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METALEPTEA

THE NEWSLETTER OF THE ORTHOPTERISTS' SOCIETY

President's Message

By MICHAEL SAMWAYS
President
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In the north, summer is approaching with the sound of orthops soon to be gracing our ears. Here in the south, even though winter is coming, there are still many orthops around, with some even emerging now. The mole crickets have gone quiet, but there are still many other crickets and katydids singing. Grasshoppers seem to make the most of the sunny winter days with many still active on sunny banks and patches of dry grass.

In KwaZulu-Natal the sky is almost perennially blue and the air very still. Above 1000 m there is strong cold air drainage and the grasshoppers move from the cooler bases of hills onto the sides and the tops, especially where they can benefit from the northern rays of the rising sun. This is also the fire season with lightning strikes in the Drakensberg being among the highest in the world. This means many natural grassland fires to which the local grasshopper fauna is well-adapted. The large, good fliers move in haste while the small ones simply seek shelter among rocks, especially on the rocky krantzes where pockets of grass remain. Although they get concentrated in these places, and are therefore prone to predation by birds and lizards in particular, they are well able to escape the predators' sharp eyes by remaining close to their retreats where there is both food and shelter.

The Orthopterists' Society is reaching a new phase of true international

consolidation with its activities running smoothly and with a wonderful rapport within the society thanks to a wonderful team of officers and an enthusiastic membership. The *Journal of Orthoptera Research* is reaching new levels under the very capable editorship of Dr. Corey Bazelet. The *JOR* always seeks new and interesting manuscripts on all aspects of othopterology, so please do send her some. Also, this is an excellent vehicle for reviews, so please do consider that too.

The International Congress of Orthopterology is approaching, late October-early November in Ileus, Brazil. Please consider going as it will be an amazing forum for meeting new orthopterists with whom to share ideas. There is also a post-congress tour to get to know some of the Brazilian fauna along with the country's amazing culture.

Additionally, it is now time to elect our new President-Elect. There were three accepted nominations. I really do thank all of you for sending in your votes. Dr. David Hunter received the majority vote and the Board of

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our Society has ratified the results. So, we welcome David as our future President! David has supported the Society with enormous dedication and enthusiasm over many years and we look forward to his further injections into the development and growth of our Society.

With warm regards to all of our members near and far!

The 12th International Congress of Orthopterology "*Orthoptera in a Changing World*" (October 30 - November 3, 2016, Ilhéus, Brazil)

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

Dear friends,

It is our pleasure to send you more news about the 12th ICO that will be held in the city of Ilhéus, Bahia, Brazil.

We´re working hard to provide you with a remarkable event where it will be possible to discuss the latest findings in the various fields of Orthopterology regarding basic and applied scientific research. The overall theme of the congress is Orthoptera in a Changing World and the program will include theme-related Plenary Lectures, Plenary Symposia, and Workshop and Information Sessions as well as poster presentations. Topics will include behavior & communication, ecology & conservation, systematics & taxonomy, functional genomics, phylogeography & speciation, physiology, morphology, and development, biotechnology in locust control, grasshopper and locust control, and integrated pest management.

VENUE:

The meeting will be held at the Hotel Praia do Sol (www.praiadosol.com.br – In Portuguese). The hotel is in front of the beach, close to the suburbs of Ilhéus and 5 minutes by car (2 km) from the airport (the organization will provide transfer from and to the airport for all ICO attendees). It is a small hotel with beautiful gardens, swimming pool, and restaurants.

Prices:

We got a special price for the ICO. The Congress official hotel has 5 nights in an apartment single, double, or triple during the event period from 30th October to 04th November at the Hotel Praia do Sol. The package includes: 5 nights in an apartment during the event period, daily breakfast, 6 meals (lunch on the days of 31st October and 1-3 November/dinner on the days of 30th October & 3rd November (all without beverages)) and regular transfer from airport to hotel to airport.

It´s important to highlight that, due to Brazilian laws, prices must be charged on a credit card in Brazilian Reais, so the rates in U.S. dollars may vary depending on the exchange rate on the purchase date. The reservation must be made at the ICO website.

	Per day/*per person*	TOTAL Price/*per room*
Single	R$ 320,00 (approx. US$ 89.00)	R$ 1.600,00 (approx. US$ 445)
Double	R$ 192,00 (approx. US$ 54.00)	R$ 1.920,00 (approx. US$ 540)
Triple	R$ 172,00 (approx. US$ 48.00)	R$ 2.580,00 (approx. US$ 720)

PLENARY CONFERENCES AND SYMPOSIA PROGRAM:

The organization is working to release the complete scientific program soon, which will include these wonderful contributions and topics:

Plennary Lectures

- Dr. Hojun Song - *"Systematics of Orthoptera: Past, Present, and Future"*
- Thomas Fartmann - *"Biodiversity and Landscape Ecology of Orthoptera"*

Symposia

- *"Acoustic and vibrational communication in Orthoptera"*
  Organizers: Dr. Fernando Montealegre-Z, Dr. Thorin Jonsson, and Dr. Tony Robillard
- *"Molecule-organ-function-adaptation: on the evolutionary history of Orthoptera in a changing environment"*
  Organizers: Dr. Ioana C. Chintauan-Marquier, and Dr. Laure Desutter
- *"The orthopteran systematics in a changing world"*
  Organizer: Dr. Hojun Song and Ricardo Mariño-Pérez
- *"Orthoptera conservation"*
  Organizer: Dr. Axel Hochkirch
- *"Locust/Grasshopper control"*
  Organizer: Dr. Alexandre Latchninsky
- *"Phylogeography and speciation of Orthoptera"*
  Organizer: Dr. Battal Çiplak

Workshops

- "Orthoptera Species File/Taxon Works"
  Organizer: Dr. Maria Marta Cigliano
- "On the new generation sequencing (NGS) methods"
  Organizer: Dr. Ioana C. Chintauan-Marquier

ABSTRACT SUBMISSIONS:

In order to submit an abstract, all participants must be previously registered for the congress. Each congress registration permits the submission of 3 abstracts. Abstracts must be written in English and prepared in a one-page two-column format according to the abstract template and should be submitted only through the web site's online system before the end of 31st July, 2016.

REGISTRATION FEES:

For those who register for the 12th ICO before July 31, 2016 the price will be:

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

SOCIAL EVENTS:

- Welcome cocktail
- "Nations Party" (will be a party where the attendants will be asked to bring some typical costume/hat/shirt, etc. and will be invited to sing a song from their country - a tradition that began during the last ICO in China)
- Gala dinner
- Daily tours to Itacaré/Morro de São Paulo/Barra Grande/Camamú and other places (prices will be indicated on the webpage, and the reservation can be made directly on the ICO website)
- One day tour: On Friday 4th November.
- Post Conference Tour: a trip to the amazing Chapada Diamantina region and Salvador city. This is a very attractive tour that will soon be announced on the Congress website in the next days. Notice that we will be starting our tour at the city of Ilhéus and finish it at the city of Salvador (the capital of Bahia state). So, we kindly encourage you to book your travel plans accordingly. For those who will participate in the tour, the last night at the hotel in Ilhéus (from 4th to 5th) is already included in the tour package. It is important to note that it will be mainly a touristic and photographic tour since insects or any other organisms are unable to be collected without the proper Brazilian collecting permits. The ICO 2016 organization is not able to make any arrangements for collecting permits for the whole group or an individual. If somebody is interested in collecting Orthoptera material, then each scientist will be responsible for getting the permits to collect and the paperwork/permits to carry the material outside Brazil (they are different permits) at the Brazilian Government: Ministry of the Environment's (MMA) and at the Ministry of Science and Technology (MCT). Also we kindly ask those who get the permits to notify the local committee in advance, so we can manage the Post Conference Tour according to the Brazilian laws because the Chapada Diamantina region is a National Park.

The Local Committee of the 12th ICO would like to inform you that your flight tickets might be cheaper if you buy one from your city to Salvador (airport code SSA) and another one from Salvador to Ilhéus. Travelers from Europe or America can fly directly to Salvador. The GT5 group (Congress Secretariat) can help you to find the best prices for the domestic flights in Brazil. You can ask for a quotation directly from the ICO website (for those going on the post conference tour, you only need a one-way fare from Salvador to Ilhéus ahead of the conference).

IMPORTANT DATES:

- Deadline for abstract submissions: 31st July, 2016
- 12th International Congress of Orthopterology: 30th October to 3rd November, 2016

WEBSITE:

We recommend to visit our website every week to stay up-to-date: http://www.ico2016.com.br

As President of the ICO 2016 organization, I am delighted to cordially invite you to join us and contribute in order for our congress to be successful.

Get a triple dose of Orthoptera at ICE/ESA, 2016

By DEREK A. WOLLER
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Fellow Society members, I come bearing even better news than in the past regarding upcoming symposia of interest! Orlando, Florida, U.S.A. will be the site of the largest gathering of entomologists in the history of our planet during this year's combined International Congress of Entomology (ICE) and Entomological Society of America (ESA) conferences (Sept. 25-30). I am pleased to once again announce that I am co-hosting the third symposium in a row to feature orthopteroids at an ESA meeting with assistance this time from my collaborator Alexandre V. Latchininsky (our current President-Elect) from the University of Wyoming, and the title is "Orthopteroids Without Borders". The name reflects the fact that we have 12 speakers (researchers, professors, and students) from eight countries across four continents speaking on a wide variety of subjects.

Additionally, there will also be two other Orthoptera-based symposia, which will focus exclusively on locusts and both have been organized by Arianne Cease and Stephen Rogers of Arizona State University: "From Molecules to Management: New Tools for Understanding Locust Swarms across Species and Research Disciplines" (Tuesday, Sept. 27, 9:15 AM - 12:30 PM) and "Mechanisms and Consequences of Phase Change in the Desert Locust, *Schistocerca gregaria*" (Tuesday, Sept. 27, 1:30 PM - 4:00 PM).

Our orthopteroid symposium will be held on Thursday, September 29th from 1:30 to 5:00 PM in the Orange County Convention Center, room W231 C (subject to change – please check the official schedule on Thursday). The event will consist of a plenary talk by Piotr Naskrecki (30 minutes) and then 11 more invited talks (15 minutes each) covering a number of fascinating topics. There will also be an after-event celebration at a near-by restaurant (location to be determined) that all attendees are welcome to join, so please stay tuned for that announcement after the symposium.

I truly hope that everyone who comes to this year's meeting will also be able to attend at least a portion of one of these three symposia. Audience size goes a long way in convincing conference organizers to continue to shine the spotlight on Orthoptera. If anyone else is interested in running a similar symposium at a conference of their choice and would like advice, or if you have any questions prior to the event, feel free to contact me.

The "Orthopteroids Without Borders" line-up is as follows:
(presentation ID #'s correspond to the official ICE schedule)

Presentation id# 94360
Piotr Naskrecki (p.naskrecki@conservation.org), Harvard University, Cambridge, MA
Start Time: 1:30 PM
The science of natural history

Presentation id# 94358
Paolo Fontana (paolo_api.fontana@fmach.it), Fondazione Edmund Mach, Pergine Valsugana, Italy
Start Time: 2:00 PM
Orthopteroid insects: A perfect group to investigate ecology, conservation, and biogeography

Presentation id# 94361
Douglas Smith (dsmith59@uwyo.edu) and Alexandre Latchininsky, University of Wyoming, Laramie, WY
Start Time: 2:15 PM
Ecological factors affecting grasshopper outbreaks in Wyoming

Presentation id# 94362
David Robinson (david.robinson@open.ac.uk)[1], Patricia Ash[2], Marion Hall[1] and Jürgen Rheinlaender[3], [1]The Open University, Milton Keynes, United Kingdom, [2]The Open University in the South, Oxford, United Kingdom, [3]Nordkirchen, Germany
Start Time: 2:30 PM
Ultrafast, ultrashort, and ultrasonic — the ecological and evolutionary implications of an enigmatic acoustic communication system in a bush cricket

Presentation id# 94370
Mario Poot Pech (mpootpech@gmail.com), Esaú Ruíz Sánchez and Horacio Ballina Gómez, Conkal Technological Institute, Conkal, Mexico
Start Time: 2:45 PM
Indicator plants in solitary phase and migration behavior of Schistocerca piceifrons in Yucatán, México

*BREAK: 3:00 - 3:15 PM

Presentation id# 94369
Tyler Raszick (tjraszick@gmail.com) and Hojun Song, Texas A&M University, College Station, TX

Start Time: 3:15 PM
Transcriptomic profiling of the chemosensory organs in grasshoppers with diverse feeding strategies

Presentation id# 94368
Michael Sergeev (mgs@fen.nsu.ru), Novosibirsk State University and Institute of Systematics and Ecology of Animals, Novosibirsk, Russia
Start Time: 3:30 PM
Grasshoppers in the eurasian temperate grasslands: Distribution, migrations, dynamics

Presentation id# 94367
Janice S. Edgerly (jedgerlyrooks@scu.edu)[1], Grace Stokes[1] and Jeff Yarger[2], [1]Santa Clara University, Santa Clara, CA, [2]Arizona State University, Tempe, AZ
Start Time: 3:45 PM
Characterization of the nano-fiber silk of Embioptera

Presentation id# 94363
David Branson (dave.branson@ars.usda.gov), USDA - ARS, Sidney, MT
Start Time: 4:00 PM
Effects of precipitation manipulation and biotic factors on grasshopper populations: Implications for responses to climate change

Presentation id# 94372
Gerlind Lehmann (Gerlind.lehmann@t-online.de), Humboldt-Universität, Berlin, Germany
Start Time: 4:15 PM
Bushcricket genitalia: Morphology, function, and their role in species isolation and female choice (Orthoptera: Ensifera)

Presentation id# 94364
Pedro Souza-Dias (pedrogdias@gmail.com), University of São Paulo, São Paulo, Brazil
Start Time: 4:30 PM
Phylogeny of neotropical Phalangopsidae (Ensifera, Grylloidea)

Presentation id# 117267
Forest Huval (lavuh07@yahoo.com), Louisiana State University, Baton Rouge, LA
Start Time: 4:45 PM
Cockroaches (Blattodea) of Southern Louisiana: Morphology, diversity, and life histories

Book Launch of Roger Farrow's "Insects of South-Eastern Australia: an Ecological and Behavioural Guide"

By DAVID HUNTER
Executive Director and Regional Representative
davidmhunter100@gmail.com

On 11 May, I had the privilege of being at the launch of the book by Roger Farrow who worked for Australia's Commonwealth Scientific and Industrial Research Organisation (CSIRO) for many years on locusts, insect migration, and plant-feeding insects. Roger has spent his retirement in various projects and one dearest to his heart has found fruition in his book "Insects of South-Eastern Australia." Many of his colleagues and friends, about 100 in all, came to the launch of his book at the Australian National Botanic Gardens in Canberra. The book differs from traditional taxonomic guides by taking an ecological and behavioural approach to insect identification. As Roger says in the preface to his book, "this guide is directed towards anyone with an interest in the rich natural history of insects" and tells the stories of the insects as they live through the hundreds of photographs of insects in their natural environment. Grassland insects are well-represented through a selection of different grasshopper species, including their different colour morphs. These photos were taken over the past decade or so on regular field trips with the Australian Native Plant Society as well as on his rural property, with generous donations of photos from colleagues and friends. Everyone at the book launch and at the social function afterwards enjoyed hearing the stories associated with the making of this most valuable insect guide.

David Hunter (standing) and Roger Farrow (sittng) at the book lauching event (Photo by Lucinda Raulston)

The book was published by CSIRO in May, 2016 and is available from the publishers as well as many bookshops worldwide, including on-line. An electronic version will be available.

The 2016 Theodore J. Cohn Research Grants Funded

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

Of the 14 research proposals submitted this year from 7 countries (Australia-1, Brazil-2, Cameroon-1, Germany-1, Mexico-2, South Africa-1, USA-6), the committee selected eight projects with a total award amount of $11,967. For the first time, two proposals from African students were selected.

• **Rebecca Ehrlich (USA)** - Paling in comparison: Sexual and thermal selection on melanin-based immunity in insects
• **Owen G. Miller (USA)** - Consequences of variation in development time in a field cricket (*Gryllus vocalis*)
• **Oumarou Ngoute Charly (Cameroon)** - Life cycle of *Eyprepocnemis plorans* (Charpentier, 1825) (Orthoptera: Eyprepocnemidinae) in south Cameroon rainforests.
• **Tim O'Connor (USA)** - Does host plant polyploidization promote co-divergence of a specialist orthopteran community?
• **Salomón Sanabria-Urbán (Mexico)**- Taxonomic revision of the Neotropical grasshoppers of the genus *Sphenarium* Charpentier, 1842 (Orthoptera; Pyrgomorphidae)
• **Jessica Tanner (USA)** - Adaptative behavioral plasticity in the calling song of *Teleogryllus oceanicus*
• **Lisa A. Treidel (USA)** - Good Eats? The effect of diet nutrient composition on development and life history traits of the variable field cricket, *Gryllus lineaticeps*
• **Precious Tshililo (South Africa)** - Testing the unified species concept: Incorporating genetic markers for species delimitation of agile grasshoppers (Acrididae: Euryphyminae), a southern African endemic subfamily with low morphological variation.

Congratulations to all the successful applicants, and best wishes for the success of their work! The committee appreciated all submitted proposals and I encourage unsuccessful applicants to resubmit new proposals in the next call for projects in early 2017.

VI Brazilian Symposium of Orthoptera

By PEDRO G.B. SOUZA-DIAS
Universidade de São Paulo, BRAZIL
pedrogdias@gmail.com

On 10 and 11 March of 2016, in the city of Cuiabá, we organized our sixth Brazilian meeting on Orthoptera, entitled "VI Brazilian Symposium of Orthoptera: 10 years of history and achievements" during the XXXI Brazilian Congress of Zoology. In these two days, we reunited several Brazilian specialists, mainly young doctors, for fruitful discussions concerning Orthoptera, and celebrated 10 years since our first meeting.

In this edition, we promoted 10 talks of Brazilian orthopterists: **1)** "VI Symposium of Orthoptera, 10 years of history and achievements" by Dr. Neucir Szinwelski; **2)** "IUCN SSC Grasshopper Specialist Group – the role of scientists in species conservation" by Dr. Marcio Perez Bolfarini; **3)** "Bioacoustics of crickets" by Dr. Edison Zefa; **4)** "Taxonomy of Orthoptera, with emphasis in Acridoidea" by Dr. Maria Katia Matiotti da Costa; **5)** "Systematics of Neotropical crickets: what do we know and where are we going?" by Dr. Pedro G.B. Souza-Dias; **6)** "Precious preciousness: the need of standardization in the formulation of morphological characters for a more robust and integrated systematics of Orthoptera" by Dr. Fernando Campos de Domenico; **7)** "Show me your wings and I'll tell who you are: morphology of katydid tegmina and its use on taxonomy" by Dr. Juliana Chamorro Rengifo; **8)** "From Pacific islands to Neotropics: the history of Neotropical Eneopterinae" by Dr. Natallia Maria de Freitas Vicente; **9)** "What may I eat: is there feeding segregation among forest cricket species?" by Dr. Carlos Frankl Sperber; and **10)** "Determinants of grasshopper fauna from Campos Rupestres" by Dr. Marco Antonio Alves Carneiro.

Additionally, results of several interesting projects were presented in the poster session.

Below there is a set of abstracts from our event.

TALKS

VI Symposium of Orthoptera: 10 years of stories and achievements

Neucir Szinwelski (neucirufv@gmail.com). Universidade Estadual do Oeste do Paraná, Cascavel, PR, Brazil.

The Brazilian Symposium of Orthoptera is a great opportunity for interaction among researchers and

students from national and international research and educational institutions. During the Symposium, the participants can report their scientific results and discuss them with colleagues. Discussions center on subjects as diverse as new methodologies, morphology, taxonomy, use of molecular markers, biogeography, and ecology. In addition to the participation of researchers with renowned international prestige, the Orthoptera Symposium consolidated its global reach to be recognized by the Orthopterists' Society. The Symposium is the result of efforts from Brazilian researchers to bring together specialists who used to work in isolation. This effort culminated in the establishment of the Orthopterologia Research Group, which has more than 30 researchers and about 40 students (in various degrees). This research group approved, in 2010, a multi-institutional research project in the announcement MCT / CNPq / MMA / MEC / CAPES / FNDCT - Cross Action / FAPs No. 47/2010 - National System of Biodiversity Research - SISBIOTA Brazil. The project, entitled "Biota de Orthoptera do Brazil" had a grant of 1.7 million of Brazilian reais, allowing for equipping laboratories and conducting research in all Brazilian biomes. As main results, orthopterologists increased their networks; the group increased its capacity of training students and, consequently, its publication quality and quantity. Our website (www.orthoptera.com.br) contains our principal publications and shows all researchers and students involved in the project. We proposed for the sixth edition of the Symposium the title "VI Symposium of Orthoptera: 10 years of history and achievements". Our goals were to share and discuss experiences, stories, and achievements obtained during the last decade, and prospects and new challenges of Brazilian orthopterologists. During the last ten years, the group conducted field expeditions to all Brazilian biomes, facing logistic challenges in a country with continental dimensions and great culture and natural diversification. During that time, the group has published over 65 articles in national and international journals, five books and book chapters, and over 200 abstracts in conference proceedings. We are confident that the several editions of the Symposium were the trigger for the success found so far.

Taxonomy of Orthoptera with emphasis in Acridoidea

Maria Kátia Matiotti da Costa (katiamatiotti@gmail.com). Pontifícia Universidade Católica do Rio Grande do Sul (PUCRS), Porto Alegre, RS, Brazil.

Taxonomy is the theoretical study of classification, including bases, principles, procedures, and rules. Orthoptera, with more than 27,213 identified species, has its highest expression in the superfamily Acridoidea, with large representation in the Neotropics. The number of known species should be even higher, considering the wide variety of biomes, but there are few taxonomists to study this group. Representatives of Acrididae are popularly known by the name of grasshoppers. They have economic importance, especially in agriculture, given the severe damage they cause. There are 8,016 species in 1,711 genera of Acridoidea and they differ from other caeliferans by have the tympanum located on the first abdominal segment. Within this superfamily there are the

families Acrididae, Romaleidae, and Ommexechidae. Acrididae is the most numerous and widely distributed family of Acridoidea, with ca. of 6,642 known valid species, and more than 1,401 genera. Over 500 species occur in Brazil, and the diversity of shapes, colors, and sizes are great as well as the variety of habitats. Romaleidae is the most diverse family of Acridoidea in the Neotropics with large specimens that often possess colorful, flashy, and bright hind wings. Members of the family Ommexechidae are small grasshoppers with rough or tubercular integuments and varied and distinctive ornamentation. To date, the taxonomic knowledge of Acridoidea in Brazil was obtained by examining numerous morphological materials coming from collections and deposited in national and international institutions. The descriptions of genera and species of Acridoidea are performed by performing morphological analyses of the external and internal genitalia of males to assist in precise identification of species. Currently, taxonomic studies on Acridoidea in Brazil are advanced in the states of Rio Grande do Sul, Santa Catarina, and Rondônia where samples were taken for years, and the material was cataloged and identified to species level. In the state of Amazonas, a survey was carried out in the Reserva Florestal Adolpho Ducke and new species records for the country were obtained. It is necessary that studies of taxonomic aspects are performed continuously in the other states of the country in order to have a better estimate of the total number of Brazilian representatives of Acridoidea.

Systematics of Neotropical crickets: what do we know and where are we going?

Pedro G.B. Souza-Dias (pedrogdias@gmail.com). Instituto de Biociências, Departamento de Zoologia, Universidade de São Paulo, São Paulo, Brazil.

Grylloidea is recognized as a monophyletic clade with almost 6,000 species in 899 genera. The number of families and/or subfamilies in Grylloidea is broadly debated. Historically, several taxonomical schools studied the group, adopting distinct taxonomic classifications and incongruent morphological interpretations, mainly regarding characters from male genitalia. The cricket fauna of Neotropical region is probably the least well-known in comparison with other biogeographical regions, with estimates of only 10% of its species described. Due to the few taxonomic studies and the complex geological history of this region, the discovery of new genera and species, in the field and collections, is relatively common. Over the last 15 years, about 210 cricket species were described for the Neotropics, but only 11 genera and 33 species in Brazil. The taxonomic knowledge of Grylloidea is incipient. The number of suprageneric lineages is uncertain, resulting in different taxonomical classifications adopted by specialists. Thus, descriptions, identification keys, catalogues, and taxonomic revisions, in all levels, are still very needed, in order to increase the knowledge of its diversity. The systematic knowledge of Grylloidea is even more incipient, with a lack of phylogenetic hypotheses and cladistic studies. In this talk state-of-art systematics of Neotropical crickets will be presented, with discussions on recent studies, including the first cladistic analysis based on morphological characters and performed for a large Neotropical group, the Phalangopsidae. These results and prospects of future studies will also be discussed.

From Pacific islands to Neotropics: The history of Neotropical Eneopterinae

Natallia Maria de Freitas Vicente (natalliavicentte@gmail.com). Universidade Federal de Viçosa, Viçosa, MG, Brazil.

Eneopterinae is a diverse cricket subfamily with a disjunct worldwide distribution with species described for all tropical regions of the world. The ca. 250 species of Eneopterinae have been extensively studied for the diversity of their communication signals since they are the only known crickets that produce high-frequency songs. We present here Eneopterinae as a model system to test hypotheses that might explain diversification and distribution patterns in widespread biota. We used fossils as calibration points and biogeographic analyzes to estimate the origin, how many colonizations occurred in South America, and the routes towards this continent. Our dating analyses showed that the subfamily is far older than expected and that its diversification can be traced back to the Late Cretaceous (ca. 76 million years ago (Ma)). The most supported biogeographical scenario suggested that colonization of the Neotropics have occurred twice independently: (1) first as a dispersal event from Australia during the break-up of Gondwana; (2) later through a northern recolonization originating from South-east Asia, likely related to a Holarctic boreotropical distribution of an eneopterine lineage during the Eocene. Therefore, we presented a dated worldwide biogeographical framework for the Eneopterinae crickets. Overall, the disjunct distribution pattern of Eneopterinae is better explained by both ancient and recent dispersal events. Whether this could reflect a widespread pattern in insect groups exhibiting a disjunct distribution remains to be investigated by studying other insect lineages. The information gathered here will also help with proposing new directions for future studies concerning the acoustic innovations presented by members of this clade.

What may I eat: is there feeding segregation among forest cricket species?

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Crickets are the most abundant organisms in litter macrofauna of tropical forests. They coexist in this high productivity stratum, without evident segregation of ecological niche. When in equilibrium, coexistence of species at the same trophic level is only possible if the rate of their resource reposition surpasses the rate of consumption, or, alternatively, if there is some kind of resource-partitioning that reduces diet overlap among co-occurring species. Here we tested the hypothesis that there is resource segregation in crickets that co-occur in litter. We evaluated trophic niche of co-occurring cricket species using stable isotope analyses for carbon and nitrogen. We studied nine cricket species in six independent forest fragments, and the co-occurrence of three to four species. In case there was diet segregation, we expected no overlap of the 95% credibility ellipses drawn in the delta space δ15N x δ13C, among species collected at the same site. We did not find differences in δ13C values in any site. Values of δ13C were bound within the spectrum of -33 to -24‰, which is evidence for consuming resources originating from C3 plants. The values for δ15N varied from 0 to 9%, showing that crickets explore a continuum of diets ranging from primary to tertiary consumers. There were overlaps among 95% credibility ellipses, within the delta space δ15N x δ13C, in all sites, encompassing 15 pair-to-pair cricket species combinations. There were only five cases of non-overlapping ellipses, suggesting diet segregation between (i) *Mellopsis doucasae* and *Phoremia zefai* + *P. rolfsi*, (ii) Luzarinae *gen. nov.* and *P. zefai* + *P. rolfsi* + *P.* sp 2, (iii) *M. doucasae* and *Eidmanacris* sp. (although both overlapped with *P. rolfsi* + *P.* sp1), (iv) *Izecksohniella* sp. and *P. zefai* and between *M. doucasae* and *P. zefai* (although both pairs overlapped with each other), and (v) between *M. doucasae* and *P. zefai* + *P. rolfsi*. The values of δ15N is evidence that crickets can occupy up to three trophic levels, from primary decomposers to carnivores 2, with intraspecific differences in trophic level among sites. Among the five observed cases of diet segregation, most occurred between genera. Niche breadth was narrower in sites with four, compared to sites with three co-occurring cricket species ($F_{1,19} = 5.27$; $P = 0.03$). Therefore, we did not find an unequivocal pattern of niche segregation. Our results showed a great trophic amplitude, reinforcing the mostly indirect concept of crickets being omnivorous. We also showed there is a great trophic plasticity in crickets among sites, and showed that feeding resource is not an absolute driver of trophic niche. Even so, we detected that higher species richness was correlated to narrower niches. As far as this occurred even in species that overlapped their trophic niches, we interpret this niche-narrowing as resulting from segregation in another niche dimension, which would lead to more restricted diets in the sites with more cricket species. We concluded that feeding resource is not limiting for litter cricket species co-occurrence.

ORAL PRESENTATION

Influence of agonistic behaviour on oviposition of *Gryllus assimilis*

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Gryllus assimilis is a well-known agricultural pest of maize, soy, rice and sunflower crops. As gregarious behavior has not been described for this species, it can be hypothesized that females do not sexually select for their partners. Considering this rationale, the objective of this study was to understand whether agonistic behavior affects the number of eggs laid by females. In the laboratory, two experimental designs were used to test it. In the first, nine couples were used. In the second, each female was kept with two males. Either couples or trebles were left in a box with dimensions of 10x10x15 cm. Average weight±S.E. of males (0.61±0.13 and 0.62±0.09 g) and females (1.03±0.08 and 1.01±0.08 g) did not differ statistically between experimental designs. A piece of damp cotton was provided for oviposition. Daily observations of the behaviors were performed and, after 31 days, the number of eggs laid were counted. From all females (nine) kept with one male, only one female laid eggs (37 eggs), resulting in an average±S.E. of 4.11±12.33. On the other hand, females kept with two males laid an average of 115.66±13.79 eggs. Regarding behavior, the following actions were recorded: (i) antennal stroking, in which females recognize their partners by tapping the cephalic region of the males; (ii) courtship songs, in which males emit acoustic signal; and (iii) sidling, in which defeated males move to the edges of the container, in a submissive behavior, which often results in death as this male is eaten either by the other males or by the female.

POSTER ABSTRACTS

A new species of *Amblytropidia* Stål, 1873 (Orthoptera, Acrididae, Gomphocerinae, Amblytropidiini) Alagoas, Brazil with chromosome complement

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Acrididae is the largest family of Acridoidea, comprising a diversity of grasshoppers, with about 6,640 species and 26 subfamilies. Gomphocerinae includes 192 genera, among them *Amblytropidia*, composed of fourteen neotropical species. The aim of this study was to describe a new species belonging to the tribe Amblytropidiini that occurs in the state of Alagoas and register, for the first time, this genus for the northeastern region of Brazil. Specimens were collected by Biota Project group Orthoptera of Brazil, in January, 2013, through an active search at the "Station Serra do Ouro"municipality of Murici (AL), 9 ° 14'7.50" S - 35 ° 50'10.40. The specimens were screened and identified at the Entomology Laboratory, Pontificia Universidade Católica of Rio Grande do Sul (PUCRS). Photographs and measurements of head, thorax, and abdomen, as well as the phallic complex structures were obtained with a stereomicroscope Discovery V20 - Zeiss. The description of the external morphology includes head, thorax, abdomen, and its appendices; the internal morphology covers the male genitalia. For morphological studies, the characters analyzed were: color pattern, shape of pronotum, form of supra-anal plate of male, subgenital plate, cerci, furculae, and characteristics of the external and internal genitalia of both sexes. Four adult males were dissected to remove testicles, which were prepared in a solution of 0.075M KCl, fixed in Carnoy I and stained with 0.5% lacto-acetic orcein. The new species differs markedly from the other cited for Brazil by the presence of micropterous wings and developed furculae, and further characterized by: rounded fastigium, pronotum with well-protruding ridges, lateral lobe of pronotum sinuous, apex of the wing rounded, supra-anal plate sub-oval, furculae composed of four sclerotized projections, aedeagus of the genitalia of male strongly tapered, and epiphallus with flat bridge. The species displays 2n = 23, X0♂ / XX♀ with all acrocentric chromosomes, four pairs of large- sized bivalent (G1- G4), five medium size (M5 - M9) and two small (P10 - Q11); presence of a chromosome B in few nuclei. The species analyzed here shares the same number and chromosome morphology of the three species studied, *Amblytropidia robusta* Bruner, 1906, *Amblytropidia australis* Bruner, 1904 and *Amblytropidia sola* Rehn, although the latter does not have megameric chromosomes.

Morphology and new occurrence of *Aeolacris bella* Rehn, 1909 (Orthoptera, Romaleidae, Romaleinae) in Porto Velho, Rondônia, Brazil

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Aeolacris is a genus consisting of three species, including *Aeolacris bella*, which belongs to the tribe Procolpini. Its distribution in South America occurs between Brazil, Peru, Guyana, and Ecuador. They are grasshoppers of well-distinct body structure compared to other members of the tribe with the presence of several tubercles on the pronotum, wings with yellow spots, and extremely robust tibial spines. This study aims to report the record of the species in the State of Rondonia and present morphological characteristics that distinguish gender. Sampling was carried out in December, 2013 in six modules in the areas of influence of UHE Santo Antônio Energia, the city of Porto Velho, Rondônia. The samples were collected by actively searching visually and with a sweep net. Screening and identification were performed in the Entomology Laboratory, Pontificia Universidade Católica do Rio Grande do Sul (PUCRS). The genitalia were dissected and drawn with the aid of a microscope equipped with a clear camera. Photos of the insect's body in different positions were performed with the aid of a digital camera. Studied specimens included observations of the following: integument of the head and pronotum dorso-laterally, antennae ensiform, fastigium with the vertex pointed; supranal plate subtriangular, longer than wide; cerci short and conic. The important characters in the recognition of internal genitalia, the phallic complex of the male, were observed, drawn, and photographed, highlighting the following structures as important for species identification: epiphallus, ancorae, apodemes of the cingulum, aedeagus, and endophallic sclerites. These characters of the internal genitalia are not mentioned in the original genus description, justifying this study. Furthermore, the distribution of the genus is being expanded.

Karyotype of the two species of crickets *Oecanthus* Serville, 1831 (Orthoptera, Grylloidea, Gryllidae) of Rio Grande do Sul

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Oecanthinae is a small subfamily of crickets that occur in the canopy of trees or shrubs, representing a new taxon in the evolutionary history of Grylloidea, with 169 described species with worldwide distribution. From the chromosomal point of view, only five species were studied with karyotypes ranging from 2n = 19 and 20 chromosomes. The aim of this

study was to describe the karyotype of *Oecanthus lineolatus* Saussure, 1897 and *Oecanthus pallidus* Zefa, 2012 occurring sympatrically in tobacco plantations and in bushes in São Lourenço, Rio Grande do Sul. The individuals were dissected with gut medium ovaries and testes 0.075 subjected to hypotonic solution for 10 min and then fixed in Carnoy I. Tissues were crushed on slides with a drop of 45% acetic acid and the chromosomes stained with 0.5% lacto-acetic orcein. *Oecanthus lineolatus* has 2n = 20 (18 + XY♂ / 18 + XX♀) with asymmetrical karyotype with two pairs of large metacentric chromosomes, the smaller one with a secondary constriction in the arm, and seven pairs of small acrocentric chromosomes; *O. pallidus* has 2n = 18 (16 + XY♂ / 16 + XX♀) with asymmetric karyotype with two pairs of large metacentric chromosomes and six pairs of small acrocentric chromosomes. In both species the X chromosome is submetacentric large size and acrocentric Y chromosome of small size. Among the species studied, *O. indicus* Saussure, 1878, *O. nigricornis* Walker, 1869 and *O. quadripunctata* Beutenmüller, 1894 present 2n = 19, X0, *O. lineolatus*, *O. longicauda* Matsumura, 1904 and *O. pelluscens* (Scopoli, 1763) 2n = 20, XY, and *O. pallidus* 2n = 18, XY, all asymmetric with karyotypes, and the chromosome X large, and Y, if present, of small size. Although only a few species have been studied, these characteristics appear to be relatively conserved within the group.

Cladistic analysis of Phalangopsidae, with emphasis in Luzarinae (Orthoptera, Ensifera, Grylloidea)

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The family Phalangopsidae, distributed in tropical and subtropical zones, comprises around a thousand species grouped in six subfamilies, and constitutes one of the most remarkable families of Grylloidea. This group reaches its largest diversification in the Neotropical region, being the largest and most common taxon of Grylloidea in tropical forests. In this region, the subfamily Luzarinae constitutes the largest lineage of Phalangopsidae, with at least 290 described species. However, the taxonomic knowledge of Luzarinae is incipient, resulting in a great debate about the number of suprageneric lineages and, consequently, in different systems of taxonomic classification. The systematics knowledge, from a phylogenetic point of view, is still more incipient. The evolutionary relationships between Phalangopsidae subfamilies, as well as Phalangopsidae with other Grylloidea groups, remain unknown. This study aims to perform the first cladistic analysis of Phalangopsidae using morphological and genital characters in order to propose a suprageneric classification for this group. The study of the male phallic complex allowed the proposition of 83 genital characters. The cladistic analysis was performed using 142 characters (83 genital + 59 morphology) and 60 species with five species used as outgroups. The analyses were performed using both equal weights and implied weights for the morphological + genital characters and only genital characters. The following taxonomic alterations were made based in one of the analyses: the genus *Endophallusia* de Mello, 1990 is now considered a junior synonym of *Eidmanacris* Chopard, 1956; the species *Strinatia teresopolis* Mesa, 1999 was not grouped with the other species of *Strinatia* and it is transferred to a new genus, to be defined; the genus *Endecous* now comprises two subgenera, *Endecous* and *Notendecous*; a new tribe Aracambini trib. nov. is proposed; the elevation of subtribe *Lernecina* to tribe Lernecini status nov. is proposed; and the tribe Luzarini is erected, Luzarini status nov.

Wet or dry: that is the question! What is the ideal humidity for litter crickets oviposition?

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Humidity can determine the distribution of organisms in the environment. For many species, adequate humidity represents greater reproductive success and rapid growth, as well as larger individuals and populations. Reproduction is a crucial step for the success of species and it would be expected that females choose adequate reproductive sites, in order to increase survival of their offspring. For litter crickets, however, the ideal moisture for reproduction is not known and the few articles published on the subject cite the temperature as the main factor, overlooking humidity. In this study, we evaluated, through manipulative experiments in the field and in the laboratory, the ideal humidity chosen by female crickets for reproduction (oviposition). In the Iguaçu Nation Park (Foz do Iguaçu – PR/BR) we conducted the field experiment, with 30 transects of 100 meters length, divided into ten points each. At each point, we randomly distributed 10 trays with water-soaked cotton in 10 levels: 0 to 198 g of water, in a 22 g interval (n=30). We performed the laboratory experiment (20,75 x lower scale) in the Laboratório de Zoologia da Uniamérica (Foz do Iguaçu – PR), with control of relative humidity, temperature and photoperiod. Parthenogenetic females of *Ubiquepuella telytokus* were placed in circular trays (n=30). Each tray received ten levels of humidity packed

in pet covers with 0.7 g of cotton. The humidity levels varied from zero to 9.54 g of water, with a 1.06 g interval. Each level was placed radially on the tray, 7.5 cm away from each other, clockwise, and randomly. The highest level was considered due to the presence of supernatant water (field and lab). Both experiments had a 48 hour duration. After the experiment, trays were screened and eggs were counted. We have adjusted generalized linear models with distribution of binomial errors. We found 270 eggs: 229 in the field and 41 in laboratory. More than 90% of the eggs were oviposited in humidity above 44%. The probability of oviposition was increased with humidity, both in the field and in the lab, and there was no significant difference in the probability of oviposition between experiments. High availability of humidity in the embryo phase correlates with the biggest and heaviest crickets, and these have higher survival rates, more fertility, and more resistance to desiccation. Optimal levels of humidity do not induce egg diapause, increasing birth rates and population size. The results provide support for the claim that the humidity is an important factor in the niche of these animals. Although the experiment was carried out with insects, there are indications that humidity availability is a limiting factor for many groups of animals by changing their geographical distribution and abundance. This work also contributes to the biological conservation of litter crickets through the knowledge of optimal variables for the population of these organisms.

Use of electron microscopy in the proposition of characters from metanotal gland in *Eidmanacris* (Orthoptera, Phalangopsidae)

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The Neotropical fauna of Grylloidea, compared with other Orthoptera, are still unknown. This is due to the small number of publications on this group, mainly taxonomic studies, resulting in an underestimated diversity. The genus *Eidmanacris* Chopard, 1956 has 19 described species, and is distributed in Atlantic Forest and Cerrado, extending towards south, southeast, and midwest Brazilian regions, reaching Bolivia and Paraguay (Chacos). They are essentially nocturnal, remaining under loose bark, hollow trunks on the ground, in natural cavities (burrows and caves), or between the litter. Although the number of described species is relatively large, being the most diverse cricket genus in Brazil, there are still many species to describe. Together with the male's phallic complex, metanotal gland characters have been important to identify these species, contributing to cladistics studies of the genus. The metanotal gland, located in the dorsal region of the metanotum under the forewings of adult males, has been used as taxonomic character by many authors for different Grylloidea taxa. Some functions have been proposed over time for this structure, the most accepted of which is its role in the reproductive behavior of crickets. During the courtship, males raise their forewings and exhibit these glands, their secretions serving as a nuptial gift for the females to feed on while the male transfers the spermatophore. The aim of this study was to examine metanotal gland characters of *Eidmanacris* using Scanning Electron Microscopy (SEM). Of the 19 species described up until now, 13 were sampled: *E. alboannulata,E. bidentata, E. caipira, E. corumbatai, E. dissimilis, E. fusca, E. larvaeformis, E. meridionalis, E. papaveroi, E. septentrionalis, E. simoesi, E. suassunai,* and *E. tridentata*. We also sampled five other undescribed species. The examined specimens were dissected with the forewings removed, and then the thorax, including pro, meso and metanotum. The samples were dehydrated via ascending alcohol series until 100% ethanol. Next, the samples were submitted to critical point drying with CO_2 as transitional fluid. The prepared metanota were fixed on stubs and coated with gold. We performed the analysis in the Scanning Electron Microscopy Zeiss Sigma of Institute of Biosciences, University of Sao Paulo. Among the species cited above, three in their descriptions did not have a metanotal gland, but we discovered that only *E. tridentata* lacked a metanotal gland. Using the SEM images we proposed the following characters: 1) triangular median crest of anterior border of metanotum; 2) position between lateral projections (parallels, convergent, directed to pronotum); 3) lateral projections surface (smooth or rugous); 4) lateral projections form (cylindrical or conical); and 5) micro projection between lateral projections. These characters are very useful in identifying *Eidmanacris* species and can be used in a phylogenetic analysis of the genus.

Metaleptea brevipennis from Mexico (Photo: P. Fontana)

Theodore J. Cohn Research Grant Reports

Inter- and Intra-island diversification in the genus *Ariagona* Krauss, 1892 (Orthoptera: Tettigoniidae)

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Oceanic archipelagos of volcanic origin are excellent areas for the study of colonization, differentiation, and speciation processes (Emerson, 2002). The Canary Islands, a volcanic archipelago situated in the northeast Atlantic Ocean, are among the best-studied archipelagos in this regard. They exhibit high rates of endemism, a broad range of habitats, and they are geologically dynamic (Emerson, 2002). Due to the fact that the geological history of the archipelago is well-known, the Canary Islands offer a temporal framework within which to examine biological diversification (Cox et al., 2010). Phylogenetic studies of numerous taxa have shown a stepwise colonization sequence from older to younger islands (Juan et al., 2000), but exceptions exist (Husemann et al., 2014). The Orthoptera fauna of the Canary Islands is comparatively well-known (Bland et al., 1996; Bland, 2001) and phylogenies of several Canarian genera has been inferred using molecular markers (*Acrostira*/*Purpuraria*: López et al., 2007; *Calliphona*: Arnedo et al., 2008; *Arminda*: Hochkirch and Görzig, 2009; *Sphingonotus*: Husemann et al., 2014). All of these studies included the discovery of hitherto undescribed species (*Arminda palmae* Hochkirch & Görzig, 2009; *Sphingonotus fuerteventurae* Husemann, 2008; *Calliphona gomerensis* Pfau & Pfau, 2007; *Purpuraria magna* López & Oromi, 2013). Thus, it is likely that more cryptic species will be discovered on the Canary Islands.

The genus *Ariagona* Krauss, 1892 is a monotypic bush-cricket genus, endemic to the Canary Islands (Fig. 1) and its type species, *Ariagona margaritae* Krauss, 1892, has been found on three (Tenerife, El Hierro and La Gomera) of the seven Islands (Gangwere et al., 1972). Recent preliminary studies suggest that some populations show morphological differences, suggesting that they represent unique species (López, unpublished).

Figure 1. Male *Ariagona margaritae*

In my PhD thesis, I tested the hypothesis that inter- and intra-island differentiation occurred in the genus *Ariagona*. I hypothesized that the populations on Tenerife and La Gomera show a significant genetic differentiation due to the high ages of these two islands, whereas the populations of the much younger island of El Hierro are assumably less differentiated. I also hypothesized that populations from La Gomera represent the sister lineage for those from El Hierro due to its closer proximity. As Tenerife originated from the aggregation of three successive shields (Guillou et

Figure 2. Locations in which *Ariagona* is present.

Figure 3. Typical habitat of *Ariagona margaritae*

al., 2004), I also want to test whether populations from here show intra-island divergence as has been shown for other taxa (Juan et al., 1996, 2000). To test these hypotheses, I combine genetic, morphological, bioacoustics, and ecological methods.

For this purpose, I performed an initial field study on Tenerife in July/August 2015, funded by the Theodore J. Cohn Research Fund. The main objectives of that trip were:

- Clarification of the distribution of *Ariagona* on Tenerife
- Collect specimens from each region for morphological and phylogenetic analysis
- Collect data on habitat preferences
- Record songs for bioacoustic analyses

Altogether, I found twelve locations in which *Ariagona* occurs (see Fig. 2) and the locations cover the northern slopes of Tenerife. I did not found any specimens in the south of the island, probably due to the climatic differences between the dry hot south and the more humid conditions in the north of Tenerife (see photos of the preferred habitat: Fig. 3).

In total, I collected 45 males and 40 females for further analysis. Due to the fact that many of the male specimens were still in the last nymphal stage, I took them back to the lab alive and reared them, so that I could record the songs. I recorded songs of 41 males from different regions of the island. For the ecological analysis I collected information on the habitat preferences of 65 females and 73 males from eleven regions. The habitat analyses performed were similar to those by Gröning et al. (2007).

The collected data still needs further analysis, but some preliminary results of phylogenetic analysis (sequencing the mitochondrial 12S rRNA gene) indicate a significant intra-island diversification. At minimum, there are two different clades on Tenerife. In addition to the intra-island examinations, I included specimens from El Hierro and La Gomera (provided by López) in the genetic analysis. The reconstructed phylogenetic tree also revealed that inter-island differentiation is strong.

The preliminary analyses of the recorded songs did not show a significant differentiation on the island of Tenerife. The songs are quiet, simple, and best described as a syllable train (Fig. 4). I assumed that the most likely differentiation would be in the temporal components. Therefore, I analyzed the duration of the gaps between two syllables, the duration of the gap between the opening and the closing part of a syllable, the duration of a syllable and the closing and opening parts, and the amount of pulses per syllable. Some of the analyzed components show significant differences between regions, but, overall, these results do not show a clear differentiation between the specimens belonging to different genetic clades. To further test my hypothesis, I will collect and analyze material from La Gomera and El Hierro. Also, I want to visit the islands La Palma and Gran Canaria to test if the genus also occurs there.

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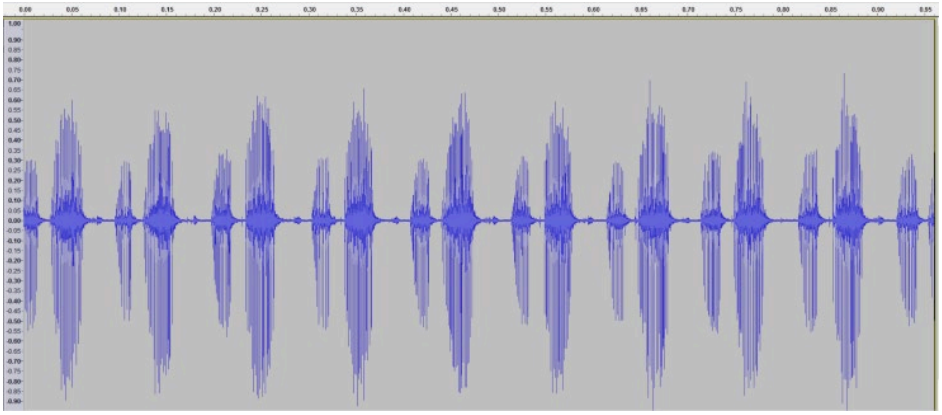

Figure 4. Oscillogram of a recorded song (0.95 seconds). Lower amplitude: opening movement, higher amplitude: wing closure.

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Integrating species distribution models, genetics, and morphology to infer species dynamics of New Zealand *Phaulacridium* grasshoppers

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The grasshopper genus *Phaulacridium* (Acrididae: Catantopini) occurs throughout Australasia with two species endemic to New Zealand. *Phaulacridium marginale* (Walker 1870) is recorded from most parts of New Zealand, including Stewart Island and various other off-shore islands. In contrast, *P. otagoense* (Westerman and Ritchie 1984) is restricted to semiarid regions of South Island.

For my MSc research with supervisors Assoc. Prof. Mary Morgan-Richards and Prof. Steve Trewick, I used species distribution models, spatial genetics, and morphology of the New Zealand *Phaulacridium* species to discover how taxonomy, geography, and biology intersect. I focused on populations of *Phaulacridium* from southern South Island where the two species ranges overlap to examine their evolutionary and ecological interactions. A model that Post Pleistocene changes in distribution explains the observed disparity of genetic variation was tested: 1) the environmental conditions underlying the predicted distributions of *P. marginale* and *P. otagoense* differ; 2) the restricted *P. otagoense* shows higher levels of genetic variation and geographic structure than the widespread *P. marginale*; 3) *P. marginale* will show recent population expansion; and 4) there is morphological variation between the two *Phaulacridium* species.

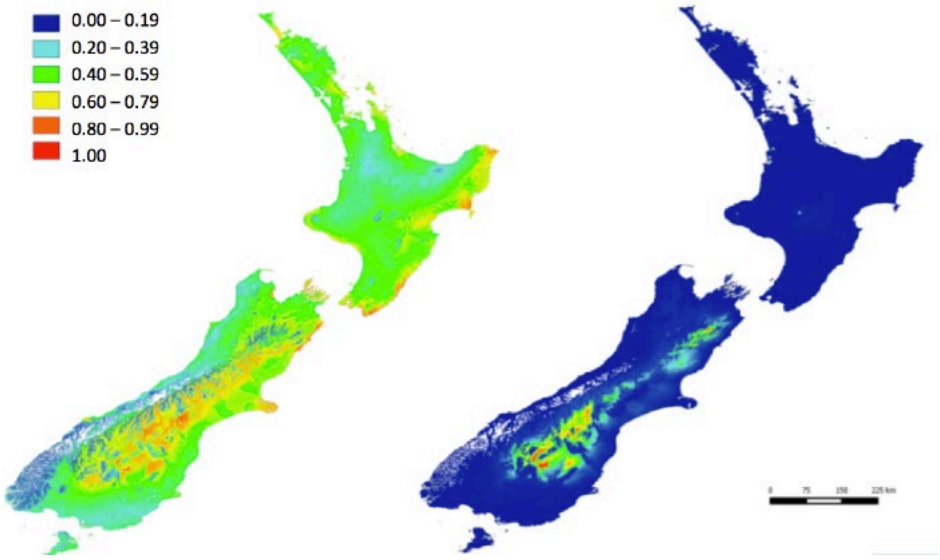

Figure 1. Species distribution model projections for the current distribution of New Zealand *Phaulacridium* grasshoppers a) *P. marginale* and b) *P. otagoense*. Warmer colours indicate land inferred to be within the niche and colder colours represent land outside of the niche. An area where no environmental variable data is available is white.

Methods

Species distribution modelling: five climate layers were used to infer potential distributions of the *Phaulacridium* species. Species distribution models were generated with Maxent (Phillips et al. 2006); with models based on georeferenced localities obtained from collections and published works.

Spatial genetics: a total of 149 *Phaulacridium* grasshoppers were collected from 18 locations. Haplotype tree topology, population genetics, and demographic history of the *Phaulacridium* individuals were examined using mtDNA COI sequences. Morphometrics: eight morphometric traits were measured for each individual using traditional morphometric methods. The model-based clustering software, Mclust (Fraley and Raftery 1999), was used to classify individuals into morphotypes. In addition, pronotum shape variation among

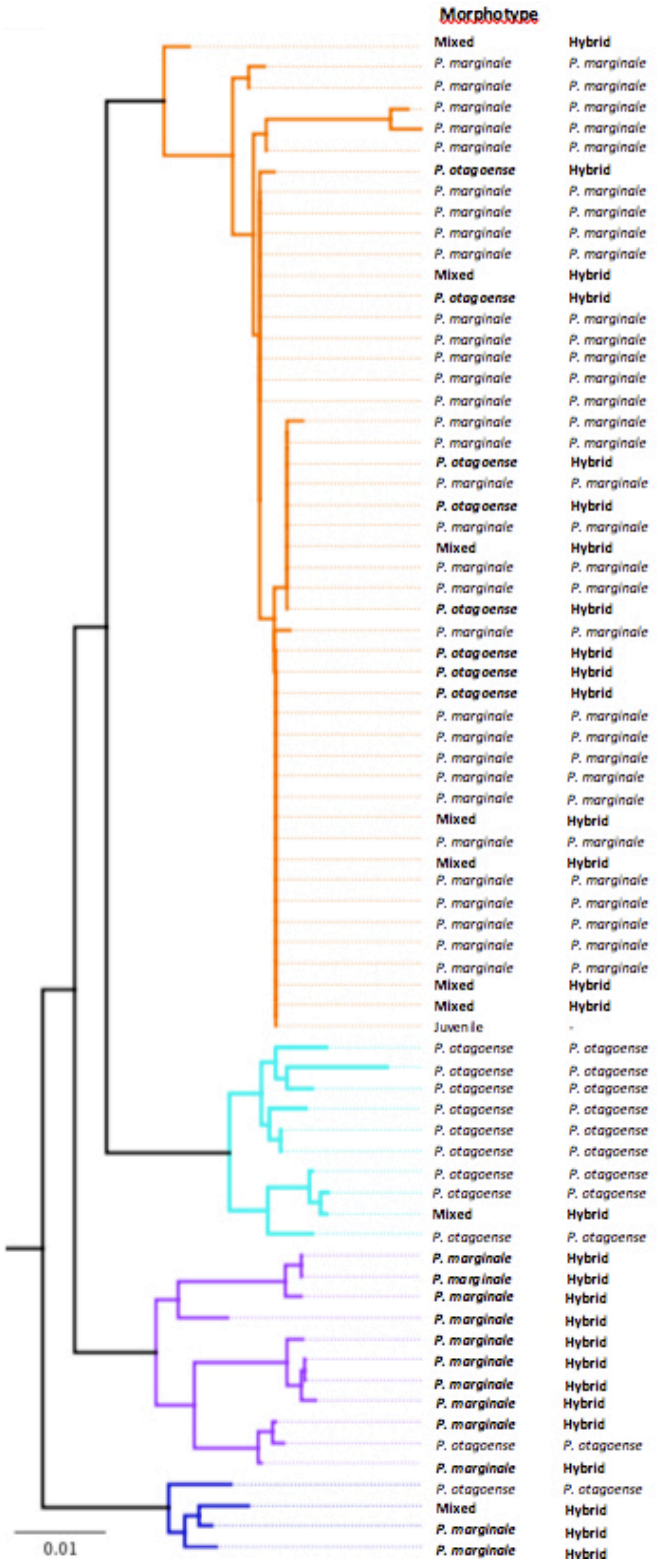

Figure 2. Classification of 73 New Zealand Phaulacridium grasshoppers from populations in central/southern South Island. The two main mtDNA COI lineages are Group 1 (Lineage I (orange)) considered to be *P. marginale* and Group 2 (Lineage II (light blue), Lineage III (dark blue), and Lineage IV (purple)) considered to be *P. otagoense*. Morphotype is obtained from cluster analysis of the traditional morphology where Type 1 is *P. marginale* and Type 2 as *P. otagoense*. Classification was determined using the combined result of genetic and morphotype data. Individuals as identified as having hybrid traits are in bold.

individuals was examined using geometric morphometric analysis.

Results

Species distribution modelling: the potential distribution of *P. marginale* covers the majority of New Zealand (Fig. 1). In contrast, *P. otagoense* habitat was limited primarily to patches in the central/southern South Island (Fig. 1). The modelled distribution of *P. otagoense* showed that this species had high potential of occurring in a region of northern South Island, although this species has not been recorded that far north (Westerman and Ritchie 1984).

Spatial genetics: results from the phylogenetic analysis of the haplotypes indicated four well-supported mtDNA COI lineages. A shallow clade (Lineage I) comprised haplotypes sampled from North Island and South Island New Zealand while three more diverse clades (Lineages II, III, and IV) comprised haplotypes sampled from grasshoppers in southern/central South Island. Two main sequence groups were formed, Group 1 contained all Lineage I individuals referred to as *P. marginale* grasshoppers in a previous study (Goldberg et al. 2015). Individuals in Lineages II, III, and IV, with the exception of Lineage II, have previously been referred to as *P. otagoense* (Goldberg et al. 2015), are considered together as Group 2. Both mtDNA COI lineage groups co-occurred within a single location at southern South Island locations.

Demographic history analysis suggests that the widespread range of *P. marginale* has resulted from recent population expansion because low genetic diversity is best explained by small population size. In contrast, *P. otagoense* has a restricted range today, but higher genetic diversity suggests that this species was represented in large populations until recently.

Morphometrics: two distinct morphotypes were apparent among New Zealand *Phaulacridium* grasshoppers using traditional and geometric morphometric methods. Individuals of Type 2 were smaller and typically had a wider pronotum and were restricted to southern South Island locations compared to the larger and widespread Type 1. Based on Westerman and Ritchie's (1984) description of New Zealand *Phaulacridium* species, I inferred that Type 1 and Type 2 individuals represent *P. marginale* and *P. otagoense*, respectively. Both *Phaulacridium* morphotypes co-occurred at some locations in the South Island. Furthermore, several individuals could not be classified to either morphotype. This suggests that these individuals had a mixture of morphological features, with some features being more similar to one grasshopper species than the other.

Discussion

The overlapping recorded and potential distributions of *Phaulacridium* grasshoppers, along with both species co-occurring at some southern South Island populations according to genetic and morphometric analyses suggest that there is some introgression. Evidence for this among *P. marginale*

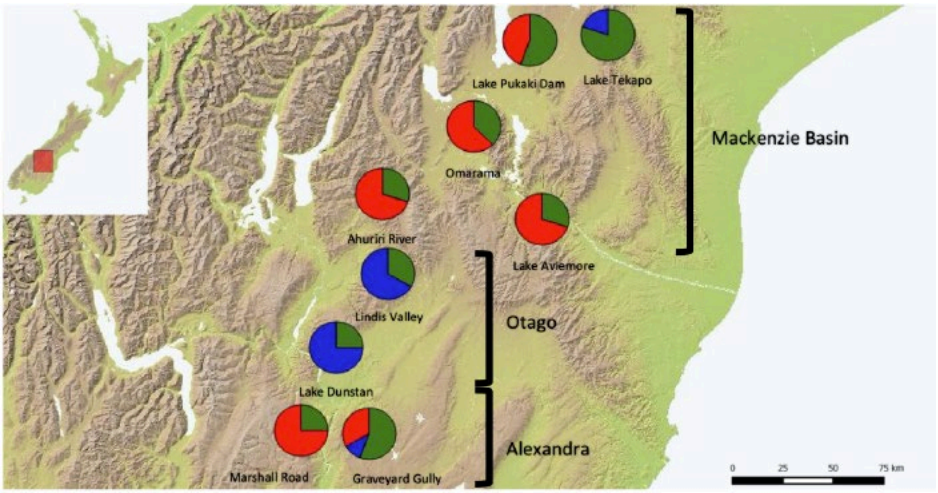

Figure 3. Geographic distribution of New Zealand *Phaulacridium* classifications around the southern South Island. The three classifications are grouped by colour: *P. marginale* (red), *P. otagoense* (blue), and putative hybrid individuals (green).

and *P. otagoense* comes from the mismatch between morphology and genetic data.

All North Island and northern South Island populations sampled consisted of individuals inferred to be *P. marginale* (Genetics = Group 1, Morphology = Type 1). However, within the samples from the nine southern South Island locations there was a mixture of *Phaulacridium* classifications (Fig. 2).

Southern South Island populations consisted of grasshoppers classified as *P. marginale*, *P. otagoense* (Genetics = Group 2, Morphology = Type 2), and putative hybrids (Group 1 and Type 2, Group 2 and Type 1, and Group 1 or 2 and Mixed).

Comparing the morphological and genetic data from my study demonstrates the first reported case of introgression between *P. marginale* and *P. otagoense*. It is evident that *Phaulacridium* hybrids exist in the wild, however it is unknown whether these hybrids are F1 and fertile. Lindis Valley and Lake Dunstan areas appear to be the last strongholds of *P. otagoense* (Fig. 3). Based on historical records of the distribution and the results of the current study, it seems that *P. marginale* is steadily replacing *P. otagoense* and this may be facilitated by human modification of landscape and vegetation.

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The large saxaul humpbacked grasshopper (*Dericorys albidula* Serv.) in Uzbekistan

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Adult description. The large saxaul humpbacked grasshopper – *Dericorys albidula* Serv. is a large acridid: body length of male is 42.5-51.2 mm, female 49.7-57.1mm [1] (Fig. 1). Wings yellowish-green with a smoky spot at tip. Tarsi with well-developed arolia. Hind tibia long, red on the inside, with clearly asymmetrical spines.

Distribution. *Dericorys albidula* is widespread in North Africa, Eastern Mediterranean zone (Syria, Iraq), Iran, Western Pakistan, Northern Afghanistan, Central Asia, Kazakhstan, and in Dzungaria (the Northern Xinjiang region of China). This acridid species is characteristic of sandy deserts - sand dunes, sand hills, and valley-shaped sandy depressions, and is also quite commonly associ-

Figure 1. Large saxaul humpbacked grasshopper – *Dericorys albidula* Serv. Photo: A. Latchininsky, 2008

Figure 2. Image of large saxaul humpbacked grasshopper damage to white saxaul (*Haloxylon persicum*). On this one saxaul shrub, there are more than 100 grasshoppers. Location: Saxaul woodland in the Nishan district of the Kashkadarya region in South Uzbekistan (Gapparov, 2008).

ated with saxaul shrubs (*Haloxylon* spp.) (Fig. 2).

In Uzbekistan, the large saxaul humpbacked grasshopper is a typical inhabitant of desert shrublands. The main habitats of this locust in Uzbekistan are desert areas with saxaul shrublands, such as: Surkhan Sherabad and Karshi steppes, and Kara-Kum and Kyzyl-Kum deserts. The largest permanent breeding areas are in the saxaul woodlands in the Bukhara region (Karakul, Olat districts) in Karakalpakstan (Turtkul, Elikkala districts) and in the Hozarasps district of the Khorezm region.

Phenology. In the Karshi steppe (Nishan district of Kashkadarya region, S. Uzbekistan), hatching of nymphs of *D. albidula* starts in late April while in Karakalpakstan (NW Uzbekistan) it starts in mid-May. Hatching begins in the late afternoon after the heat of the day declines and all nymphs from the same egg-pod hatch out together. The egg-pod is flask-shaped and contains 22-34 eggs (Fig. 3) [1]. Hatchlings immediately shed their egg capsule (the so-called intermediate molt) when coming out onto the soil surface and then climb up on a saxaul crown. All further stages of nymphal development as well as adult mating occur on saxaul and other halophytic shrubs and bushes [2,3].

The duration of nymphal development is 44-50 days. Over this period, the nymphs molt five times and the adults emerge in early to mid June. Oviposition starts in early July and continues into August. Egg-pods are deposited in open clay depressions (takyr) and in the compacted soils along sheep trails. Under natural conditions, the large saxaul humpbacked grasshopper feeds on green shoots of black saxaul (*Haloxylon aphyllum*), white saxaul (*H. persicum*), and plants of the Amaranthaceae (formerly Chenopodiaceae) family growing on salinized soils such as *Salsola longifolia*, *S. arbuscula*, and *S. richteri*. According to Tokgayev [4], in the laboratory, this grasshopper fed on *Gamanthus gamocarpus* (Amaranthaceae), *Lycium ruthenicum* (Solanaceae), *Peganum harmala* (Nitririaceae), *Atriplex micrantha* (Amaranthaceae), and *Agriophyllum latifolium* (Amaranthaceae).

Ecology. In Uzbekistan, the government pays a great deal of attention to propagating shrubs, in particular the saxaul woodlands. Prior to 1991, the total area of saxaul woodlands in the republic was about 600 thousand hectares. After Uzbekistan became independent in 1991, the extent of saxaul woodlands has increased by two and a half times. Dozens of oil refineries and gas-processing plants have been constructed jointly with Russian and European companies in the past two decades and to prevent sand encroaching onto these industrial facilities, saxaul plantations have been created and the area of saxaul woodlands increased greatly. Saxaul woodlands have also been planted in areas where the Aral Sea waters receded with such plantations now covering 125 thousand hectares. During Soviet times, the populations of Uzbekistan living in desert areas had a shortage of electricity and gas and were compelled to go to the saxaul woodlands, in particular, to provide themselves with fuel. Thus, instead of coal and gas, the saxaul firewood was used in large quantities, with more than one thousand hectares of saxaul woodlands destroyed every year. Since 1991, the percentage of the population of Uzbekistan that use gas has increased from 17% to 78% and saxaul woodlands are protected

Figure 3. Egg-pod of *Dericorys albidula*. Vertical line equals to 1 cm (from [3]).

by the state through the creation of a special protection service.

The large saxaul humpbacked grasshopper is a typical inhabitant of desert shrublands. As indicated before, its diet is quite narrow and includes primarily saxaul (*Haloxylon* spp.) shrubs and *Salsola* spp. plants. However, to protect saxaul woodlands from the grasshopper damage, a locust control service was specially created in the Bukhara region of Uzbekistan. Every year this service uses pesticides to treat 10 to 30 thousand hectares of saxaul woodlands infested by this grasshopper. During mass outbreaks these grasshoppers form swarms and can completely destroy shrubs by feeding on them from the top. In 2008, there was a mass outbreak of this grasshopper in saxaul woodlands, which resulted in a very high level of damage. Interestingly, the saxaul grasshoppers are attracted to light and when their large swarms fly into villages they create panic among the local population. However, since both the nymph and adult stages feed primarily on saxaul shrubs the saxaul grasshoppers are not dangerous to agricultural crops.

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Notes on Ngogoma

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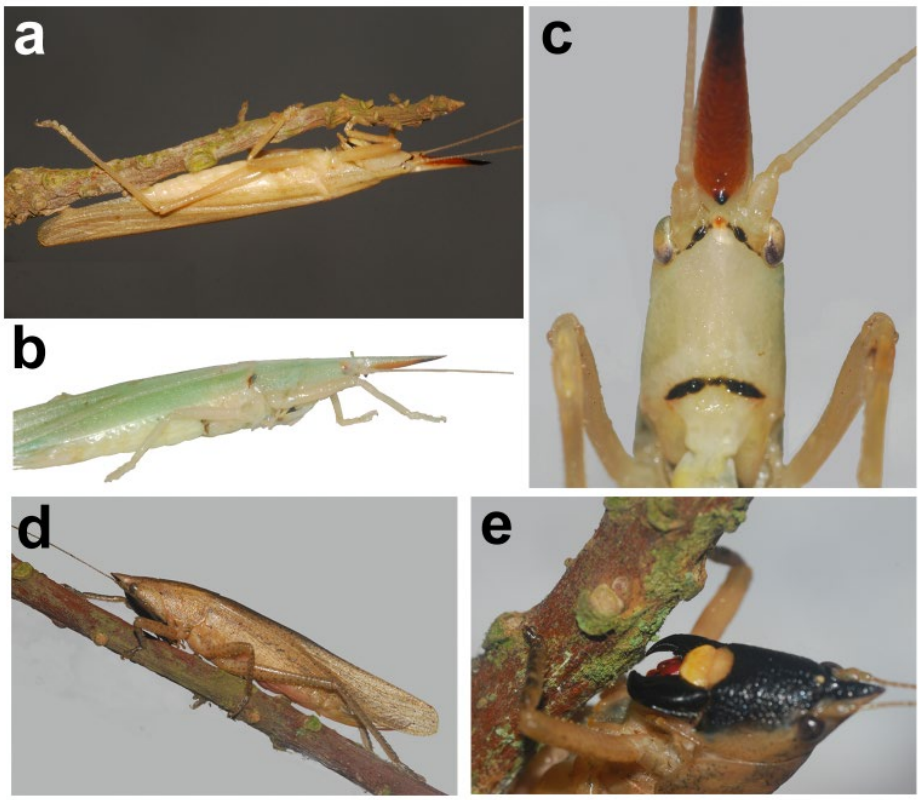
According to both the Banyoro and the Baganda people of Uganda, a child who wets his/her bed can be permanently cured of the habit by having him/her eat a certain species of roasted tettigoniid.

Actually, 2 species, both Copiphorini, that are found living in-between the fibrous sheaths of a plantain/banana main stem. They are both known as Ngogoma (Nyoro) or Bukamungogoma (Ganda) - both names refer to its position in the sheath (ngogoma), -buka being the root of the Luganda (the major language of Uganda) verb meaning "to jump into". I have not been able yet to discover how widely the belief is distributed among other Ugandan peoples, who include many non-Bantu language speakers as well. It is perhaps worth adding that another closely-related Conocephaline, *Ruspolia differens* (in Luganda, "Nsenene"), is prized throughout East Africa as a tasty snack when fried, so it should therefore be easy to get a child of this region to take this medicine without complaint.



Figures a-e. a) *P. pungens*, brown morph; b) *P. pungens*, green morph; c) *P. pungens*, frontal view of frons; d) *Lanista annulicornis*, brown morph; e) *Lanista annulicornis*, oblique view of frons and mandibles.

Claudia Hemp kindly identified specimens of these copiphorins for me: they are *Pseudorhynchus pungens* and *Lanista* sp. nr. *annulicornis*. I was informed of the interesting medicinal properties of these grasshoppers by Tibagamba Ereza Joseph, of Masindi, and Namubiru Phiona Phoebe, of Entebbe.

Orthopteran diversity in adjacent forest fragments between Southeast Asia's first overhead ecological bridge

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Forest fragmentation is one of the primary threats to biodiversity around the world (Turner & Corlett, 1996; Tscharntke et al., 2002; Fahrig, 2003; Tscharntke & Brandl, 2004; Haddad et al., 2015). Roads and other linear infrastructures, which are among the most common factors of fragmentation, are known to have acute environmental impacts on natural habitats, especially in tropical rainforests. A mitigation method for fragmentation is the provision of ecological corridors, which are physical or biological strips that connect patches for the dispersal and migration of species (Foreman et al., 1995; Rosenberg et al., 1997; Jongman et al., 2004). An example is the Eco-Link@BKE in Singapore (N1.3568, E103.7835). This is the first overhead wildlife bridge in Southeast Asia and was completed at the end of 2013 (Chung et al., 2014). At about 60 m in length and 50 m wide, it was constructed to enhance connectivity between two rainforest nature reserves, the Bukit Timah Nature Reserve (BTNR) and the larger Central Catchment Nature Reserve (CCNR), which were separated by the construction of an eight-lane vehicular expressway in 1986.

Figure 1. Aerial photograph of the Eco-Link@BKE and its adjacent forests. Right side of the corridor is the Central Catchment Nature Reserve (CCNR) and left side is the Bukit Timah Nature Reserve (BTNR). The expressway running below the corridor is the Bukit Timah Expressway.

Between 2011 and 2013, we investigated the orthopteran diversity in two forest fragments on both ends of the Eco-Link@BKE (Fig. 1). Sampling was conducted at night (8 PM), during which most species are active, along two belt-transects (50 m×5 m) about 100 m apart in each forest reserve (Fig. 2). Within 30 minutes of active searching along each sampling transect, Orthoptera were collected, identified, and quantified before released. This was repeated ten times for each forest reserve. In total, 61 species were recorded from the two forest fragments with 32 and 48 species recorded from the BTNR and CCNR fragments respectively. Species accumulation curves using the Kindt exact method suggested that the asymptote was not reached (Fig. 3). Species diversity (richness and abundance-weighted diversity) and community structure have been used to understand biodiversity response to habitat fragmentation (Turner, 1996; Didham et al., 1998; Kemper et al., 1999; Benítez-Malvido & Martínez-Ramos, 2003; Henle et al., 2004; Zhu et al., 2004). We found that CCNR (mean = 9) support a significantly richer orthopteran community than BTNR (mean =7) (Mann-Whitney test, p-value = 0.021) (Fig. 4). Since species richness is not representative of the diversity, we also calculated the Shannon diversity to account for abundance and evenness. The Shannon diversity in the two fragments were 1.70 and 1.90 but were not statistically significant (Mann-Whitney test, p-value = 0.147) (Fig. 4).

We also examined the ecological traits that were hypothesised to influence fragmentation vulnerability. These traits, such as rarity (abundance and occurrence), trophic position, body size, dispersal ability, vertical

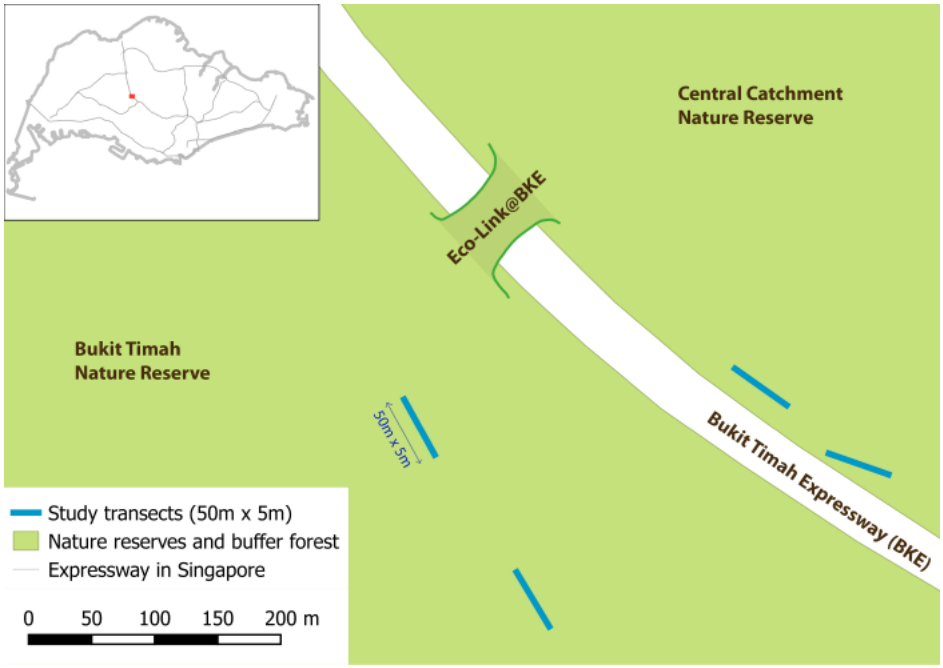

Figure 2. Map of Eco-Link@BKE adjacent forest. Two belt transects (50m×5m) were placed about 100 m apart in each forest reserve. Boundary of the map was traced with Google Earth Pro (2015) satellite image dated 27 June 2015.

stratification, and habitat specialisation were among the factors that correlate with vulnerability of species extinction (Pimm and Lawton 1977; Simberloff, 1986; Robinson & Quinn, 1988; Caughley, 1994; Lawton, 1994; Gaston & Blackburn, 1995; Blackburn & Gaston, 1997; Frank & Amarasekare, 1998; Holt et al., 1999; Davies et al., 2000; Duncan & Young, 2000; Owens & Bennett, 2000; Purvis et al., 2000; Davies et al. 2001; Van Houtan et al., 2007; Meyer et al., 2008). We found that most species are rare (low abundance and low occurrence) from both forest fragments. Trophic position, dispersal, and vertical stratification show similar distribution for species found in both forest fragments. Body size and habitat specialisation appear normally distributed in both forest fragments, suggesting that the orthopteran communities in both forest fragments are functionally diverse.

Being abundant and diverse in nearly every biome, especially in biodiversity hotspots, like Tropical Southeast Asia (Myers et al., 2000), orthopterans are important fauna in various ecosystems and fulfill numerous ecological roles (Joern, 1979, 1982; Lockwood, 1998; Belovsky & Slade, 1993; Samways, 1997; Gardiner & Dover, 2008; Micheneau et al., 2010; Bazelet & Samways, 2011; Yang & Gratton, 2014). Our study highlighted the potential use of orthopterans as ecological indicator in Singapore and Southeast Asia where it is still rarely applied. Moreover, little about the life history of most orthopterans in tropical Southeast Asia is known as many species are known only from taxonomic descriptions. This calls for more baseline studies to allow a more precise categorisation of ecological traits. There are on-going efforts to improve our understanding of the diversity and ecology of orthopterans in this region. By filling in this knowledge gap we hope orthopterans will be a useful indicator for evaluating the success of biodiversity and ecological conservation projects.

Acknowledgements

The authors thank Yen Kheng Chua, National Parks Board (NParks), Singapore, for initiating the project. The collection

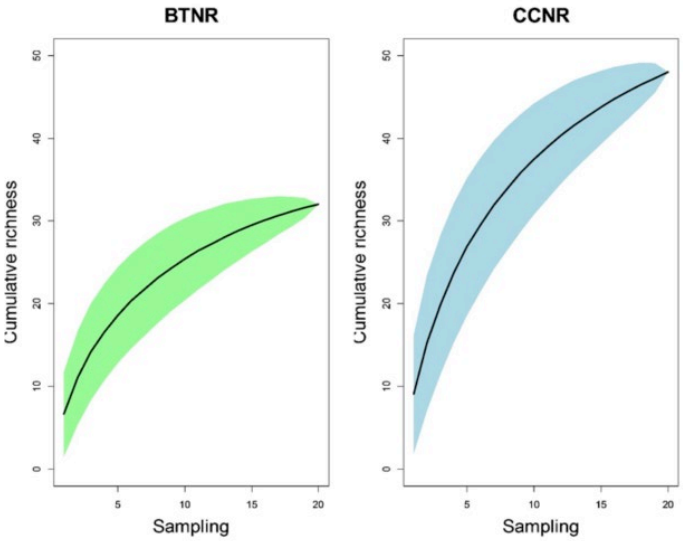

Figure 3. Species accumulation curves of BTNR and CCNR forest fragments.

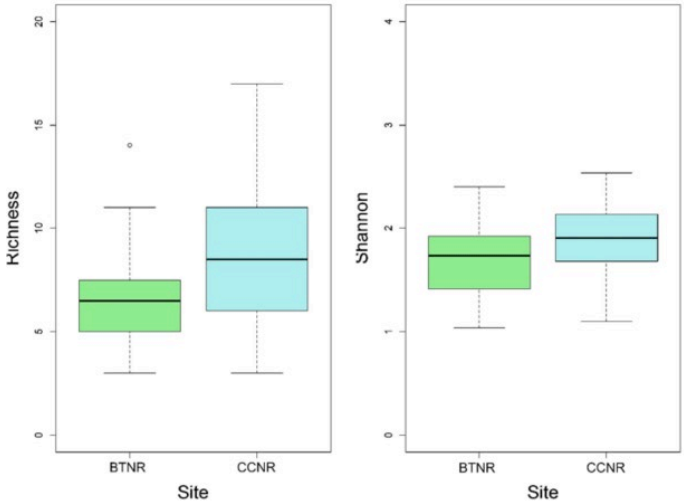

Figure 4. Boxplot comparing richness and Shannon diversity between BTNR and CCNR forest fragments.

of material in the Central Catchment Nature Reserve and Bukit Timah Nature Reserve was granted by the NParks (NP/RP10-073-2). The work of MKT was partly supported by the Lady Yuen Peng McNeice Graduate Fellowship. This research was funded by the National Parks Board (NParks) of Singapore for faunal survey for the Ecological Corridor Project "Eco-Link@BKE".

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Salvador Dalí and the grasshoppers

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It was not until I was in front of the "Face of the Great Masturbator" in the Museo Nacional Centro de Arte Rina Sofía in Madrid, Spain the last year when I started to question the relationship of Dalí with the grasshoppers. In page 128 of his book "The Secret Life of Salvador Dalí" he expressed that at the beginning, when he was a kid, he liked grasshoppers and he even chased them together with his aunt and sister. He claimed he unfolded their wings to appreciate colors, such as pink and blue. But later, some of his friends threw grasshoppers at him and then he started to be afraid of them. Even 37 years old he would prefer to jump over the edge of a cliff than to deal with a large grasshopper in his face. His panic and aberration for grasshoppers was obvious in some of his paintings.

In 1929, at the beginning of his surrealism stage, he painted two paintings at the same time. In both, he uses grasshoppers as a symbol of hysterical fear and disgust. In the first one "Portrait of Paul Eluard" (oil on canvas - Fig. 1), it is possible to appreciate the bust of Eluard and to the left a self-portrait of Dalí with an upside-down grasshopper. Apparently this grasshopper has the first two pair of legs and the hind femur. The tegmina are present but no antennae are visible. In the second one "Face of the Great Masturbator" (oil on canvas - detail of the grasshopper in Fig. 2), an autobiographic painting, a grasshopper is sucking a very modified body form of Dalí. In this case, the grasshopper has antennae, wings, and two pairs of legs (one of these pairs are the hind legs). The grasshopper is dead and has attracted ants that symbolize death.

It turns out that both works tell us the emotional state of Dalí at that time. He fell in love with Gala (beginning their fifty-year relationship) that at that time was the wife of the French Poet Paul Eluard. In Figure 3, it is possible to appreciate another painting that has a grasshopper. This work is entitled "The First Days of Spring". Finally, I found that in 1964-1967 he painted "Locusta et bruchus" (Fig. 4). Here the style is different and what came into my attention were the spines in the legs. Also, some titles of his paintings referred to grasshoppers (although in the

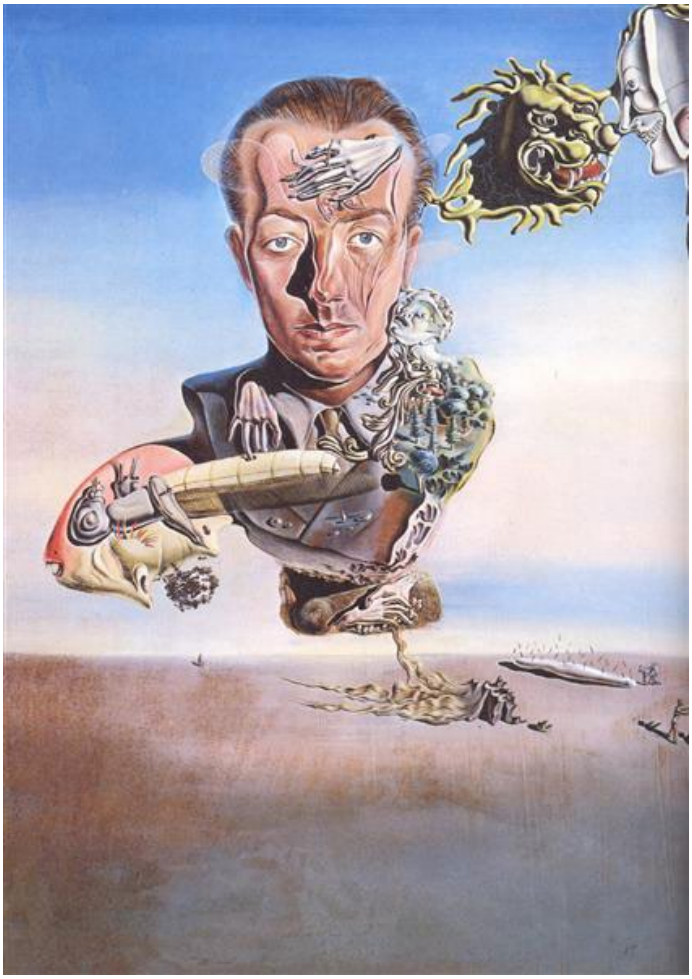

Figure 1. Portrait of Paul Eluard (1929), oil on canvas.

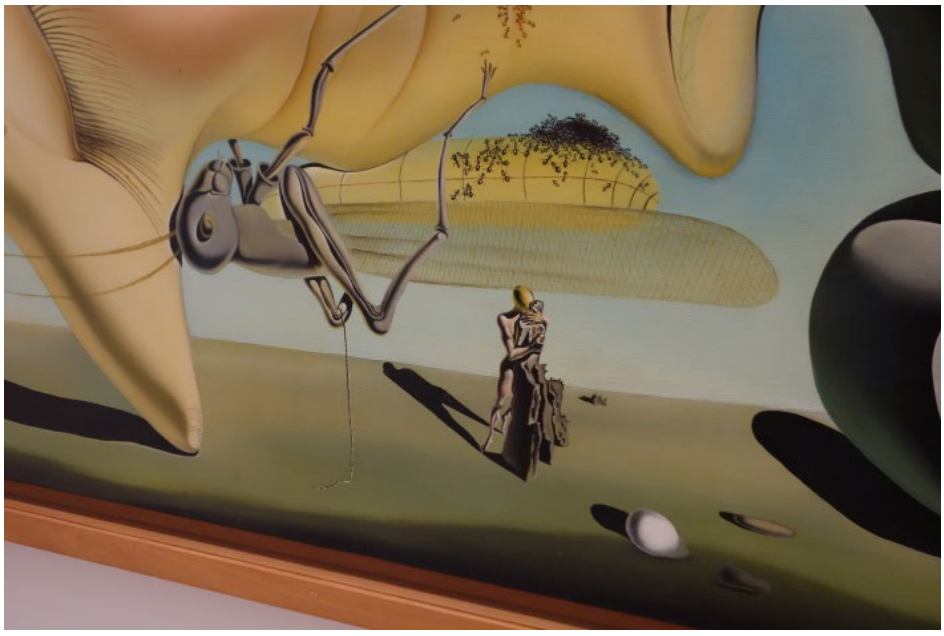

Figure 2. Detail of Face of the Great Masturbator (1929), oil on canvas.

Figure 3. The First Day of Spring (1929), collage, oil on canvas, panel.

Figure 4. Locusta et bruchus (1964-1967), gouache.

works themselves not a single one appears), such as "Myself at the age of ten when I was the grasshopper child" (1933) and an engraving entitled "The grasshopper child" (1933). I already appreciated the work of Dalí, but after knowing that grasshoppers played such a significant role in his life, I now admire him.

Hidden Beauty

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These marvelous hind legs belong to *Pardalophora phoenicoptera* (Burmeister, 1838), also known as the "Orange-Winged Grasshopper". However, if you're a fan of the American football team at the University of Florida, U.S.A., then you might know this species as the "Gator Grasshopper" because its brilliant orange and blue interior matches the school's official colors extraordinarily well and it's found across Florida (and much of the southeastern U.S.A.). Belonging to the Oedipodinae subfamily of Acrididae, these grasshoppers are often identified by pronotal differentiation and hind wing coloration (the "bands" from which the subfamily gets its common name: "banded-wing grasshoppers"), and even by the sometimes-vivid coloration on the inner side of their hind legs as seen here. Although I have seen and collected many specimens of this quite large acridid I have yet to see it use its hind leg coloration for a specific function if one exists, although startle display comes to mind, although the wings could also, presumably, be used for this. Both sexes have this coloration, so sexual display does not seem to be its purpose. If anyone out there knows the answer or has any ideas, feel free to write! *(focal-stacked image was taken using a Visionary Digital Imaging System combined with StackShot and Zerene Stacker for compositing – resulting image was enhanced using Adobe Photoshop CS5 Extended)*

Editorial

By HOJUN SONG
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My students often tell me that this editorial section is where I vent out my frustrations and maybe it appears so, but I consider it more as a record of my career as an orthopterist. The first issue of *Metaleptea* that I edited was Vol. 30(1), which was published in January 2010. I was a postdoc back then, desperately searching for a faculty position. Back then, I never imagined I would be in Texas in 7 years with my own lab and doing cool orthopteran research. Certainly, a lot of things have changed since I started this editorship and they have been sort of recorded in the editorials of the back issues of *Metaleptea*. This issue is the 20th issue that I have edited so far. Although it's tedious to put together a nice-looking newsletter, I do enjoy this task a lot and I can proudly say that we probably have the best newsletter compared to all other insect-related societies in the world. This is possible because we have enthusiastic members who contribute interesting contents and, of course, because Orthoptera is the most awesome insect group to work with.

As always, this issue is full of interesting contents and it certainly gives the impression that orthopterists are a busy and active group of scientists. In all corners of the world, we are advancing the science of orthopterology and there is no sign of slowing down. This is especially evident whenever I read through the Ted Cohn grant reports. I really feel that our society's dedication and investment in the future generation of orthopterists will have a transformative effect on our field.

I would like to thank all those who have contributed to this issue as well as our associate editor, Derek A. Woller, for his continued assistance in the editorial process.

Metaleptea is an excellent outlet to communicate to our members around the world. There is no limit on what we can publish: articles, stories, photos, artwork, etc. However, specifically, I would like to solicit the following types of contributions for all future issues:

-Collecting travelogues
-Museum visit travelogues
-Highlights of your peer-reviewed publications
-Photography/collecting techniques
-Collecting techniques
-Personal stories

To publish in *Metaleptea*, please send articles, photographs, or anything related to orthopteroid insects to hsong@tamu.edu with a subject line starting with [Metaleptea]. As for the format, a MS Word document is preferred and images should be in JPEG or TIFF format with a resolution of at least 144 DPI. Please do not embed figures in the Word document, but send me **separate** figure files. The next issue of *Metaleptea* will be published in September, 2016, so please send me content promptly. I look forward to hearing from you soon!

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