METALEPTEA

THE NEWSLETTER OF THE ORTHOPTERISTS' SOCIETY

President's Message

Autumn has arrived with its yellow and orange leaves in the Southern Hemisphere, which means lab and office work for most of us, while the opposite (fieldwork) is true for those in the Northern Hemisphere. The nice warm and sunny days of summer have gone and so I do not have any more excuses to be outdoors chasing grasshoppers. Since my last message to you, together with the OS Executive Committee, we have made some decisions and achievements that I want to share with you.

The Website and new payment/purchase system

I am pleased to announce that a new server and software were purchased by the Society, which will allow Piotr Naskrecki to redesign and rebuild the entire website using modern web standards.
Piotr is working hard on this new development that will also incorporate a secure credit card payment/purchase system. A Paypal account for the Society was created and Ted Cohn and Piotr are working through the details of the account in order to set this new system into the website. The new system will be designed in a way that will allow payments of renewals of membership, new memberships, as well as purchase of the Journal of Orthoptera Research (JOR) and other publications of the Society. This system will also include a secure section to allow members to have free access to JOR through BioOne. In order to implement this new system, Piotr and Charles Bomar are working on creating a centralized database of members, where every member of the society will have a unique user name and a password ID. Due to this near future implementation of the Society's payment/purchase system, we will send the announcement letter of dues and subscriptions annual statement once the website is finalized, so that our members can use this new payment alternative.

Orthopterists' Society grants

This newsletter contains the announcement of the 18th annual call for applications for Orthopterists' Society grants, primarily in support of graduate students and young professionals for significant basic research in Orthoptera (*s. l.*) and innovative presentation of findings. This research grants program is funded solely on its members' contributions and matched by an anonymous donor. I would like to thank all the generous donators who allow us to maintain this program which provides an extremely valuable way to foster research into all aspects of orthopteroid insects.

11th International Congress of Orthopterology

I am happy to announce that our Executive Committee has selected Kunming, China as the venue for our 11th International Congress of Orthopterology, to be held in October of 2013, under the chairmanship of Dr. Long Zhang (OS Regional Representative for China,

In this issue...

North and South Korea). Kunming, the capital city of Yunnan Province in the South of China, is in the middle of the Yunnan-Guizhou Plateau, located at an altitude of 1,900 m above sea level. Yunnan, as mentioned in the proposal, has some of the most magical and diverse scenery in all of China. There are endless trekking opportunities in the south's tropical rainforests, and in the north snow-capped Tibetan peaks hide dozens of tiny villages and temples. Yunnan is also home to a third of all of China's ethnic groups. Kunming, called the "Spring City", retains an individuality that has earned it a reputation for being one of the more cosmopolitan and relaxed cities in the southwest. The province is also home to the nation's highest number of species of flora and fauna, and is known for its mild climate year-round. We hope that the selected venue will attract a large audience and it will also reach a huge number of potential new members in what it is currently a key region of the world.

The Orthoptera Species File Online

The Orthoptera Species File online (OSF) is the leading online resource for taxonomic and nomenclatural data on Orthoptera. It was originally founded by Daniel Otte who published the first volume of the Orthoptera Species File in 1994 to cover crickets (Grylloidea). Subsequent volumes continued through volume eight in 2000 to complete all Orthoptera. The collaboration between Dan Otte and Piotr Naskrecki led to version one of the Orthoptera Species File Online, first posted to the Internet on October 20, 1997. David Eades was responsible for the new design and new versions of OSF that provide cross-checking of data calling the attention to errors, as well as the addition of new data in a way that identifies and prevents many nomenclatural errors, and also greatly reduces the number of changes that must be entered manually (Eades & Otte, 2010). Since the inception of OSF its strength and value to the taxonomic community has been the combination of the complete coverage of synonyms and taxonomic literature for all taxa within it, the addition of digital images of type specimens, as well as interactive keys, sound recordings, and maps. The OSF has been continually maintained and updated by a team based at the Illinois Natural History Survey, University of Illinois at Urbana-Champaign, USA. However, since March 1st the primary responsibility for data in OSF has passed on to me at the División Entomología, Museo de La Plata, Argentina. I am honored with this huge responsibility and thank David Eades and Dan Otte for their confidence in me.

Holger Braun enjoying Mate. (Photo credit: Maria Marta Cigliano)

Fortunately, I am not alone down here working with data in OSF. We are a small group of four which Holger Braun has recently joined. We are very happy to have him here and I believe that he finds himself quite adapted to his new working place. Although he still drinks beer and tea, he is getting used to our red wine Malbec and Mate.

With best wishes,
Maria Marta Cigliano
President

Formation of the IUCN/SSC Grasshopper Specialist Group (GSG)

Stopping the loss of biodiversity is one of the most challenging tasks facing mankind today. Many animal and plant species show negative population trends, including Orthoptera. The main threats to biodiversity are habitat loss, fragmentation and deterioration, but invasive species, over-exploitation and climate change are also contributing factors. The International Union for Conservation of Nature (IUCN) is the worlds oldest and largest environmental network, running thousands of field projects around the globe. Within the IUCN, the Species Survival Commission (SSC) is a network of some 7,500 volunteer experts engaged in the preservation of biodiversity, organised into more than 100 specialist groups. Well perceived activities of the SSC are the red list assessments, which are published in the IUCN red list (www.iucnredlist.org). The current version of the red list contains data on approximately 45,000 species. However, searching the red list for "Orthoptera" reveals only 74 assessed species, all of which need to be updated. When I presented this information in my talk at the 10th International Congress of Orthopterology in Antalya (21-25 June 2009), I did not expect such an enormous response. The audience was shocked. A clear need for more conservation efforts concerning Orthoptera was identified. There is little doubt, that the number of threatened orthopteran species is much greater than the currently listed species. However, we can not blame anybody for the lack of Orthoptera species in the red list. It is our own responsibility to perform red list assessments and submit them to the SSC. Hence, we can only change this by implementing our own activities. Also, a coordination of assessment (and conservation) projects is needed to

The fieldcricket (Gryllus campestris) is one of the four Orthoptera species to be included in the IUCN project Species of the Day. Photo Credit: René Krekels (Source: www.ortheur.org)

get a more realistic picture of the status of many Orthoptera species.

The discussions in Antalya soon reached the conclusion that an Orthoptera Specialist Group is needed in the framework of the IUCN/SSC. However, such a group will not be successful, if it is not driven by the activities of its members. In October 2009, we proposed to instigate a "Grasshopper Specialist Group (GSG)" in the IUCN/SSC structure and developed a working plan for the group. It is called the Grasshopper SG, because the IUCN has to relate to a wide public audience and a well-known common name is therefore, more appropriate. The SG does however, cover katydids, crickets, mantids and phasmids as well as grasshoppers. On 28th of January 2010 the Grasshopper Specialist Group was approved by the IUCN/SSC Steering Committee.

The GSG has currently (28 April 2010) 35 members, most of which are based in Europe. Our first aims include to perform red list assessments, develop bioacoustic monitoring tools, and write guidelines for Orthoptera conservation. Baudewijn Odé (our red list authority focal point), Roy Kleukers and Luc Willemse (all from Leiden, Netherlands) will coordinate the European Redlisting of Orthoptera (ERO). This project aims at performing global red list assessments for all European Orthoptera within the next 2-3 years. The group uses an open platform (Facebook) for discussions (search "European Redlisting of Orthoptera" on Facebook). Currently, some pre-assessments are conducted to get some practice with the application of the IUCN red list criteria. Klaus Riede (Bonn, Germany) is active in developing bioacoustic monitoring tools.

The group also contributes to IUCN/SSC initiatives, such as "Species of the Day." This initiative has been started to increase awareness of the huge variety of life and raise the profile of threatened species in the International Year of Biodiversity 2010. Each day in 2010, a different species is featured on a range of websites and through other media channels (http://www.iucnredlist.org/species-of-the-day). The species are selected from the entire range of taxonomic groups, representing all regions and detailing the threats to their existence. "Species of the Day" is featured on the IUCN and IUCN Red List websites as well as on the UNEP and ARKive websites and websites of other Red List Partners. The Grasshopper Specialist Group has meanwhile submitted seven contributions (*Gryllus campestris*, *Chorthippus lacustris*, *Ixalidium transiens*, *Acrostira euphorbiae*, *Prionotropis hystrix rhodanica*, *Podismopsis styriaca*, *Dryococelus australis*).

The only opportunity to keep Orthoptera on the agenda of the conservation community will be to steadily point out their diversity, beauty, importance and highlight the threats they face. It will also be important to develop positive attitudes to this insect group. In Germany, the common name of Orthoptera is "Heuschrecke", which is also used for locusts. During the last years, the name has also been used for hedge funds and is associated with negative attitudes (particularly after the financial crisis). In the 1990s, I studied the ecology of endemic grasshoppers in African rainforests. When I mentioned that I study African grasshoppers, many people applauded that somebody does something against these pests. Indeed, the preservation of charismatic vertebrates is easier to mediate than the need for conservation of insects (except for butterflies). This bias is evident in conservation projects, in the media, in scientific journals as well as in the IUCN/SSC. In a recent paper in Science, Simon Stuart (the chair of the SSC) and others (Butchart et al. 2010) point out that the IUCN red list is a valuable resource for tracking changes in biodiversity. They also state that the current version of the red list is strongly biased towards vertebrates. We now have the opportunity to change this.

Therefore, we invite any interested orthopterists to join the IUCN/SSC Grasshopper Specialist Group. Membership is for free. The only requirement is that you should be willing to contribute to conservation projects, red list assessments, management plans and other activities. We particularly would like to invite non-European Orthopterists as nature conservation is a global task. If you are interested in participating, please write an e-mail to Axel Hochkirch, Chair of the IUCN/SSC Grasshopper Specialist Group (hochkirch@uni-trier.de).

Axel Hochkirch
University of Trier

Reference

Butchart, S.H.M. et al. (43 other authors) 2010. Global biodiversity: indicators of recent declines. Science, published online 29 April, DOI: 10.1126/science.1187512

We are now on Facebook!

I have recently assembled a society page on Facebook to increase communications amongst members, as well as encourage those outside the organization to find us and potentially join the Society. There has been a desire by numerous members to have a discussion or forum area so that people can readily post questions and discuss. I am currently listed as the only administrator for the group, if others would like to assume this role please send me an email at BomarC@uwstout.edu. We will benefit, especially at the regional level, with multiple administrators of this site.

Charles Bomar
Executive Director

PSYCHE Special Issue on Locusts and Grasshoppers: Behavior, Ecology, and Biogeography

Call for Papers

Locusts and grasshoppers (L&G) remain serious enemies of agriculturists in the twenty-first century. Outbreaks of these pests continue to occur on all continents except Antarctica. Besides the economic damage, L&G outbreaks may seriously alter ecological processes across landscapes (e.g., carbon and water cycles). They can cause rapid loss in vegetation cover resulting in soil erosion and increased runoff. L&G can also destroy food sources for many animals and thus affect biodiversity. Despite decades of intensive research, the mechanisms underlying L&G population dynamics (and for locusts - phase transformation) are not fully elucidated. Only recently, significant advances were made in our understanding of L&G behavior and ecology, particularly individual and group movement as well as nutritional requirements.

The main focus of this special issue will be twofold: (i) recent advances in the studies on locust phase polyphenism and (ii) the use of new tools in research on L&G biology and ecology. The special issue is open for both research and review articles. We particularly welcome manuscripts dealing with L&G from Asia, Africa, and Central and South America.

Main topics include, but are not limited to:

- L&G migratory behavior
- L&G foraging and nutritional ecology
- Molecular markers for locust phase polyphenism
- Molecular tools for L&G taxonomic and biogeographical studies
- Individual and social learning in L&G
- Grasshopper species in a habitat: a community or an assemblage?
- Robotics in L&G behavioral studies
- Geospatial tools in L&G ecology
- Locusts as models

Before submission authors should carefully read over the journal's Author Guidelines, which are located at http://www.hindawi.com/journals/psyche/guidelines.html. Prospective authors should submit an electronic copy of their complete manuscript through the journal Manuscript Tracking System at http://mts.hindawi.com/ according to the following timetable:

Red locust Nomadacris septemfasciata. Photo credit: Alex Franc (Source: http://agents.cirad.fr/index.php/alex.franc)

Manuscript Due: **June 1, 2010**
First Round of Reviews: **September 1, 2010**
Publication Date: **December 1, 2010**

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III Brazilian Symposium on Orthoptera: "Strengthening the scientific cooperation between Brazilian and South American researchers"

The XXIII Brazilian Congress of Entomology will take place in the amazing and beautiful city of Natal, located in Rio Grande do Norte State from September 26-30, 2010. During this biannual event, which is expected to have more than 1500 participants, we have the honor of organizing the 3rd Brazilian Symposium on Orthoptera.

Since the Symposium started in 2006, we have had enormous progress in the field of orthopterology, establishing much cooperation among the South American researchers. The theme of this year's Symposium is to discuss about the studies made in our region and about how we can strengthen scientific corporation in South America.

The Symposium has the support from The Orthopterists' Society and the presentations will cover several areas of research consisting of one Lecture and two Round-tables.

Tentative schedule
Lecture (need to be confirmed): Neotropical Orthoptera and Orthopterists (Prof. Carlos S. Carbonell - Universidad de la Republica, Uruguay)

Round-table 1: Taxonomy, Reproduction, Bioacoustics and Ecology of Grylloidea
(Moderator: Dr. Carlos Frankl Sperber)
- Female monopolies by male crickets (Orthoptera, Grylloidea): forced copulation, genital mutilation and female monogamy induced (Dr. Francisco de Assis Ganeo de Mello – University of São Paulo State, Campus Botucatu, Brazil);
- Are female terminalia of crickets (Orthoptera, Grylloidea) useful for taxonomy? (Dr. Carina Marciela Mews – Federal University of Viçosa, Brazil);
- Taxonomy of cavernicolous crickets (Orthoptera, Grylloidea) (MSc. Marcio Perez Bolfarini – University of São Paulo State, Campus Botucatu, Brazil);
- The importance of bioacoustics for the taxonomy of cryptic species of Grylloidea (Orthoptera, Ensifera) (MSc. Luciano de Pinho Martins – The National Institute of Amazonian Research, Brazil);
- The emergent and collective properties of communities and populations of crickets (Orthoptera, Grylloidea) in a fragmented habitat (Dr. Carlos Frankl Sperber – Federal University of Viçosa, Brazil);

Round-table 2: Acridoidea: Diversity and Taxonomy
(Moderator: Dr. Maria Kátia Matiotti da Costa)
- Systematics, cladistic analysis and biogeographic considerations of the Andean genus *Jivarus* Giglio-Tos (Acrididae, Melanoplinae): An example of cybertaxonomy (Dr. Maria Marta Cigliano - Universidad Nacional de La Plata, Argentina);
- Diversity analysis of Brazilian semi-aquatic grasshoppers (Acrididae, Leptysminae) (Dr. Marcos Gonçalves Lhano – Federal University of Reconcavo of Bahia, Brazil);
- Aspects of phenology and morphometry of *Cornops aquaticum* (Bruner,1906) (Acrididae, Leptysminae) at the Pantanal of Poconé, Mato Grosso State (MSc. Fatima Regina Jaloretto da Silva – Federal University of Mato Grosso, Brazil);
- Diversity patterns of acrididians (Orthoptera, Acridoidea) in the Pampean Region (Dr. Maria Laura de Wysieski - Center for Parasitological Studies and Vectors, Argentina);
- Grasshoppers diversity in the South of Brazil (Orthoptera, Acridoidea) (Dr. Maria Kátia Matiotti da Costa – Pontifical Catholic University of Rio Grande do Sul, Brazil).

We would like to invite all members of the Society to join us at this Symposium! More information at: http://www.cbe2010.com.br/ (In Brazilian Portuguese) or marcos@ufrb.edu.br
See you at Natal!

Symposium Organizers:
Dr. Marcos Lhano (UFRB, Brazil - Regional Representative of OS)
MSc. Marcelo Ribeiro Pereira (Federal University of Viçosa, Brazil)

Regional Reports - What is happening around the world?

China

In China, locusts and migratory grasshoppers cause great damage to crops and grasses.
There are many technological problems that should be solved in the near future, including monitoring migratory grasshoppers and locusts and the application of biotechnology and information technology in locust control. We have demonstrated the effectiveness of using protozoan biocontrol agents from 2005-2008, for a total area of about 100,000 ha. Locusts and migratory grasshoppers often migrate between countries in Asia and as a result, international coordination for the control effort is crucial. In November 2008, the governments of China and Kazakhstan held a joint meeting focused on the control of locusts and grasshoppers in these two countries. Dr. Long Zhang attended the meeting and gave a talk on biological control of locusts and grasshoppers. Recently, there have been incidents where migratory grasshoppers migrated into cities. In 2002-2005, *Oedaleus asiaticus* migrated into cities such as Beijing. Dr. Long Zhang suggested strategies for the control of the migratory grasshopper which were implemented by the Chinese government. In order to promote the communication between countries Dr. Long Zhang took part in the International Symposium on Biotechnology for locust control, and gave two oral presentations in Morocco, July 1st to 3rd, 2008.


The products of biological control agents against locusts and grasshoppers. (Photo credit: Long Zhang)


A joint meeting between the Chinese and Kazakhstan governments focused on the control of locusts and grasshoppers held in November 2008. (Photo credit: Long Zhang)

There are two prominent orthopteran taxonomists in China who have been highly productive. Professor Zhemin Zheng's group classified more than 40 new species of orthopteran insects during 2009, and all the results of this research have been published in Chinese journals. Professor Xiangchu Yin's group studied the subfamily Conophyminae (Orthoptera : Caelifera : Acridoidea) from Eurasia. They described 3 new tribes (Bienkoini, Genimenini and Plotnikovini) and a new genus (Eozubovskya) and provided a key to tribes and genera of the subfamily from Eurasia.

Additionally, Professor Le Kang's group studied the physiology and

molecular biology of some grasshoppers and locust. They maintain the highly useful "LocustDB" at http://lo-custdb.genomics.org.cn/ which currently hosts 45,474 high quality EST sequences of *Locusta migratoria*.

Long Zhang
Regional Representative
(China, North and South Korea)

The Orthopterists' Society Grant Reports

Running into your relatives: the story of *Aglaothorax* song evolution in southern California

The conspicuous acoustic displays of orthopteran insects are an example of the incredible diversity of animal mating behaviors. Because different animal species tend to have unique mating behaviors, evolutionary biologists are interested in how mating system evolution and species formation are connected. As a southern California native enthused with singing insects, I came to appreciate the diversity of the shield-back katydids (Tettigoniinae) of that corner of the world. The shield-back katydids seemed ideal for speciation studies: most are flightless and tend to get stuck in local "mountain island" habitats and diversify. I chose to study the song evolution and speciation of *Aglaothorax* for a PhD project. I was inspired by the excellent revisions by Rentz & Birchim (1968) and Rentz & Weissman (1981), which showed virtually every population to be subtly different in morphology and song. After studying the latter work, which focused on the numerous small taxa in the Santa Monica Mountains just northwest of Los Angeles where I grew up, I guessed that some of these *Aglaothorax* may represent the earliest stages of the speciation process, and given that the shield-back katydids are the most diverse katydid subfamily in North America, I thought that understanding something about their speciation and song evolution may lead to a valuable scientific contribution.

Fig. 1. *Aglaothorax morsei costalis male, Point Mugu State Park, Ventura Co., CA*

Song analysis

Analysis of *Aglaothorax* calling songs, revealed several discrepancies between song and taxonomy. First, songs of *A. morsei* populations span the entire range of variation in the genus. In the western Santa Monica Mountains, the interpulse intervals of *A. morsei costalis* songs are extremely short (i.e. fast pulse rate), but in the San Gabriel Mountains to the east the intervals of *A. morsei morsei* are long (slow pulse rate). Although morphologically distinct, *A. morsei morsei* songs are statistically indistinguishable from another species with a long interpulse interval, *A. diminutiva*. Second, interpulse intervals of two recognized species vary along a cline. If known populations of *A. morsei*, previously unreported populations of *A. morsei* occurring on isolated sand dunes in the Los Angeles Basin, and populations of *A. longipennis* are arranged geographically, the interpulse interval increases exponentially from west to east. Longitude alone explains 75% of the variation in interpulse interval. Two forces commonly underlie clinal variation such as I observed in the songs: selection (natural or sexual) and hybridization. I used behavioral and phylogenetic methods to delve into the current and historical forces driving song evolution and test these hypotheses.

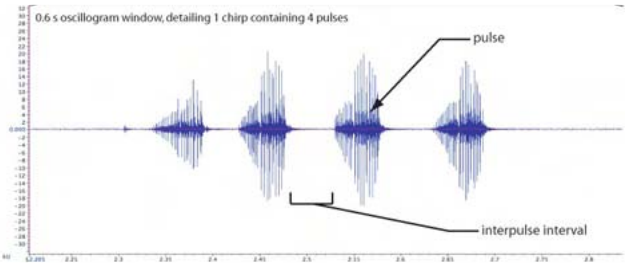

Fig. 2. *Waveform of A. ovata gigantea song, McMurray Meadows, Inyo Co, CA, illustrating song features.*

Female preference

I studied female preference for interpulse interval, using a servosphere in the lab of Johannes Schul at the University of Missouri. This treadmill device works like an inverted mouse track ball, upon which the movement of the female katydid is output as vector data, allowing construction of detailed preference functions. Female responses to test stimuli, which contained digitally altered interpulse intervals, were compared against responses to control stimuli, which contained the average interval for the female's population. In general, females were remarkably indiscriminate, approaching nearly any song broadcast to them, an unexpected result if sexual selection were occurring. Female preferences were only significant in *A. diminutiva dactyla* and *A. morsei costalis*, taxa that occur together in the western Santa Monica Mountains. Responses of each dropped precipitously as the interpulse intervals of the opposite species were approached. This suggests the interpulse interval has a species recognition function, reducing the probability of mating mistakes between species. Females from populations found alone responded to a

Fig. 3. *Servosphere used for female preference work.*

wide variety of songs, including those possessing intervals of "incorrect" species. Even in the discriminating pair, recognition was far from perfect, and on average a female may approach the wrong species about 20% of the time. Hybridization therefore appears to be not only possible but probable.

Phylogenetic analysis

Apart from behavioral experiments that show currently operating processes, a consideration of history is essential for speciation studies. I estimated the evolutionary tree of *Aglaothorax* using DNA sequence data. I then employed comparative phylogenetic methods to reconstruct historical geographic distributions and song evolution. I used parsimony to reconstruct ancestral ranges, which assumes that the fewest number of range shifts explain the current distribution. Santa Monica Mountains *Aglaothorax* come from the most recent branches of two separate lineages: *A. diminutiva* are a southward extension of a Coast Range lineage, and *A. morsei* and *A. longipennis* are from an interior Peninsular and Transverse Range lineage. To reconstruct song evolution I computed Felsenstein's independent contrasts for four song features, including

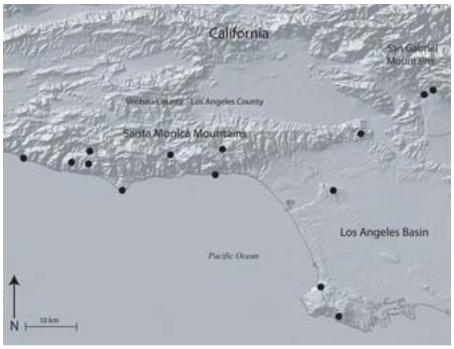

Fig. 4. *Map of song cline study sites along the Transverse Ranges of southern California.*

the interpulse interval. Rapid song evolution was shown by significantly higher standardized contrast magnitudes in both of these lineages, beginning precisely at the ancestors shown to have invaded the Santa Monica Mountains. These lines of evidence support the idea that song evolved to facilitate species recognition and prevent mating mistakes. Equally telling are the lack of high song evolution rates in the *A. ovata* lineage, in which no taxa occur together.

The situation revealed in *Aglaothorax* is one possible outcome when closely related taxa run into each other: songs or other mating traits can evolve to improve mate discrimination and strengthen reproductive isolation. I tentatively conclude the song cline I observed is the result of hybridization, which is suggested by the behavioral data. Now that I know where the action is in terms of song evolution, and that hybridization is likely, a fruitful future direction will be to use population genetic methods to study gene flow. Natural selection deserves also further consideration. The *Aglaothorax* I studied inhabit similar coastal sage scrub and chaparral habitats, which may reduce ecological selection, but future studies must address the effect of habitat in greater detail.

I am grateful to the Orthopterists' Society for funding fieldwork in the Santa Monica Mountains during the 2007 field season.

Jeffrey Cole
University of Kansas

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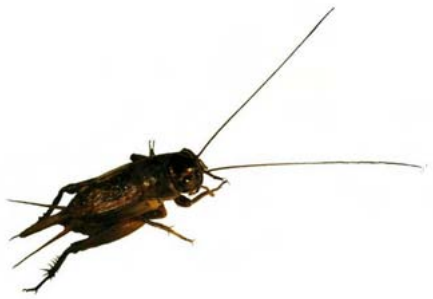
Rentz, D. C. & Weissman, D. B. 1981. Faunal affinities, systematics and bionomics of the Orthoptera of the California Channel Islands. University of California Publications in Entomology 94: 1-240.

Why shout when she's standing right here?

When I think of crickets, I remember what many of you probably do: fond memories of a flood of chirps filling an otherwise silent backdrop on a warm summer's evening. As a kid growing up in Ohio, there was nothing better than that sound because I knew it meant summer vacation and I didn't have to worry about staying up late or getting up early. Which is why, to a certain degree, I find a great sense of satisfaction in revisiting those chirps during the summer as an adult only to study them. It isn't that long-range chirping, called the calling song, which drew me back to crickets, but rather a quieter close-range song called the courtship song.

Females listen to calling males' songs to choose and locate mates, but as they near a singing male and make antennal contact with him, he begins to produce a second, lesser known song, the courtship song. The courtship song appears critical for the female's decision to mate or not. As a kid I was unaware of this; as an adult my curiosity was piqued. If a female has already made a decision to go to a particular male because of his calling song, why should he shout at her, again, when she's standing right there?

In some field crickets (subfamily Gryllinae), males may exhibit an alternative mating strategy. Rather than calling, which potentially makes them vulnerable to predators and parasitoids, these males act as satellites and hang around calling males, intercepting females en route. Satellite males will then court their intercepted quarry by producing the courtship song, in



Polynesian field cricket, Teleogryllus oceanicus (Source: http://www.faculty.ucr.edu/~mzuk)

hopes of enticing her to mate. Perhaps the lesser known and often neglected courtship song plays a more important role in female mate choice than previously thought. Using the Polynesian field cricket, *Teleogryllus oceanicus*, which is distributed through Australia and the Pacific Islands, I set out to address this question.

As a masters student in Marlene

Zuk's lab at UC Riverside, I tested a population of this field cricket from the Hawaiian Islands. To determine whether females preferentially mated with males depending on variation in the structure of their courtship song, I devised a two-day preference tournament. I performed mating trials by presenting females with a random male, using how quickly they mated with a given male as a proxy for what song characteristics they prefer. Females prefer males that have a higher 'duty cycle.' Such males produce more sound per unit time, in other words, their pulses are longer (chirps when wings close) and the intervals between each chirp are shorter. But does this really show that females choose males based on their courtship song?

One question always invokes another. In cricket courtship behavior, a host of cues, including tactile and chemical cues, might play a role in female decisions. Therefore, to establish whether courtship song itself is responsible for a female's decision to mate, and not some separate, but correlated factor, I had to disentangle males from their songs. Performing a simple surgical operation, I clipped the file from each male's wing to mute him. Then, I constructed an artificial courtship song that matched the mean parameters of the "preferred" and "non-preferred" group. Using playbacks, I reversed the males' courtship songs: preferred males were accompanied by the "non-preferred" song and non-preferred males were accompanied by the "preferred" song. In these subsequent trials, anytime a male tried to produce courtship song, a speaker above the arena broadcast the 'opposite' courtship song. When I broadcast a preferred song model during courtship by previously non-preferred males, females showed greater attraction, and vice versa. Comparing female responses between these two trials (male with its own courtship song versus male with opposite courtship song) showed that courtship song mediating female preference, irrespective of any other characteristics of the males, like their odor or behavior.

While I have achieved some understanding of the importance of courtship song on female mate preference, many questions still remain. I'm currently investigating whether this female preference leads to increased male reproductive success and whether a female's experience (quality of her previous mate) influences her subsequent preference. In the end, I have found that the simple, peaceful chirping of crickets at night really isn't that simple at all. In an attempt to attract and retain mates, males and females engage in a complex behavioral sequence seen by few, but certainly appreciated by many. I am extremely thankful for having received funding from the Orthopterists' Society to pursue this research and am proud to contribute to the growing field of Orthoptera research.

Darren Rebar
University of Wisconsin, Milwaukee

Searching for phylogenetic information in New Jersey

Jumping through cranberry bogs, sleeping in yurts, listening for new species, this was my trip to New Jersey funded by a grant from the Orthopterists' Society (Fig. 1). The intention of this grant money was to fund the collection and calculation of a molecular clock for the cone-headed katydid, *Neoconocephalus*, genus-wide phylogeny. After carrying out my initial work creating a phylogeny, I sought to collect populations of the species *Neoconocephalus lyristes*; a bog katydid, originally identified in 1915 with known populations along the East Coast (southeastern New Jersey) and in the Midwest (Great Lakes area). This species now has two disjointed populations that were once continuous through the Mohawk-Hudson outlet. The M-H outlet corridor closed as a result of succession and the populations are now separated.

Fig. 1. *Yurt I stayed in while collecting in New Jersey*

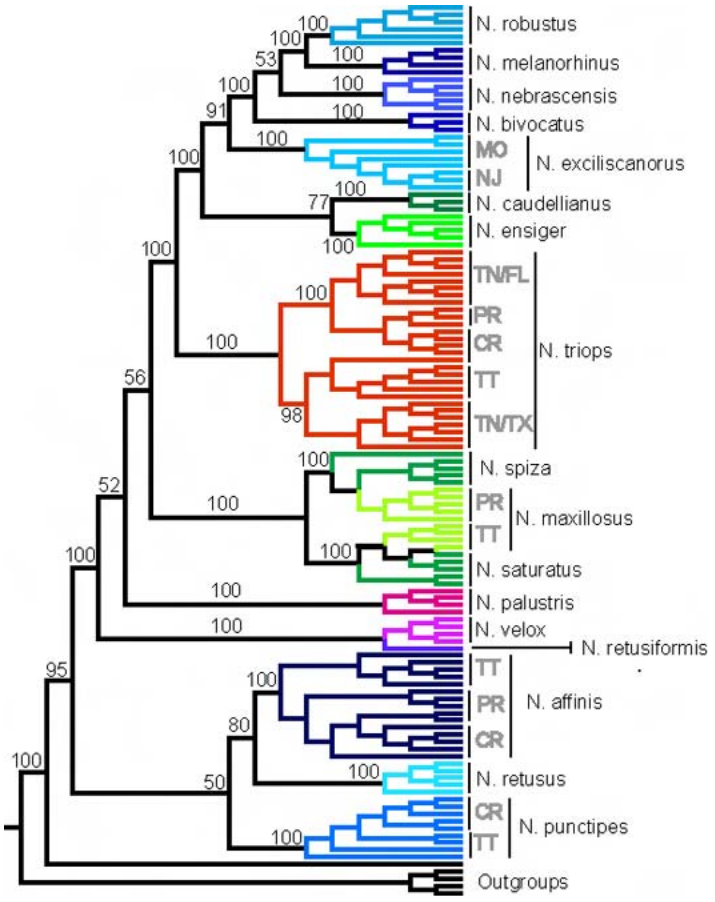


Fig. 2. *Neoconocephalus phylogeny, built from AFLP data using Bayesian analysis. Posterior probabilities reported as percentages at nodes. Colored branches indicate species. For more information see Snyder et al. (2009).*

With a general idea of the type of habitat that these katydids prefer we set out for the cranberry bogs of southeastern New Jersey and met Dr. Jamie Cromartie who showed us around numerous field sites. We found New Jersey to be one of the most diverse locations in the US for *Neoconocephalus* species. Although, we did not find any *N. lyristes* we did collect many other species: *N. robustus*, *N. velox*, *N. retusus*, *N. exciliscanorus*, *N. palustris* and *N. caudellianus*. Some of these species are rare in the Midwest and therefore contributed to the *Neoconocephalus* phylogeny.

The AFLP (amplified fragment length polymorphism) phylogenetic analysis, which was underway at the time of this trip, was made more robust due to the addition of New Jersey specimens (Fig. 2). Because AFLP's are genome-wide, non-specific markers it is best to have many individuals from multiple populations of each species represented in the taxa set, for more accurate relationship estimations. With the added information from New Jersey, we found an interesting pattern of incongruence between the AFLP tree and the COI (cytochrome oxidase I) mitochondrial gene tree. The COI data showed that the *N. exciliscanorus* populations had distinct mt haplotypes that were not closest relatives (Fig. 3). For example, *N. exciliscanorus* from Missouri are more closely related to *N. robustus* and *N. bivocatus* (native Missouri species), than they are to *N. exciliscanorus* from New Jersey. This difference in *N. exciliscanorus* haplotypes is not the only example of incongruence between mtDNA and nDNA throughout the phylogeny, but would not have been detected without the New Jersey collecting trip.

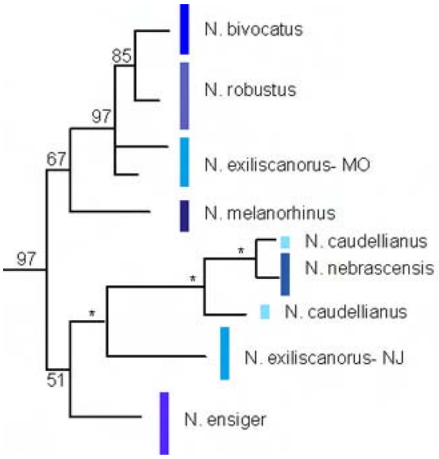


Fig. 3. *Portion of the Neoconocephalus phylogeny, built from partial mtDNA data (CO1) using Bayesian analysis. This portion shows the polyphyletic results from N. exciliscanorus. Posterior probabilities reported as percentages at nodes. Colored branches indicate species. For more information see Snyder et al. (2009.)*

Although my Orthopterists' Society Grant did not support its original intention, the calculation of a molecular clock, it did support the collection of a great deal of data for the *Neoconocephalus* phylogeny. Additionally, I had the opportunity to meet Dr. Otte at the Natural Academy of Sciences Museum and tour the Orthoptera collection. While at the museum we studied the collected sites and dates of the *N. lyristes* specimens and now have a better understanding of their habitat for future collecting trips.

Katy Frederick-Hudson
University of Missouri

Reference

Snyder RL, Frederick-Hudson KH, Schul J (2009) Molecular Phylogenetics of the Genus *Neoconocephalus* (Orthoptera, Tettigoniidae) and the Evolution of Temperate Life Histories. PLoS ONE 4(9): e7203. doi:10.1371/journal.pone.0007203

18th Annual Call for Applications for the Orthopterists' Society Grants

Fellow Orthopterists,

We herewith announce the 18th annual call for applications for $300-$1,000 Orthopterists' Society grants primarily in support of graduate students and young professionals for significant basic research in Orthoptera (*s. l.*) and innovative presentation of findings. The Research Committee generally favors applicants without other funds, and encourages orthopterists from Asia, Latin America, and Africa to apply.

This research grants program is funded entirely by membership contributions, and is matched by an anonymous donor. I urge you to contribute in any amount with your dues and subscriptions.

This year grants will be awarded in late July, and December, with due dates for applications on **15 June** and **15 September**. Proposals should be submitted to the Chair at the address below (Fax and E-mail applications [plain text or RTF only] are preferred). The proposals should be in the following format and restricted to the indicated number of pages: **DESCRIPTION** (one page): 1) TITLE, 2) SIGNIFICANCE, stressing the new aspects of the proposal, expected contribution to theory, relation to previous work, etc. (applicants should emphasize the nature and significance of their proposal to provide the judges with the basis for weighing different projects especially in fields outside their expertise), 3) RESEARCH PLAN, including the particular orthopterans to be studied, methods, logistics, an approximate timetable (to give the judges some idea of feasibility), etc., and, 4) INNOVATIONS IN PRESENTATION (if applicable), such as special tabulation, distinctive illustrations and diagrams, material on computer discs, CD-ROMs, etc. **CURRICULUM VITAE** (half page) including present position or years in graduate school, education, number of papers published or completed, citation of selected publications pertinent to the proposal to aid the judges; vital statistics are NOT desired. **BUDGET** (half page) including justification of items where appropriate (i. e. why special equipment is necessary unless self-obvious), other funding for the project, etc. Overhead CANNOT be provided on Society grants.

The Committee prefers proposals with clearly stated hypotheses and predictions, and evidence to be gathered to test the hypotheses and predictions. Taxonomic projects should also involve clear questions, hypotheses, and predicted evidence, and applicants for these projects must demonstrate some understanding of taxonomic theory

and methodology, especially of the newer molecular techniques, and of cladistics, maximum likelihood, etc. Similarly, applicants for survey projects must clearly identify the biological problems to be solved. Projects which merely involve "finding out what is there" (important as that may be) will not be funded.

Proposals from graduate students must include a simple recommendation of their major professor or advisor.Those not affiliated with an educational or research institution should indicate where the work is to be done. A report will be required from the successful applicants.

Last year, 15 proposals were submitted by applicants from eight countries. The Committee, comprising Karim Vahed (UK), Theodore Cohn (USA), and David Hunter (Australia), funded 12 proposals. Advice on some projects was offered by committee members and consultants in keeping with the Society goal to encourage exchange of ideas and information.

Our Research Fund investments are still sufficient to fund only a few grants. I therefore appeal to the generosity of our members to contribute to the Fund so that we can continue awarding grants at high levels and need not disappoint applicants with worthy proposals.

As a token of our appreciation, contributors to the Research Fund will receive a set of Carbonell notepaper with envelopes for contributions of $20-39, the 1993 JOR colored plate for $40-99, and a Carbonell original for $100. (Please remind me if I have been remiss in sending these to past donors.)

Through contributions and matching funds from an anonymous contributor, we hope to support this year's applicants and have some left over to build up this fund as an endowment to support future research projects.

Please submit grant proposal to:
Theodore J. Cohn
Chair, Research Committee
Insect Division, Museum of Zoology, 1109 Geddes Ave., University of Michigan, Ann Arbor, MI 48109-1079, USA, Fax: (734) 763-0480, E-mail: tcohn@sunstroke.sdsu.edu. [plain text or RTF only]

The following grants were made in amounts from US$ 400 to $1,000:

Bazelet, Corinna S. (South Africa). Revision of the Cape Floristic Region species of *Euryphymus* using molecular and morphological methods (Acrididae).
Frederick-Hudson, Katy H. (USA). Consequences of gene flow on communication in *Neoconcephalus* (Tettigoniiedae)
Gershman, Susan N. (USA). Differential rejection of spermatophylaxes based on amino composition (Gryllidae)
Grant, Paul G. (Canada). Influence of bat-eared fox predation on call structure and behavior in South African Tettigoniidae.
Gu, Jun-Jie (China). Revision and phylogenetic affinities of the Prophangopsideae (Tetigoniidate).
Husemann, Martin (Germany) & **Ding, Baoquing** (China). Phylogeography of the Chinese species of *Sphingonotus* (Acrididae): unraveling the origin of the genus.
Ladowski, Alexander (USA). Opportunity for deception in the aggressive call of the house cricket
Lenhart, Paul (USA). Quantifying the nutritional landscape and its effect on herbivore community structure.
Mitra, Chandreyee (USA). Examining the costs of wing polymorphism in *Gryllus lineaticeps* (Gryllidae)
Spearman, Lauren A. (USA). Exploration of the radiation of *Loryma* grasshoppers in South Africa (Acrididae)
Symes, L. B. (USA). The effect of anthropogenic noise on acoustic communication in Orthoptera.
Taek, Paulus (Indonesia). Bio-ecological studies of the migratory locust in Timur Province, Indonesia (Acrididae).

In Memoriam

Dr. Colin Hartley (1932 – 2010)

Colin Hartley, who passed away in January 2010, was a dedicated entomologist and orthopterist who possessed an extensive knowledge of the biology of European bushcrickets (tettigoniids). His research focussed on the biology of the egg stage and the acoustic behaviour of tettigoniids. Quiet, knowledgeable and with a passion for nature, Colin was fascinated by insects all his life. He was a true English gentleman: well dressed, well mannered and well spoken. He loved being out in the countryside and shared this enthusiasm with all his family, come rain or shine.

Born in 1932, Colin was still a young boy when he first showed an interest in wildlife. His sister Jennifer recalls Colin rearing caterpillars on flowers in vases on their dining room table. Their father, Spencer, worked as a research chemist at Porton Down during the war and Colin went to school in Salisbury. In 1947, the family moved from Wiltshire to Cambridge, where Jennifer went to the convent school and made friends with a girl called Daphne. Little did she know she had just found her brother his future wife!

In 1951 Colin was called up for National Service and spent two years in the Navy, working in the Intelligence Division. He went to Bristol University in 1953 and gained a B.Sc. (Hons.) in Biological Sciences, then stayed on to do his Ph.D. on the morphology, biology and taxonomy of syrphid larvae, from which he produced several publications. The year before they were married, Colin and Daphne spent their time foraging in rot holes, cow pats and cow drains for these un-charismatic creatures. Daphne, whilst studying in London, was doing a special project on leeches. Showing his loving support, Colin used to find leeches for her, wrap them in damp cotton wool and send them live to her through the post.

Colin and Daphne married in 1957 and lived in Bristol where their first daughter, Carol was born. In 1960 Colin was awarded his Ph.D. at Bristol University and

was offered a two year post-doctoral research fellowship there. They moved to Nottingham in 1962 where their second daughter, Gillian was born. Colin took up a post to lecture on Ecology and Entomology at the University of Nottingham, where he began his research on the biology of tettigoniids, beginning with a study of the structure of the eggs of British bushcrickets (Hartley 1964). Together with his first PhD student, A. C. Warne, Colin then embarked upon a programme of research on embryonic development and diapause in a very wide range of bushcrickets. Aspects of these studies were published in an impressive monograph on the "Biology of the egg stage of Western European Tettigoniidae" (Hartley & Warne 1972). Colin continued with this research throughout his career, publishing numerous papers on egg diapause in different species, such as *Ephippiger cruciger* (with Ph.D. student R.L. Dean), *Leptophyes punctatissima* (with Ph.D. student K. Deura) and *Ruspolia* (in collaboration with Y. Ando, Hirosaki University, Japan) and a further monograph on the topic in the form of a book chapter entitled "Egg Biology of the Tettigoniidae" (Hartley 1990).

Colin's other main research interest was the acoustic behaviour of tettigoniids. In collaboration with his Ph.D. student D. J. Robinson, he studied female response song in ephippigerines (e.g. Hartley, Robinson & Warne 1974) and in *Leptophyes punctatissima* (Hartley & Robinson 1976; Robinson, Rheinlaender & Hartley 1986) and published several papers on other aspects of sound production and perception in bushcrickets in collaboration with R. O. Stephen (University of Leicester) and others, including K. Kalmring (Philipps University, Germany) (e.g. Hartley & Stephen 1989, 1992; Stephen & Hartley 1991, 1995a, 1995b; Hartley et al. 2000). Other aspects of tettigoniid biology studied by Colin included colour polymorphism (Robinson & Hartley 1978; Hartley & Bugren 1986), the taxonomy of the *Ephippiger ephippiger* complex (Hartley & Warne 1985) and macropterism in *Conocephalus* (Ando & Hartley 1982).

Every summer from 1967 to the mid- 1990s, Colin travelled extensively around Europe in his trusty V-W camping van to collect bushcrickets for his studies, normally with the family in tow. Colin's family became expert bushcricket catchers. Eventually the camping van would become packed to the roof with boxes of singing bushcrickets. If the girls had problems getting to sleep because of the chirping, Colin would ask them to count the seconds between the chirps! I had the privilege of joining two of these epic collecting expeditions during studies for my Ph.D. (for which Colin was a joint supervisor) in the early 1990's. On one trip, we travelled from the southernmost tip of Spain, zig-zagged across the Pyrenees then worked our way up the West coast of France and back on a ferry to England, collecting as we went. I was greatly impressed by Colin's immense knowledge of the Tettigoniidae, including precise collecting locations for virtually every Western European species: having presented Colin with a rather ambitious "shopping list" of species for my comparative studies of bushcricket nuptial gifts, he proceeded to find each and every one for me. Colin passed on much of his knowledge of bushcricket distributions, making, for example, numerous contributions to the Atlas des Orthoptères de France in the 1980's.

Colin in September 2009, on the last of the many camper-van holidays that he and his wife Daphne enjoyed.

Back in the lab at the University of Nottingham, Colin maintained a large glasshouse full of specially designed wooden-framed, mesh covered cages housing numerous bushcricket species in more-or-less continuous culture. This was no mean feat given that European bushcrickets are notoriously difficult to rear. Fortunately, Colin possessed an extensive knowledge of the precise feeding requirements of each species, together with the temperatures and conditions needed for the successful development and diapause of the eggs. Eggs from at least 50 species were housed in a series of incubators which filled an entire corridor.

Colin was a keen and knowledgeable gardener and an excellent photographer. He was also, for many years, an active member of numerous societies, including the International Orthopterists' Society, the Royal Entomological Society, the Verrall Association of Entomologists, the Nottinghamshire Wildlife Trust, Wollaton Natural History Society, the Derbyshire and Nottinghamshire Entomological Society, the Freshwater Biological Association (of which he was a life member), the Institute of Biology (of which he was a fellow), the Nottinghamshire Trust for Nature Conservation and Friends of Nottingham Museums. Colin was involved with international meetings on insect sound and vibration and attended numerous international meetings of the Orthopterists' Society. In addition, Colin regularly attended and, in many cases, chaired the annual national conference and meeting of

Colin tending some of his caged bushcrickets during a collecting expedition in France with Daphne and K. Vahed in 1990.

Orthopterists. Five years ago Colin was diagnosed with cancer, but he was still able to continue most of his interests. Despite ill health and mobility problems resulting from a fractured hip, last November Colin chaired the most recent national Orthopterists' meeting at the Natural History Museum in London, having, in his characteristically stoic manner, travelled across London on the tube system rather than catching a taxi– a journey that involved a considerable amount of walking.

Both of Colin's daughters went on to study science at University – Carol followed her grandfather by taking Chemistry and Gillian became a Microbiologist. Colin's grandchildren Philip, Suzie and Daniel gave Colin great pleasure. Each of the grandchildren is taking forward Colin's love of science and wildlife in their own way. Philip enjoys nature and the outdoor life, Suzie hopes to study Physics with astronomy and Daniel, the youngest, is a budding entomologist. In 2007 Colin and Daphne celebrated their Golden Wedding anniversary while on a family holiday in North Wales- under canvas of course! Looking back on their life together, Daphne says "Colin and I had a long and happy marriage, with two lovely daughters. He leaves behind a united and loving family who will all miss him very much indeed" – a sentiment shared by his colleagues and former Ph.D students.

Acknowledgements

I am grateful to Daphne Hartley for permission to use extracts from Colin Hartley's eulogy and for her help in preparing this obituary and to Judith Marshall, David Robinson and Anthony Warne for their comments.

Karim Vahed
University of Derby

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Introducing two new websites!

In this issue of Metaleptea, I am happy to feature two fantastic websites dedicated to Orthoptera. Both websites are developed and maintained by amateur entomologists who truly appreciate our marvelous creatures. Be sure to check these out. They are really great!

The first website is oecanthinae.com which is by far the most extensive and the most informative website on a gryllid subfamily, Oecanthinae. Oecanthines are commonly known as tree crickets which are widely distributed around the world and well known for their beautiful trilling call. The website is developed, maintained, and updated by Nancy Collins, a registered nurse from Wisconsin. In 2006, Nancy became fascinated by one little tree cricket that took up residence on an accidentally grown sunflower plant from birdseed on her third floor patio! This tree cricket, which was later identified as *Neoxabea bipunctata* with a help from Dr. Thomas J. Walker from the University of Florida, changed Nancy's life forever and now she even plans her vacations around searching for tree crickets. The oecanthinae.com is full of very useful information and tons of great pictures. Want to see what tree cricket eggs look like? How about the stems that female tree crickets bore holes for oviposition? Trying to find information

Bob at Fern Canyon, Humboldt Co., CA. Photo credit: Karen LeMay. (Source: www.naturewideimages.com)

on common tree crickets with photos and their calls? What about a delightful children's book titled, "Trixie the Tree Cricket"? All these information and a whole lot more can be found at the oecanthinae.com. This website is truly a product of passion and dedication and I congratulate Nancy on her achievements.

The second website I would like to feature is "Grasshoppers Galore (nwiassoc.com)" by an accomplished nature photographer, Robert A. Behrstock. Robert is very well known for his works on birds and dragonflies, but he ventured into the world of grasshoppers when he decided to add grasshoppers to the ongoing exploration of his two-acre backyard in 2006. To date, he has documented 48 species of grasshoppers in his southern Arizona property and they are vividly shown in this website. The website is essentially an excerpt from the article "Grasshoppers Galore" which was published 6 October

Two of the colorful grasshoppers found in Robert's backyard. (top) Taenipoda eques (bottom) Poecilotettix pantherinus. (Source: nwiassoc.com)

2008 in the Arizona Daily Star with minor changes and different photos. The 48 species of grasshoppers belong to Romaleidae, Acrididae, and Tetrigidae and each photo is accompanied by a brief description and sighting information. The quality of these photos is amazing and this website has challenged me to learn more about my own backyard. Biodiversity is nearby – so many interesting creatures are living very close to our homes and we just need to take a moment to notice and appreciate them.

Hojun Song
Editor

Left: Home page of the oecanthinae.com, Right: The tree cricket (Neoxabea bipunctata) that motivated the development of the website.

Book Review:

"Locust Phase Polyphenism: An Update" by Meir Paul Pener and Stephen J. Simpson

Pener, M.P. and Simpson, S. J. 2009. Locust Phase Polyphenism: An Update. Advances in Insect Physiology 36: 1-286.

Since its original formulation by Sir Boris Uvarov in 1921, locust phase theory has evolved tremendously and our current understanding of locust phase change is considerably different from its conception. Although it has been nearly 90 years since Uvarov discovered that locusts could exhibit two extreme life forms – known as the solitarious phase and the gregarious phase – depending on local population density, we still do not fully understand the entire mechanism of phase transformation. However, with innovative approaches to dissect and understand the complexity of locust phase polyphenism, there comes a point where a review of what we have discovered so far is desperately needed. Uvarov's first major book published in 1928 entitled, "Locusts and Grasshoppers" was such a review. About forty years later, Uvarov (1966, 1977) published an updated treatise on the subject, entitled "Grasshoppers and Locusts," in which he reviewed all known aspects of locust biology up to 1964. The first volume (1966) was devoted mostly to physiology of grasshoppers, and the second volume (1977), which was published posthumously, was devoted mostly to biology and ecology of locusts. Phase expression, although most well-known in locusts, had been reported in numerous non-locust grasshopper species. The concept of phase was thus broadened to explain the general phenomenon of polyphenism and this was reflected in the change in the title of the book, whose 1928 edition had "locusts" before "grasshoppers." Although there have been a number of reviews dedicated to specific aspects of locust phase polyphenism, none of it comes close to the comprehensive scope of Uvarov's work.

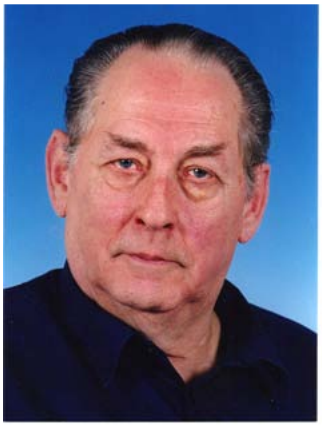
That is until now. A new review by Pener and Simpson published as the volume 36 of the Advances in Insect Physiology series summarizes many recent advances made in the field of locust phase polyphenism in a thorough and comprehensive manner. This review continues from where the earlier reviews by Pener (1991) and Pener and Yerushalmi (1998) left off and is mostly devoted to recent findings within the past 10 years, but it integrates numerous older findings as well in every aspect of the field. Before talking about some of the details of the review, it is important to mention some things about the authors themselves. Meir Paul Pener is the world's leading authority on the endocrine aspects of locust phase polyphenism and is an author of several previous reviews on this subject. He has an incredible depth and breath of knowledge not only on this subject but also on just about every subject related to Orthoptera, which he has accumulated over more than 50 years. Stephen J. Simpson revitalized the study of locust phase polyphenism by devising an innovative behavioral assay technique and using it to unravel the mechanisms that induce swarming in locusts. Most of what we know about the behavior, ecology, and physiology of locusts within the last 10 years comes from Simpson's research group. Thus, this comprehensive review by two of the world's leading experts on locust phase polyphenism is truly an authoritative piece of work.

The review covers virtually all aspects of locust phase polyphenism that are affected by the change in local population density: morphology, color, reproductive biology, endocrine responses, biochemistry, gene expression, behavior, chemical ecology, developmental biology and ecological interactions. Under each subject, Pener and Simpson provide a succinct and general background followed by specific details of each study and also cite other relevant reviews on the subject matter. In other words, readers can

jump to any section of interest and get a clear understanding of the subject without referring to other parts of the review, although reading the whole review is of course highly recommended. Because most of the recent knowledge of locust phase polyphenism comes from studying two species of model organism, *Schistocerca gregaria* and *Locusta migratoria*, the review deals with the phase characteristics of these two species in great detail. However, the authors do not forget to talk about other locust and grasshopper species whenever appropriate and relevant.

The review starts off by describing the locust menace that is still affecting many parts of the world. Every continent except Antarctica is potentially under the threat of locust plagues and efforts are continuously underway to better understand swarm dynamics and devise more effective management schemes. The authors then describe the general phenomenon of polyphenism in insects and gradually focus on density-dependent phase polyphenism in locusts.

Among the most visible aspects of locust phase polyphenism is the change in morphometric ratios of



Meir Paul Pener (left) and Stephen J. Simpson (right)

different body parts and the change in nymphal coloration in response to change in population density. The role of 'dark-color-inducing neurohormone (DCIN)', also known as '[His^7]-corazonin' in phase transformation has been a main subject in many recent studies, of which the authors provide a thorough and fair treatment in the review.

Reproduction biology is another aspect of locust phase change in which the gregarious phase exhibits considerably different life history strategies than solitarious phase. Local population density has an effect on the rate of sexual maturation, mating strategies, oviposition, fecundity and fertility. Pener and Simpson discuss numerous recent findings based on the study of *S. gregaria* and *L. migratoria*, but also include elegant reviews on life history traits of other locust species including *Nomadacris septemfasciata*, *Austracris guttulosa*, *Locustana pardalina*, *Chortoicetes terminifera*, *Dociostaurus maroccanus*, *Calliptamus italicus*, *Schistocerca cancellata*, and *Schistocerca piceifrons*.

A large part of the review is dedicated to the endocrine aspect of locust phase polyphenism, especially the role of juvenile hormone, ecdysteroids, and many different kinds of neuropeptides. This in-depth coverage is understandable given the Pener's expertise and represents one of the most thorough reviews of the subject to date. However, the authors end this section by commenting, "although the subject attained interest and considerable advancement has been made in the last decade or two, relevant research is still in its infancy." (p.150) and this demonstrates how much more work is needed to clarify this important area of research.

Understanding the molecular basis of locust phase polyphenism is the "final frontier" in locust research as the authors describe it. There are many phase-specific genes, peptides, proteins, and other biomolecules. Currently, we have limited understanding of what these molecules do during the phase transformation, but as the technology develops enabling increasingly detailed analyses, it will soon become possible to pinpoint specific genes and gene interactions at exact stages of gregarization. This review documents the beginning of this exciting area of research.

The quantitative behavioral assay based on the logistic regression model pioneered by Simpson's research group revolutionized the way we study locust phase polyphenism, especially the first stage of phase transformation, namely behavioral gregarization. Based on this powerful technique, we now have a good understanding of what the phase-related behavioral differences are between solitarious and gregarious phases at various instar stages, the time-course change in behavior in response to change in population density from solitarious to gregarious and back to solitarious phase, and neural differences between phases at least in *S. gregaria*. The technique has been applied to other locust species including a congeneric *S. americana*, two other locust species in Oedipodinae, *L. migratoria* and *C. terminifera*, and it will certainly prove to be valuable in studying phase polyphenism in other locust species.

Chemical ecology of locust phase polyphenism has been studied since 1960s, but it is only in the last 10–15 years that modern analytical techniques have been applied to tease apart the role of individual pheromones produced during phase transformation. There are instar-specific pheromones, sex-specific pheromones, maturation acceleration/retardation pheromones, oviposition aggregating pheromones, volatiles associated with gut bacteria and feces, and aggregation pheromones and contact pheromones. Tremendous advances have been made in our understanding of the chemical structures, production sites, and primary and secondary functions of these pheromones, and these are comprehensively covered in the review. The role of phenylacetonitrile (PAN) has been highly controversial because one research group has consistently shown that PAN functions as an aggregation pheromone, while another research group has clearly demonstrated it actually repels adult males suggesting that PAN may work as a courtship-inhibiting pheromone. Pener and Simpson's review provides a fair assessment of the results produced by each research group and concludes that PAN may have a dual role depending on its concentration citing a recent study. Nevertheless, additional controversies regarding the other roles of PAN have not been resolved and the authors adequately leave these as open questions for future research.

There are many phase-specific traits, but what factors and stimuli are actually inducing gregarious phase characteristics? Recent studies have clearly demonstrated that the main cue is the tactile stimulus, sensed by mechanoreceptors located on the outer face of hind femur and proprioceptors associated with the basal leg joints. Tactile stimulation or a combination of visual and olfactory simulation leads to a rise in the serotonin in the thoracic ganglia and now we begin to gain understanding of phase transition at a very fine level.

The authors also summarize fascinating aspects of epigenetic transmission of phase state across generations. The maternal gregarizing agent in *S. gregaria*, which is found in egg foam of gregarious females, has been the main subject of many recent investigations. This compound, which is yet to be chemically determined, is responsible for inducing gregarization of the offspring in terms of behavior and color. The nature of this compound and exact action is still being worked out.

The review ends with a discus-

sion of the ecological aspects of swarm formation. Recently, the importance of resource distribution, nutrient content of available host plants, avoidance of natural enemies, and the role of cannibalism have been examined and studied. In many respects, these studies provide the critical link between hypotheses generated in the laboratory and their subsequent testing and validation on wild locusts in the field.

Over the last 10–15 years, there have been incredible advances of knowledge in the study of locust phase polyphenism. We have begun to understand this amazing phenomenon at different scales of biology, from genes to individuals, individuals to populations, and populations to species. Armed with new technologies and innovative approaches, locust researchers stand to reveal even more about the mechanism of phase transformation in the near future. Importantly, most of what we have gained has primarily come from studying two model organisms. However, there are many other locust species that have not been so thoroughly studied and precisely what surprises they have in store remains to be seen. That is what makes this field so exciting and also makes us humble. Sir Boris Uvarov would have loved to witness all these advances and would certainly have praised Pener and Simpson for this marvelous piece of scholarship.

Acknowledgments

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Editor

Officers of the Orthopterists' Society

Orthoptera Photograph of this Issue

*This handsome grasshopper is **Dericorys albidula** which belongs to an Old World family Dericorythidae. The genus Dericorys is characterized by the high crested prozona and flat metazona of the pronutum, and the curved hind tibiae and mainly distributed in the Middle East. D. albidula is often found in sandy deserts with a cover of shrub, but always near the saltbushes Haloxylon spp. and Salsola richteri on which it feeds. This photograph was taken at the Bukhara region of Uzbekistan in June 2007 by **Alex Latchininsky**. The biological information was taken from the Locust and Grasshopper Agricultural Manual (COPR, 1982).*

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