









Rovereto (TN) Italy 4-6 JULY 2024

4TH EUROPEAN CONGRESS ON ORTHOPTERA CONSERVATION in memoriam Antonio Galvagni (1924 - 2015)

# PROGRAM



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4-6 July 2024



Dear participants,

It is a great pleasure to welcome you to the Fourth European Congress on Orthoptera Conservation and the 4<sup>th</sup> meeting of the Gruppo di Ricerca sugli INsetto Ortotteroidei (GRIO), at Museo di Scienze e Archeologia in Rovereto (Italy).

Altogether 60 participants from 16 countries registered for this meeting. Fondazione Museo Civico di Rovereto (FMCR) is honored to welcome all of you, FMCR is not only a museum but also a research institute. The Orthoptera research carried out in FMCR is linked to a collection which currently holds about 50.000 specimens. The Orthoptera collection is the largest in Italy and especially rich for the Mediterranean and Central American fauna.

The program for this meeting includes talks and posters on a wide variety of subjects involving grasshoppers. On behalf of the Società Entomologica Italiana, the Società the IUCN Grasshopper Specialist Group, Fondazione Edmund Mach and Università degli Studi di Padova who are supporting the event we wish you a very inspiring meeting and a pleasant stay in Rovereto and Italy.

Filippo Maria Buzzetti and Gionata Stancher

#### Venue

The congress will be hosted by Fondazione Museo Civico di Rovereto at Museo di Scienze e Archeologia (Borgo S. Caterina 41, 38068 Rovereto TN, Italy). The meeting will be held in the Sala Convegni F. Zeni. The museum is a 10 minutes walk from Rovereto Train Station. You have free access to the exhibitions of Museo di Scienze e Archeologia, showing your badge.

#### Travel

For those arriving by plane at Verona Airport, the best way is to travel by bus (every 20 minutes) to Verona train station, then by train to Rovereto (approx 40 minutes). For those coming by car, the Museo di Scienze e Archeologia has toll parking areas: Santa Caterina street and Piazzale Leoni parking area.

#### Program

The program of the congress has been fixed and is published in this booklet. For current information see the congress website on <u>www.fondazionemcr.it</u>. The congress will be live streamed on the YouTube channel of Fondazione Museo Civico di Rovereto (at the following link: www.youtube.com/@fondazionemuseocivicorovereto).

The presentations will be recorded and made available on YouTube channel of FMCR.

#### Sign up

Those attending the meeting in person can sign up upon arrival at the museum, on July 4 and 5. During sign up you'll receive a name badge and a welcome bag including the booklet with the program and abstracts

#### **Book tables**

There will be some tables in the coffee room for selling books or sharing free publications and flyers. In case you intend to make use of this option it helps if you could let the organization know beforehand by sending a mail to buzzettifilippo@fondazionemcr.it.

#### Contact

In case you have questions please do not hesitate to contact us via email buzzettifilippo@fondazionemcr.it.

#### Program of the fourth European Congress on Orthoptera Conservation / 4th GRIO meeting - in memoriam Antonio Galvagni (1924-2015)

Thursday 4 July (morning)

[Legend: underscored name = presenter]

09:45 registration

10:00 Welcome by the Organizing committee: Filippo Maria Buzzetti and Gionata Stancher and greetings by the President of FMCR Giovanni Laezza.

Chairman: Axel Hochkirch

10:15 <u>Luc Willemse</u>: Fieldguides and fieldcourses as tools to stimulate the study of grasshoppers.

10:30 <u>Armin Landmann</u>: On the road to a new Red List of Austrian grasshoppers: an analysis of niche breadth and thermosensitivity as causes of threat.

10:45 <u>Oliver Hawlitschek</u>, Carsten Bruns, Lara-Sophie Dey, Soňa Nuhlíčková, Rob Felix, Hein van Kleef, Jacqueline Nakel and Martin Husemann: Conservation genomics of *Gampsocleis glabra* in Western and Central Europe

11:00 coffee break

11:30 Lisa Reiss: Monitoring of *Barbitistes serricauda* in Germany

11:45 <u>Anton Krištín</u> & Balla Miloš: Expansion or recolonization: case study with two grasshopper genera Acrida & Acrotylus at the northern range limit 12:00 <u>Hilpold Andreas</u>, Repetto Emanuele, Tappeiner Ulrike, Guariento Elia: High importance of extensively managed grasslands for the conservation of orthopteran diversity in agricultural landscapes

12:15 <u>Ricardo Mariño-Pérez</u>: Desert long-horned grasshoppers (Tanaoceridae) and razor-backed bush-hoppers (Xyronotidae). An update in their IUCN assessments

12:30 lunch break

#### Thursday 4 July (afternoon)

Chairman: Bruno Massa

14:00 <u>Paolo Fontana</u>: Records on the possible effect of climate changes on the distribution of some orthopteroid insects

14:15 <u>Ettore Rivalta</u>, Costanza Geppert, Lorenzo Marini, Filippo Maria Buzzetti: Selected localities for monitoring Orthoptera in Trento province across time

14:30 <u>Filippo M. Buzzetti</u>: Orthoptera Conservation in Italy, Zeuneriana marmorata and Anonconotus italoaustriacus

14:45 <u>Karmela Adžić</u>, Maks Deranja, Marko Pavlović, Sebastian Ćato, Josip Skejo: One season of Orthoptera research projects in Croatia

15:00 <u>Antonia Donner</u>, Margarita Delles. Sophie Papczyk: Grasshopper Summer School 2023 in Greece: Inspiring the next generation of Orthoptera enthusiasts

15:15 Group photo

15:30 coffee break

16:00 <u>Emanuele Repetto</u>, Pietro Milanesi, Livia De Caria, Francesca Della Rocca: Identifying ecological corridors of the bush cricket *Saga pedo* in fragmented seminatural grasslands

16:15 <u>Roberto Battiston</u>: The GPTs Red List: can Artificial Intelligence help in species conservation?

16:30 <u>Philipp Kirschner</u> & Petra Kranebitter: Glacial legacies: Refugial dynamics of the endemic bush cricket *Anonconotus italoaustriacus* 

16:45 <u>Giacomo Ortis</u>, Laura Maretto, Isabel Martinez-Sañudo, Luca Mazzon: Biological relation between the red listed species *Barbitistes vicetinus* (Orthoptera: Tettigoniidae) and a ground-searching parasitoid

17:00 <u>Mattia Ragazzini</u>, Lara-Sophie Dey, Roy M. J. C. Kleukers, Luc Willemse, Oliver Hawlitschek: DNA barcoding and species delimitation of Orthopterans from the Mediterranean Basin

17:15 meeting of the GRIO

#### Friday 5 July (morning)

Chairmen: Luc Willemse and Josip Skejo

10:00 <u>Nefeli Kotitsa</u>, Simeon Borissov, Dragan Chobanov: Hopping across the mountaintops of South Balkans: the phylogeny of the genus *Oropodisma*.

10:15 <u>Sílvia Pina</u>, Francisco Barros, Gellért Puskás, Márk László, Gergely Szövényi: Recent improvement in the knowledge on the conservation status of two Iberian endemic Stone Grasshoppers in Portugal

10:30 <u>Axel Hochkirch</u>: A national Red List of Orthoptera for Luxembourg 10:45 Inge Illich, Brigitte Gottsberger & <u>Thomas Zuna-Kratky</u>: New insights into the distribution of Eisentrauts's Bow-winged Grasshopper *Chorthippus eisentrauti* in the Eastern Alps

11:00 Coffee break

11:30 <u>Sebastian König</u>: Traits shape the climatic niches of Orthoptera along micro- and macroclimatic gradients: Case study from the Berchtesgaden Alps 11:45 <u>Apostolis Stefanidis</u>, Konstantinos Kougioumoutzis, Konstantina Zografou, Georgios Fotiadis, Olga Tzortzakaki, Luc Willemse, Vassiliki Kati: Distribution pattern and conservation ecology of two globally threatened Orthoptera of Greece

12:00 Zohreh Mirzaee, Roberto Battiston: Unlocking the Unknown: the case of *Holaptilon* (Mantodea: Gonypetidae) for the conservation of new species

12:15 Joaquín Ortego, Jorge Gutiérrez-Rodríguez, Marina Trillo and Vicente García-Navas: Integrative taxonomic, demographic, and extinction risk assessment of Podismini grasshoppers (Orthoptera: Acrididae) from Mediterranean sky island archipelagos with extreme vulnerability to climate change

12:30 Lunch break

#### Friday 5 July (afternoon) - in memory of Gianni Pavan

chairmen: Filippo Maria Buzzetti and Baudewijn Odé

14:00 <u>Cesare Brizio</u> & Filippo Maria Buzzetti: Our memory of Gianni Pavan.14.15 <u>David Bennett</u>: Relative performance of passive acoustic monitoring

with Audiomoth compared to traditional transect methods, and construction of an automatic machine learning classifier for Orthoptera in Schleswig Holstein, Germany.

14.30 <u>Florent Prunier</u>: Training for building a European Orthoptera sound database

14.45 <u>Francisco Rivas Fuenzalida</u>: Rthoptera, a New Open-source Software for Standardized Insect Bioacoustics

15.00 Coffee break

15.30 Baudewijn Odé: Orthoptera in Xeno-canto

15.45 <u>Cesare Brizio</u>, Antonella Di Palma, Paolo Fontana, Bruno Massa: Passive acoustic monitoring as a possible method to detect night-singing Orthoptera

16.00 <u>Karol Wałach</u>, Szymon Czyżewski, Maksymilian P. Bieniara, Bartosz Halik, Paweł Sobik, Krzysztof Basista, Pritam K. Dey, Szymon P. Kuś, Anton Krištín: Novel insights into the natural history of a Western Carpathian endemic – *Pseudochorthippus tatrae* 

16.15 <u>Gergely Szövényi</u>, Márk László: On the way to the conservation of the large banded grasshopper in Hungary – attempts to establish new populations by translocation

16:30 <u>Simeon Borissov</u>, Nefeli Kotitsa, Jos Tilmans, Dragan Chobanov: Biogeographic questions of the Aegean: genetic diversity and dispersal patterns of flightless orthopterans across archipelagos

16:45 <u>Lara-Sophie Dey</u>: Species distribution modeling in Orthopterans: benefit or nonsense?

17: 00 closing remarks

#### Saturday 6 July Bring your bottle: save plastic!

Pocket lunch available for all registered participants, according to their dietary needs. In order to save plastic, each participant will bring his own bottle.

9:00 meeting at Parcheggio Piazza Achille Leoni 9:15 departure by bus to Viote del Monte Bondone 18:00 meeting at bus park 18:15 departure to Rovereto





#### Posters

1 Bardiani Marco, Fausto Leandri: The importance of wetland remnants for rare and endangered Orthoptera in highly transformed lowlands. Recent data from the provinces of Mantua and Cremona (Lombardy, Italy).

2 Roberto Battiston, William Di Pietro, Antonio Fasano, Oscar

Maioglio, Federico Boscato, Ivan Petri: Guidelines for the management of alien mantises in Europe: a proposal for shared actions between institutions, the scientific community and citizens

3 Sebastian Ćato, Josip Skejo, Karmela Adžić, Maks Deranja, Marko Pavlović: *Dinarippiger* gen. nov. (Tettigoniidae: Bradyporinae: Ephippigerini), a new saddle bush-cricket genus for *Ephippiger discoidalis* Fieber, 1853 from the Dinaric karst

4 Francesco Forte, Joaquín Ortego, Marina Trillo, Fabrizio Freda, Marco A. Bologna, Bruno Massa, Paolo Fontana, and Alessandra Riccieri: An integrative taxonomy approach towards the conservation of the Italian endemic genus *Italopodisma*, Harz 1973 (Orthoptera: Acrididae)

5 Francesco Forte, Marina Trillo, Fabrizio Freda, Marco A. Bologna, Bruno Massa, Paolo Fontana, Alessandra Riccieri and Joaquín Ortego: Taxonomic and conservation genomic assessment of the Italian endemic genus *Italohippus* Fontana & La Greca, 1999 (Orthoptera: Acrididae)

6 GRIO members, WBA: The brief history of orthopterology in Italy and the birth of the GRIO (Gruppo di Ricerca Insetti Ortotteroidei - Research Group for Orthopteroid Insects).

7 Gellért Puskás, Márk László, Orsolya Kiss, Gergely Szövényi: The Egyptian Bird Grasshopper just landed in Pannonia. The present situation of *Anacridium aegyptium* in Hungary.

8 Emanuele Repetto, Elia Guariento, Andreas Hilpold: Orthopterological highlights from the Biodiversity Monitoring South Tyrol.

9 Ginés Rodríguez-Castilla, Florent Prunier, Diego Peinazo-Amo, Salvador Arenas-Castro: Unveiling the effects of climate change on spatial distribution of Pterolepis cordubensis in southern Europe.

10 Robin Schmidt, Sebastian König, Inge Illich, Oliver Hawlitschek: Phylogeographic patterns and hybridization in *Chorthippus biguttulus* and *Ch. eisentrauti* (Orthoptera: Gomphocerinae) across the Alps .

11 Josip Skejo, Marko Pavlović, Josef Tumbrinck, Sebastian Ćato, Karmela Adžić, Maks Deranja, Niko Kasalo: A call for conservation action: subpopulations of the endangered Transsylvanian wingless groundhopper (Tetrix transsylvanica) discovered in Croatia may already be threatened.

12 Francesca Tami, Paolo Fontana, Paola Tirello: Orthoptera species widespread in Friuli Venezia Giulia region but rare or absent in most of Italy.

13 Marina Trillo and Joaquín Ortego: Integrative species delimitation with hybridization: A case study with a complex of grasshoppers of the genus *Chorthippus* (Orthoptera: Acrididae) from southern Greece.

14 Marina Trillo and Joaquín Ortego: Evolutionary and demographic history of the Aegean grasshopper *Chorthippus biroi* (Orthoptera: Acrididae): Implications for its distribution and conservation

15 Robert Vlk: Monitoring and conservational management of the Predatory Bush-cricket (*Saga pedo*) in Czechia.

#### Abstracts

### Fieldguides and fieldcourses as tools to stimulate the study of grasshoppers

Luc Willemse

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Popular, easily accessible and well illustrated overviews of animal or plant groups like field guides offer a unique means to spread our current state of knowledge. As such they are ambassadors for their respective group and form a perfect means to draw more attention and raise interest. Over the past decades our knowledge about European grasshoppers has increased enormously but there are still quite some gaps, and new species are still being discovered in Europe up to this day. Despite the still incomplete knowledge of the European grasshopper fauna, quite a few popular and nicely illustrated overviews of national faunas have been published over the past 20-30 years. Besides being useful in their own right, popular overviews like field guides also form an ideal tool to be used as baseline information in field courses. An example of a field course held in Greece in 2023 based on a field guide will be presented. Whereas In Europe one can argue that there is an urgent need to raise more interest in Orthoptera this certainly and much more applies to other parts of the world, especially the tropical regions. These regions are more species rich, often lack local specialists and consequently the knowledge gaps are larger and the number of undescribed species lie significantly higher. Evidently the lack of specialists and essential facilities impedes the study of the local fauna. As an example the situation in West Papua (Indonesia) will be introduced and some thoughts and ideas shared of what could be done to alleviate the situation.

### On the road to a new Red List of Austrian grasshoppers: an analysis of niche breadth and thermosensitivity as causes of threat

#### Armin Landmann

Institut für Naturkunde & amp; Ökologie, Karl Kapfererstrasse. 3, A-6020 Innsbruck, office@arminlandmann.at

According to the IUCN Red List (HOCHKIRCH et al. 2016), around half of the 1075 grasshopper species assessed in Europe are currently classified as "least concern" and "only" about 16 % as "Endangered" or "Critically Endangered". The still valid Red List of Austrian grasshoppers (BERG et al. 2005), is even more alerting with only 43 % of the 126 species assessed (at that time) classified as save, and with 33 species or 26 % evaluated as critically endangered. However, the assessments of the threat levels in the Red List published in 2005 were largely based on data from the 20th century. In recent decades, however, not only has land use in Austria continued to intensify, but increased global warming has also manifested itself as another potential threat factor. At the same time, the data compilation and mapping activities of Austrian Orthopterologists which a few years ago resulted in a comprehensive overview (Zuna-Kratky et al 2017) and ongoing data collection since then, have significantly improved the basis for assessing the causes and dimensions of the endangerment of Austrian Orthoptera. For the 100 most common of the 138 autochthonous Austrian species, there are around 80,000 data sets from the last two decades of the 20th century alone, and over 300,000 since 2000, which can be analyzed in a variety of ways on the road to a new, updated Red List. In particular, changes in abundance and detection frequencies as well as shifts in range patterns in recent decades can be used as a measure of the current degree of endangerment of native grasshoppers and for a revision of the Red List. The central question in my talk, however, is whether and to what extent niche breadth, altitudinal- and habitat preferences on the one hand and thermal requirements and origin (biogeographical provenance) on the other can be used as predictors or indicators of the threat status of Austrian grasshoppers.

### Conservation genomics of *Gampsocleis glabra* (Orthoptera: Tettigoniidae) in Western and Central Europe.

Oliver Hawlitschek, Carsten Bruns, Lara-Sophie Dey, Soňa Nuhlíčková, Rob Felix, Hein van Kleef, Jacqueline Nakel and Martin Husemann Oliver Hawlitschek,

Department of Evolutionary Biology and Environmental Studies, University of Zurich, Zurich, Switzerland; ORCID: 0000-0001-8010-4157, oliver.hawlitschek@uzh.ch

Habitat destruction and fragmentation are among the major current threats to Orthoptera worldwide, but especially in Europe. Fragmentation may also affect species with good dispersal abilities, such as the heath bushcricket *Gampsocleis glabra*, a specialist of steppe-like habitats across Europe that are highly fragmented. We genome-wide SNP data generated with ddRAD sequencing to study if these isolated populations can be distinguished using population genomics and if there are any traces of admixture or dispersal among them. F-statistics and STRUCTURE plots showed that all populations except one that was represented by a singleton were clearly distinct, with limited but visible admixture across most populations and probably also an exchange of individuals between populations of Germany and the Netherlands. We suggest that the conservation of larger populations should be maintained, that the preservation of even small habitat fragments may be beneficial for the conservation of this species, and that these habitats should be regularly monitored for possible (re-)colonization.

#### Monitoring of *Barbitistes serricauda* in Germany

Lisa Reiss

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Barbitistes serricauda is one of the few Central European Orthoptera species occurring in forest habitats. It occurs in different forest types, particularly in oak-hornbeam forests. These are considered valuable for nature conservation due to their high insect diversity. However, the exact habitat preferences of Barbitistes serricauda were previously unknown. We analyzed the light regime, the vegetation composition and the vegetation structure in various forest types using hemispherical photography and detailed vegetation surveys in Rhineland-Palatinate (Germany). Our results shed light on the common denominator of the previously known habitat spectrum - almost literally, as there is a significant correlation between the presence of the species and the degree of canopy openness. We also tested three different monitoring methods for Barbitistes serricauda along nine transects: Visual search for nymphs at forest edges in spring, insect baits and ultrasonic detectors. Our results show that bioacoustics monitoring using an ultrasonic detector between 16:00 and 21:30 in July is optimal for mapping. Our data also allows a first analysis of population dynamics for the years 2021-2023.

### Expansion or recolonization: case study with two grasshopper genera *Acrida & Acrotylus* at the northern range border

Krištín Anton<sup>1</sup> & Balla Miloš<sup>2</sup>

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<sup>2</sup> Landscape protected area Latorica administration, J. Záborského 1, Trebišov, Slovakia

Several thermophilous insect species show expansion northwards in the last decades, but in some of them seems to be only a matter of the recolonisation of old historic sites. *Acrida ungarica* (AU) and *Acrotylus insubricus & A. longipes* (AI & AL) are ponto-mediterranean species of Afrotropic origin. The long-term northern edge of these thermo- and psammophilous grasshoppers is in Central Europe (Slovakia). Historically, all these three species were known as rare between 1867 and 1962 in southern Slovakia. AU and AI were more abundant, AU known at cca 40 sites, AI at four sites, AL was found only once (1961) in one site of SE Slovakia (Gulička, Mařan). Later, up to 2010, the

most frequent AU has shown decreasing population and range trend (only 11 sites known), AI was not documented between 1962 and 2019, AL not found between 1961 and 2023 in spite of large sampling effort in all historic sites after 1998. Since 2016 we checked 53 sandy habitats in S Slovakia (SW 31, SC 6 and SE 16), when population and range of AU and AI were increasing and AU was found in 40 sites (SW 28, SC 4, SE 8), AI in 8 sites (only SE) in 2023-2024. AL we found only in 2023 (Aug 21-Nov 3) in two sites of SE Slovakia, always with AI. Recently, the northernmost edge of AU and AI range in C Europe is 48.53N, in AL 48.40N. We describe here the distribution changes from 1960s, habitats, abundance and phenology and compare with surrounding countries. In regard to habitat, AU is the most tolerant and abundant psammophil, occurring also in ruderal vegetation, AI and AL need sandy bare ground with sparse psammophilous vegetation, frequently after human intervence. In connection with overwintering, we could find only AI in all 8 sites from autumnal occurrence. Thus, we hypothesize a recent expansion of AU in new habitats, when AI and AL recolonize historical sites and can spread in anthropogenic bare sandy soils.

### High importance of extensively managed grasslands for the conservation of orthopteran diversity in agricultural landscapes

Hilpold Andreas<sup>1\*</sup>, Repetto Emanuele<sup>1</sup>, Tappeiner Ulrike<sup>1,2</sup>, Guariento Elia<sup>1</sup>:

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<sup>2</sup> Department of Ecology, University of Innsbruck, Technikerstrasse 25/Sternwartestrasse 15, A-6020, Innsbruck, Austria

In order to stop biodiversity decline in European agricultural landscapes, an evaluation of the various land-use practices for single taxonomic groups is necessary. Orthoptera, as an important ecological indicator taxon, inhabit a wide range of habitats. However, the composition in different agricultural habitats differs and land-use changes and management intensification are currently responsible for orthopteran decline. To better understand these issues, we compared 160 grasshopper communities recorded from seven widely distributed land-use types including meadows, pastures, intensive apple

orchards, vineyards, crop fields and settlements. All data derived from the long-term project Biodiversity Monitoring South Tyrol. The surveys were carried out on a plot size of 100 m2 (1000 m2 for settlements) once a year in late summer over a 5-years period between 2019 and 2023. The species were identified by both visual and acoustic assessments within a time span of 30 minutes. We analyzed community composition and species diversity to assess the effects of land-use. We were particularly interested to verify whether extensively managed grasslands of supposedly high conservation and high nature value (HNV farmland) harbor characteristic grasshopper assemblages, which would corroborate the effectiveness of related management practices to counteract biodiversity erosion. Our results showed in fact a high Orthoptera diversity in HNV grasslands. All other land-use types showed significantly lower values, with decreasing scores in vineyards, (semi-)intensive meadows, arable lands, intensive apple orchards and settlements. Moreover, extensive grasslands supported communities of more specialized species whilst all other non-HNV land-use types showed communities characterized predominantly by generalists. Hence, we found supporting evidence for the effectiveness of regional Agri-Environmental Measures (AEMs) for grasshopper conservation, which give subsidies for extensively managed hay meadows. The strategy of many European conservation schemes to promote the preservation of extensively managed grasslands seems to be the most promising to support a diverse Orthoptera fauna in European cultural landscapes. Furthermore, we clearly show the poor ecological state of Orthoptera communities in more disturbed land-use types (including urban areas) and recommend adopting measures to improve the ecological value of these environments.

### Desert long-horned grasshoppers (Tanaoceridae) and razor-backed bush-hoppers (Xyronotidae). An update in their IUCN assessments

Ricardo Mariño-Pérez

Vice Chair for North and Central America, Grasshopper Specialist Group, Species Survival Commission, IUCN, pselliopus@yahoo.com.mx

Desert long-horned grasshopper (Family Tanaoceridae) consists of two genera with three species (*Tanaocerus koebelei*, *T. rugosus* and *Mohavacris* 

timberlakei). They are unusual and relict lineage with a very restricted distribution in desert habitats in southwestern US, mainly in the states of California and Nevada and with some records from Arizona and Utah. In northern Mexico, there are few records from Northern Baja California and probably Sonora state. They are small, wingless and are unique in all grasshoppers in having long and filiform antennae (longer than the entire body itself). Males possess a stridulatory organ on the third abdominal segment which function is probably acoustic communication but their biology is not well known. Razor-backed bush-hoppers (Family Xyronotidae) consists of two genera with four species (Xyronotus aztecus, X. cohni, X. hubbelli and Axyronotus cantralli). They are unique and relict lineage (its closer relative is endemic to Southeast Asia, Family Trigonopterygidae) found in cloud forest in the states of Veracruz, Oaxaca and Chiapas, Mexico. They are characterized by a laterally compressed body, lack of wings and tympanum, and the presence of a crescent-shaped row of stridulatory ridges on the abdomen. Both families are relict lineages, evolutionary distinct from their closest relatives, possess unique stridulatory structures and have very narrow distributions threatened by land conversion. Both taxa are priorities (targets) of the Grasshopper Specialist Group and here we discuss new and valuable information from two recent expeditions sponsored by an SSC EDGE Internal Grant, the first one to California and Nevada states in the USA and the second one to Veracruz, Oaxaca and Chiapas states in Mexico. These expeditions allowed us to observe first hand the threats and conservation status of the localities visited. In general, many of the populations from different species from both families in both countries are found in well-protected areas ranging from national and state to local and private levels. However, threats such as land conversion, fire and deforestation exist. This recent information coupled with an exhaustive review of type and non-type material from the main collections in the USA (University of Michigan Museum of Zoology, UMMZ; Academy of Sciences, Philadelphia, ANSP and California Academy of Sciences, CAS) has allowed us to generate well-informed distribution maps to provide precise IUCN assessments that will help stakeholders to take decisions to protect their habitats. People from Mexico and USA will benefit as well as humanity in general because two EDGE lineages will be better understood.

### Records on the possible effect of climate changes on the distribution of some orthopteroid insects

#### Paolo Fontana

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In recent years, several studies have been conducted in high-altitude mountain areas of Italy, both in the Alps and the Apennines. The aim of this research was to search for species of Orthopteroids typically living in high mountain habitats, with particular attention to the Orthoptera and Dermaptera. Some genera of Podismini such as Podisma Berthold, 1827, Italopodisma Harz, 1973, Epipodisma Ramme, 1951 and Bohemanella Ramme, 1951 and the Dermaptera of the genera Chelidura Latreille, 1825, Forficula Linnaeus, 1758 and Pseudochelidura Verhoeff, 1902 have been the subject of research. Even in the absence of quantitative and continuous data, it is still possible to assume that a rarefaction of some taxa or their movement to higher altitudes, where this is possible, is underway, although it cannot be said for how long or how much. In fact, research conducted in locations known to be the Locus typicus of some taxa and in many other locations known for the presence of some of these species according to bibliographic and collection data, in many cases gave negative results or the species were found with populations extremely reduced. This is the case for example of *Podisma pedestris caprai* Salfi, 1935, described from Alpe Finestre (Biella, Italy) and found abundant in the same locality in recent decades, according to literature, but not found during research conducted in 2023. Another emblematic case is that of the Chelidura genus. Most of the localities (having an adequately precise location) known to host populations of these typically Alpine Dermaptera, visited in recent years did not return any specimens while the species Anechura bipunctata (Fabricius, 1781) was very abundant in the same localities. A population of Forficula apennina Costa, 1881 monitored for several years during the 1990s at the Rifugio Duca degli Abruzzi (Gran Sasso, Italy) was no longer found during research conducted in the last 3 years, but was found a few hundred meters further away high, on Mount Aquila (Gran Sasso, Italy), where in previous years it had never been found. Epipodisma pedemontana (Brunner von Wattenwyl, 1882)), in some locations where it was found abundantly in the early 2000s, was found to be scarce or absent during recent trucking. It is

not possible to say whether these declines in populations are to be explained by normal demographic fluctuations, typical for many species of Orthopteroids, or are to be interpreted as a real rarefaction, but it would be important to create a monitoring network for at least some of these typically high-quality species. altitude to verify the possible hypotheses of these phenomena.

### Selected localities for monitoring Orthoptera in Trento province across time

Ettore Rivalta<sup>1</sup>, Costanza Geppert<sup>2</sup>, Lorenzo Marini<sup>2</sup>, Gionata Stancher<sup>1</sup>, Filippo Maria Buzzetti<sup>1</sup>

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Aim of this study is to assess the Orthoptera species composition of selected localities in Trento province and compare the results with the species detected in previous similar researches. Thirty-three localities have been chosen among those surveyed in 2008-2009, samplings have been carried out with the same methods. Preliminar results show a decrease in the number of species (49 in 2008-2009 vs 43 in 2022-2023). The relative abundance of species have changed with *Pseudochorthippus parallelus, Stauroderus scalaris, Decticus verrucivorus* being the most abundant in 2008-2009, *Chorthippus dorsatus, Pseudochorthippus parallelus, Chorthippus brunneus* in 2022-2023. Also the species composition has changed with the appearance of *Decticus albifrons*, a thermophilous species every year more abundant and distributed.

### Orthoptera Conservation in Italy, Zeuneriana marmorata and Anonconotus italoaustriacus

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After the successful establishment of a new population of Zeuneriana marmorata in NE Italy, questions arise about its future and its implications on conservation efforts of other Orthoptera species in Italy, such as Anonconotus italoaustriacus. The new population of Z. marmorata originates from the translocation of individuals from a nearby area. Specimens of both sexes from the same donor site were bred in captivity, with females laying eggs in an artificial substrate, which hatched the following year. This initiative was part of an international collaboration between national and foreign institutions. To determine the success of the translocation, monitoring of the newly established population is required for at least two years. Captive breeding is essential to produce multiple-purpose individuals. Ongoing in situ monitoring, alongside captive breeding and observation, is necessary to gain a comprehensive understanding of the species' ecology. If this approach has been successful on this species, could it be applied on others? The next target is the population of A. italoaustriacus in the Dolomiti Bellunesi National Park: one of the only three populations of the species in Italy, this is the most isolated and genetically divergent. Assessing the current status of this population, understanding its ecology, evaluation of possible threats and spotting suitable areas of presence/translocation are some of the key factors for the success of this species conservation.

#### One season of Orthoptera research projects in Croatia

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Last year (2023) was a very productive one for Croatian orthopterology. Apart from contributions done through scientific publications, some of which will be presented at this congress as well, there were also research and conservation projects focused on Orthoptera, some of which are still ongoing. In the summer of 2023 a governmentally funded research of *Saga pedo* was

conducted in Croatia. Saga pedo (Pallas, 1771) is the only orthopteran species protected by law in Croatia and is thus a part of national monitoring programmes. Through the conducted project fundamental steps towards better understanding of this species were made, including data gathering of all available records, new data gathering through fieldwork, and species monitoring program design, testing, and improvements. This project was only the first for the species, with future projects planned to follow up and upgrade the current knowledge. An ongoing project "Assessing the sensitivity to habitat changes of grasshoppers in the genus Prionotropis" is focused on research of P. hystrix (Germar 1817) in Croatia. Project aims to deepen our understanding of *P. hystrix* by gathering data on its ecology, behavior, and morphometry, and hopefully also through molecular research in near future. Due to a very shortened activity period of P. hystrix in Croatia in 2023 the project was not finished as planned and was extended to enable research in the upcoming season, a normal but perhaps not a well known thing to happen to research of seasonally active animals. Final goal is to use the knowledge to help aid conservation efforts of its threatened congeners through collaboration efforts established during the project.

### "Grasshopper Summer School 2023 in Greece" Inspiring the next generation of Orthoptera enthusiasts

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Greece is a hotspot for grasshopper species in Europe. With 378 different species, a lot of them endemic and red-listed makes Greece a great place to study this insect group. After publishing their field guide about the "The Grasshoppers of Greece", the authors decided to get this in full use and inspire a new generation of Orthoptera enthusiasts. That was when last year the first European Summer School on Orthoptera Taxonomy and Conservation took place in Konitsa, Greece. After having introductory online lectures on grasshopper ecology, systematics and conservation, a group of five teachers and 20 students from all over Europe explored the grasshopper fauna of different

habitat types in Epirus during one week in July in 2023. Students were introduced into several field techniques, species identification in situ and ex situ and preparation of specimens in the laboratory. In the end the students held presentations about one species they had chosen and studied in more detail during the field surveys. Certificates were handed after passing the final exams and 5 ECTS were given. It was a wonderful time and we want to share our experience with you!

### Identifying ecological corridors of the bush cricket *Saga pedo* in fragmented seminatural-grasslands

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The bush cricket *Saga pedo*, currently listed as Vulnerable globally by the IUCN and included in Annex IV of the European Union Habitats Directive, is a parthenogenetic species, highly sensitivity to environmental changes and thus facing threats due to the expansion and encroachment of forests as well as the intensification of agriculture. Indeed, *S. pedo* prefers dry and open habitats with sparse vegetation, and due to its pronounced thermophily and heliophily, it occurs in xerothermic patches, thereby establishing itself as a primary insect indicator of these habitats. Semi-natural grasslands are highly fragmented in many areas of Italy, including the Northern Apennines (Piedmont, Italy) where we carried out this study. Here, open habitats have been reduced to small and isolated patches surrounded by forests due to the abandonment of agropastoral activities such as mowing and extensive

grazing. Consequently, the occurrence of open habitat species in these territories is related to the quality and availability of suitable areas, as well as ecological connectivity between the remaining open patches. To identify areas of occurrence for the predatory bush cricket, *S. pedo*, we applied spatial site occupancy models and then used the inverse of the resulting probability of occurrence to derive ecological corridors among suitable patches for this species. In conclusion, given the risk of extinction S. pedo is facing in our study area, we urgently advocate the intervention of local administrations and managers to maintain and possibly improve suitable areas for conservation and guarantee the network of ecological corridors, identified in our research.

### The GPTs Red List: can Artificial Intelligence help in species conservation?

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The recent mainstream diffusion of new Artificial Intelligence models, such as large language models (AI - LLM), has opened new windows also for scientific study and research even in previously unexplored areas. In recent years, AI models applied to large biodiversity databases have already started to show the great potential of these technologies applied to natural sciences, as well as the risks due to misuse and various environmental costs. Some further possible virtuous applications of AI to species conservation are discussed here, both from a general point of view, through i.e. the training of specific GPTs that can assist specialists in assessing the species threat level or in compiling red-lists, according to IUCN procedures, and in the creation of predictive machine learning models to identify conservation priorities for the most threatened species, with a particular focus on the orthopteroid insects. Further study and the creation of a roundtable to discuss future AI developments in the field of species conservation are therefore encouraged.

### Glacial legacies: Refugial dynamics of the endemic bush cricket Anonconotus italoaustriacus

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Temperate mountain ranges such as the European Alps are home to a large number of endemic species. However, the evolutionary processes underlying patterns of endemism in the Alps remain poorly understood, especially for Alpine arthropods. This research focuses on the bush-cricket species Anonconotus italoaustriacus, which is endemic to the Southern Limestone Alps (SLA) and the Eastern Central Alps. The study uses genomic data to investigate the species' diversification and refugial dynamics, comparing two non-exclusive evolutionary hypotheses to explain its extant distribution. We find that A. italoaustriacus did not recolonize the Alps from the southern margin of the SLA, but from refugia on the eastern or southeastern margin of the Alps. All known populations in the interior of the Alps originate from these eastern refugia, suggesting a dynamic spatiotemporal history including rapid range expansions. The age of interior populations coincides with either the last glacial maximum or the postglacial period (~32-5 ka), which is likely the result of allopatric isolation facilitated by large glacial advances and the subsequent postglacial expansion of forests. A geographically isolated population from the southernmost Dolomites was resolved as phylogenetic sisters to all other lineages, which separated before the last interglacial period (~220 ka). Our results contribute to a deeper understanding of Alpine biogeography and have important implications for the conservation and management of A. italoaustriacus that might be applicable to other endemic species in these area.

### Biological relation between the red listed species *Barbitistes vicetinus* (Orthoptera: Tettigoniidae) and a ground-searching parasitoid

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#### Abstract

Barbitistes vicetinus, a bush-cricket endemic to northeastern Italy (including the Lessinian mountains, Euganean and Berici Hills), was first described in the early 1990s by Galvagni & Fontana and considered a rare species for the subsequent decade. Due to its restricted range, it was included in the red list by IUCN as endangered species. However, since 2008, recurring outbreaks occurred in the Euganean Hills, resulting in significant defoliation of forests and adjacent crops. During a research project in an outbreak area, several eggs were collected from the forest soil, leading to the discovery of a new egg parasitoid species, Platvstethynium triclavatum (Hymenoptera, Mymaridae). This wasp is present throughout the Euganean Hills, however, its capability to parasitize B. vicetinus remains to be fully elucidated. This research aimed to reveal biological attributes of *P. triclavatum*, including field and laboratory data on parasitization rates, fecundity, and hatching period. Additionally, genetic characterization of five subpopulations from various outbreak sites was conducted by analysing both nuclear and mitochondrial DNA fragments. Low parasitization rates were found across the five sampled sites. However, the potential impact of this parasitoid on regulating host populations is better reflected by the average number of individuals that can hatch from a single B. vicetinus egg (95). Like many other Tettigoniid this bush-cricket is univoltine and its eggs have the capacity to enter a prolonged diapause of two or more years. Results showed that parasitoids were able to oviposit on B. vicetinus eggs of different ages, exhibiting a higher rate of embryonic development in one-year-old eggs compared to newly laid eggs. Genetic analysis revealed low values of haplotype diversity within subpopulations and the presence of two main haplotypes diffused across almost all the sites.

### DNA barcoding and species delimitation of Orthopterans from the Mediterranean Basin

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The Mediterranean Basin, recognized as one of the primary biodiversity hotspots globally, showcases a remarkable variety of grasshoppers, katydids, and crickets. This diversity is evidenced by numerous centers of endemism and isolated populations. Traditional taxonomic methods often yield results that differ from those obtained through molecular approaches, such as DNA barcoding. This methodology relies on extracting standardized sequences of mitochondrial DNA (mtDNA), specifically the cytochrome c oxidase subunit I (COI), to identify biological samples by comparing them with existing databases. The current research evaluates the effectiveness of DNA barcoding for species delimitation across a comprehensive dataset of Orthopterans' COI sequences. Initially, our dataset comprised 1,469 barcodes from 275 identified species within the Ensifera and Caelifera suborders. Subsequent phylogenetic analysis with Maximum Likelihood (ML), and BIN discordance analysis, implemented by the BOLD (Barcoding Of Life Data) systems, were performed incorporating these sequences with additional data from two other barcoding projects. The final dataset featured 2,606 barcodes representing 349 identified species, alongside numerous unidentified records. The findings indicate that DNA barcoding enables reliable identification for up to 71.39% of the species evaluated, with a remarkably higher success rate in Ensifera (88.53%) compared to Caelifera (52.15%). Five species delimitation methods (BIN, ABGD, ASAP, GMYC, and PTP) were applied to this dataset, pursuing consensus results. The resultant delimitation patterns, discussed by taxonomic

family, suggest a substantial presence of cryptic biodiversity. Further research is however necessary to elucidate the taxonomic status of numerous species and subspecies. At the same time, challenges such as Incomplete Lineage Sorting (ILS) and hybridization, known to impact barcoding efficacy in Orthopterans, present significant obstacles. Despite rigorous quality protocols, phylogenetic and taxonomic delimitation of certain taxa remains contentious, prompting the recommendation for multi-locus strategies to address these complexities.

### Hopping across the mountaintops of South Balkans: the phylogeny of the genus *Oropodisma* (Acrididae: Podismini)

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The Balkan Peninsula is a well-known Palearctic biodiversity hotspot. It has a complex geological history and geomorphology with long mountain ranges and a large number of high-altitude summits. These are often isolated, forming sky islands and hosting a plethora of endemic species, and thus presenting a great "natural laboratory" for evolutionary studies. The grasshopper genus Oropodisma is a typical inhabitant of these sky islands. It consists of ten described species and many populations with unclear taxonomic status, which are restricted to the mountain summits of the South-Western Balkan Peninsula, usually above 1600 m altitude. All known species are currently listed as Threatened in the IUCN Red List of Threatened species. This study aims to define the phylogenetic relationships of Oropodisma populations originating from different mountains based on molecular methods, and to discuss hypotheses about their evolutionary history. We performed collecting trips in 26 mountains of the South-Western Balkan Peninsula. Total DNA was isolated from hind leg muscles, sequences were obtained via the Sanger method, and phylogenies were reconstructed using Bayesian Inference and Maximum Likelihood analyses. Our results show two distinct phylogenetic clades in Oropodisma, one including the samples from Peloponnese and the other from continental Greece. We suggest that the Pleistocene glacial cycles have played

an important role in the evolutionary history and current distribution patterns of the genus, as it is the case for numerous other taxa in the area. Our results set a background for taxonomic revisions, discussions on species response to climate change, and highlight the need for implementing conservation measures for some *Oropodisma* taxa.

#### Recent improvement in the knowledge on the conservation status of two Iberian endemic Stone Grasshoppers in Portugal

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Since the Iberian revision of the Pamphagidae family carried out by Llorente and Presa in 1997, there have been few studies focused on the biology and ecology of the Stone Grasshoppers species that occur in the Iberian Peninsula. There are five genera of Stone Grasshoppers in Portugal and the genus Acinipe is one of the least known, with only two species occurring in Portugal: *Acinipe ignatii* and *Acinipe paulinoi*. As a result, these two species were assessed as Data Deficient in the European Red List of Grasshoppers, Crickets and Bush-crickets in 2016. During the first Red List of Terrestrial and Freshwater Invertebrates of Portugal assessments, which took place between 2019 and 2023, it was possible to evaluate *A. ignatii* as Vulnerable and *A.*  paulinoi as Least Concern. However, the assessments were based on the geographic range and the decline of suitable habitat, highlighting the need for more in-depth studies on these species. These results, together with recent data collected during faunistic surveys carried out in southern Portugal, encouraged the creation of a study aimed at filling the knowledge gaps about the biology and ecology of these two species, as well as obtaining more detailed information on their major threats, so that strategies for their conservation can be designed. In this work, financed by the Mohamed bin Zayed Conservation fund, a detailed study on their distribution range was carried out, where all the occurrence locations were checked, the number of individuals counted, and ecological requirements as well as major threats were identified. A phenological study was also performed in which it was possible to characterize the different stages of development and principal food plant species. Due to the high morphological similarities between the two species, we also performed a careful morphological analysis of all the adult specimens collected and a genetic analysis on them.

#### A national Red List of Orthoptera for Luxembourg

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Red Lists are an important tool to inform conservation decisions as they provide information about the extinction risk of species and help to prioritize species for conservation action. In addition to the international IUCN Red List, many countries also maintain national or even regional Red Lists. A first national Red List of Orthoptera for the Grand Duchy of Luxembourg has been published by Proess & Meyer in 2003. This Red List is meanwhile outdated and, therefore, the Orthopterists in the country have agreed to conduct a re-assessment of all Orthoptera species in the next years. During an atlas project by Proess (2004) a total of 200 study sites was surveyed for Orthoptera. To obtain better information on the population trends of Orthoptera, we have chosen 100 of these sites with the aim to obtain a good sample size for all species. The first 56 study sites were surveyed in 2023 and the results confirm trends observed in neighbouring regions, such as

Rhineland-Palatinate. While average alpha diversity increased, we found evidence for biotic homogenization, i.e. a decrease in beta diversity. Some species benefited from climate change, such as *Oedipoda caerulescens* or *Calliptamus italicus*, which has just recently colonized the country. Highly specialized and flightless species showed the strongest declines, such as *Decticus verrucivorus* or *Pseudochorthippus montanus*. In 2024 we aim to complete the surveys so that re-assessments can be completed in 2025.

#### New insights into the distribution of Eisentrauts's Bow-winged Grasshopper *Chorthippus eisentrauti* in the Eastern Alps

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It is well documented, that Chorthippus eisentrauti is endemic to the southern parts of the Central European Alps. However, during the last decade populations of grasshoppers with features of C. eisentrauti were also found along the northern ridge of the Alps amidst the large area of its closest relative, the Bow-winged Grasshopper C. biguttulus. To assess the status of these disjunct populations, individuals of both species as well as of the Common Field Grasshopper C. brunneus were collected and measured and their songs were recorded from over 25 mountain ranges in the Northern Limestone Alps as well as from the "traditional" sites south of the alpine main ridge. Morphological parameters (ratio of the width of costal- to subcostal field, wing length, width of the head) and song parameters (length and number of verses) did not differ between the populations north and south of the alpine ridge, but showed significant differences to C. biguttulus and C. brunneus from the same mountains. The habitats of C. eisentrauti are typically steep, sun exposed limestone cliffs and scree fields with very sparse vegetation, where only few other species of Orthoptera occur syntopically. They differ

markedly from the ones occupied by *C. biguttulus*. We conclude that *C. eisentrauti* is therefore well established in the northern parts of the Alps and that colonization came from glacial refuges at the southern and northeastern edge of the ice-shield prior to *C. biguttulus*. This widespread species reached these areas later and forced *C. eisentrauti* to retreat to its small isolated habitats too extreme to be inhabited by its sibling species. Differences in habitat choice and song preserved the status of the sister species despite the known potential of hybridization.

#### Climatic niches of Orthoptera along micro- and macroclimatic gradients: Case studies from the Berchtesgaden Alps (Germany)

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Temperature is one of the main drivers shaping assembly processes and, therefore, diversity. Yet, local microclimatic effects on species and trait compositions of Orthoptera assemblages have rarely been assessed along macroclimatic temperature clines. Especially, microclimatic heterogeneity is suggested to play a crucial role for securing populations in the face of climate change. We combined ecological and morphological traits in Bayesian joint species distribution models to investigate how traits drive variation in the climatic niches of 32 grasshopper species on 93 grassland sites with different microclimatic conditions along a steep elevational macroclimatic gradient in an Alpine region in Bavaria (Germany, Central Europe). Additionally, we modelled microclimatic heterogeneity to assess its effect on the Orthoptera communities at the sites. Species richness and abundance decreased along the micro- and macroclimatic gradients. Microclimatically heterogeneous sites harboured the most diverse communities. Interactive effects of elevation and microclimate on the abundances were, however, species-specific, and partly mediated by traits: Warm microclimatic niches facilitated the persistence of demanding xerophilic and late-hatching species also in higher elevations, resulting in marked community dissimilarities between microclimatically cold and warm sites. The microclimate response of some species was

elevation-dependent. Intraspecifically, only the body sizes and wing lengths of the larger females decreased with elevation like the community mean, and brown colour morphs were more frequent at sites with warm microclimate. Our results suggest trait-dependent responses of species to micro- and macroclimate in the assembly and structuring of insect communities. Since microclimate effects can change with elevation, we conclude that both microand macroclimatic gradients must be considered when predicting species responses to climate change. Microclimatic contrasts between sites as well as site-level heterogeneity enhanced beta- and alpha-diversity, respectively, highlighting the invaluable conservation importance of mountains as climatic refugia where species with diverging niches can persist in proximity.

#### Distribution pattern and conservation ecology of two globally threatened Orthoptera species of Greece

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Greece hosts 35% (378 species) of the European Orthoptera fauna with a high degree of endemic (37%) and threatened species (37%). We employed plot sampling (100 m2) to investigate the distribution pattern and ecology of two Greek mountain endemic and red-listed species: *Parnassiana parnassica* (CR) and *Oropodisma parnassica* (EN). Both are confined in the high-altitude areas (1527-2320 m) of Mts Parnassos and Elikonas. We used Species Distribution Models with Random Forests in an ensemble of small models' framework to estimate their suitable habitat. The topographical position index and slope drives the distribution of *P. parnassica* and the Normalized Difference Vegetation Index (NDVI) and slope that of *O. parnassica*. It occurred

in 26 patches (effective mesh size of 156,73 ha) and presented a rather high patch cohesion index (98.66 %), while *O. parnassica* occurred in 56 patches (effective mesh size of 30.01 ha) with a lower patch cohesion index (95.1 %). Generalized linear models showed that the abundance of *P. parnassica* was negatively influenced by the mean height of herbaceous vegetation, and the abundance of *O. parnassica* was positively influenced by altitude. The species' restricted and patchy ranges emphasize the importance of continuous monitoring and up-to-date distribution data to guide conservation initiatives. The expansion of a local ski resort and wind turbine installations could pose serious future threats to the species' habitats.

### Unlocking the Unknown: the case of *Holaptilon* (Mantodea: Gonypetidae) for the conservation of new species

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More than 2500 species of Mantodea are known worldwide and others are described each year. Still, their ecological needs, biogeography, phylogeny and conservation are mostly unknown. In this changing world, these unknown species might suffer the effects of human activities like land use and climate change as many other taxonomic groups without even being studied. Here, we present the ecology, phylogeny and biogeography of four newly described species of *Holaptilon* genus in the light of conservation. These species are restricted to geographically small problematic areas, making them particularly susceptible to the risk of extinction due to the combined effects of climate change and human activities. Using these species as a showcase, we propose the value of preliminary assessments of the threatened status of understudied species using IUCN criteria in their description. Moreover, we show how

sensitive these species are to changes in the ecosystem similar to other praying mantids, making them potential bioindicators. This means that changes in their population and behavior, emerging from the data used in their formal description, can provide valuable insights into the overall health and ecological balance of their habitats. Thanks to the description of these new species, emphasizing their taxonomic status and their ecological needs, we aim helping implementing effective conservation strategies to safeguard understudied biodiversity in a rapidly changing world.

#### Integrative taxonomic, demographic, and extinction risk assessment of Podismini grasshoppers (Orthoptera: Acrididae) from Mediterranean sky island archipelagos with extreme vulnerability to climate change

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Mediterranean sky island archipelagos harbour extraordinarily high levels of local microendemism and often represent the warm distributional margin for many cold-adapted taxa more widely distributed at higher latitudes. However, despite the high vulnerability to climate warming and great conservation value of Mediterranean sky islands, the geological, evolutionary, and ecological processes that have shaped their rich biodiversity remain poorly-known, the taxonomic status of their putatively endemic species is often controversial, and the fate of their populations under future climate change scenarios has never been forecasted using mechanistic models incorporating species-specific demographic parameters. Here, we focus on three radiations of Podismini (Orthoptera: Acrididae) grasshoppers from the Iberian (genus Podisma), Italian (genus Italopodisma) and Balkan (genus Oropodisma) peninsulas that currently form extremely isolated populations and include several taxa classified as "critically endangered" in the IUCN Red List of Threatened Species. Specifically, we aim to (i) integrate genomic data and phenotypic information to evaluate the taxonomic status and evolutionary distinctiveness

and cohesiveness of the different taxa within each species radiation; (ii) infer the processes that have contributed to the high levels of local microendemism among alpine biotas from Mediterranean sky islands; and (iii) document recent distributional shifts, determine the factors that have shaped the demographic history of each species, evaluate alternative spatiotemporally-explicit demographic and coalescent models, and use the inferred parameters to forecast the fate of the species and populations under future scenarios of global warming and identify those that will be more vulnerable/resilient to climate change. We will present some preliminary results of this project, with particular emphasis on distributional shifts towards higher elevations and severe population declines documented for certain taxa, phylogenomic inference and integrative taxonomy, and genomic-based demographic reconstructions of populations.

#### How Gianni Pavan helped us on Orthoptera bioacoustic

Cesare Brizio<sup>1</sup>, Filippo Maria Buzzetti<sup>2</sup>

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The late Gianni Pavan, professor at the University of Pavia, was an outstanding researcher on marine mammals ecoacoustics. But his interest for Nature, deriving from a familiar background and from an intimate vocation, had his attention turned also to other animals such as birds and orthopterans. He was also a reference personality for soundscape studies. We try to outline his technical expertise, his eclecticism and his genuine modesty. Gianni devoted time and energy also for bioacoustic outreach projects that involved non-scholarly nature recordists.

Relative performance of passive acoustic monitoring with Audiomoth compared to traditional transect methods, and construction of an automatic machine learning classifier for Orthoptera in Schleswig Holstein, Germany.

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Passive acoustic monitoring (PAM) uses stationary recorders to detect wildlife in monitoring or conservation programs. The method has long been valuable for surveying certain species groups, especially bats. However, until recently, PAM has been limited by the costs of recorders and the availability of automatic classifiers to assist data analysis. With recent developments of inexpensive devices, such as Audiomoth, landscape scale monitoring has become more feasible. This also opens new possibilities to apply PAM to species groups that traditionally have been studied via expert-based, labour-intensive active acoustic, optical or trap monitoring, such as Orthoptera. Utilizing sound recordings of Orthoptera from online databases, Orthopteran specialists and from recordings made during our own works, we built and assessed a machine-learning classifier to automatically identify 17 Orthoptera species. Assessment included the comparison of PAM to traditional netting surveys along transects. We also compared the performance of inexpensive Audiomoth with classic Batlogger stationary bat recorders for surveying Orthoptera species with PAM, at eight of our sites, where we also tested whether adding two additional Audiomoths in 50 m distances from the initial device towards the edge of the wildflower area would increase species detections. We also assessed how the number of species detected changed over time. In total, we detected 20 Orthopteran species during the study. Our new classifier (which covers 17 of those species) achieved a true positive rate of 86.4% validated against independent test data. PAM outperformed traditional sweep netting transects overall. There was no difference in the number or identity of species detected by Audiomoth v1.2 or Elekon Batlogger A+. There was no difference in the species communities detected by three devices compared to one device, nor any difference between hedgerow and centre communities. We conclude that relatively inexpensive equipment allows for

effective PAM of Orthoptera. The classifier we have constructed here could represent a useful tool for future PAM studies or monitoring schemes in northern Europe, and serve as an extendable basis for studies elsewhere in Europe. Provided that species presence predictions are verified by an expert, the new classifier offers additional options in research, monitoring, and conservation of Orthoptera at a broad range of temporal and spatial scales.

#### Training for building a European Orthoptera sound database

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The creation of machine learning tools to recognize male grasshopper (Orthoptera) sounds can have a practical impact on biodiversity monitoring and conservation efforts. By training people in sound-based identification of grasshoppers and collecting sound data using open access websites, new sound recognition models can be developed and published. We present TEOSS, the on-going project aiming at training basic field skills for recording Orthoptera bioacoustic. TEOSS is funded by the TETTRIS, a contribution of CETAF - the Consortium of European taxonomic facilities - to provide knowledge, systems and services to tackle biodiversity loss. We have decided to plan for four events in total: one basic training workshop in each of the Mediterranean peninsulas and one advanced training camp dedicated to explore the least studied region from the point of view of Orthoptera bioacoustics. The aim of the workshops is to teach field and lab procedures which allow to upload sounds and their metadata to Xeno Canto website. We call interested parties into participating to the training camps and ask informations about sharing their records on Xeno Canto

### Rthoptera, a New Open-source Software for Standardized Insect Bioacoustics

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A century after insect bioacoustics was founded, the methods for measuring sound are not fully standardized. Many of the software used in bioacoustics research is proprietary, limiting access by researchers in many countries. Additionally, the default parameters vary by developer, making comparisons between measurements made with different software problematic. An alternative adopted by researchers is open-source tools that require some programming skills. The R programming environment has become the standard for statistical analysis by many researchers worldwide, and its capabilities have expanded to cover virtually all the steps in a researcher's workflow. Leveraging the ever-growing capabilities of R, we developed "Rthoptera", a package for standardized measurements of insect acoustic signals. To overcome potential barriers to initial researchers, we wrapped up the package as a Shiny app, which integrates a Graphical User Interface (GUI) for those without experience in R.

### Orthoptera in Xeno Canto. Recent progress in sharing sound recordings worldwide

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In the past year the online platform for nature sounds www.xeno-canto.org has been greatly enriched with Orthoptera sounds. Throughout the world people have become active, sharing their sound recordings. However, especially in Europe and with some extra funding, we have been able to disclose the songs of most of the about 700 loudly singing species, spread over many thousands of individual sound recordings.

### Passive acoustic monitoring as a possible method to detect night-singing Orthoptera

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Inspired by the serendipitous discovery of Acheta pantescus Massa, Cusimano, Fontana & Brizio, 2022 during the review of passive acoustic monitoring (PAM) recordings, we explored the potential of unsupervised recorders as tools for the assessment of orthopteran biodiversity. We report the results of a one-month, nightly PAM campaign in two Apulian locations, that resulted in the observation of no less than 19 (nineteen) species, including the observation of Pteronemobius heydenii (Fischer, 1853), previously unreported for the area, and the putative recognition of the Lombard effect in the songs by *Oecanthus* pellucens (Scopoli, 1763). Our presentation introduces the concept of Surviving Acoustic Signature (SAS) as opposed to an exemplary audio file (RAS for Reference Audio Sample), and addresses the special issues of medium-quality record settings (24 kHz sampling frequency, 0 kHz - 12 kHz band), chosen as the best compromise between quality and storage capacity. After illustrating the manual filtering techniques adopted for song separation in contested soundscapes, an analysis and diagnosis workflow is outlined, and some of the several lessons learned are presented. At the price of substantial labour, PAM proved suitable for a preliminary assessment of the diversity of the night-singing orthoptera.

### Novel insights into the natural history of a Western Carpathian endemic – *Pseudochorthippus tatrae*

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Montane areas are characterised by many species specialized in living in these environments. Vast majority of mountain endemic species may exhibit extremely restricted ranges. An example of such organism is the Tatra Grasshopper *Pseudochorthippus tatrae* (Harz, 1971) which inhabits Western Carpathian Mountains. Initially described as a subspecies of *Chorthippus apricarius*, subsequently transformed into *Ch. tatrae* and later transferred into *Pseudochorthippus* genus, this grasshopper species had remained elusive with poorly known ecology. Conducted research aimed at the better understanding of the species' acoustics, morphology and habitat preferences. Field studies had been held in Tatra National Park (TNP) in Poland and Slovakia, during August 2022 and July 2023. All observed individuals were photographed. If it

was possible, males were recorded via camera for documentation purposes and further studies on their morphology. Observations on the numbers of specimens, ecological preferences within the sites and any additional information were noted during fieldwork. All of the georeferenced records of P. tatrae and its sister species, Ch. apricarius, were downloaded from the orthoptera.sk website in order to analyse the niche preferences of these orthopterans. Then, within a 25 m radius of each observation, the presence of forest, anthropogenic disturbed ground, and grassland was assessed by inspecting satellite images. Finally, a generalized linear model with a binomial logit link function was fitted. The model included occurrence of P. tatrae (using Ch. apricarius sites as absence) as response variable and the presence of forest, anthropogenic bare ground, and grassland as predictors. As a result of the 2022's and 2023's fieldwork conducted in TNP eight specimens were recorded in Hala Kondratowa and one near Łysa Polana . Those are the first documented records of *P. tatrae* in Poland. To the best of our knowledge, we have managed to obtain the first recordings of stridulating *P. tatrae* males. Furthermore, our analysis has shown that *P. tatrae* exhibits strong preferences towards habitats with anthropogenic bare ground (p = 0.001, R2 = 0.88), which is the only significant predictor. This raises the question on how the ancestral habitats of a species with such restricted range could have possibly looked like before human arrival. A possible explanation is the activity of large herbivores (e.g., horses, bison, or wild boars) which can disturb soil on a large scale and had been present all throughout Europe in high densities before the arrival of modern humans

### On the way to the conservation of the large banded grasshopper in Hungary – attempts to establish new populations by translocation

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The large banded grasshopper (*Arcyptera fusca*) is a widely distributed species across Temperate Eurasia. In Europe, it occurs mostly in mountain grasslands

of the middle and southern parts of the continent, and it has become endangered in several countries in this region in the last decades. The species has decreased drastically in the last few decades In Hungary as well. According to a recent survey, it occurs in only eight locations in three distant mountain ranges in N-Hungary, opposed to the formerly known 31 localities in six mountain regions. In order to enhance the chance of long-term survival of the species in the mountain ranges where only one or two populations exist, a population recovery programme was started in cooperation with the local nature conservation authorities. Partially successful attempts to establish new populations have taken place between 2018 and 2023 in three locations each in Mountains. Börzsöny in mountain meadows the Bükk and with grasshopper-friendly habitat management. Groups of young adults and large nymphs (20-60 specimens in each translocation event) were translocated from large populations of the same region to apparently appropriate habitats in the given meadow. The success of the establishment attempts were checked in the following years by visual and acoustic methods.

### Biogeographic questions of the Aegean: genetic diversity and dispersal patterns of flightless orthopterans across archipelagos

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The Eastern Mediterranean region attracts the attention of biogeographers because of its thousands of islands and complex paleogeographic history. Despite the large amount of data accumulated, many geographical questions remain unanswered. Crete, which is the largest island in the region, closes the Aegean archipelago-mainland system from the south and stays on the way of faunal exchange between Peloponnese and Anatolia. Geological studies support the isolation of Crete from other landmasses since the end of the Miocene but also suggest the existence of two or more paleo-islands in the area during the Pliocene. Our study focuses on the dispersal routes of flightless orthopterans between Crete and the lands to the north. We compare the genetic diversity of selected orthopterans found on Crete and other islands and test hypotheses regarding their evolutionary history. We outline a deep divergence scenario of Poecilimon cretensis Werner, 1903, which is widespread on the island of Crete but is also found on Antikythira and some islands of the Cyclades archipelago. Our results show relatively high east-west genetic divergence on Crete as well as high genetic distances between the populations on the smaller islands, which reflects a long and complex evolutionary history in the area. We compare these findings with the diversity of other orthopterans in the Aegean region and discuss different patterns of evolutionary history. Finally, we outline deeply diverged populations and subregions that require more attention from conservationists.

#### Species distribution modeling in Orthopterans: benefit or nonsense?

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The luxury of today's science is the ability to use many different methods. In particular the development of new computer-based programs, algorithms and models has been a versatile use of resources. One critical methodology is the modeling of potential distribution patterns using abiotic factors and mathematical models, as well as known historical and recent occurrences. In theory, species distribution modeling can be a useful tool to investigate for e.g. potential dispersal routes of disease vectors, biogeographical dispersal patterns in the past or the potential ecological niche of neobiota. Many different forms of mobility can be observed within grasshoppers. Some species are able to migrate several hundred kilometers, while other endemic species only occur in very specific places. Thus grasshoppers are a very interesting group to study for e.g. distribution patterns, ecological niches or even compare the ecological niche of closely related species by using species distribution modeling. But whether this method is a benefit or absolute nonsense will be discussed in this talk.

#### **Poster abstracts**

#### The importance of wetland remnants for rare and endangered Orthoptera in highly transformed lowlands. Recent data from the provinces of Mantua and Cremona (Lombardy, Italy).

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The provinces of Mantua and Cremona (Lombardy) are located in the core of the Po Valley, a territory highly modified, mainly by intensive agriculture. The presence of numerous watercourses, although highly regulated, allowed that small and isolated wetlands, such as peat bogs, oxbow lakes, marshlands, wet meadows and small hygrophilous woods, still survive in these provinces. The lack of recent studies on the Orthoptera fauna in these wetlands was the reason for the investigations presented, which started in 2019. Populations of Orthoptera species of high ecological value were found: Zeuneriana marmorata (Fieber, 1853) (EN by the European IUCN Red List), known for Italy only from lagoons and coastal areas of the northern Adriatic region; Chrysochraon dispar giganteus Harz, 1975, known for the same habitats but also for some more inland areas of Friuli Venezia-Giulia, with localized and isolated populations; Mecostethus parapleurus parapleurus (Hagenbach, 1822), Stethophyma grossum (Linnaeus, 1758) and Paracinema tricolor bisignatum (Charpentier, 1825) (NT by the European IUCN Red List), species typical of wetlands and with localized and fragmented populations in the Po Valley; Andreiniimon nuptialis (Karny, 1918) (VU by the European IUCN Red List), species known from central Italy with isolated populations and recently along the Po river in the province of Ferrara found (Emilia-Romagna).

#### Guidelines for the management of alien mantises in Europe: a proposal for shared actions between the institutions, the scientific community and the citizens.

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The impacts of new alien invasive species on native communities and ecosystems are often wide, complex and difficult to predict, comprising significant economic costs for identifying, managing and reducing them. Among the recently introduced alien species in Italy, but involving many different European countries there are the Giant Asian mantises Hierodula tenuidentata Saussure, 1869 and H. patellifera Serville, 1839, the Afro-Mediterranean Sphodromantis viridis Forskal, 1775, and at least 2-3 other species under evaluation in the EU. The human-mediated fast spreading of these generalist predators, helped by warmer climatic conditions, led them to reach not only a dramatic increase of their global distribution but also local high-densities of individuals, raising concerns for native ecosystems and biodiversity. Here some guidelines for managing alien Mantodea and limiting their further spread to new areas and ecosystems are proposed. Different level are suggested: institutional actions to promote scientific research and fast and shared early detection and biocontrol actions, according to the existing EU frameworks; citizen-science guidelines to help citizens in their correct interaction with these species and to avoid misinformation, cognitive bias and anti-scientific practices and set up a virtuous exchange of information and knowledge with the scientific community, crucial to better understand the diffusion dynamics and complex impacts of these species.

## *Dinarippiger* gen. nov. (Tettigoniidae: Bradyporinae: Ephippigerini), a new saddle bush-cricket genus for *Ephippiger discoidalis* Fieber, 1853 from the Dinaric karst

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Ephippiger discoidalis Fieber, 1853 was a former name carried by a very common species of bush crickets inhabiting NE Italy, SW Slovenia, Croatia, Bosnia & Herzegovina, and Montenegro. Detailed analysis revealed that this well-known species belongs to an unknown genus, which led to the description of Dinarippiger Skejo, Kasalo, Fontana et Tvrtković, uncovering that not everything is known about it. The genus is at the moment monophyletic, with the only known species belonging to it being Dalmatian Saddle Bush Cricket. Dinarippiger discoidalis (Fieber. 1853). Morphologically Dinarippiger is somewhat of an intermediate between the genera Ephippiger Berthold, 1827 and Uromenus Bolívar, 1878. Distribution data, morphological analysis, and bioacoustic analysis provide evidence supporting taxonomical changes presented in the recent paper, but also indicate potential existence of cryptic species. The story of Dinarippiger has resolved some questions which had been pending for a long time, but has also unraveled new questions now serving as an inspiration for future research. Zootaxa 5271 (1), 49–90.

### An integrative taxonomy approach towards the conservation of the Italian endemic genus *Italopodisma*, Harz 1973 (Orthoptera: Acrididae)

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Italopodisma Harz, 1973 is a genus endemic to the central Italian Apennines inhabiting mainly grasslands and rocky areas at high elevations (1600-2800 m-asl). It includes nine species and five subspecies, all of them distributed on the summits of major mountain ranges. Due to the increasingly serious anthropogenic threats to high-altitude environments and their restricted range, three of these species are classified by the IUCN as 'Critically endangered' (I. ebneri, I. lagrecai and I. lucianae), three as 'Endangered' (I. fiscellana, I. samnitica and I. trapezoidalis), and one of them is considered 'Critically endangered (Possibly extinct)' (I. baccetti). Taxa have been described mainly based on the morphology of the aedeagus of the male genitalia. However, considering the lack of detailed molecular and morphological data, the taxonomy of this genus needs to be further investigated. The aim of this study is to integrate genomic data (ddRADseq, >4000 loci) with a geometric morphometrics approach on the shape of the dorsal stylets of the aedeagus of male genitalia to better define the taxonomic rank of the described species and subspecies, understand the phylogenetic relationships between taxa, and investigate the possible existence of hybrids and/or co-distributed species in the same or nearby localities. Preliminary results of PCA and CVA analyses on the shape of dorsal stylets show that the different putative taxa seem to separate into well-defined clusters in the morphospace even though some of these appear to partially overlap, suggesting the potential presence of hybrids and incomplete reproductive isolation. Morphometric analyses will be expanded by adding more specimens in order to integrate this information with genomic data, reconstruct the phylogenetic relationships among morphotaxa, and delimit species and conservation units within this genus.

### Taxonomic and conservation genomic assessment of the Italian endemic genus *Italohippus* Fontana & La Greca, 1999 (Orthoptera: Acrididae)

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Italohippus Fontana & La Greca, 1999 is a genus endemic to the central Apennines mainly distributed at high elevations and linked to rocky habitats and dwarf juniper formations (1500 - 2200 m-asl). The genus includes three species: I. albicornis, I. modestus and I. monticola. The first two are endemic to the Matese Massif and Monte Terminillo, respectively, while the latter is present in several localities along the central Apennines. Due to their restricted range and the threatened environment in which they live, I. albicornis and I. monticola are classified by the IUCN as "Endangered". These three species were described mainly based on differences in courtship song and forewing length. Due to the lack of clearly distinctive morphological characters, the aim of this study is to combine genomic data (ddRADseq, >4000 loci) and a geometric morphometric approach to delimit the taxonomic boundaries within the genus, reconstruct the phylogenetic relationships among the three putative species, as well as their affinity with the close genus Chorthippus, and determine the genetic connectivity among populations, which has important implications for the conservation of such peculiar narrow-endemic taxa.

## The brief history of orthopterology in Italy and the birth of the GRIO (Gruppo di Ricerca Insetti Ortotteroidei - Research Group for Orthopteroid Insects).

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The GRIO (Gruppo di Ricerca Insetti Ortotteroidei - Research Group for

Orthopteroid Insects) has been active in Italy since 2003, with the aim of bringing together Italian scientists from this group to expand scientific knowledge and raise public interest in these insects. Italy is a country rich in Orthoptera. 89 species have their typical locality within its borders (Orthoptera Species Files), and the total number of species occurring in this country rises to 382 if all reported species are taken into account (WBA Handbooks: Grasshoppers & Crickets of Italy). And although Italy is historically and currently well-studied, it is not uncommon for new species to be described, such as Oedipoda cynthiae Fontana, Buzzetti & Massa, 2019; Acheta pantescus Massa, Cusimano, Fontana & Brizio, 2022. Italy is also rich in praving mantises, with 13 species (LifeWatch Italy), among which the endemic species Pseudoyersinia lagrecai Lombardo, 1984 stands out. Moreover, Italy is a hotspot for embiids in the Mediterranean and hosts the richest and best-known populations in the region. Recently, some new species been discovered, such as Embia minapalumboi Fontana 2024 and have another one that is currently being described. From a historical point of view, it is also important to mention the presence of fundamental Italian scholars in orthopterology, including Felice Capra, Marcello La Greca and Antonio Galvagni. Thanks to these influential personalities, the study of orthopteroids has continued in Italy over time. Today, the members of the GRIO, which has become a branch of the larger World Biodiversity Association (WBA), not only deal with the Orthoptera in the strict sense, but also with other orthopteroids (Blattodea, Dermaptera, Embioptera, Mantodea, Phasmatodea). Projects focusing on alien species are also underway, notably the Alien Mantids Project led by our members William Di Pietro and Roberto Battiston. Finally, we acknowledge the efforts of our member Filippo Maria Buzzetti in organizing this congress and the subsequent workshop "Recording Orthoptera Sounds: International Workshop" at the Civic Museum of Natural History in Verona.

### The Egyptian Bird Grasshopper just landed in Pannonia. The present situation of *Anacridium aegyptium* in Hungary

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In 1970, a single specimen of Anacridium aegyptium (Linnaeus, 1758) was collected on a saline meadow near Kétegyháza, SE Hungary. This is the first known record of this Mediterranean species in our country, possibly of natural origin. Then, for almost fifty years, the Egyptian Bird Grasshopper was not found in Hungary again. In the last decade, however, an increasing number of observations have been were reported throughout the country. We have collected more than sixty independent data, most of them from citizen science portals and social media. As opposed to the first discovery in 1970, these observations originate almost exclusively from human settlements, in many cases, from garden centres and warehouses, where a significant amount of goods arrive from countries where *Anacridim aegyptium* is native, particularly from Italy. In a few cases, the fact of the importation was also documented. when the grasshoppers hopped from a lorry that had just arrived or from a package that had just been opened. The distribution of records throughout the year is uneven: 80% of the observations occurred between October and March, and only 20% between April to October. In the last 2-3 years the data seems to be aggregated. Numerous observations have been made in Székesfehérvár (Central Transdanubia) and also in some towns of the Southern Great Plain: Hódmezővásárhely, Orosháza, Kiskunfélegyháza and Tiszakécske. These individuals were not found in garden centres but instead on buildings, roadsides and private gardens, in some cases tens of adults at the same place. Hibernating specimens have been found in attics and building crevices, and since 2023, several independent cases of mass overwintering have also been observed in door gaps and between windows, similarly to some alien bugs (e.g. Nezara viridula) or the harlequin ladybird (Harmonia axvridis). Mating was also observed last year, and a specimen in the nymphal stage was photographed. These data show that Anacridum aegyptium is not only a regular guest in Hungary, but is also definitely established. It is able to reproduce successfully, and it can withstand the critical continental winter cold in the urban environment. Being a good flyer, the Egyptian Bird Grasshopper is able to find the cracks of heated buildings in winter, and also the suitable

places for feeding and reproduction in its active season. Its rapid spread in the Pannonian region is therefore expected in the near future.

### Orthopterological highlights from the Biodiversity Monitoring South Tyrol

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The long-term project Biodiversity Monitoring South Tyrol started in 2019, led by Eurac Research (Bolzano), in collaboration with the Museum of Nature South Tyrol and the Autonomous Province of Bolzano. It aims at gaining insights into the actual state of biodiversity and to observe the future response to environmental and land use changes. As part of the project, 320 locations at an altitude of between 320 and 3000 meters will be studied repeatedly. It is conducted on a quinquennial basis with 64 sites surveyed each year. For the grasshoppers (meaning Orthoptera and Mantodea), one survey per site is carried out at the end of the summer. Each survey uses a combination of walking transects (14°m) and a comprehensive search within a 100°m2 area (extended in forests to a 1000°m2in settlements and lakes to a 50°m walking transect survey is conducted). In addition, data from other survey methods will be used to validate and complete the community data (e.g. data collected with pitfall traps).

At the end of the first cycle, which ended in 2023, some fascinating records have been made. Two new sites of occurrence for the rare bush cricket species *Anonconotus italoastriacus* were located. *Pezotettix giornae, Euchorthippus declivus, Bicolorana bicolor* were recorded for the first time for the province of Bolzano/Alto Adige. Additional interesting findings and confirmations were made for the rare species *Conocephalus dorsalis, Pseudochorthippus montanus, Omocestus petraeus, Stenobothrus nigromaculatus* and *Aeropedellus variegatus*.

### Unveiling the effects of climate change on spatial distribution of *Pterolepis cordubensis* in southern Europe.

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The orthopterofauna of open and nutrient-poor terrestrial ecosystems is strongly affected by both the effects of climate change (CC) and the land-use intensification and changes occurring in most parts of Europe, where these formerly widespread habitats are nowadays restricted to small and isolated remnants. Negative influences of CC on Orthoptera distribution and habitat quality have been documented in high altitude ecosystems, but very little information is available for endangered species restricted to lowlands.We use the species Pterolepis cordubensis Bolivar, 1900, an endemism of the Guadalquivir River basin (Andalusia, southern Spain), closely related to dryland crops and ruderal habitats, to analyse the effects of CC on the habitat of this very unknown species. To do that, we calculate ecological niche models (ENMs) using bioclimatic predictor variables, and project to the future for different periods (2040-2070 and 2070-2100) and socioeconomic scenarios (ssp126 and ssp585). In general, the models were good (AUC=0.98±0.02 and TSS=0.95±0.03). The four most contributing variables were the Temperature Annual Range, Mean Temperature of Wettest Quarter, Annual Precipitation and Elevation. Regarding CC projections, significant changes in the habitat suitability for the target species are expected in both optimistic (ssp126) and drastic (ssp585) scenarios, and for both time periods. Although the inclusion of other types of environmental predictors (such as land use or topographic attributes) could improve the ENM performance, our modelling-based approach represents an early warning system to anticipate CC effects on the spatial distribution of rare species such as P. cordubensis, becoming a robust tool to help decision making in conservation.

### Phylogeographic patterns and hybridization in *Chorthippus biguttulus* and *Ch. eisentrauti* (Orthoptera: Gomphocerinae) across the Alps

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The cryptic *Chorthippus biguttulus* group includes the sister species *Ch. biguttulus* and *Ch. eisentrauti*, with the latter traditionally considered endemic to the Southern Alps. Recent evidence suggests a broader distribution for *Ch. eisentrauti*, including the Northern Alps, as indicated by (micro-) habitat selection, morphological, and bioacoustics data in a study by Illich et al. (2023).

We employed ddRADseq to analyze genomic markers from samples of Ch. biguttulus and Ch. eisentrauti collected in both the Northern and Southern Alps, along with additional samples of Ch. biguttulus from other parts of its range, to corroborate the findings of Illich et al. (2023) genetically. Phylogenetic analysis identified distinct genetic clusters, and gene flow was further examined using STRUCTURE analysis. Our results confirm the presence of Ch. eisentrauti in the Northern Alps, including populations identified in Berchtesgaden, Germany. Within Ch. eisentrauti, we identified two main genetic clusters: one in the Northern Alps of Austria and Berchtesgaden, and another in the Southern Alps of Italy. Additionally, a hybrid cluster of Ch. biguttulus and Ch. eisentrauti was detected in the Dobratsch, the eastern foothills of the Gailtal Alps. These findings suggest that the distribution of Ch. eisentrauti extends beyond the Southern Alps, supporting the conclusions of Illich et al. (2023). We propose that glacial refugia played a significant role in the colonization of Ch. eisentrauti in the Northern Alps, with recent hybridization between Ch. biguttulus and Ch. eisentrauti occurring at the contact zones in the peripheries of their

distribution ranges. Future research should focus on investigating hybridization at other eastern and western contact zones to gain deeper insights into the speciation and colonization of *Ch. eisentrauti* as well as other closely related taxa within the *Ch. biguttulus* group.

#### A call for conservation action: subpopulations of the endangered Transsylvanian wingless groundhopper (*Tetrix transsylvanica*) discovered in Croatia may already be threatened

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The Transsylvanian wingless groundhopper, Tetrix transsylvanica (Bazyluk et Kis, 1960) (Tetrigidae: Tetrigini), inhabiting Romania, Croatia, and Slovenia, is one of only two flightless pygmy grasshopper species in Europe, the second one being Iberian Tetrix nodulosa (Fieber, 1853). It is listed as endangered (EN) on the IUCN Red List due to its small and severely fragmented The species comprises two subspecies: eastern T. distribution. t. transsylvanica, found in the southern Carpathians of Romania, and western T. transsylvanica hypsocorypha Skejo, 2014, known from several localities in Slovenia and northern Croatia. During our recent research onto the distribution and habitat of this species in Croatia, several subpopulations were discovered in Hrvatsko Zagorje, on Medvednica, Zelinska, Ivanščica and Strahinjčica mountains, the largest observed at Siljevec on Ivanščica. We are especially concerned about the subpopulation on Medvednica's peak, Sljeme, which is in close proximity to a ski lift, the about the subpopulation on Strahinjčica, part of whose habitat was destroyed by a quarry. T. transsylvanica, believed to be a relic from the Pleistocene era, may be the sole groundhopper endemic to Central Europe. It lives inside the beech (Fagus sylvatica) forests and inside beech forest clearings rich in leaf-litter and cold streams on the northern exposures of SW Peripannonian mountains. The findings were recently published in Skejo et al. (2023) Endangered Transsylvanian wingless groundhopper (Tetrix transsylvanica) is not extinct in Croatia and requires

urgent protection. Natura Croatica, 32(1), 24-255.

### Orthoptera specie widespread in Friuli Venezia Giulia region but rare or absent in most of Italy

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Friuli Venezia Giulia region lies in north-eastern part of Italy on Adriatic Sea. Its territory includes a part of south-eastern Alps, a part of Karst and the eastern Venetian-Friulian plain. Due to its collocation, flora and fauna includes weather species with Alpine or with Illyrian or with Eurasian distribution; the region represents the limit of range of many vegetal and animal species, in particular species having eastern-European distribution. In consequence of this, all or most Italian populations of some Orthopteran species live in Friuli Venezia Giulia. So the conservation of these populations has importance at Italian level. A first group includes species with a main area of distribution in Balkan Peninsula, as Prionotropis hystrix (Germar, 1817), Modestana modesta and Bicolorana kraussi (Padewieth, (Fieber. 1853) 1900), whose north-western limit of range extends up to Friuli Venezia Giulia, in Italian Karst or Alps. A second group includes species living in wetlands along the Adriatic Sea coast; two of these (Zeuneriana marmorata (Fieber, 1853) and Roeseliana brunneri Ramme, 1951) have a limited area of distribution, other have a larger European (as Chrysochraon dispar giganteus Harz, 1975) or Eurasian (as Epacromius coerulipes coerulipes (Ivanov, 1887)) distribution. Other species, which live in the plain or in Alpine area, are widespread in Europe or in Eurasia but they occur just in small areas of Italian territory: is the case of Pseudopodisma fieberi (Scudder, 1898), Celes variabilis variabilis (Pallas, 1771) and Stenobothrus stigmaticus stigmaticus (Rambur, 1938). Most of the considered species have a fragmented distribution and are rare in their range due to their ecological needs and to past anthropic action. The main threat for their populations consists in destruction or change of habitats where they live, due to local human action (or non-action) and to climate change.

The most important current threats for species living in meadows habitats are encroachment of shrubs and trees, expansion of invasive plants, intensive pasture and fires. The coastal species are threatened by increase of sea level and consequent increase of episodes of high water and flooding. The species living in mountain or lowland wetlands are threatened by recurrent drought and lowering in ground water levels. Some species have apparently disappeared or their populations have declined in recent years (especially in Karst), and this trend must be investigated.

#### Evolutionary and demographic history of the Aegean grasshopper *Chorthippus biroi* (Orthoptera: Acrididae): Implications for its distribution and conservation

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Chorthippus biroi is a tiny grasshopper distributed in the Aegean islands of Crete, Gavdos, Tinos, Andros and Naxos, where it mostly inhabits stony slopes with phrygana vegetation from sea level to alpine habitats (>2000 m in Crete). Although the species is classified as "least concern" in the IUCN Red List of Threatened Species, it often forms small and fragmented populations. We hypothesize that the limited dispersal capacity of this small and short-winged grasshopper has probably resulted in ancient fragmentation of populations established in different islands and limited genetic connectivity among populations within islands. We obtained samples from several populations of the species across its entire known distribution range and genotyped them using a ddRADseq approach (>6000 loci). Our preliminary phylogenomic results show that populations of Tinos and Naxos cluster in the same clade and are sister to the populations from Crete. Remarkably, the population from the island of Andros - described in 2004 on the basis of two juvenile specimens – does not correspond to C. biroi and, rather, is closely related, and probably conspecific, to the mainland species C. pulloides. This result limits the northernmost distribution of *C. biroi* to the island of Tinos.

Our estimates of genetic diversity showed that the populations of *C. biroi* from Crete present the highest levels of genetic diversity, followed by those from Naxos and Tinos, which is congruent with the respective size of these islands (Crete: 8450 km<sup>2</sup>; Naxos: 430 km<sup>2</sup>; Tinos: 194 km<sup>2</sup>) and the different effective population sizes that they are expected to sustain for the species. Analyses of genetic structure revealed a marked genetic structure of populations both within and across islands, with most sampled populations forming unique genetic clusters with no or limited genetic admixture among them. We will expand these analyses with genomic-based estimates of divergence time among populations and demographic reconstructions, which will help to understand the colonization/fragmentation history of the populations of *C. biroi*, one of the very few Acrididae taxa endemic to the Aegean Islands.

## Integrative species delimitation with hybridization: A case study with a complex of grasshoppers of the genus *Chorthippus* (Orthoptera: Acrididae) from southern Greece

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Accurate species delimitation and identifying areas of secondary contact and potential hybridization between closely related taxa is critical for defining conservation units and has major implications for species and population management. Here, we integrate genomic data (ddRADseq, >4000 loci) and linear and geometric morphometric characterization of different traits (pronotum and tegmen shape and body size) to delimit species and study interspecific gene flow within a complex of gomphocerine grasshoppers of the genus *Chorthippus* from southern Greece, with a specific focus on taxa distributed in the Peloponnese region. This complex includes the mainland taxa *C. pulloides, C. moreanus, C. parnon, C. crassiceps,* and *C. willemsei*, the Ionian island-endemic *C. sangiorgii*, and the Aegean island-endemic *C. biroi*. Although three of these taxa (*C. pulloides, C. parnon,* and *C. crassiceps*) are narrow endemics classified in the IUCN Red List of Threatened Species

within the category "Near Threatened", preliminary phenotypic-based studies suggest that many of their populations present atypical morphological and/or bioacoustical characters and have an uncertain taxonomic status. Our preliminary morphological and genomic data confirm the presence of populations with intermediate phenotypes and support hybridization in areas of secondary contact between some lineages, suggesting that reproductive isolation between putative species is still incomplete. Our study will contribute to shed light on the taxonomy of this species complex and will have important implications for understanding the high levels of local endemism characterizing the Mediterranean biodiversity hotspot and the specific role of the Peloponnese region as a cradle of diversification for certain groups of arthropods of great conservation concern.

### Monitoring and conservational management of the Predatory Bush-cricket (*Saga pedo*) in Czechia

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Monitoring: Since the Predatory Bush-cricket (*Saga pedo*) is listed as a species of European importance in the Czech Republic, the state of its populations is monitored once every two years there. The selection of monitoring plots corresponds to the known distribution in the SE part of the country and monitoring consists of the controlling of inhabited and potentially inhabited localities. Monitoring is carried out in sunny weather at an air temperature above 16 °C by systematically searching through individual monitoring plots in the period from mid-April to mid-July. The survey is usually carried out by one or two persons for at least one hour, while in most cases the entire monitoring plot is surveyed. The presence and abundance of nymphs of different instars in the vegetation is detected visually after disturbing them with the help of an entomological sweeping net. Even though it is a critically endangered species according to current Czech legislation, the number of localities with the occurrence of the Predatory Bush-cricket in Czechia have been slowly increasing since 2006. Population densities at

individual localities are also increasing, which is apparently caused by a favorable population trend in connection with climate change.

Conservational management: The localities where the Predatory Bush-cricket occurs in Czechia are either steppes or forest-steppes in places of former pastures or locally lawns or meadows created on places of former vineyards or even on former arable land. All localities have a very extensive use in common; while many localities are mainly grazed, others are rather mowed in a mosaic pattern. At most localities, there is a relatively high coverage of bushes and trees. Woody plants contribute significantly to the greater heterogeneity of habitats, and perhaps also to their greater attractiveness for Saga pedo. At least in such a way that they offer more options of hiding from predators. Overall, these are very heterogeneous habitats, often shaped by the grazing activity of sheep and goats, and locally also horses. Grazing has a significantly extensive character in the localities in question, the result of which is a wide range of grazing microhabitats, from bare places and low-stalked lawns to higher vegetation on ungrazed places, in a mosaic with varying densities of woody plants. Outside of pasturing, expansive bush and tree species are parallelly regulated with the aim of preventing the formation of continuously overgrown areas. Sometimes it is not easy to determine what density of woody plants is acceptable and when degradation of the locality is already taking place due to overgrowth. Because of the considerable area of some localities and limited capacities, reduction interventions are carried out only on smaller areas, which guarantees the existence of a wide range of different overgrown plots. Extensive use is apparently key to maintaining suitable conditions at the localities of the Predatory Bush-cricket. To successfully protect populations of the species, it is necessary to ensure that localities do not remain completely unmanaged for several years, which can lead to increased overgrowth and/or accumulation of old grass. In the same way, the management should not be too intensive. Regular mowing to low growth leading to habitat homogenization does not seem to suit this species.

"And please: speak as you might to a young child, or a golden retriever...it wasn't brain that got me here"

(ECOC IV) 4-6 July 2024 Rovereto (Italy)

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