International Tenebrionoidea Virtual Symposium VI

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Psorodes tuberculata (Fabricius, 1792)

taxonomy phylogenetics biogeography ecology evolution

Book of Abstracts

INTERNATIONAL TENEBRIONOIDEA VIRTUAL SYMPOSIUM VI

Book of Abstracts

Steering committee:

Aaron Smith – *Purdue University, Indiana, USA. pimeliinae@gmail.com*

Marcin Kamiński – *Museum and Institute of Zoology Warszawa, Poland. kaminskientomo@gmail.com*

Patrice Bouchard – *Agriculture and Agri-Food Canada, Canada. patrice.bouchard@canada.ca*

Kojun Kanda – *U.S. Department of Agriculture, Washington D.C., USA kojun.kanda@usda.gov*

Andrew Johnston – *Biodiversity Knowledge Integration Center, Arizona, USA. ajohnston@asu.edu*

Paloma Mas-Peinado – *Museo Nacional de Ciencias Naturales, Madrid, Spain. maspeina@gmail.com*

External advisor:

Nicole Gunter – *Cleveland Museum of Natural History, USA. nicolelgunter@gmail.com*

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Tenebrionidae, examples for different faunal histories

Wolfgang Schawaller[1]

[1] *Staatliches Museum für Naturkunde, Rosenstein 1, 70191 Stuttgart, Germany. schawaller.ehrenamt@smns-bw.de*

Wolfgang Schawaller is Professor Emeritus at the Staatliches Museum für Naturkunde in Stuttgart (Germany). He is author of over 150 scientific publications on darkling beetles and one of the most recognized specialists on the group. During this invited talk he will summarize his taxonomic expertise on selected lineages of Tenebrionidae, and illuminate their implications for biogeography

Review of genus-group names in the family Tenebrionidae

Patrice Bouchard[1], Yves Bousquet[2], Rolf L. Aalbu[3], Miguel A. Alonso-Zarazaga[4], Ottó Merkl[5] †, Anthony E. Davies[1]

[1] *Canadian National Collection of Insects, Arachnids and Nematodes, Agriculture and Agri-Food Canada, 960 Carling Avenue, Ottawa, Ontario, K1A 0C6, Canada. patrice.bouchard@canada.ca*
[2] *Gatineau, Quebec, Canada*
[3] *California Academy of Sciences, Department of Entomology, 55 Music Concourse Drive, Golden Gate Park, San Francisco, California, 94118, USA*
[4] *Departamento de Biodiversidad y Biología Evolutiva, Museo Nacional de Ciencias Naturales (CSIC), José Gutiérrez Abascal, 2, E-28006, Madrid, Spain*
[5] *Hungarian Natural History Museum, Department of Zoology, H-1088 Baross u. 13, Budapest, Hungary*
† *Deceased*

We present a review of genus-group names for darkling beetles in the family Tenebrionidae (Insecta: Coleoptera). A catalogue of nomenclaturally available genus-group names is given. Genus-group names in this family are also recorded in a classification framework, along with data on the distribution of valid genera and subgenera within major biogeographical realms.

Let's Tok about Tok-Tok beetles: Phylogenomic analyses reveal taxonomic problems within Sepidiini (Tenebrionidae: Pimeliinae)

Olivia M. Gearner[1], Marcin J. Kamiński[2], Kojun Kanda[3], Kali Swichtenburg[1], Aaron D. Smith[1]

[1] *Department of Entomology, Purdue University, 901 W. State Street, West Lafayette, IN 47907, USA*

[2] *Zoological Museum, Museum and Institute of Zoology, Polish Academy of Sciences, Wilcza 64, 00-679 Warszawa, Poland*

[3] *USDA Systematic Entomology Laboratory, c/o Smithsonian Institution, National Museum of Natural History, 10th and Constitution NW, MRC-168, Rm. CE521, Washington, DC 20013-7012, USA*

Sepidiini Eschscholtz, 1829, is a species-rich (>1,000 sp./spp.) and morphologically diverse tribe of desert-inhabiting darkling beetles (Tenebrionidae: Pimeliinae) distributed throughout Africa and the southern Western Palearctic. This tribe contains many large and charismatic species, including the largest known tenebrionid species, *Stridulomus sulcicollis* (Péringuey, 1885)--measuring ~80.0 mm! Additionally, many sepidiines are known for their substrate tapping behavior, a form of sexual communication which gives them the nickname Tok-Tokkie beetles. Despite the cultural significance and attention this group receives, the tribe is in need of revision at all taxonomic levels. In order to test current subtribal and generic limits within the group, we reconstructed a phylogeny for the tribe based on targeted enrichment sequence data for 554 genetic loci from 75 taxa. The resulting phylogeny is being used to identify relationships between morphologically distinct lineages and propose new subtribal and generic limits within the tribe.

The colonization of the Puna and Atacama Biogeographic Province by sister clades of *Psectrascelis* (Coleoptera: Tenebrionidae): Synchronous expansion without spatial overlap

Alvaro Zúñiga-Reinoso[1], Benedikt Ritter[2], Reinhard Predel[1]

[1] *Institute for Zoology, University of Cologne, Zülpicher Str. 47b, 50674 Cologne, Germany. azunigar@uni-koeln.de*
[2] *Institute of Geology and Mineralogy, University of Cologne, Zülpicher Str. 49b, 50674 Cologne, Germany*

We investigated the colonization history of the species-rich genus *Psectrascelis* (Insecta: Coleoptera) in the Central Andes and the Chilean Atacama Desert as an example for insect evolution in such a geologically and climatically highly dynamic arid region. A phylogenetic tree was run for multiple individuals from 36 populations of the region representing 14 taxa. Additionally, divergence times, ancestral ranges and biogeographic were estimated. The first split within the genus began at the time of global cooling at ~3.5 Ma, when the Andes had already reached their current altitude. Further differentiations of *Psectrascelis* lineages were mostly caused by common and more global drivers resulting in major clusters of diversifications at ~2.6-2.2 Ma, ~1.3-0.7 Ma and several subsequent events during the mid to late Quaternary. Today, the two main clades of *Psectrascelis* almost meet each other after presumably synchronous range expansions along the Western Cordillera.

The genera of Praociini from Northern Peru (Coleoptera: Tenebrionidae: Pimeliinae): Morphological comparison between *Parapraocis*, *Pilobaloderes* and *Praocidia*

Gustavo E. Flores[1], Alfredo E. Giraldo-Mendoza[2] , Víctor M. Diéguez[3]

[1] *CONICET, Laboratorio de Entomología, Instituto Argentino de Investigaciones de las Zonas Áridas (IADIZA, CCT CONICET Mendoza), Casilla de correo 507, 5500 Mendoza, Argentina. E-mail: gflores@mendoza-conicet.gob.ar*
[2] *Universidad Nacional Agraria La Molina, Museo de Entomología Klaus Raven Büller, Av. La Molina s/n, Lima 12, Lima, Perú. E-mail: alfre2cotobius@yahoo.com*
[3] *Camino Las Pircas 4200, Peñalolén, Santiago, Chile. Email: vmdieguez@disal.cl*

The South American tribe Praociini (Tenebrionidae: Pimeliinae) comprises 150 species/subspecies arranged in 15 genera distributed in arid lands from Western and Southern South America. In this presentation we compare adult morphology of three genera inhabiting Northern Peru: *Pilobaloderes* Kulzer, *Praocidia* Fairmaire, and *Parapraocis* Flores & Giraldo. The main features for each genus on external morphology and male and female genitalia are presented and illustrated, highlighting the synapomorphies for each genus within the tribe.

Pimelia (Pimeliinae: Pimeliini) on the African – European edges

Paloma Mas-Peinado [1,2], David Buckley[1,2,4], José L. Ruiz [3], Mario García-París [1]

[1] *Departamento de Biodiversidad y Biología Evolutiva, Museo Nacional de Ciencias Naturales (MNCN-CSIC), c/ José Gutiérrez Abascal 2, 28006-Madrid, Spain. p.mas@mncn.csic.es*
[2] *Centro de Investigación en Biodiversidad y Cambio Global CIBC-UAM, Facultad de Ciencias, Universidad Autónoma de Madrid, c/Darwin 2, 28049-Madrid, Spain.*
[3] *Instituto de Estudios Ceutíes. Paseo del Revellín, 30. 51001-Ceuta, Spain.*
[4] *Departamento de Biología (Genética), Facultad de Ciencias, Universidad Autónoma de Madrid (UAM), c/Darwin 2, 28049-Madrid, Spain.*

Pimelia Fabricius, 1775 is the most speciose genus and widely distributed of the tribe Pimeliini Latreiile, 1802. It includes 324 species from xeric environments in the western Palaearctic region and northern deserts in the Afrotropical region. A recent new taxonomic arrangement for *Pimelia* including fourteen subgenera, show the morphological conservatism of *Pimelia* with repetitive patterns of variation, a diversification for more than 31.2 Ma and multiple independent colonization patterns between Africa and Europe. Three of the clades present at the African – European edges are *Amblypteraca*, *Amblyptera* and *Magrebemelia*. We determined levels of intra- and interspecific genetic variation (based on three molecular markers), identified evolutionary lineages within subgenera and discussed how this single geographical feature acted as a barrier for *Magrebmelia* since the Middle Miocene but did not prevent a post Messinian colonization for *Amblyptera* and *Amblypteraca*. Finally, we are currently revising the Iberian Peninsula endemic subgenera *Iberomelia* and *Hispanomelia*, analyzing the geographic distribution of their genetic variability.

Flightless beetles on islands: Distribution and life history of darkling beetles of the genus *Branchus* (Coleoptera: Tenebrionidae)

Warren E. Steiner[1]

[1] *Department of Entomology, NHB-187, Smithsonian Institution, Washington, DC 20560. steinerw@si.edu*

Darkling beetles of the genus *Branchus* LeConte are flightless, each of the known species often being restricted to localized ecologic islands, semi-arid areas from Panama to southern Texas, and eastward through the Greater Antilles and southern Florida to the Turks and Caicos Islands. Species are proving to be unique to each island or bank of islands. The majority of known morphospecies in collections are represented by single or very few specimens, and many remain to be described. The known aspects of the life history of these secretive beetles are summarized, with notes on the larval and pupal stages, habitats, and threats to the survival of species.

Phylogeny and genus-level revision of the Amphidorini LeConte, 1862

M. Andrew Johnston[1]

[1] *Biodiversity Knowledge Integration Center, Arizona State University, Tempe, AZ, USA.*
ajohnston@asu.edu

The Desert Stink Beetles of the tribe Amphidorini LeConte, 1862 comprise a diverse lineage of beetles in western North America. In this talk, I will give an overview of previous and ongoing collaborative molecular phylogenetic and phylogenomic investigations within this tribe. The emerging phylogenetic signal from these studies is that there is good support for monophyletic groups of species but the relationships between them are unclear, possibly due to a rapid early radiation event. There are currently six genera and 16 subgenera within the large genus *Eleodes* Eschscholtz, 1829. Building upon the molecular phylogenetic studies, detailed morphological investigations lead to the recognition of 16 genera (two new to science) with nine subgenera remaining within *Eleodes*. Updated concepts for each genus are given with a summary of nearly 125 taxonomic changes within the group.

Evaluating informativeness of female terminalia morphology for reconstructing tok-tok beetle (Tenebrionidae: Sepidiini) phylogenies

Marcin J. Kamiński[1,2], Olivia M. Gearner[2], Marcin Raś[1], Elliot Thomas Hunsinger[2], Amelia L. Smith[2], Paloma Mas-Peinado[3,4], Jennifer C. Girón[2,5], Aleksandra G. Bilska[1], Werner Strümpher[6], Christopher C. Wirth[2], Kojun Kanda[7], Kali Swichtenberg[2], Dariusz Iwan[1], Aaron D. Smith[2]

[1] *Zoological Museum, Museum and Institute of Zoology, Polish Academy of Sciences, Warszawa, Poland*
[2] *Purdue University, Department of Entomology, West Lafayette, USA*
[3] *Departamento de Biodiversidad y Biología Evolutiva, Museo Nacional de Ciencias Naturales (MNCN-CSIC), Madrid, Spain*
[4] *Centro de Investigación en Biodiversidad y Cambio Global CIBC-UAM, Facultad de Ciencias, Universidad Autónoma de Madrid, Spain*
[5] *Natural Science Research Laboratory, Museum of Texas Tech University, Lubbock, USA*
[6] *National Museum of Natural History, Pretoria, Republic of South Africa*
[7] *USDA Systematic Entomology Laboratory, c/o Smithsonian Institution, National Museum of Natural History, Washington, DC, U.S.A.*

Tok-tok beetles (Pimeliinae: Sepidiini) are one of the most iconic lineages within the hyperdiverse family Tenebrionidae. In addition to containing the largest known darkling beetle species, this tribe is widely recognized for displaying a remarkable form of sexual communication known as substrate tapping. Despite this, the phylogenetic relations within the group and its taxonomy remain poorly understood. Present study investigates the usefulness of female terminalia morphology for delimiting Sepidiini and reconstructing phylogenetic relationships within it. Data on the structure of the ovipositors, genital tubes (vagina, spermatheca), and spicula ventrali has been generated for over 200 species representing 28 Pimeliinae tribes distributed worldwide, with Sepidiini being represented by 35 genera (out of 59) and 125 species (out of ~1,000). This dataset was implemented in different types of taxonomic and phylogenetic analyses i.e., comparative analysis at the subfamilial level, morphology-based cladistic analysis, and combined (molecular data and morphological features) phylogenetic investigation. Finally, a preliminary study of the muscular system of a selected Sepidiini species has been carried out with the application of the micro-computed tomography. Five different muscles were recovered and named. This study illuminates the muscular system as a reliable reference point for recognizing homological elements between highly modified ovipositors.

Phylogeography of the giant blister beetle *Berberomeloe insignis* (Coleoptera: Meloidae), a narrow Iberian endemic species facing intensive green-house expansion

Alberto Sánchez-Vialas[1], Arnau Calatayud-Mascarell[1,2], Ernesto Recuero[1], José L. Ruiz[3], Mario García-París[1]

[1] *Museo Nacional de Ciencias Naturales (MNCN-CSIC), calle José Gutiérrez Abascal 2, 28006, Madrid, Spain*

[2] *Universidad Internacional Menéndez Pelayo (UIMP), calle de Isaac Peral 23, 28040, Madrid, Spain*

[3] *Instituto de Estudios Ceutíes, Paseo del Revellín 30, 51001 Ceuta, Spain*

Berberomeloe insignis is a narrowly distributed species of blister beetle endemic to the south-east of the Iberian Peninsula, limited to the coastal and subcoastal regions of the provinces of Murcia, Almería and Granada. It is easily recognizable from other congeneric species by the presence of two conspicuous red blotches over the head temples, which vary in shape among populations, and by their strongly dentate male's antennae, among other traits. This species is threatened and listed as "vulnerable" in the Red Book of Threatened Invertebrates of Spain, as a result of the strong habitat loss documented across its distribution range. Its geographic area encompasses one of the most disturbed regions of the Mediterranean Basin as a consequence of greenhouse and building expansion. Here, by combining phylogeographic (including two mitochondrial [*Cox1* and *16S*] and one nuclear [*ITS2*] gene fragments), ecological and morphological analyses, we aim to determine whether the populations of *B. insignis* are genetically structured in order to recognize and define conservation areas to protect while preserving its genetic heritage and morphological diversity, taking into account the species vulnerability within different climate change scenarios. Our results uncovered a complex phylogeographic structure, including some lineages highly threatened currently, and provide insights into their intraspecific diversity conservation.

Ultrapsammophilic darkling beetles of the tribe Pimeliini (Coleoptera: Tenebrionidae) with dorso-lateral eyes: evolutionary transformations of structures and morphological adaptations

Svetlana N. Chigray[1], Maxim V. Nabozhenko[2,3,4], Ivan A. Chigray[5], Evgeny V. Abakumov[1]

[1] *Saint Petersburg State University, 16th line of Vasilevskiy Island, 29, St Petersburg 199178 Russia.*
[2] *Precaspian Institute of Biological Resources of the Daghestan Federal Research Centre of the Russian Academy of Sciences, M. Gadzhiev str., 45, Makhachkala, Republic of Dagestan 367000 Russia.*
[3] *Dagestan State University, M. Gadzhiev str., 43a, Makhachkala, Republic of Dagestan 367000 Russia.*
[4] *A.N. Severtsov Institute of ecology and evolution of the Russian Academy of sciences, Leninsky Prospect, 33, Moscow 119071 Russia.*
[5] *Zoological Institute of the Russian Academy of Sciences, Universitetskaya Emb. 1, Saint Petersburg 199034 Russia.*

A taxonomic review of tenebrionid platyopoid genera of the subfamily Pimeliinae from Central Asia, Afghanistan, Iran and Pakistan is given. This group of taxa was known before 1994 as the tribe Platyopini, which is now interpreted as a junior synonym of Pimeliini. The group is different from other Pimeliini in having dorso-lateral eyes, located above the level of the genae, and it includes the following ultrapsammophilic genera at least from Central and Southern Asia: *Apatopsis* Semenov, 1891, *Habrochiton* Semenov-Tjan-Shansky, 1907, *Habrobates* Semenov, 1903 [= *Kawiria* Schuster, 1935, **syn. nov.**], *Dietomorpha* Kühnelt, 1957, *Przewalskia* Semenov, 1893, *Mantichorula* Reitter, 1889, *Platyope* Fischer von Waldheim, 1820 [= *Homopsis* Semenov, 1893 **syn. nov.**], *Earophanta* Semenov, 1903. These genera are distributed in almost all large deserts of Palaearctic Asia: Karakum, Kyzylkum, Muyunkum, Taklamakan, Gobi, Registan, Dasht-e-Kawir, Dasht-e-Lut, as well as in other arid and semi-arid sandy landscapes from European Russia to south of Siberia. The group of platyopoid genera is polyphyletic. We propose at least two monophyletic branches: the *Habrobates* genus-group (the first four genera mentioned above), which

represents the subtribe Habrobatina Nabozhenko et S. Chigray, **subtribus nov.** and the *Platyope* genus-group (latter four genera) within the nominotypical subtribe. A new species is described from Pakistan (Balochistan): *Dietomorpha gonsalezi* S. Chigray et Nabozhenko, **sp. nov.** *Platyope granulata* Fischer von Waldheim, 1820 is recorded for Kazakhstan for the first time. The following synonymy is resurrected: *Apatopsis grombczewskii* Semenov, 1890 = *Apatopsis conradti* Semenov, 1890, **syn. resurr.** Two new combinations resulting from the synonymy of genera are given: *Habrobates gabrieli* Schuster, 1935, **comb. nov.** (from *Kawiria*), *Platyope grumi* Semenov, 1893, **comb. nov.** (from *Homopsis*).

To bask, or not to bask, that is the question. A preliminary phylogenomic analysis of Adesmiini (Coleoptera: Tenebrionidae: Pimeliinae)

Kali Swichtenberg[1,2*], Kojun Kanda[3], Olivia Gearner[1], Ryan Lumen[1], Aaron D. Smith[1]

[1] *Purdue University, Department of Entomology, 901 W. State Street, West Lafayette, IN 47906,*
[2] *Arizona State University, School of Life Sciences, 427 E. Tyler Mall, Tempe, AZ 85281*
[3] *USDA Systematic Entomology Laboratory, c/o Smithsonian Institution, National Museum of Natural History, Washington D.C.*

The darkling beetle tribe Adesmiini (Coleoptera: Tenebrionidae) includes over 200 species in 11 genera, primarily occurring in sub-Saharan southern Africa and the Palearctic region. However, generic diversity is much higher in southern Africa (all genera present) versus the Palearctic (only *Adesmia* represented). The tribe contains many conspicuous diurnal species, including the fog-basking beetle *Onymacris unguicularis*; a focal taxon in ecological research for decades. Despite interest in the tribe, the validity of Adesmiini generic concepts has not been extensively tested, with few published phylogenetic studies existing. In this study, the evolutionary history of Adesmiini was reconstructed using targeted enrichment and high-throughput sequencing of over 500 protein-coding genes. Taxonomic and behavioral relationships between the current genera are discussed in light of the resulting phylogeny.

The genus *Entomogonus* Solier, 1848 (Coleoptera: Tenebrionidae): distribution, reasons for habitat fragmentation and the pathway from forest lichenophages to semi-desert phytophages

Maxim V. Nabozhenko[1,2], Bekir Keskin[3], Svetlana V. Nabozhenko[4], Nurşen Alpagut Keskin[3], Anna Papadopoulou[5], Ludmila V. Gagarina[6], Konstantinos Ntatsopoulos[5], Loudmila Jelinscaia Lagou[5]

[1] *Precaspian Institute of Biological Resources of the Daghestan Federal Research Centre of the Russian Academy of Sciences, M. Gadzhiev str., 45, Makhachkala, Republic of Dagestan 367000, Russia*
[2] *Dagestan State University, M. Gadzhiev str., 43a, Makhachkala, Republic of Dagestan 367000, Russia*
[3] *Ege University, Bornova-Izmir 35100, Turkey*
[4] *Federal Research Centre the Southern Scientific Centre of the Russian Academy of Sciences, Chekhov av., 41, Rostov-on-Don 344006, Russia*
[5] *Department of Biological Sciences, University of Cyprus, 1678 Nicosia P.O. Box 20537, Cyprus*
[6] *Komarov Botanical Institute of the Russian Academy of Sciences, Professors Popov str., 2, St Petersburg 197376, Russia*

The genus *Entomogonus* demonstrates a transition from forest humid to arid habitats and it is divided into three ecological groups, roughly corresponding to subgenera: forest mesophylic lichenophages (*Eutelogonus*) mediterranean dry meadows (s. str.) or semi-desert (*Delonurops*) xerophylic phytophages. Lichen-feeding species inhabit coniferous forests (*Pinus brutia*) in Western Anatolia and broadleaf woodlands (*Quercus* spp., *Prunus dulcis*) in Eastern Anatolia, Iraq and Transcaucasia, where they feed on foliose lichens, Parmeliaceae (*Parmelina*) and Physciaceae (*Physcia*, *Phaeophyscia*, *Physconia*). They require specific habitat conditions that include the presence of host lichens on old large sparsely located trees at low and medium elevations (up to 1000 m), large stones near trunks and sources of moisture. Such habitats are very rare in Eastern Mediterranean and therefore populations have very narrow ranges along some rivers or streams. Herbivorous species are distributed in upland xerophytic landscapes, semi-deserts and deserts in the Central Anatolia, Cyprus, Syria, Jordan and Transcaucasia. The change in trophic association allowed this group to occupy vast arid territories, however, anthropogenic activity caused a strong

fragmentation of the ranges of xeromorphic species. Species of the nominotypical subgenus require large stones in combination with large herbaceous plants and small shrubs, sandstone soil and sources of moisture, which remain around ancient fortresses, medieval ruins or in very small areas between agricultural fields, resulting in highly fragmented ranges. Semi-desert species have less specific habitat requirements, so they can be found in highly degraded biotopes, but natural factors, such as moisture (salt lakes, streams or fogs in highlands) and sub-sandy or sandy soil (usually volcanic sand) limit the population ranges. The study was funded by TUBITAK project 119Z102 and the Russian Foundation for Basic Research and RPF (project no. 19-54-25001).

Phylogeny of Pimeliinae: progress and surprises

Aaron D. Smith[1], Marcin J. Kamiński[1,2], Kojun Kanda[3], Olivia Gearner[1], Kali Switchtenberg[1], Christopher Wirth[1], Ryan Lumen[1], Patrice Bouchard[4], Gustavo E. Flores[5], Gael J. Kergoat[6], Fabien L. Condamine[7], Rolf L. Aalbu[8], Trip Lamb[9], Luboš Purchart[10]

[1] *Purdue University, Department of Entomology, West Lafayette, IN, USA*
[2] *Museum and Institute of Zoology, Polish Academy of Sciences, Warsaw, Poland*
[3] *USDA Systematic Entomology Laboratory, c/o Smithsonian Institution, National Museum of Natural History, Washington, DC, USA*
[4] *Canadian National Collection of Insects, Arachnids and Nematodes, Agriculture and Agri-Food Canada, Ottawa, Ontario, Canada*
[5] *Laboratorio de Entomología, Instituto Argentino de Investigaciones de las Zonas Áridas (CCT CONICET Mendoza) Mendoza, Argentina*
6 *French National Research Institute for Agriculture, Food and Environment, Montpellier, France*
[7] *CNRS, Institut des Sciences de l'Evolution (Université de Montpellier), Montpellier, France*
[8] *Department of Entomology, California Academy of Sciences, San Francisco, California USA*
[9] *Eastern Carolina University, Department of Biology, Greenville, NC, USA*
[10] *Mendel University in Brno, Department of Forest Ecology, Brno, Czech Republic*

A phylogeny of the Tenebrionidae subfamily Pimeliinae was reconstructed based on 420 taxa and 629 genetic loci from 33 of the 38 pimeliine tribes. The majority of represented tribes were recovered as monophyletic, with a few interesting exceptions. Pimeliinae as a whole was recovered as non-monophyletic, though further analyses with additional outgroup taxa are needed to confirm this finding. Additional revisionary work at the generic level is clearly needed within several species-rich tribes (ex. Asidini, Adesmiini, Edrotini, Sepidiini).

Diversification of the genus *Wolladrus* Iwan & Kamiński, 2016 (Coleoptera: Tenebrionidae), an endemic taxon of the Madeiran archipelago

Leticia Puerta [1], Paloma Mas-Peinado[1,2], Helena A. Gonçalves[3,4], Augusto Faustino[3], Mario García-París[1]

[1] *Departamento de Biodiversidad y Biología Evolutiva, Museo Nacional de Ciencias Naturales (MNCN-CSIC), c/José Gutiérrez Abascal, 2, 28006, Madrid, Spain.*
[2] *Centro de Investigación en Biodiversidad y Cambio Global CIBC-UAM, Facultad de Ciencias, Universidad Autónoma de Madrid, c/Darwin 2, 28049-Madrid, Spain.*
[3] *Research Centre in Biodiversity and Genetic Resources (CIBIO-InBIO), Universidade do Porto, Campus Agrário de Vairão, Rua Padre Armando Quintas, 4485-661 Vairão, Portugal*
[4] *Museu de História Natural e da Ciência da Universidade do Porto (MHNC-UP) Campo dos Mártires da Pátria, 81, 4050-368 Porto*

The genus *Wolladrus* Iwan & Kamiński, 2016 (Coleoptera: Tenebrionidae: Opatrini) is endemic to the Madeiran archipelago (islands of Porto Santo, Madeira and Desertas). *Wolladrus* presents a conflicting taxonomy and its evolutionary history is still unknown. Based on a mitochondrial marker (*cox1*) and two nuclear markers (*ITS2* and *H3*), we conducted a phylogeographic study to: (i) determine the levels of congruence with regard to morphological patterns as defined by the taxonomic hypotheses (Wollaston, 1854 and Ardoin, 1960); (ii) evaluate patterns of colonization between islands and diversification within the islands. Our results show a complex scenario, with an absence of congruence between the current taxonomy of *Wolladrus* and the phylogeographic hypotheses established by the molecular markers. In addition, *Wolladrus* diversification patterns within the Madeira archipelago seem discordant with its paleogeographic history. *Wolladrus* includes four nuclear lineages, three inhabit the islands of Madeira and the Desertas, and one isolated in the island of Porto Santo. mtDNA results show a far more complex pattern, allowing us to explain the historical patterns of dispersal and colonization across islands.

Testing for the effect that host shifts and phoresy had in the diversification dynamics of blister beetles (Meloidae: Coleoptera)

Estefany Karen López-Estrada[1,2], Isabel Sanmartín[2], Juan Esteban Uribe[1] , Samuel Abalde[1,3], Mario GarcíaParís[1]

[1] *Museo Nacional de Ciencias Naturales (MNCN-CSIC). José Gutiérrez Abascal, 2, 28006 Madrid, España.*
[2] *Real Jardín Botánico (RJB-CSIC). Plaza de Murillo, 2, 28014. Madrid, España.*
[3] *Centro de Estudios Avanzados de Blanes (CEAB-CSIC). Accéss a Cala Sant Francesc, 14, 17300 Blanes, España*

Changes in life history traits are often considered speciation triggers and can have dramatic effects on the evolutionary history of a lineage. Here, we examine the consequences of changes in two homoplastic life history traits, host-type and phoresy, within the hypermetamorphic clade of blister beetles, Meloidae. This clade exhibits a complex life cycle involving multiple metamorphoses and parasitoidism. Most tribes within the clade are bee-parasitoids, phoretic or non-phoretic, while two tribes feed on grasshopper eggs. Species richness differs greatly between bee and grasshopper specialist clades, and between phoretic and non-phoretic genera. We generated a mitogenomic phylogeny for the hypermetamorphic subfamilies Nemognathinae and Meloinae. The dated phylogeny was used to explore the association between diversification rates and changes in host specificity and phoresy, using State-Dependent Speciation and Extinction (SSE) models. Results show that bee-parasitoid lineages that are non-phoretic have significantly higher relative extinction rates and lower diversification rates than grasshopper or phoretic bee-parasitoids, while no significant differences were found between the latter two strategies. This suggests that host shifts and the onset of phoresy contributed independently to the evolutionary success of Nemognathinae and Meloinae, allowing them to escape from the evolutionary constraints imposed by their hypermetamorphic life-cycle.

Problems of the subgeneric structure of the genus *Blaps* Fabricius, 1775 (Coleoptera: Tenebrionidae)

Ivan A. Chigray[1]

[1] *Zoological Institute of the Russian Academy of Sciences, Universitetskaya Emb., 1, Saint Petersburg 199034 Russia. chigray93@bk.ru*

The genus *Blaps* Fabricius, 1775 includes more than 270 species and it is divided on four subgenera: the largest nominotypical one, *Arenoblaps*, *Dineria*, *Prosoblapsia*). The systems of *Blaps* and the subtribe Blaptina are insufficiently substantiated. The current system of the genus *Blaps* and allied taxa is still based on the Seidlitz's classification of the 19th century. We propose to use a wider complex of adult and larval structures in the framework of an integrative approach to improving the system of this genus: structure of legs (interclaval ventral lamella, pubescence of tarsomeres, structure of male metafemora), male and female genitalia (aedeagus, inner sternite VIII, spiculum gastrale, ovipositor, spiculum ventrale), female genital tubes, structures of mouthparts, abdominal segments and chaetotaxy of larvae. After the analysis of the mentioned structures the following changes are proposed: (1) the species-group *Lithoblaps* (1st Seidlitz's division) must be resurrected from a synonymy of *Blaps* and can be returned to the genus level after Skopin's (1960) opinion and support of molecular analysis (Kergoat et al., 2014; Soldati et al., 2017); (2) the genus *Ablapsis* must be included in Blaps as the subgenus; (3) the subgenus*Prosoblapsia* must be synonymized with the subgenus *Ablapsis*. The research was funded by Russian Foundation for Basic Research (grant 19-54-25001-Кипр_а).

Reconstitution of some Lagriine tribes and genera (Coleoptera: Tenebrionidae)

Rolf L. Aalbu[1], **Kojun Kanda**[2], M. Andrew Johnston[3], Ottó Merkl[4†], Michael A. Ivie[5]

[1] *California Academy of Sciences, Department of Entomology, 55 Music Concourse Drive, Golden Gate Park, San Francisco, California, 94118, USA. rla@akisconsulting.com*
[2] *USDA Systematic Entomology Laboratory, c/o Smithsonian Institution, National Museum of Natural History, 10th and Constitution NW, MRC-168, Rm. CE521, Washington, DC 20013-7012, USA. kojun.kanda@usda.gov*
[3] *Biodiversity Knowledge Integration Center, Arizona State University, Tempe, AZ, USA. ajohnston@asu.edu*
[4] *Hungarian Natural History Museum, Department of Zoology, H-1088 Baross u. 13, Budapest, Hungary*
[5] *Montana Entomology Collection, Marsh Labs, Room 50. Montana State University. Bozeman, MT 59717, USA. mivie@montana.edu*
† *Deceased*

Recent molecular phylogenies of Lagriinae demonstrated that a number of tribes in the subfamily are not monophyletic. Based on these molecular studies and a thorough examination of morphological characters, the tribes Lupropini and Goniaderini are redefined. A new tribe, the Prateini is established containing genera that were previously classified in both tribes. Phobeliina Ardoin, 1961, which is currently a synonym of Goniaderini, is transferred to the Lagriini, and is considered valid. In the course of examining material for this study, the need for new generic synonymies as well as reversals of previous synonymies was also revealed.

Richness and distribution of three genera of Praociini from northern Peru: *Parapraocis*, *Pilobaloderes*, and *Praocidia* (Coleoptera: Tenebrionidae: Pimeliinae)

Alfredo E. Giraldo-Mendoza[1], Gustavo E. Flores[2] , Víctor M. Diéguez[3]

[1] *Universidad Nacional Agraria La Molina, Museo de Entomología Klaus Raven Büller, Av. La Molina s/n, Lima 12, Lima, Perú. E-mail: alfre2cotobius@yahoo.com*
[2] *CONICET, Laboratorio de Entomología, Instituto Argentino de Investigaciones de las Zonas Áridas (IADIZA, CCT CONICET Mendoza), Casilla de correo 507, 5500 Mendoza, Argentina. E-mail: gflores@mendoza-conicet.gob.ar*
[3] *Camino Las Pircas 4200, Peñalolén, Santiago, Chile. Email: vmdieguez@disal.cl*

The South American tribe Praociini (Tenebrionidae: Pimeliinae) comprises 15 genera and 150 species/subspecies distributed from Northern Peru to Southern part of Patagonia in Chile and Argentina, including a variety of arid and semi-arid ecosystems. In northern Peru, three endemic genera are noteworthy faunal elements: *Pilobaloderes* Kulzer, *Praocidia* Fairmaire, and *Parapraocis* Flores & Giraldo which inhabit from coastal desert to high Andean arid lands. The current and estimated number of species for these three genera is presented. The distribution ranges of the genera, including new records from collections and recent expeditions, are given. Habitat preferences and a discussion of the biogeography of the genera are also presented.

Tribal relationships in the edrotine and tentyriine clades (Tenebrionidae: Pimeliinae): Preliminary findings from morphology and targeted enrichment sequencing

Christopher C. Wirth[1], Aaron D. Smith[1]

[1] *Purdue University, Department of Entomology, 901 W. State Street, West Lafayette, IN 47907, USA*

The edrotine (= eurymetopine) and tentyriine clades sensu Doyen (1994) encompass seven morphologically diverse tribes, with a majority restricted to the Americas. However, the relationships between the New World tribes Edrotini, Epitragini (edrotine clade) and Evaniosomini, Thinobatini, Trilobocarini (tentyriine clade, in part) are unclear. Limited taxonomic sampling and use of problematic morphological characters in prior studies recovered ambiguous tribal relationships. Analyses of multi-locus molecular data were similarly limited and unsuccessful in recovering well-supported tribal relationships. The lack of resolution has compounded historical, poorly-articulated tribal concepts, hampering both descriptive and applied research in these groups. During a revision of Edrotini genera, we analysed morphological and molecular data from targeted enrichment sequencing representing all New World tribes in the edrotine and tentyriine clades. Based on these results we discuss changes in tribal composition and the need for new tribal concepts in both clades.

Activity patterns of *Cybotus estriatus* (Coleoptera: Tenebrionidae) in a Caribbean beach in Costa Rica

Julia Morales-García[1], Jaime García-Gila[1], Mario García-París[1], Natalia Rosas Ramos[1,2]

[1] *Museo Nacional de Ciencias Naturales, MNCN-CSIC. C/ José Gutiérrez Abascal, 2. 28006 Madrid, Spain*
[2] *Departamento de Biología Animal (Área de Zoología), Facultad de Biología (Edificio de Farmacia, planta 5), Universidad de Salamanca, Campus Miguel de Unamuno s/n. 37007 Salamanca, Spain*

The aim of this study is to identify the daily activity patterns of *Cybotus estriatus* (LeConte, 1878) (Coleoptera: Tenebrionidae), and determine the influence of temperature on its activity. We also studied how vegetation cover influences its abundance. In this way, adaptations or behavioral mechanisms related to the thermal tolerance limits of neotropical darkling beetles can be found. The study was conducted in a beach in the Caribbean coast of Costa Rica where the dominant plant species was *Ipomoea pes-caprae* (L.) Roth (Convolvulaceae). A field study was conducted to determine the effect of the temperature on daily activity patterns carrying out observation of active individuals; to evaluate the influence of the vegetation cover on *C. estriatus* abundance, the observations were performed along transects in two separate areas. The results obtained show a bimodal daily activity pattern in *C. estriatus* and a significant influence of *I. pes-caprae* cover on *C. estriatus* abundance. This suggests that although *C. estriatus* shows activity at higher temperatures than other species of Tenebrionidae, its activity patterns and microhabitat selection are influenced by the need to reduce environmental stress. Research on *C. estriatus* could offer new keys for the study of the functioning of arid ecosystems of the Neotropics, and for the evolution of the adaptations of darkling beetles in these ecosystems.

Systematics of two sympatric species of Mordellidae (Coleoptera): *Mediimorda batteni* Plaza-Infante, 1985 and *Mediimorda bipunctata* (Germar, 1827) in the Iberian Peninsula

Annui M. Sanz[1], Estefany Karen López-Estrada[1], Mario García-París[1]

[1] *Museo Nacional de Ciencias Naturales (MNCN-CSIC), José Gutiérrez Abascal, 2, 28006 Madrid, Spain*

Mediimorda (Méquignon, 1946) is one of the 155 genera included within Mordellidae (Latreille, 1802). This genus includes 13 species distributed along the Mediterranean region, central Europe, southwestern Africa, Madagascar and Yemen. In the Iberian Peninsula there are only four species of *Mediimorda*, *M. batteni* and *M. bipunctata* with a wide geographic range throughout the Peninsula, and *M. angeliquae* Leblanc, 2002 and *M. brusteli* Leblanc, 2002 limited to the northeast area. Intriguingly, *M. batteni* and *M. bipunctata* have an almost complete sympatric distribution, which is not common among closely related taxa, and exhibit a rather little morphological variation severely questioning the existence of two independent evolutionary units as previously proposed. In this study, we performed phylogeographic and phylogenetic analyses based on mitochondrial and nuclear markers to test whether the previous taxonomy of these species is accurate. Our preliminary results based on molecular information support the existence of two evolutionary lineages, that corresponded with the previously described taxa. We carried out subsequently a morphological revision in search of new characters that help with the identification of the two lineages. However, we have found scarce morphological differences between the two taxa, mostly concentrated in the genitalia, as previously proposed. The evident decoupling between genetic and morphological differentiation make us wonder whether we are facing lineages under strong selective pressure on external traits.

Systematics of Western Mediterranean Meloidae

Mario García-París[1], Estefany Karen López-Estrada[1,2], Yolanda Jiménez-Ruiz[1] , Alberto Sánchez-Vialas[1], Jose Luis Ruiz[3]

[1] *Museo Nacional de Ciencias Naturales (MNCN-CSIC). C/ José Gutiérrez Abascal, 2. 28006 Madrid. Spain*
[2] *Real Jardín Botánico (RJB-CSIC). Plaza de Murillo, 2. 28014 Madrid. Spain*
[3] *Instituto de Estudios Ceutíes. Paseo del Revellín, 30. 51001 Ceuta. Spain*

Morphological characterization of blister beetles of the Western Mediterranean Region is generally well established at genus and species levels. Recent molecular phylogenetic and phylogeographic analyses are often congruent with previous taxonomic hypotheses. In a few cases, congruence was not complete and resulted in the recognition of a previously undetected diversity (as within the genus *Berberomeloe*) or in some generic or subgeneric rearrangements (splitting of *Mylabris*, and restitution of *Anchomeloe*). But, the study of many of the taxonomically complex groups has not been yet undertaken. During these last years we have been assembling a large molecular data set that allows us to discuss the systematics of some species groups (as for example those involving North African *Mylabris* of the *M. tricincta* - *M. guerini* group, or the Iberian species of the *E. rugosus* group), and the phylogenetic position of some genera of particularly difficult placement (*Berberomeloe*, *Lagorina*…).

"High-throughput DNA sequencing on historical collections of beetles: phylogenetic studies among Platynotini (Tenebrionidae)" – a new government-funded project on darkling beetles

Marcin J. Kamiński[1]

[1] *Zoological Museum, Museum and Institute of Zoology, Polish Academy of Sciences, Warszawa, Poland*

The presentation highlights the main goals and methodology of the recently funded phylogenetic project on the tribe Platynotini (National Science Centre, Poland; OPUS 19 #2020/37/B/NZ8/02496). Due to the specific distribution of the studied subtribe and the fact that many unidentified Platynotini specimens are dispersed throughout different entomological collections of the World, the main aim of this presentation is to invite members of the tenebrionid community to cooperate on different aspects of this project (alphataxonomy, phylogenetics, biogeography).

Tenebrionidae Research in the Smith Insect Biodiversity Lab

Christopher C. Wirth[1], Kali Swichtenberg[1] , Olivia M. Gearner[1] , Aaron D. Smith[1]

[1] *Purdue University, Department of Entomology, 901 W. State Street, West Lafayette, IN 47907, USA*

Darkling beetles (Coleoptera: Tenebrionidae) are the primary research focus of the Smith Insect Biodiversity Lab. Here we introduce lab personnel and active projects, along with a tour of our tenebrionid collection, library, and other research facilities.

Phylogeography of *Scaurus uncinus* (Förster, 1771) and a preliminary phylogeny of *Scaurus* from the Western Mediterranean Region

Carmen Duque-Amado[1], Alberto Sánchez-Vialas[1], Mercedes París[1], Mario García-París[1]

[1] *Museo Nacional de Ciencias Naturales (MNCN-CSIC), c/ José Gutiérrez Abascal 2, 28006, Madrid, Spain. carmenduque@hotmail.es*

Widely distributed species with limited dispersal abilities usually exhibit geographical structuring either at genetic, morphological or ecological levels. The species of the genus *Scaurus* are flightless but, despite their limited dispersal abilities, *Scaurus uncinus* has a widespread distribution, which extends from southern France and Pyrenees to North Africa and Cape Verde. The present study, by analyzing the partial sequences of two genes (*cytB* and *ITS2*) from 11 *S. uncinus* populations of the Iberian Peninsula and Morocco, aims to reveals whether their genetic diversity is geographically structured and if so, if current geographic barriers such as the Gibraltar Strait have played a role on their diversification. Additionally, we provided the first phylogenetic framework for the genus *Scaurus* from the western Mediterranean by including 10 species. We identify two deep and distinctive lineages of *S. uncinus*, which are not monophyletic, which suggest that subsequent taxonomic revision is needed for the species of this genus.

Nilio (Micronilio) pusillus Ihering, 1914 (Tenebrionidae: Nilioninae) collected in cultural goods in Paraná, Brazil

Bruna P. Macari[1], Lúcia M. Almeida[1], Janice S. Bernardo[2], Igor Chmyz[3]

[1] *Laboratório de Sistemática e Bioecologia de Coleoptera, Departamento de Zoologia, Universidade Federal do Paraná, Curitiba, Brazil*
[2] *Associação de Restauradores e Conservadores de Bens Culturais (Arco.it), Curitiba, Brazil*
[3] *Centro de Estudos e Pesquisas Arqueológicas (CEPA), Departamento de Antropologia, Universidade Federal do Paraná, Curitiba, Brazil*

Nilioninae is a subfamily of Tenebrionidae composed of a single genus, *Nilio* Latreille, 1802, which includes 43 species with Neotropical distribution. *Nilio* species are found on living and dead trees with presence of fungi and show gregarious behavior, although little is known about their biology. In collections carried out in heritage sites, immatures and adults of *Nilio (Micronilio) pusillus* Ihering, 1914 are recorded for the first time from the state of Paraná, Brazil. Twenty specimens (eggs, larvae and pupae) were collected in 19th-century Polish immigrant historical buildings, traditionally constructed in *Araucaria angustifolia* (Bertol.) Kuntze 1898, situated in the rural area of the city of São José dos Pinhais. Also, six adults were recovered from the sediment of a Tupiguarani indigenous funerary urn dating from the 17th century, excavated in 1976, on the east bank of Lake Xambré, Paraná River, city of Altônia. As noted by other authors, the specimens on the wooden houses showed gregarious behavior and occurred on attic affected by wood-decay fungus. However, the species association with human remains, as observed in funerary archeological context, is unclear, but should be an eventual occurrence.

Hybridization processes in *Akis* detected by phylogeographic analyses

Pilar Jurado-Angulo[1], Ernesto Recuero[1], Mario García-París[1]

[1] *Departamento de Biodiversidad y Biología Evolutiva, Museo Nacional de Ciencias Naturales, MNCN-CSIC. c/ José Gutiérrez Abascal, 2. 28006, Madrid. Spain.*

The phylogeographic study of Iberian species of the genus *Akis* (Pimeliinae) has allowed us to identify two local hybridization processes. The first of them occurs in the contact zone between *A. acuminata* and *A. granulifera* in southern Spain. In this area we found specimens morphologically assignable to either *A. acuminata* or *A. granulifera* with mitochondrial DNA of the opposite species suggesting that gene introgression is taking place among them. Some occasional specimens present a morphotype coinciding with the morphology previously described as *A. acuminata var. dorsigera*, form subsequently elevated to the species level. However, these specimens present mtDNA of *A. acuminata*, and therefore we hypothesize that they correspond to hybrids between *A. acuminata* and *A. granulifera*. A similar process of gene introgression was observed between, *A. genei* and *A. lusitanica*, two species with wide geographic contact zones. In some of these areas, specimens morphologically assignable to one species present mitochondrial haplotypes of the other. However, a similar situation has been observed also in areas where only one of the two species is present. We hypothesize that hybridization *A. genei* and *A. lusitanica* has occurred both in past and current contact areas.

Spatial and temporal distribution of Tenebrionids on the border between arid and hyper arid deserts

Elli Groner[1]

[1] *Ramon Branch. Dead Sea and Arava Science Center. P.O. box 262 Mitpe Ramon, Israel. elli@adssc.org*

The research describes the distribution of darkling beetles between an arid ecosystem and a hyper-arid ecosystem in the Negev desert. The two ecosystems are only 10 km apart but since this border is crucial species turnover (beta diversity) is very high. The research also tries to investigate what allows such a high diversity of species. It shows the temporal segregation of the species between seasons. Finally we try to study larva biology and we show some examples.

Revision of the genus *Emmallodera* Blanchard (Coleoptera: Tenebrionidae)

Violeta A. Silvestro

[1] *IBBEA-CONICET, Laboratorio de Entomología, Instituto de Biodiversidad y Biología Experimental y Aplicada (IBBEA), Facultad de Ciencias Exactas y Naturales, Universidad de Buenos Aires, Argentina. ayelensilvestro@hotmail.com*

The genus *Emmallodera* Blanchard (Tenebrioninae: Scotobiini) comprises 17 species and subspecies distributed from northwestern Argentina to the southern part of Patagonia in Argentina and Chile, with two species inhabiting Tierra del Fuego island. Species of *Emmallodera* inhabit the biogeographic provinces Patagonia and Monte and are characterized by having one spine on the profemur, the last antennomere pointed, and the tarsomeres loosely articulated to each other, with the last tarsomere more prominent. In this contribution the genus is revised using external features. A dichotomous key, illustrations of external features and a distribution map are included.

Diversity of Tenebrionidae in stranded marine vertebrates on the central coast of Peru

José Iannacone[1,2,3], Alejandra Liza[1], Geancarlo Alarcon[1], Mirian Palomino[1], Erson Flores[1], David Minaya[1], Lorena Alvariño[1]

[1] Laboratorio de Ecología y Biodiversidad Animal (LEBA), Facultad de Ciencias Naturales y Matemática, Grupo de Investigación en Sostenibilidad Ambiental (GISA), Escuela de posgrado (EPG), El Agustino, Universidad Nacional Federico Villarreal, Lima, Perú
[2] Laboratorio de Parasitología, Facultad de Ciencias Biológicas, Universidad Ricardo Palma, Santiago de Surco, Lima, Perú
[3] Universidad Científica del Sur, Carrera de Ingeniería Ambiental, Laboratorio de Ingeniería Ambiental, Villa El Salvador, Lima, Perú

The present investigation evaluates the diversity of Tenebrionidae in stranded marine vertebrates on the central coast of Peru. The fauna of Tenebrionidae found in various stages of decomposition of 18 stranded marine birds and mammals was evaluated: *Otaria flavescens*, *Canis lupus familiaris*, *Haematopus ater*, *H. palliattus*, *Larosterna inca*, *Larus belcheri*, *Leucocarbo bougainvillii*, *Leucophaeus modestus*, *Lontra felina*, *Otaria flavescens*, *Pelecanus thagus*, *Phalacrocorax bougainvilli*, *P. brasilianus*, *Phocoena sinus*, *Spheniscus humboldti*, *Streptopelia decaocto*, *Sula nebouxii*, *S. variegata* and *Tursiops truncatus* in eight beaches of the department of Lima and Ica during two seasons of the year, summer and spring between October 2015 and April 2019. 2928 specimens were collected, distributed in larvae-pupae and adults: *Phaleria maculata* (1 and 209), *P. gayi* (558 and 2102) and *Tenebrio molitor* (1 and 57), respectively. *Phaleria gayi* was presented during the five years of evaluation; On the other hand, *P. maculata* was observed only between 2017 and 2019, and *T. molitor*, only in 2017. The four most frequent carcasses were *O. flavescens*, *P. thagus*, *S. variegata* and *P. brasilianus*. The family Tenebrionidae was associated with advanced decomposition stages and dry remains in stranded marine vertebrates. The ecosystem services covered by Tenebrionidae involve necrophilia.

Influence of shrub heterogeneity on the diversity of darkling beetles (Coleoptera: Tenebrionidae) in arid high altitude environments in northwestern Argentina

Hilda B. Macagno[1], Gustavo E. Flores[2], José A. Corronca[1]

[1] *Instituto para el Estudio de la Biodiversidad de Invertebrados, Facultad de Ciencias Naturales, Universidad Nacional de Salta-CONICET, Av. Bolívia 5150, Código postal 4400, Salta, Argentina,*
[2] *Laboratorio de Entomología, Instituto Argentino de Investigaciones de las Zonas Áridas (IADIZA), Centro Científico Tecnológico Mendoza, Casilla de correo 507, 5500 Mendoza, Argentina.*

Using pitfall traps and suction sampling in 9 sites with different degrees of plant heterogeneity (high: HH, intermediate: IH and low: LH), we collected tenebrionid beetles in the Altos Andes and Puna ecoregions (up to 4300 msl) to evaluate how the increase in heterogeneity of shrub vegetation influence their assemblages. Samplings were carried out in 2014 (December), 2015 (June) and 2018 (February). In total, we registered 108 individuals of 9 species, the abundance and richness of species was higher in IH (N = 60, *S* = 6) than in HH (N = 35, *S* = 5) and LH (N = 13, *S* = 3), but only the abundance registered statistically significant differences. *Physogaster andinus* was the species shared between the different habitats, *Entomochilus varius* was present exclusively in LH, *Epipedonota interandina* and *Caenocrypticoides translucidus* were exclusive to IH, while *Hylithus forsteri meridionalis* and *Praocis pentachorda* were only present in HH. The tenebrionid assemblages of the three habitats studied had different dominant species, in LH it was *P. andinus*, in IH *E. interandina,* and in HH *Praocis magnoi*. Beta diversity between habitats was moderate and we recorded a high rotation of species between habitats. The increase in the bush heterogeneity of the PU and AA generated changes in the structure of the assemblages of Tenebrionidae associated with it. Therefore, the presence of shrubs in arid environments is very important for these beetles because, despite their low canopy coverage, they produce changes in micro-climatological variables, provide shelter from the sun and food resources.

The role of *Nyctelia circumundata* (Coleoptera: Tenebrionidae) on litter fragmentation processes and soil fertility in Northeastern arid Patagonia

German Horacio Cheli[1,2], Tomas Bosco[1,2], Gustavo E. Flores[3]

[1] *Instituto Patagónico para el Estudio de los Ecosistemas Continentales (IPEEC), Centro Científico Tecnológico CENPAT-CONICET. Bvd. Brown 2915, Puerto Madryn -CP: U9120ACF-, Chubut, Argentina.*
[2] *Universidad Nacional de la Patagonia San Juan Bosco. Bvd. Brown 3051, Puerto Madryn -CP: U9120ACF-, Chubut, Argentina.*
[3] *Laboratorio de Entomología, Instituto Argentino de Investigaciones de las Zonas Áridas (IADIZA), Centro Científico Tecnológico CONICET. Av. Ruiz Leal s/n Parque General San Martín, Mendoza –CP: 5500-, Mendoza, Argentina. Mendoza - Argentina.*

Darkling beetles are the most abundant macrodetritivores in many arid environments worldwide, and it is widely suggested that these beetles are responsible for most of the nutrient cycling from accumulated litter. In this study, the role of *Nyctelia circumundata* (Lesne) (Coleoptera: Tenebrionidae: Pimeliinae) on soil fertility during warm-dry season was experimentally evaluated in northeastern Patagonia, using microcosm experiments in laboratory. Our results showed that litter presence alone is not enough to incorporate organic matter (OM), nitrogen (N) nor carbon (C) to the soil. *N. circumundata* consumed a significant fraction of the litter offered in the experimental pots (≈10 %) and this activity was also associated to increased soil N, C, and OM contents, and C/N ratio. These facts confirmed that, litter fragmentation, consumption, and its conversion into feces by adults of *N. circumundata*, positively affects soil fertility in northeastern Patagonia. Considering that darkling beetles are a major group of primary consumers in desert, these beetles seems to be very important into the base of the aboveground food web and a key energy conduit from plants (as litter) to higher trophic levels in this region.

Altitudinal distribution of Tenebrionidae with forensic interest

Fernando N. Jofré[1], Gustavo E. Flores[1], Florencia M. Fernándes-Campón[1], Fernando H. Aballay[2]

[1] *CONICET, Laboratorio de Entomología, Instituto Argentino de Investigaciones de las Zonas Áridas (IADIZA, CCT CONICET Mendoza) Casilla de correo 507, 5500 Mendoza, Argentina; *e-mail: fjofre@mendoza-conicet.gob.ar*

[2] *Departamento de Biología, Facultad de Ciencias Exactas Físicas y Naturales, Universidad Nacional de San Juan, San Juan, Argentina*

In the present work, I studied Tenebrionidae insects associated to the decomposition of animal tissue in an altitudinal and latitudinal gradient. This information will be used in forensic investigations carried out in the province of Mendoza, Argentina. The objective of the work was to evaluate the cadaveric Tenebrionidae community and how are affected by the different altitudinal levels in natural environments. The study was carried out in three natural reserves: Villavicencio, Manzano Histórico and Laguna del Diamante in the Province of Mendoza, Argentina. In each reserve traps baited at 1000, 1400, 1800, 2200, 2600 and 3000 masl were placed and left in the field for 30 days during two consecutive years in the spring-summer period. Based on their distribution, I recognized as of forensic interest the necrophagous families *Hylithus* Guérin-Méneville, *Omopheres* Casey and *Scotobius* Germar.

Systematic review and phylogenetic analysis of the tribe Scotobiini (Coleoptera: Tenebrionidae)

Violeta A. Silvestro

[1] *IBBEA-CONICET, Laboratorio de Entomología, Instituto de Biodiversidad y Biología Experimental y Aplicada (IBBEA), Facultad de Ciencias Exactas y Naturales, Universidad de Buenos Aires, Argentina. ayelensilvestro@hotmail.com*

Scotobiini is a tribe with species adapted to live in arid and semi-arid environments of Western and Southern South America. The tribe is composed of 115 species/subspecies arranged in six genera, namely: *Ammophorus* Guérin-Méneville, *Diastoleus* Solier, *Emmallodera* Blanchard, *Leptynoderes* Solier, *Pumiliofossorum* Silvestro & Giraldo, and *Scotobius* Germar. This study presents the diagnosis, updated distribution and morphological phylogeny of the tribe Scotobiini and its six genera. The performed morphological phylogeny shows the monophyly of the tribe based on last tarsomere of foreleg with a longitudinal groove on the anterior margin and the presence of clusters on dome-shaped placoid sensoria on the apex of the last antennomere, which are also visible on the apical surface of antennomeres VIII–X. The phylogeny also shows the sister relation of *Ammophorus* with *Pumiliofossorum* and of *Diastoleus* with *Leptynoderes*, all monophyletic clades, and the polyphyletic origin of *Scotobius*.

Effect of an agricultural undertaking on the composition of an assemblage of Tenebrionidae (Coleoptera) in the Central Monte of Argentina

Gabriel Quiroga[1], Fernando H. Aballay[1,2], Leonardo M. Díaz-Nieto[1,2], Fernando Murúa[1], Gustavo E. Flores[3]

[1] *Departamento de Biología, Instituto y Museo de Ciencias Naturales, Universidad Nacional de San Juan, San Juan, Argentina; gabrielqq8@gmail.com, fmurua80@gmail.com, ldiaznieto@unsj-cuim.edu.ar,faballay@mendozaconicet.gob.ar*
[2] *Consejo Nacional de Investigaciones Científicas y Técnicas, San Juan, Argentina*
[3] *CONICET, Laboratorio de Entomología Instituto Argentino de Investigaciones de las Zonas Áridas (IADIZA, CCT-CONICET Mendoza) Casilla de correo 507, 5500 Mendoza, Argentina; gflores@mendoza-conicet.gob.ar*

Introduction: The advance of agriculture on natural environments raises the need to measure the effect of human activities on them. Tenebrionidae family is considered a good biological indicator for this purpose. **Objetive:** To study the response of the Tenebrionidae fauna to the modification of the habitat by comparing a natural environment and a vine crop. **Methods:** Pitfall type traps distributed in two environments were used: 1. Commercial cultivation of *Vitis vinifera*, 2. Dunes, considered a natural area with low human intervention. According to their ability to resist aridity, tenebrionids were classified into three groups: 1) Very Highly Adapted, 2) Highly Adapted and 3) Less Adapted. Based on this classification, comparative analyzes were carried out between environments. **Results:** 1792 tenebrionids were collected, grouped into five subfamilies and 22 species, with 8 new records for the study area. The diversity was similar for both sites, however the dominance in each environment was different. The comparison of the species in relation to their adaptation, yielded significant differences between environments. **Conclusions:** New records of Tenebrionidae are reported for the central Monte of Argentina. Agricultural activity would affect the species most adapted to the arid natural environment, although it does not show an effect on the diversity of the taxon.

A revision of *Emmallodera perlifera* species group (Coleoptera: Tenebrionidae) with description of two new species

Violeta A. Silvestro[1], Hilda B. Macagno[2], Gustavo E. Flores[3]

[1] *IBBEA-CONICET, Laboratorio de Entomología, Instituto de Biodiversidad y Biología Experimental y Aplicada (IBBEA), Facultad de Ciencias Exactas y Naturales, Universidad de Buenos Aires, Argentina. ayelensilvestro@hotmail.com*
[2] *CONICET, Facultad de Ciencias naturales, Universidad Nacional de Salta, Argentina. hildamacagno@gmail.com*
[3] *CONICET, Laboratorio de Entomología, Instituto Argentino de Investigaciones de las Zonas Áridas (IADIZA), Centro Científico Tecnológico CONICET Mendoza, Argentina. gflores@mendoza-conicet.gov.ar*

The genus *Emmallodera* (Tenebrioninae: Scotobiini) is widely distributed in Argentina, inhabiting the biogeographic provinces Patagonian and Monte. *Emmallodera perlifera* Burmeister is the biggest species of the genus, with a length between 24 and 27 mm and characterized by the presence of tubercles on elytral intervals. Between the years 2014 and 2015 were placed pitfall traps in the Puna biogeographic provinces, in Catamarca and Salta provinces at altitudes between 2466 and 3.930 msnm. We found specimens of a new species related to *Emmallodera perlifera* to the North of its distribution area. A revision of the known specimens of Burmeister´s species threw unexpected information: this species should be separated into two phenotypically distinct species with separate distributions, one of them, the type series, inhabiting the Monte, from Catamarca to the center of Mendoza, and the other, a new species, inhabiting the Patagonian steppe of southern Mendoza and northern Neuquén. Northern new species inhabits the Puna, expanding both the altitudinal range and distribution of the genus to another biogeographic province. This work has systematic implications and for conservation, revealing the existence of endemic species in areas of extreme conditions such as the Puna.

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