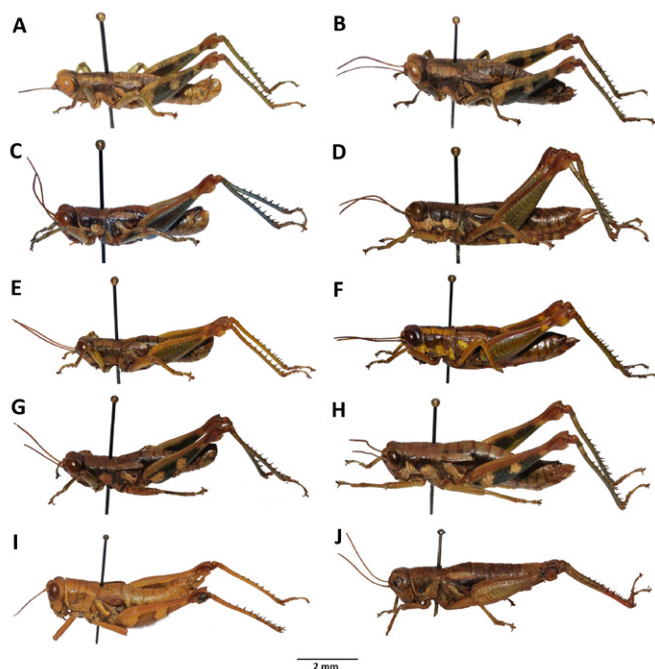


Figure 1. Images of Holotypes, Allotypes and Paratypes of *Pteropera* species in lateral view. **A:** *P. augustini* (Holotype ♂). **B:** *P. augustini* (Allotype ♀). **C:** *P. balachowskyi* (Holotype ♂). **D:** *P. balachowskyi* (Allotype ♀). **E:** *P. bertii* (Holotype ♂). **F:** *P. bertii* (paratype ♀). **G:** *P. brosetti* (Holotype ♂). **H:** *P. brosetti* (Allotype ♀). **I:** *P. basilewskyi* (paratype ♀). **J:** *P. bredoi* (Holotype ♀).

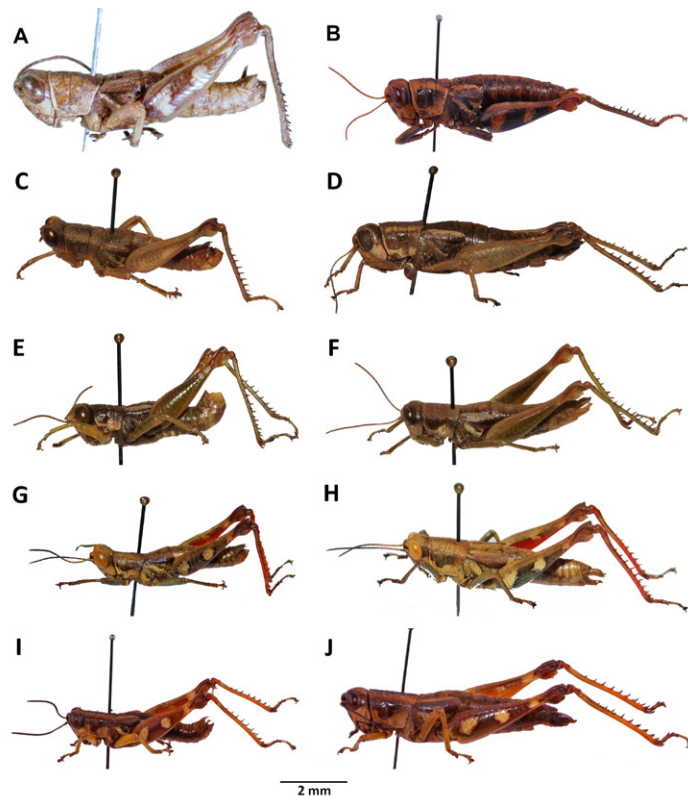
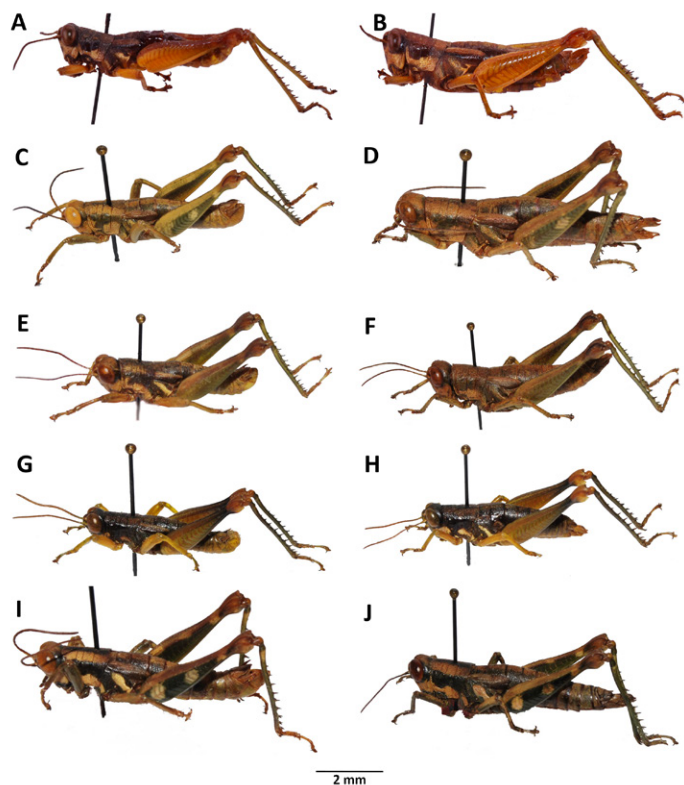


Figure 2. Images of Holotypes and Allotypes of *Pteropera* species in lateral view. **A:** *P. carnapi* (Holotype ♂). **B:** *P. carnapi* (Paratype ♀). **C:** *P. congoensis* (Holotype ♂). **D:** *P. congoensis* (Allotype ♀). **E:** *P. cornici* (Holotype ♂). **F:** *P. cornici* (allotype ♀). **G:** *P. descampsi* (Holotype ♂). **H:** *P. descampsi* (Allotype ♀). **I:** *P. descarpentriasi* (Holotype ♂). **J:** *P. descarpentriasi* (Allotype ♀).

Figure 3. Images of Holotypes, Allotypes and Paratypes of *Pteropera* species and subspecies in lateral view. **A:** *P. femorata* (Holotype ♂; Cigliano et al., 2024). **B:** *P. femorata* (♀). **C:** *P. grilloti* (Holotype ♂). **D:** *P. meridionalis* (Holotype ♂). **E:** *P. jeanninae* (Holotype ♂). **F:** *P. jeanninae* (Allotype ♀). **G:** *P. karschi karschi* (♂). **H:** *P. karschi karschi* (♀). **I:** *P. karschi zenkeri* (Holotype ♂). **J:** *P. karschi zenkeri* (Allotype ♀).

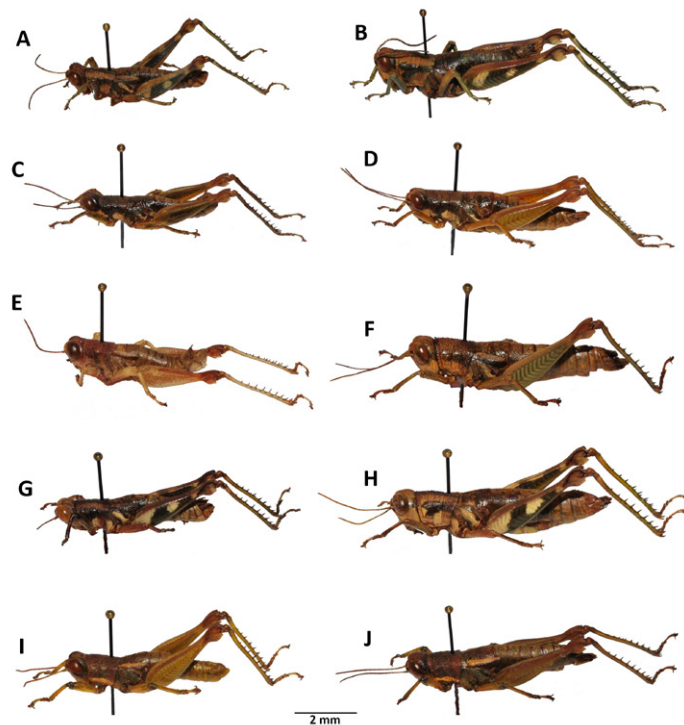


Figure 4. Images of Holotypes and Allotypes of *Pteropera* species in lateral view. **A:** *P. menieri* (Holotype ♂). **B:** *P. menieri* (Allotype ♀). **C:** *P. mirei* (Holotype ♂). **D:** *P. mirei* (Allotype ♀). **E:** *P. morini* (Holotype ♂). **F:** *P. morini* (Allotype ♀). **G:** *P. pillaulti* (Holotype ♂). **H:** *P. pillaulti* (Allotype ♀). **I:** *P. poirieri* (Holotype ♂). **J:** *P. poirieri* (Allotype ♀).

features, and described 21 new species. In 1981, the genus comprised 27 valid species described from Central African forests only. Since then, no other taxonomic work dedicated to species of this genus have been done. Given the large number of localities where inventory works have not yet been conducted, it is possible that the genus *Pteropera* could be more diverse than what is currently known. Furthermore, no molecular data of the genus have

been collected since its first description. Thus, I aim in this project to shed further light on the taxonomic status of grasshopper species of the genus *Pteropera* using an integrative approach, including morphology and molecular analyses. With the help of the Theodore J. Cohn Research Fund, I was able to visit the Orthoptera collections of the MNHN Paris and the MFN Berlin, in order to check and photograph all types and species of the genus *Pteropera*. This grant also helped me describe three species new to science, to record the distribution data of all *Pteropera* species, and to sequence three molecular markers (COI, 16S, and 12S) for the first phylogenetic analysis of the genus.

METHODS

Specimen collection and morphological studies

The fresh samples I used for this project were collected between June 2017 and April 2022 in various loca-

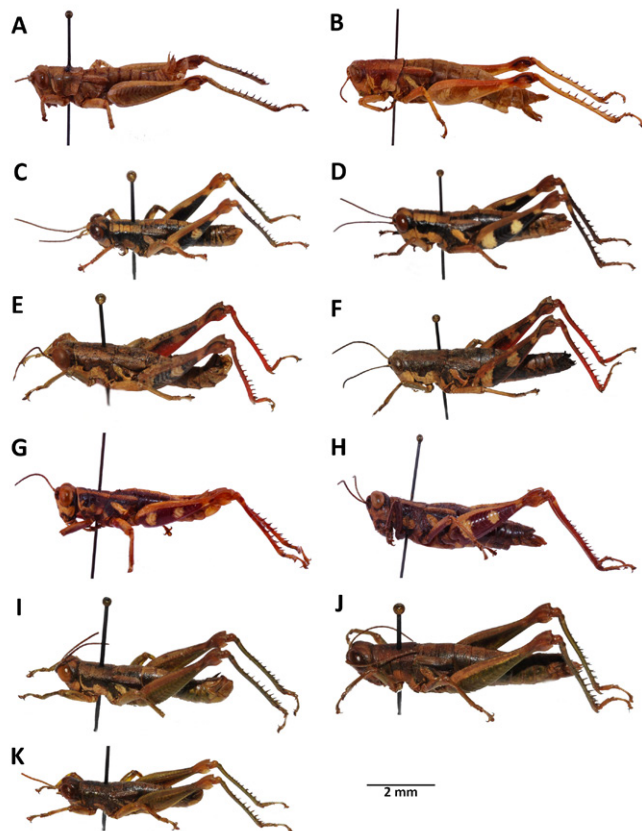


Figure 5. Images of Holotypes, Allotypes and Neallotype of *Pteropera* species in lateral view. **A:** *P. spleniata* (Holotype ♂). **B:** *P. spleniata* (Holotype ♀). **C:** *P. teocchii* (Holotype ♂). **D:** *P. teocchii* (Allotype ♀). **E:** *P. thibaudi* (Holotype ♂). **F:** *P. thibaudi* (Allotype ♀). **G:** *P. verrucigena* (♂). **H:** *P. verrucigena* (♀). **I:** *P. villiersi* (Holotype ♂). **J:** *P. villiersi* (Allotype ♀). **K:** *P. uniformis* (NeAllotype ♂).

Molecular studies

For molecular studies, I extracted genomic DNA from femoral muscle tissue of 41 specimens of *Pteropera* stored in 96% ethanol, using a high-salt extraction protocol (Paxton *et al.*, 1996). I amplified the nucleotide sequences of the grasshopper

COI, 16S, and 12S markers and purified PCR Amplicons. They were then sequenced in both directions by Macrogen Europe (Amsterdam, Netherlands) and all sequences were deposited in GenBank. To build the phylogenetic trees, I used the Maximum Likelihood (ML) and the Bayesian Inference (BI) analyses, based both on the concatenated (COI, 16S, and 12S) datasets.

RESULTS

Taxonomy and species distribution

The images of holotypes, allotypes, paratypes, and neallotype of all known *Pteropera* species are presented in Figures 1-5. The distribution of all species in the African rainforests is also shown in Figure 6. I recorded *Pteropera augustini* Donskoff, 1981 for the first time from Cameroon, and discovered three new species from the country, whose

tions in the Centre, East, and Littoral regions of Cameroon. They were stored in absolute ethanol for further DNA analysis. The specimens were then identified using the identification key of Donskoff (1981). I identified in total nine species, including three new species in the study area. In addition, I examined types and paratypes held in the Muséum Nationale d'Histoire Naturelle Paris, France (MNHN), and Museum für Naturkunde Berlin, Germany (MFN). Distributional data was obtained from geographical coordinates recorded during field observations, and on locality records taken from specimen labels in MfN, MNHN, and ZMH collections.

For the extraction and preparation of the internal genitalia, I used standard methods of Kevan *et al.* (1969) and Martinelli *et al.* (2017). Photographs of the habitus of types, allotypes and paratypes were captured with a Canon EOS Rebel digital camera. Images of male and female genitalia were made at the ZMH with a Keyence VHX-7000 digital microscope.

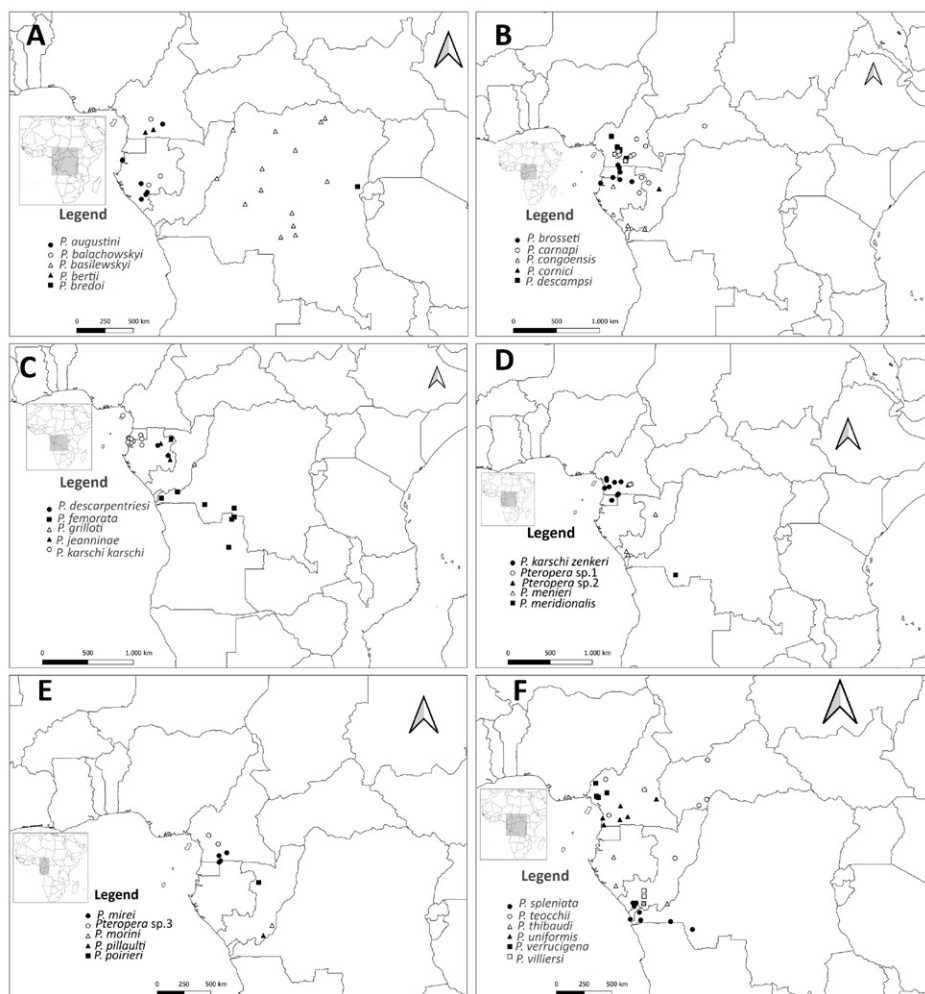


Figure 6. Distribution of all *Pteropera* species in Tropical African forests.

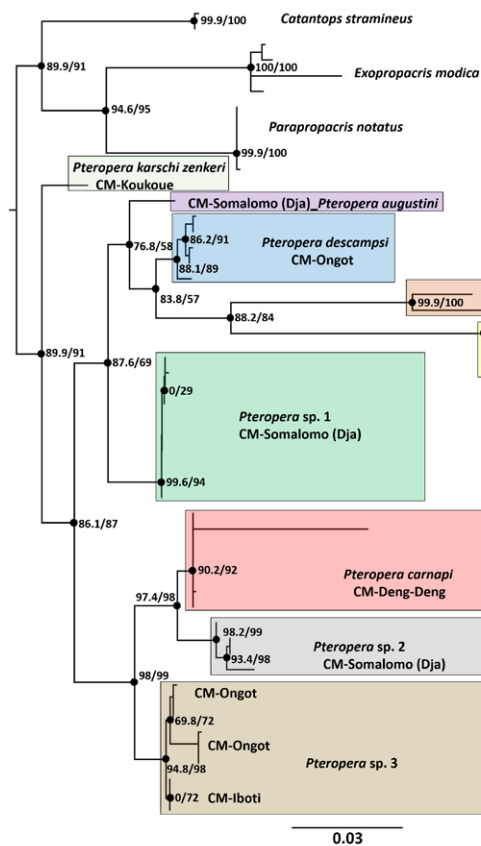


Figure 7. Maximum likelihood (ML) tree based on the concatenated (COI/16S/12S) dataset. Values close to the nodes represent the SH-aLRT support (%) and the ultrafast bootstrap support (%).

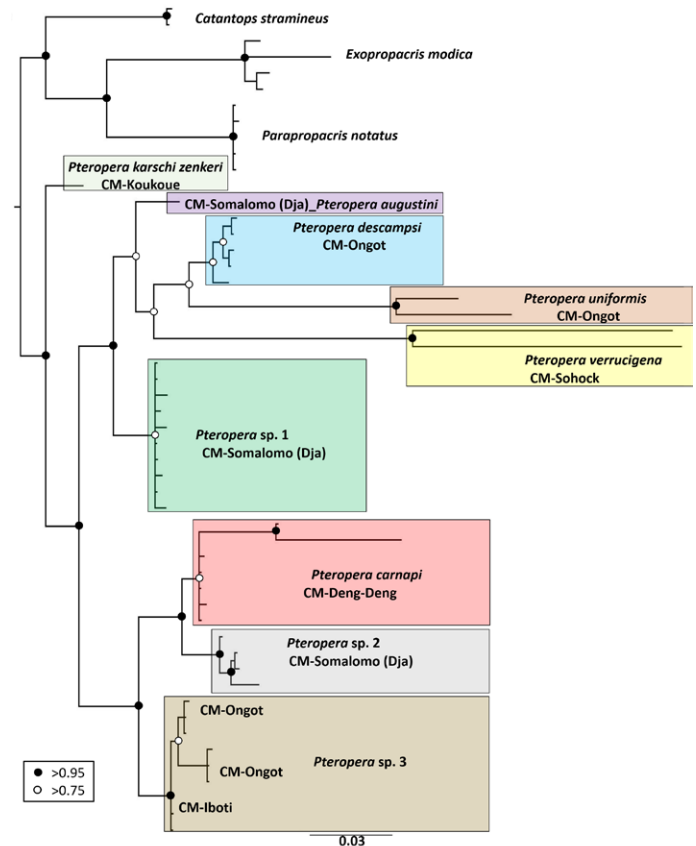


Figure 8. Bayesian Inference (BI) tree based on the concatenated (COI/16S/12S) dataset. Values close to the nodes represent the Bayesian posterior probabilities (PP).

description is currently in progress. These three new species were also supported by DNA barcodes. With these three new species and the first record of *P. augustini*, the number of *Pteropera* species in Cameroon is raised from eight to 12 and, overall, 30 *Pteropera* species and subspecies in African rainforests. Despite this, it is possible that this genus is even more diverse than currently known, given the large number of locations where inventory studies have not yet been carried out in the African rainforests. Thus, further sampling efforts in different locations and habitat types are needed.

Phylogenetic analyses

I constructed two phylogenetic trees based on the concatenated sequence alignments of the three individual gene datasets (COI = 486 bp, 16S = 273 bp, 12S = 107 bp): one with the ML method and one with the BI method (Figs. 7 and 8). The concatenated sequence alignment included 866 bp.

The results recovered species of *Pteropera* and the outgroup taxa as monophyletic, most with high bootstrap values and posterior probability values (Fig. 7 and 8). This result is not consistent with Liu *et al.* (2008), Chapco (2013), and Song *et al.* (2018) who found that the subfamily Catantopinae is a non-monophyletic group. This may be due to the differences in taxon sampling among these studies. For example, in contrast to the previous studies that included a high number of genera, our study included only four genera of the subfamily Catantopidae. The ML and BI analyses of the combined dataset showed similar topology.

In all cases, the delimitation of taxonomic units on the basis of genetic information contained in the barcodes was congruent with the species limits acknowledged by traditional taxonomy. Although some attempts have been made to generate the DNA barcode data of orthopterans and mantids from Central African Republic,

Gabon, Ivory Coast, and South Africa (Moulin *et al.*, 2017; Massa *et al.*, 2018; O’Hare *et al.*, 2023), no attempt focusing on Orthoptera has been made from Cameroon so far. Thus, this current study presents the first barcode data of morphologically identified *Pteropera* species from Cameroon. The majority of species of this diversified genus are not included in our analyses due to the fact that most of them are represented in museum collections by old samples for which it was not possible to have DNA using a classical barcoding method. We only included in the trees Cameroonian species for which we had fresh samples. This study demonstrates the use of the multilocus dataset to estimate well-supported species trees. However, further studies including a larger dataset are required in order to increase the species count.

Acknowledgement

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Cohn Research Fund. I am grateful to the Linnean Society and the Systematics Association for providing additional support through the 2023 LineSys: Systematic Research Fund Grant. I am thankful to Prof. Laure Desutter-Grandcolas and Mrs. Birgit Jaenicke for granting me permission to check the types and paratypes housed by the MNHN Paris (France) and MFN Berlin (Germany), respectively. I also thank the Museum of Nature Hamburg (Germany) for providing laboratory space and the necessary facilities. I extend my thanks to Dr. Martina Pocco for her support during my visit at the MNHN Paris. I also address my sincere thanks to Prof. Dr. Martin Husemann for his valuable advice and support during laboratory work.

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Orthoptera Species File Grant Reports

Photographing Blattodea Types in Australian Museums

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The objectives of this grant were to photograph the Blattodea holotypes held in three Australian museums (Queensland Museum, South Australia Museum, and Western Australia Museum), and look for additional specimens of a possible new genus of desert cockroach. Regarding the latter, a search for museum specimens revealed that the genus had already been described, but many new specimens representing possible new species were found, both pinned and in ethanol, at 4 of the 5 museums. These have all been processed for loans and shipped. At the fifth museum, only 2 immatures were found, so locality data was collected but the specimens were not borrowed. At two museums, one specimen each of what appears to be two new genera of Corydiidae

were discovered, one from Northern Territory and the other from Tasmania.

The lists of primary types for Blattodea provided by two of the museums were not entirely accurate. The lists from Queensland Museum and South Australia Museum had numerous mistakes and/or were compiled by someone with no taxonomic knowledge. Therefore, in addition to photographing primary types, the database of Blattodea types at these two museums had to be thoroughly curated and corrected. Corrections are listed beside each species below; note that in some cases, the specimens were never sent to the museum(s) by the describing authors. With the exception of those that were out on loan, or stored in ethanol, all Blattodea holotypes at the three museums were photographed in dorsal and

ventral aspects, and a photograph of the labels was taken. At South Australia Museum, most specimens only required a ventral photograph, as dorsal and label photographs had already been taken by the museum. Due to time limitations, when only syntypes were present photographs were not taken. My visit also revealed long overdue loans of holotypes, which museum staff are now working to have returned. Should they be located and returned, the museums have pledged to take photographs of these holotypes and forward them to me. Corrected databases and/or copies of all photographs were sent to each museum, once all updates and edits were completed. All photographs have been uploaded to Cockroach Species File on TaxonWorks. The list of types (**photographed types**) from each museum is shown below.

Queensland Museum

Ancaudellia undulata australiensis=MS name or specimen never sent by author	Balta praestans=Syntypes only	Eppertia furcata
Calolampra candidula	Balta serraticauda=Syntypes only	Euzosteria lata
Elfridaia ebomae	Balta toowoomba=Syntypes only	Euzosteria sordida
Epilampra aspera=Syntypes only	Balta transversa=Syntypes only	Euzosteria tuberculata
Epilampra atra=Syntypes only	Balta verticalis=Syntypes only	Mallotoblatta obscura=Syntypes only
Epilampra fraserensis=Syntypes only	Beybienkoa bellendensis	Melanozosteria cingulata
Epilampra propria=Syntypes only	Beybienkoa finniganensis	Melanozosteria dookiensis=Melanozosteria tepperi
Geoscapheus crenulatus	Dyakinodes waterhousei	Melanozosteria feriarum
Geoscapheus crenulatus fraserensis	Ectoneura pallidula=Syntypes only	Melanozosteria illingworthi
Geoscapheus rugulosus	Ectoneura pictifrons=Syntypes only	Melanozosteria kellyi
Geoscapheus woodwardi	Ellipsoidion simulans=Syntypes only	Melanozosteria nigrofasciata
Laxta shawi	Johnrehnia bellendenkerensis	Melanozosteria nitidella
Oniscosoma minima	Johnrehnia fisherana	Melanozosteria spryi
Macropanesthia heppleorum	Johnrehnia geniculuteola	Melanozosteria uncinata
Macropanesthia intemorpha	Johnrehnia hinchbrookensis	Methana parva
Macropanesthia kinkuna	Johnrehnia kroombitopsensis	Periplaneta aboriginea
Macropanesthia lineopunctata	Johnrehnia ruggi	Periplaneta brunnea=holotype housed at BMNH
Macropanesthia lithgowae	Neotemnopteryx baylissensis=Specimen never sent by author	Platyzosteria anceps
Macropanesthia monteithi	Neotemnopteryx braesensis=Specimen never sent by author	Platyzosteria bifida
Macropanesthia mutica	Neotemnopteryx gloriosa	Platyzosteria biglumis
Macropanesthia rothi	Neotemnopteryx nana	Platyzosteria incurva
Macropanesthia saxicola	Neotemnopteryx undarensis=Specimen never sent by author	Platyzosteria melanaria
Macropanesthia spuritegmina	Paratemnopteryx rosensis=Specimen never sent by author	Platyzosteria perpolita
Neogeoscapheus barbarae	Paratemnopteryx weinsteini=Specimen never sent by author	Platyzosteria scabrella
Neogeoscapheus hanni	Robshelfordia fraserensis	Platyzosteria soror
Neolaxta monteithi	Shelfordina cooki	Platyzosteria spatiosa
Neolaxta triangulifera	Shelfordina robertsi	Platyzosteria stradbrogensis
Panesthia ancaudellioides	Shelfordina yeatesi	Polyzosteria obscuriviridis
Panesthia obtusa	Celatoblatta quadriloba	Pseudobalta cinctella
Panesthia parva	Celatoblatta marksae	Pseudobalta pusilla=Syntypes only
Panesthia sloanei	Celatoblatta papuae	Pseudobalta queenslandica
Panesthia tryoni tegminifera	Celatoblatta perpolita	Nocticola australiensis
Panesthia tryoni tryoni	Celatoblatta shelfordi	Austropolyphaga perkinsi=On loan
Parapanesthia pearsoni	Celatoblatta tryoni	Austropolyphaga queenslandensis=In alcohol couldn't be located*
Anaplecta brachyptera	Cosmozosteria sloanei	Polyphagoides cantrelli=On loan
Balta bicolor=Syntypes only	Cosmozosteria subzonata	Tryonicus mackerrasae
Balta fragilis	Cutilia brevitarsis=Melanozosteria brevitarsis=Not in the collection	Tryonicus monteithi
Balta luteicosta=Syntypes only	Cutilia nitidella=Melanozosteria nitidella	Tryonicus parvus
Balta nebulosa=Syntypes only	Cutilia tepperi=Melanozosteria tepperi	

*on May 10, 2023 I received notice that this holotype had been found. The museum took photos and forwarded them to me but said they could not be used on TaxonWorks (the reason for this is not clear, and a query to the Collections Manager has not yet been answered).

South Australia Museum

Anamesia frenchii	Ellipsoidion humerale	Platyzosteria biglumis=No holotype
Anamesia fulvomata	Ellipsoidion marginiferum=Balta decorata	Platyzosteria brunnea=Not in collection
Anamesia lambii	Eppertia furcata	Platyzosteria carpentariensis=on loan
Anamesia lindsayi	Euzosteria elegans	Platyzosteria cingulata=Not in collection
Anamesia maculosa	Euzosteria ferruginea	Platyzosteria coolgardiensis
Ataxigamia tatei	Euzosteria metallica=No holotype	Platyzosteria denticulata=No holotype
Ataxigamia basedowi	Euzosteria minor	Platyzosteria ferox=Not in collection
Balta epilamproides	Euzosteria nobilis=Euzosteria subnobilis	Platyzosteria glabra
Balta fratercula=No holotype	Euzosteria sordida=No holotype	Platyzosteria grandis=Platyzosteria albomarginata brunnea =Platyzosteria rufusca
Balta litura	Euzosteria subreflexa	Platyzosteria invisiva=No holotype
Balta minuta=No holotype	Geoscaphus dilatatus=No holotype	Platyzosteria jungi
Balta notulata=Lupparia notulata=No holotype	Geoscaphus robustus	Platyzosteria melanaria=No holotype
Balta patula=Apolyta pallida	Hebardina concinna=No holotype	Platyzosteria novaezealandiae
Balta spuria=Apolyta marginata	Hensausseura halmaturina	Platyzosteria obscuripes
Balta testacea=on loan	Hensausseura tricolor	Platyzosteria prima
Blatta orientalis=No holotype	Jotepperia contraria	Platyzosteria provisionalis
Calolampra aspera=on loan	Leptozosteria prima	Platyzosteria pseudatrata
Calolampra atomifera=No holotype	Megamareta verticallis=No holotype	Platyzosteria pseudocastanea
Calolampra atra=on loan	Megazosteria impressa	Platyzosteria punctata=No holotype
Calolampra fraserensis=on loan	Megazosteria purpurascens	Platyzosteria rufosca=Not in collection
Calolampra ignota=No holotype	Melanozosteria atra	Platyzosteria rugosa
Calolampra notabilis=No holotype	Melanozosteria balteata	Platyzosteria scabra=No holotype
Calolampra obscura=on loan	Melanozosteria castanea=Platyzosteria exaspera	Platyzosteria scabrella
Calolampra paula=on loan	Melanozosteria circumducta=No holotype	Platyzosteria subaptera=No holotype
Calolampra tepperi=on loan	Melanozosteria exigua	Platyzosteria tenuis
[Genus?] manicata	Melanozosteria hermannsburgensis	Polypodia australia
Carbrunneria pallescens=Balta pallescens	Melanozosteria insulae=No holotype	Polyzosteria flavomaculosa=No holotype
Choristima galeruoides=Choristima kershawi=Choristima loftyensis	Melanozosteria insularis	Polyzosteria fulgens=No holotype
Choristima hydrophoroides=No holotype	Melanozosteria nitidella=No holotype	Polyzosteria limbata=Polyzosteria frenchii
Cosmozosteria bicolor	Melanozosteria obscura=Melanozosteria scabriuscula	Polyzosteria obscuriviridis=Polyzosteria bagoti =Polyzosteria iricolor
Cosmozosteria maculimarginata	Melanozosteria popeae=No holotype	Polyzosteria occulata
Cosmozosteria mesomacula	Melanozosteria ruberculata	Polyzosteria pubescens
Cosmozosteria picta	Melanozosteria subbifasciata	Pseudolampra omata=Anamesia omata
Cosmozosteria sloanei=No holotype	Melanozosteria triangulata=Leptozosteria secunda	Pseudolampra punctata=Anamesia punctata
Cosmozosteria striata	Methana jocastae	Pseudolampra rothei=Anamesia rothei
Cosmozosteria subzonata	Methana symmeria	Pycnoscelis surinamensis=Epilampra tatei
Cosmozosteria trifasciata	Neogeoscaphus hirsuta	Robshelfordia anastomosa=Loboptera duodecimsignata
Desmozosteria cincta=No holotype	Panesthia cribrata=Panesthia laevicollis=No holotype	Robshelfordia circumducta=Ischnoptera annulata=Loboptera circumcincta
Desmozosteria easti=Polyzosteria zebra	Panesthia lata	Robshelfordia longiuscula=Ischnoptera obscura
Desmozosteria elongata=No holotype	Panesthia tepperi	Temnelytra abbreviata=No holotype

South Australia Museum (Cont'd)

Desmозosteria lunata	Parapanesthia giganteus	Temnelytra truncata=Temnelytra harpuri
Desmозosteria obscura	Panesthia tryoni tegmenifera=No holotype	Trogloblatella nullarborensis=No holotype
Desmозosteria pallidula	Paraphoraspis castanea	Tryonicus parvus
Desmозosteria scripta=No holotype	Paratemnopteryx coulouiana=Paratemnopteryx blattoides	Zonioploca alutacea=Zonioploca ardrossanensis
Drymaplaneta communis=Platyzosteria submarginata	Paratemnopteryx glauerti=No holotype	Zonioploca flavocincta=No holotype
Dyakinodes centralis=Ischnoptera brunneonigra	Paratemnopteryx rufa=Paratemnopteryx zeitzi	Zonioploca latizona
Ectobius perspicillaris	Periplaneta australasiae=No holotype	Zonioploca medilinea
Ectoneura tepperi	Platyzosteria aposematica=Leptozosteria aposematica=No holotype	Zonioploca occidentalis
Ellipsoidion australe=No holotype	Platyzosteria armata	Zonioploca tepperi
Ellipsoidion australis=Not in the collection	Platyzosteria atra=No holotype	
Ellipsoidion bicolor	Platyzosteria avocaensis	

Western Australia Museum

Anamesia angusta	Melanozosteria flavofusca	Platyzosteria fulva
Anamesia douglasi	Melanozosteria lentiginosa	Platyzosteria marginalis
Anamesia serrata	Melanozosteria minima	Platyzosteria polita
Anamesia uniformis	Melanozosteria minor	Platyzosteria shelfordi
Calolampra ignota	Melanozosteria obesa	Platyzosteria similis
Calolampra submarginalis	Melanozosteria picea	Platyzosteria tibialis
Celatoblatta zonata	Metanoticola christmasensis=Couldn't be located never sent by author (?)	Platyzosteria tricaudata
Drymaplaneta lobipennis	Neotemnopteryx douglasi	Polyzosteria arenicola (nomen nudum)
Eppertia punctata	Neotemnopteryx wynei	Polyzosteria flavomaculosa
Euzosteria callosa	Nocticola brooksi=Couldn't be located never sent by author (?)	Polyzosteria fulgens
Hensaussurea pedestris	Nocticola flabella	Pseudolampra venusta
Leptozosteria latissima	Paratemnopteryx atra	Robshelfordia simplex
Leptozosteria subaquila=Platyzosteria subaquila	Paratemnopteryx broomehillensis	Tivia australica
Maoriblatta sublobata	Paratemnopteryx glauerti	Trogloblattella nullarborensis
Megazosteria shawi	Paratemnopteryx kookabinnensis=Specimen never sent to	Zonioploca fullerae
Melanozosteria aculeata	Platyzosteria albopilosa	
Melanozosteria barrominensis	Platyzosteria denticulata	



Sample photographs from each of the three museums where photographs were taken. (A) Queensland Museum, (B) Western Australia Museum, (C) South Australia Museum.

Photographic Database of Western Asia Acridomorpha (Orthoptera, Caelifera) Type Specimens Deposited at NHM London

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Western Asia connects to Africa through Saudi Arabia and to Europe through Asia Minor. The Red Sea acts as a narrow channel between these two continents, with similar soil, fauna, and flora. It doesn't break the stretch of deserts across the Old World, extending into Iran.

Both Asia and North Africa provide a favorable habitat, making them rich in diversity for Acridomorpha grasshoppers. This diversity has attracted many researchers to explore the wildlife of this region, leading to the discovery, documentation, and description of numerous species. These findings, along with type materials, are stored in various museums, including the Natural History Museum of London (NHM, formerly BNHM).

While exploring the TAXONWORKS website, we noticed that several type specimens in the NHM have not been photographed or published.

As a result, we believe it's essential to revisit these samples and capture different pictures, including dorsal and lateral views, and labels. This effort aims to enhance the TAXONWORKS website, making it a more valuable resource for the scientific community and easing their research efforts.

Examination and digitalisation

The organization of specimens in boxes at the Natural History Museum (NHM) in London facilitated the observations. Photos were captured using a Canon EOS 5DS R camera

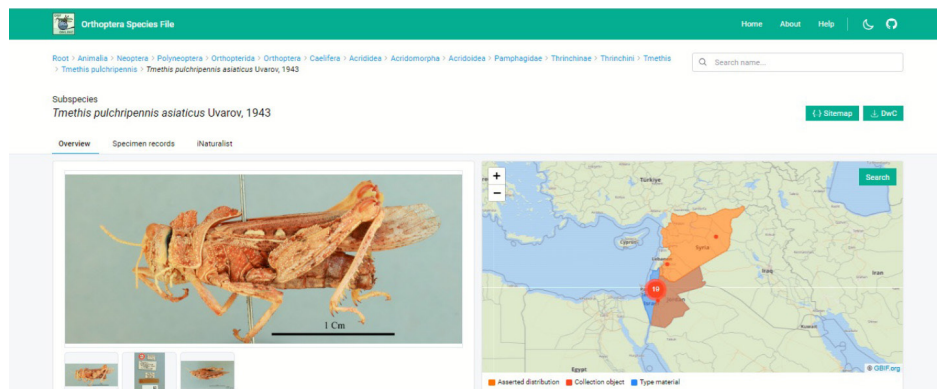


Figure 1. Screenshot of the descriptive sheet for the subspecies *Tmethis pulchripennis asiaticus* Uvarov, 1943

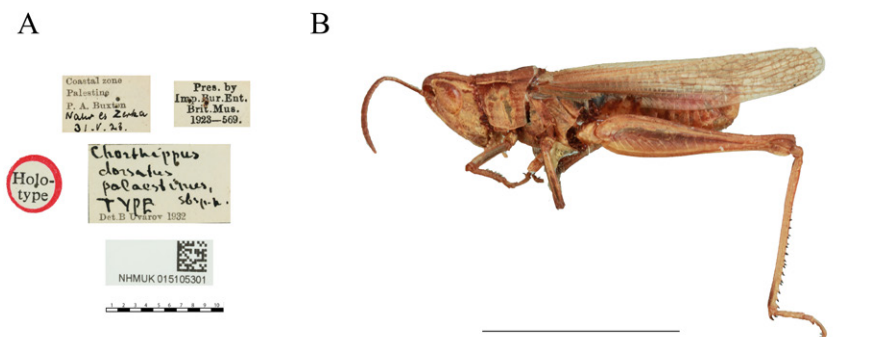


Figure 2. Habitus of *Chorthippus (Chorthippus) dorsatus palaestinus* Uvarov, 1933 from Palestine: A–B, Holotype male, lateral view (A), labels (B). Scale bar 1 cm.

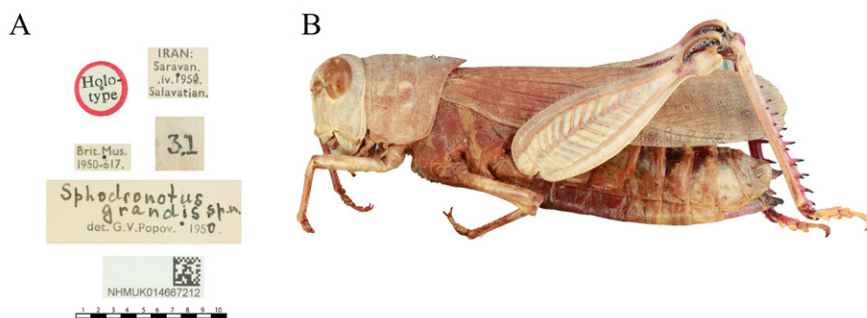


Figure 3. Habitus of *Sphodronotus grandis* Popov, 1951 from Iran: A–B, Holotype female, lateral view (A), labels (B). Scale bar 1 cm.

equipped with a Canon 100mm EF 2.8L Macro IS USM lens and a 1 cm scale. To ensure complete documentation, we photographed each individual specimen from lateral and dorsal

views, and also captured images of the labels. The photos were edited using Adobe Photoshop CS6 (2012). Identifications of all photographed specimens were checked.

Table 1. Complete table of type specimens photographed from NHM and uploaded to Taxonworks.

Family	Subfamily	Genus	Species and subspecies	Kind of type	Barcode	
Acrididae	Acridinae	<i>Duroniella</i>	<i>Duroniella acuta</i> Uvarov, 1952	Holotype	NHMUK013803980	
			<i>Duroniella laeviceps</i> Uvarov, 1938	Holotype	NHMUK015105309	
			<i>Duroniella parallella</i> Uvarov, 1952	Holotype	NHMUK015105310	
			<i>Duroniella volucris</i> Uvarov, 1938	Holotype	NHMUK015105311	
		<i>Truxalis</i>	<i>Truxalis eximia cypria</i> Dirsh, 1950	Holotype	NHMUK014667239	
		Calliptaminae	<i>Sphodronotus</i>	<i>Sphodronotus cyclopterus</i> (Uvarov, 1933)	Paratype	NHMUK014667213
	<i>Sphodronotus grandis</i> Popov, 1951			Holotype	NHMUK014667212	
		Catantopinae	<i>Wiltshirella</i>	<i>Wiltshirella fusiformis</i> Popov, 1951	Holotype	NHMUK014667240
		Egnatiinae	<i>Egnatiooides</i>	<i>Egnatiooides lizae</i> Pfadt, 1970	Holotype	NHMUK015105312
			<i>Paracharora</i>	<i>Paracharora popovi</i> Fishelson, 1993	Holotype	NHMUK014667201
			<i>Paregnatius</i>	<i>Paregnatius salavatiani</i> Popov, 1951	Holotype	NHMUK014667202
		Eyprepocnemidinae	<i>Heteracris</i>	<i>Heteracris buxtoni</i> (Uvarov, 1921)	Lectotype	NHMUK014667165
				<i>Heteracris hemiptera aja</i> Popov, 1981	Holotype	NHMUK014667244
				<i>Heteracris morbosa cincticollis</i> (Walker, 1870)	Neotype	NHMUK014667245
				<i>Heteracris muscatensis</i> Popov, 1981	Holotype	NHMUK014667243
				<i>Heteracris persa</i> (Uvarov, 1933)	Paratype	NHMUK014667164
				<i>Heteracris popovi</i> (Uvarov, 1952)	Holotype	NHMUK014667246
				<i>Heteracris rantae</i> (Uvarov, 1936)	Holotype	NHMUK014667166
				<i>Heteracris sabaea</i> Popov, 1981	Holotype	NHMUK014667247
			<i>Heteracris theodori</i> (Uvarov, 1929)	Holotype	NHMUK014667163	
		Gomphocerinae	<i>Arcyptera</i>	<i>Arcyptera (Pararcyptera) microptera karadagi</i> Karabag, 1956	Holotype	NHMUK015105298
			<i>Chorthippus</i>	<i>Chorthippus (Chorthippus) dorsatus palaestinus</i> Uvarov, 1933	Holotype	NHMUK015105301
			<i>Dociostaurus</i>	<i>Dociostaurus (Kazakia) genei littoralis</i> Soltani, 1978	Holotype	NHMUK014667172
			<i>Gomphocerus</i>	<i>Gomphocerus (Bolivarianus) acutus</i> Karabag, 1957	Holotype	NHMUK014667162
			<i>Leva</i>	<i>Leva jordania</i> (Uvarov, 1933)	Holotype	NHMUK014667197
			<i>Notostaurus</i>	<i>Notostaurus albicornis turcmenus</i> (Uvarov, 1926)	Paratype	NHMUK015105308
				<i>Notostaurus cephalotes</i> (Uvarov, 1923)	Holotype	NHMUK015105306
				<i>Notostaurus larensis</i> (Soltani, 1978)	Holotype	NHMUK015105305
			<i>Stenobothrus</i>	<i>Stenobothrus burri</i> Karabag, 1953	Holotype	NHMUK014667214
			<i>Xerohippus</i>	<i>Xerohippus alkani</i> Karabag, 1953	Holotype	NHMUK014667237
		Oedipodinae	<i>Aiolopus</i>	<i>Aiolopus simulatrix simulatrix</i> (Walker, 1870)	Holotype	NHMUK013806000
			<i>Cophotylus</i>	<i>Cophotylus eos</i> Popov, 1985	Holotype	NHMUK015105304
				<i>Cophotylus iranicus</i> Dirsh, 1949	Holotype	NHMUK014666567
				<i>Cophotylus purpureus</i> (Uvarov, 1940)	Holotype	NHMUK015105302
			<i>Crinita</i>	<i>Crinita hirtipes</i> (Uvarov, 1923)	Holotype	NHMUK013806058
				<i>Crinita nigripes</i> (Uvarov, 1929)	Holotype	NHMUK013806059
			<i>Hilethera</i>	<i>Hilethera hierichonica</i> Uvarov, 1923	Holotype	NHMUK014667168
			<i>Pseudocoles</i>	<i>Pseudocoles armeniacus</i> Dirsh, 1949	Holotype	NHMUK014667210
				<i>Pseudocoles dirshi</i> Popov, 1951	Holotype	NHMUK014667208
				<i>Pseudocoles ebneri</i> Dirsh, 1949	Holotype	NHMUK014667207
				<i>Pseudocoles obscurus lateritius</i> Karabag, 1957	Holotype	NHMUK014667209
				<i>Pseudocoles zangezuri</i> Dirsh, 1949	Holotype	NHMUK014667211
		Pezotettiginae	<i>Pezotettix</i>	<i>Pezotettix cotti</i> Dirsh, 1949	Holotype	NHMUK014667203
				<i>Pezotettix curvicerca</i> Uvarov, 1934	Holotype	NHMUK014667205
				<i>Pezotettix cypria</i> Dirsh, 1949	Holotype	NHMUK014667204
				<i>Pezotettix judaica</i> Uvarov, 1934	Holotype	NHMUK014667206
		Tropidopolinae	<i>Tropidopola</i>	<i>Tropidopola cylindrica obtusa</i> Uvarov, 1922	Holotype	NHMUK014667238
	Dericorythidae	Iranellinae	<i>Iranella</i>	<i>Iranella eremiaphila</i> Uvarov, 1922	Holotype	NHMUK014667194
	Pamphagidae	Pamphaginae	<i>Nocaracris</i>	<i>Nocaracris citripes</i> (Uvarov, 1949)	Holotype	NHMUK014667196
				<i>Nocaracris idrisi</i> (Karabag, 1953)	Holotype	NHMUK014667242
<i>Nocaracris sabulosa</i> Ramme, 1951				Holotype	NHMUK014667241	
<i>Orchamus</i>			<i>Orchamus hebraeus</i> Uvarov, 1942	Holotype	NHMUK014667199	
		<i>Orchamus yersini davisi</i> Uvarov, 1949	Holotype	NHMUK014667200		
Thrinchinae		<i>Eremocharis</i>	<i>Eremocharis bampura bampura</i> Uvarov, 1933	Paratype	NHMUK014667153	
			<i>Eremocharis zaheri</i> Pfadt, 1969	Holotype	NHMUK014667152	
		<i>Eremopeza</i>	<i>Eremopeza angusta</i> (Uvarov, 1934)	Holotype	NHMUK014667155	
			<i>Eremopeza cinerascens</i> (Stål, 1875)	Syntype	NHMUK014667157	
			<i>Eremopeza cinerascens afghana</i> (Uvarov, 1940)	Holotype	NHMUK014667158	
			<i>Eremopeza gibbera lata</i> (Uvarov, 1934)	Holotype	NHMUK014667154	
			<i>Eremopeza reducta</i> (Uvarov, 1934)	Paratype	NHMUK014667156	
			<i>Eremopeza saussurei cyanea</i> Bey-Bienko, 1951	Paratype	NHMUK014667160	
			<i>Eremopeza saussurei violacea</i> (Uvarov, 1922)	Syntype	NHMUK014667159	
	<i>Glyphotmethis</i>	<i>Glyphotmethis holtzi pulchripes</i> (Uvarov, 1943)	Holotype	NHMUK014667161		
<i>Tmethis</i>	<i>Tmethis pulchripennis asiaticus</i> Uvarov, 1943	Holotype	NHMUK014667236			

Result

During the research, we examined 45 boxes and around 73 samples, which included both males and females classified into different categories, like holotype, syntype, paratype, lectotype, synonym or neotype. We took over 219 photos, showing the side and back views of the specimens, as well as their labels. These samples represent 64 species spread across 30 genera, 12 subfamilies, and 3 families (refer to Table 1). The images were captured from 64 type specimens in the study area, including 54 holotypes, 6 paratypes, 2 syntypes, 1 lectotype, and 1 neotype. We've also added a label with a barcode for each specimen. All these images have been uploaded on the Orthoptera Species File (OSF)/TAXONWORKS website and are now accessible to the viewer at the appropriate location for each image (see example in Fig. 1).

Name of our data source

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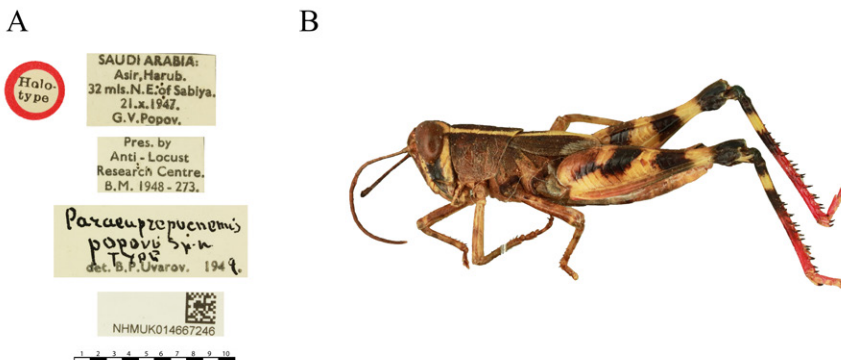


Figure 3. Habitus of *Heteracris popovi* (Uvarov, 1952) from Saudi Arabia: A–B, Holotype male, lateral view (A), labels (B). Scale bar 1 cm.

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Perspectives

We aim to expand this study on caeliferans to other geographical regions of Africa, particularly to countries from North-East Africa (Libya and Egypt), but also countries from Western Asia.

Acknowledgements

First and foremost, we express our gratitude to the Orthopterists' Society for funding this project through a 2020 OSF Grant. We extend our thanks to Beulah

Garner and Ben Price from the Natural History Museum (NHM) in London (United Kingdom) for their generous support during our research visit to the Orthoptera collection. Additionally, we thank Dan Hall for his technical assistance. We also appreciate the support of Laure Desutter-Grandcolas and Bruno Massa in our grant application process.

*Note: The funding was awarded in 2020, but due to various impediments, such as the COVID-19 pandemic and health issues affecting one of the authors, the project's execution has been postponed to 2024.

Seemingly Risky Feeding Behavior by an Adult *Melanoplus confusus* Scudder

By **MATHEW L. BRUST¹** AND **JOVONN G. HILL²**

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Most species of short-horned grasshopper (Orthoptera: Acrididae) appear to be primarily herbivorous, although observations and diet analyses have revealed that scavenging is also a common feeding mode (Mulkern et al. 1969, Joern 1985, Lockwood 1988, O'Neill et al. 1993, O'Neill et al. 1994, Woods et al. 1997). Mulkern et al. (1969) and Joern (1985) found that scavenged

insects generally constitute a small portion of the crop contents of grasshopper species examined. However, O'Neill et al. (1994) and Woods et al. (1997) found that some grasshopper species readily scavenge on insect cadavers, including those of other grasshoppers, and may even do so preferentially. Some species appear to even compete aggressively for access to cadavers for scavenging (O'Neill et al. 1993). Some species will even readily scavenge dead or injured indi-

viduals of their own species (Fig. 1), as has been noted in previous studies (Lockwood 1988, O'Neill et al. 1994, Woods et al. 1997).

Apparently, scavenging by some grasshopper species may occur on vertebrates as well. For example, Hill (2007) overserved nymphs of *Schistocerca americana* (Drury) feeding on the tail from a dead mouse. Whitman and Richardson (2010) observed numerous adult *Taeniopoda eques* (Burmeister) feeding on a dead coyote



Figure 1. Female *Melanoplus bivittatus* scavenging on another *M. bivittatus*. Photographed along King Canyon Road, about 8.8 km (5.5 miles) south of Chadron, Nebraska, USA on July 20, 2022.

(*Canis latrans* Say) over the course of 11 days. The authors noted that all of the grasshoppers feeding on the coyote carcass were adults, despite the fact that nymphs made up at least a small portion of the population present (Whitman and Richardson 2010). The authors also noted that most of the adult grasshoppers seen feeding on the dead coyote (20 of 22) were females (Whitman and Richardson 2010). These observations suggest that at least some grasshopper species will readily scavenge on dead vertebrates, and the sexual skewing noted by Whitman and Richardson (2010) suggests that perhaps differences in nutritional needs between the sexes may make females more prone to scavenging than males.

Furthermore, O'Neill et al. (1994) noted that scavenging occurred more rapidly at higher temperatures, which can likely be attributed to differences in mobility in relation to temperature. In that study, it was also found that certain grasshopper species arrived at carcasses faster than others and some also appeared to be less attracted to carcasses (O'Neill et al. 1994). For example, *Melanoplus packardii* Scudder were consistently the first species

to find and feed on a carcass, while *Ageneotettix deorum* (Scudder) was consistently among the last at carcasses and the least likely to feed on a carcass based on its relative abundance in the study by O'Neill et al. (1994). This study suggests that some grasshopper species are more effective at finding carcasses and some species

more readily scavenge than others.

Results

Here we present a unique and extreme case of a short-horned grasshopper scavenging on another short-horned grasshopper under unusual and, seemingly, very risky conditions. While filming fast-running soil mites on an exposed sandy road bank about 10.5 km (6.5 miles) south of Chadron, Nebraska (USA), a female *Melanoplus confusus* Scudder was noticed feeding on a dead nymph of *Brachystola magna* (Girard). However, it was quickly noticed that the *B. magna* nymph was in a small pit in the sand and seemingly stuck in the soil (Fig. 2). Upon closer examination, the female *M. confusus* backed away from the *B. magna* nymph. As this occurred, it was noticed that the *B. magna* nymph was being fed upon by a third instar *Cicindela formosa formosa* Say (Coleoptera: Cicindelidae), a tiger beetle larva (Figs. 3 and 4). The larvae of this tiger beetle species are unique in having a pitfall trap at the front of their burrow. Several small ants were also observed on the dead *B. magna* nymph. The ants ap-



Figure 2. Female *Melanoplus confusus* feeding on nymphal *Brachystola magna* with larval *Cicindela formosa* also feeding on it. Photographed about 10.5 km (6.5 miles) south of Chadron, Nebraska on June 23, 2021.



Figure 3. Female *Melanoplus confusus* having stopped feeding on nymphal *Brachystola magna* due to the author catching its attention. Larval *Cicindela formosa* continues feeding on it. Photographed about 10.5 km (6.5 miles) south of Chadron, Nebraska on June 23, 2021.

pear to be odorous house ants (*Tapi-noma sessile* (Say)) and appear to be feeding on fluids of the grasshopper nymph. Footage of the event can be seen at <https://www.youtube.com/watch?v=A8cgqtPqH4I>.

Discussion

It is suspected that the *B. magna* nymph was initially captured by the tiger beetle larva. Perhaps seeing an easy opportunity, the female *M. confusus* approached and began to feed on the side opposite the tiger beetle larva. Presumably, the tiger beetle larva could not see the grasshopper feeding at the other side due to the prey blocking its view. This observation suggests that not only is scavenging likely a common behavior in

many grasshopper species, but that under at least certain conditions they will engage in comparatively risky activities in order to scavenge.

In common with previous observations and studies involving grasshopper scavenging, this case suggests that although most grasshopper species are generally herbivores, many species are also opportunistic scavengers at times.

Future observations and studies will like-

ly clarify remaining questions involving perhaps **1**) why certain species, or perhaps even genera or subfamilies, are more prone to scavenging than others, **2**) will one sex more readily scavenge than the other and if so, why, **3**) do factors, such as body mass or age, affect affinity for scavenging, and **4**) what risks are grasshoppers willing to take to scavenge and how are these risks possibly energetically offset by the potential reward.

Acknowledgements

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Figure 4. Partially eaten *Brachystola magna* nymph. Photographed about 10.5 km (6.5 miles) south of Chadron, Nebraska on June 23, 2021.

The Magic World of Akira Toriyama

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Akira Toriyama, the manga artist, designer, and author of Dragon Ball and several Japanese graphic novels, passed away on March 1st, 2024, at the age of 68. People from across the world, especially his fans, and artists who were also influenced by Toriyama's work, were impacted by this tragic news. The entire industry is in mourning. He was one of the biggest responsible for the increasing popularity globally of Japanese animation in Western culture, especially with Dragon Ball Z. Toriyama's art was very important to me, so I just want to share some fascinating facts regarding Dragon Ball, and some connections with insects.

In the Dragon Ball multiverse, there are some rather weird creatures that resemble humans, ranging across demons, robots, dinosaurs, aliens, and humanoid animals. Several insects show up in the series, such as bees, butterflies, beetles, and cicadas. I would like to highlight the humanoid insects, the Arlian, from the planet Arlia that were shown in the anime at the beginning of Dragon Ball Z, when Vegeta and Napa pulled over on Arlian, and faced for the first time this insectoid species. These humanoids resemble giant bugs, with a body divided into segments that are grouped into larger functional units, one pair of arms, one pair of legs, large red, greenish, or blue eyes, and antennae (Fig. 1A).

A famous villain in Dragon Ball Z was Cell, an insect-form humanoid created from the tissues and DNA of the most important and powerful series' characters. In his larval form, Cell resembled a big, four-legged cicada with long V-shaped horns on top of his head (Fig. 1B-C). However, one



Figure 1. A. Two Arlians, humanoid insects from planet Arlia, B-C. Cell "Cicada" skin shed found by Gohan, Bulma and Trunks, D-E. Gregory on King Kai's planet, and F. Gohan showing the golden ants to Piccolo in the Dragon Ball Super: Super Hero movie.

of the most interesting characters related to orthopterology was Gregory, a little, dark green humanoid cricket with antennae and bug-like eyes (Fig. 1D-E). He serves and works as King Kai's butler. In the Saiyan arc, Gregory appears when King Kai asks him to assist in Goku's training on his planet. One of Goku's challenges was to strike Gregory with a large hammer, which was extremely difficult because of Gregory's skills and agility. After managing to hit Gregory, King Kai finally started training Goku.

Another entomological curiosity

was related to Gohan, one of the most important characters in Dragon Ball Z, and Goku's son. Gohan's day job has long been a mystery, but Dragon Ball Super: Super Hero makes it clear that he has an office filled with framed pinned insects (Fig. 1F). It is evident from this scene that Gohan is an entomologist!

Farewell Toriyama, thank you for spreading far and wide Japanese pop culture (anime, manga, games), and representing in your works the fascinating world of insects.

Royal Society Theo Murphy Meeting “Locust and Bee Plasticity in a Changing World”

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Predicting how phenotypes arise from the interaction between an individual’s genome and its environment is a major challenge. The concept of phenotypic plasticity – the ability of a genotype to produce different phenotypes in different environments – can serve as a unifying framework across disciplines and levels of biological organization. Fundamental generalizable understanding of the mechanisms of phenotypic plasticity have come from studies of locusts and bees. Locusts and bees both express striking examples of phenotypic plasticity, but in very different ways. For locusts crowding is a trigger that can cause shy and sedentary “solitarious” phase individuals to transform into the much more active “gregarious” phase that swarms and migrates en masse, with potentially devastating consequences as agricultural pests. In honeybees, variation in the nutritional environment during larval development causes a single genotype to produce females that are either sterile workers or fertile queens. Among the workers there is further plasticity in which tasks they undertake for the colony.

In 2022, Dr. Stephen Simpson, an eminent locust biologist, published a paper entitled “A journey towards an integrated understanding of behavioral phase change in locusts” (Simpson, *J Insect Physiol*, 138:104370, 2022; DOI: 10.1016/j.jinphys.2022.104370), documenting his personal journey studying behavioral phase transition in the desert locust. Dr. Gene Robinson, an eminent honeybee biologist, read this article and reached out to Simpson because he saw numerous parallels between locusts and bees as research systems

and how they have been studied. Simpson and Robinson developed a symposium proposal along with other locust and bee biologists that aimed at contrasting the genomic, neural, and physiological mechanisms of plasticity in both insects. The main objectives of the meeting were to deliver a comprehensive understanding and to examine how the study of plasticity in response to global environmental change may improve future management of these species. The proposal was submitted to the Royal Society Theo Murphy meeting program and was accepted. The meeting was held in Cambridge, U.K. on May 20-21, 2024, and featured many locust and bee biologists. Many members of the Orthopterists’ Society participated in the meeting, and shared their ideas and research.

This two-day event, entitled “Locust and Bee Plasticity in a Changing World” (<https://royalsociety.org/science-events-and-lectures/2024/05/locust-and-bees/>) was a small and intimate gathering with about 50 participants. The meeting consisted of four sessions, “Sociogenomics of Plasticity,” “Nutritional Ecology,” “Modeling and Management,” and “Bees and Locusts as Exemplars for a New



Theo Murphy Meeting Program

ence-events-and-lectures/2024/05/locust-and-bees/) was a small and intimate gathering with about 50 participants. The meeting consisted of four sessions, “Sociogenomics of Plasticity,” “Nutritional Ecology,” “Modeling and Management,” and “Bees and Locusts as Exemplars for a New



Stephen Simpson (right) and Gene Robinson (left) kicking off Theo Murphy Meeting

Organismal Biology,” followed by a panel discussion. There were 15 talks with ample time for questions and answers, followed by various social events. This intellectually stimulating meeting further highlighted locusts as a fascinating model system for studying phenotypic plasticity.



Orthopterists from around the world: (from left) Mohamed Abdellahi Ould Babah EBBE, Jozef Vanden Broeck, Hojun Song, Koutaro Maeno, Le Kang, and Spence Behmer.



GLI Director Arianne Cease giving a presentation



Stephen Simpson giving a presentation



Group photo of the participants of Theo Murphy Meeting

Editorial

By **HOJUN SONG**

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contact our society members three times a year, asking for contributions to *Metaleptea*. The recipients of the Ted Cohn Research Grant and the OSF Grant send me reports of their exciting activities. Regional representatives send me reports of what's going on around the world. Occasionally, I receive contributed articles and meeting reports that interest our society members. I have been serving as the Editor of *Metaleptea* for the past 15 years, and this issue marks the 45th issue that I have put together. As an academic, I have engaged in many service activities, from manuscript reviewing to society governance. Some I enjoy and others I dislike. One service activity that I absolutely love is putting together *Metaleptea* three times a year. It's a lot of work, and meeting deadlines is always stressful. But there is joy in learning that more and more people become fascinated with the insects that I dearly love. It is also amazing to witness how the society has grown over these years. There were times when I was really concerned about the lack of the younger generation of orthopterists. But, now, we have many excellent young orthopterists worldwide, and that number only keeps increasing. The future of our field is bright!

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 (and who also just realized he's been assisting me for almost 12 years now).

Some time ago, I made a proposal for a new section in *Metaleptea*, but this did not actually pan out as I hoped. So, here is another reminder.

For each issue, I would like to invite an established Society member to write a personal essay about how he/she got interested in Orthoptera and built a career as an orthopterist. I think it will serve as a great inspiration for our younger members and an opportunity to get to know more about our members. I will be contacting the first person soon!

To publish in *Metaleptea*, please send your contribution to hsong@tamu.edu with a subject line starting with [Metaleptea]. As for the format, a MS Word document is preferred and images should be in JPEG or TIFF format with a resolution of at least 144 DPI. The next issue of *Metalep-*

tea will be published in September of 2024, so please send me content promptly. I look forward to hearing from you soon!

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