



# 1<sup>st</sup> Dinaric Symposium on Subterranean Biology

23<sup>rd</sup> - 24<sup>th</sup> September 2016  
Zagreb, Croatia

# Abstract Book

1<sup>st</sup> Dinaric Symposium on Subterranean Biology  
23<sup>rd</sup> - 24<sup>th</sup> September 2016, Zagreb, Croatia

# ABSTRACT BOOK



## 1<sup>st</sup> Dinaric Symposium on Subterranean Biology

23<sup>rd</sup> - 24<sup>th</sup> September 2016  
Zagreb, Croatia

**Organizers:**

Croatian Biospeleological Society, Zagreb  
Ruđer Bošković Institute, Zagreb

Organized under the auspices of the International Society for Subterranean Biology.

Published by Croatian Biospeleological Society, Zagreb

**Edited by:**

Marko Lukić

**Organizing Committee:**

Marko Lukić, Martina Pavlek, Tvrtko Dražina, Ana Komerički, Petra Kutleša

All rights reserved. This book may not be reproduced in whole or in part without permission from the publisher.

The authors are responsible for scientific and linguistic standard of the book.

Manuscript did not pass through editorial or linguistic correction.

**Typography:**

Tin Rožman

**Cover design:**

Tin Rožman

**Conference logo design:**

Anđela Čukušić, Tin Rožman

**Publication year:**

2016

**Printed:**

PDF only

ISBN 978-953-59239-0-9

# Table of contents

<b>4</b>	Scientific program
<b>7</b>	Abstracts
<b>42</b>	List of poster presentations
<b>43</b>	Author index

# Scientific program

## Thursday 22 September 2016

**20:00** Icebreaker meeting in the premises of the Croatian Biospeleological Society, at the address Lomnička 3

## Friday 23 September 2016

**8:30-9:00** Registration

**9:00-9:20** Opening

### Symposium of Cave species genome evolution project

---

**9:20** Marco Isaia\*, Stefano Mammola  
Climate change drives subterranean spiders to extinction: the response of *Troglohyphantes* spiders to global warming

**9:40** Stefano Mammola\*, Marco Isaia  
Niche overlap and competition in subterranean spiders

**10:00** Miquel A. Arnedo\*, Fulvio Gasparo  
Origin and diversification of the cave-dwelling spider genus *Stalita* in the Dinaric karst

**10:20-10:50** **Coffee break**

### 1<sup>st</sup> Dinaric Symposium on Subterranean Biology

---

**10:50** Jana Bedek  
Croatian Biospeleological Society – the first 20 years

**11:10** Dragan Antić\*, Tvrtko Dražina, Sofija Pavković Lučić, Luka Lučić, Slobodan Makarov  
Cave-dwelling millipedes (Myriapoda, Diplopoda) in the Dinaric Region: diversification and biogeographic features

**11:30** Fulvio Gasparo, Fabio Stoch\*  
Species diversity in the northwestern part of the Dinaric Karst in Italy

**11:50** Ivo Karaman\*, Mladen Horvatović  
Complexity of the Dinaric cave fauna: the case of the genera *Cyphonethes* Verhoeff, 1926 and *Titanethes* Schioedte, 1849 (Isopoda: Oniscoidea: Trichoniscidae)

**12:10-14:00 Lunch**

**14:00** Fabio Stoch\*, Teo Delić, Cene Fišer, Jean-François Flot  
Dinaric species in peninsular Italy: a molecular perspective in explaining trans-Adriatic distribution in the genus *Niphargus* (Crustacea, Amphipoda)

**14:20** Teo Delić\*, Slavko Polak, Peter Trontelj  
Molecular phylogeny of the hygropetricolous cave beetle genus *Hadesia*

**14:40** Špela Gorički\*, David Stanković, Magdalena Năpăruș-Aljančič, Aleš Snoj, Gregor Aljančič  
Searching for black *Proteus* (*Proteus anguinus parkelj*) in karst groundwater with the help of eDNA

**15:00-15:30 Poster session**

**15:30** Špela Borko\*, Teo Delić, Peter Trontelj  
Testing the uniqueness of fauna in deep caves

**15:50** Teo Delić\*, Peter Trontelj, Cene Fišer  
Thermal adaptation and ecological speciation in subterranean fauna

**16:10** Žiga Fišer\*, Zarja Muršič, Peter Trontelj  
Evolution of behavioral response to light in subterranean populations of the freshwater isopod *Asellus aquaticus*

**16:30-17:00 Coffee break**

**17:00** Ivo Lučić  
History of subterranean fauna: dragon, photo-model and bio-indicator

**17:20** Lada Lukić Bilela\*, Damir Smajić, Roman Ozimec  
The caves of the Sarajevo canton: conservation and protection

**17:40** Roman Ozimec\*, Lada Lukić Bilela, Branko Jalžić, Ana Soldo  
The Biospeleological Museum Vjetrenica: a new model for biospeleology promotion

**19:00 National and university library in Zagreb, at the adress Hrvatske Bratske Zajednice 4**

- Opening ceremony of the exhibition Cave fauna of the Krka National Park
- premiere of documentary film "Krka River-secrets of underground"
- social event with local delicacies

**21:00 Social event in bar "Route 66" or "Spunk" depending on the weather conditions**

## Saturday 24 September 2016

- 9:00** Marko Lukić  
Potential and limitation of cave Collembola research in Dinaric karst
- 9:20** Dalibor Z. Stojanović\*, Boris D. Dudić, Vladimir T. Tomić, Bojan M. Mitić  
The cave species of the centipede genus *Lithobius* Leach, 1814 (Chilopoda: Lithobiomorpha: Lithobiidae) originally described from Dinarides
- 09:40** Ľubomír Kováčč\*, Roman Ozimec  
New cave Collembola from the Dubrovnik region, Croatia
- 10:00** Marjan Komnenov  
The faunistic diversity of cave spiders (Arachnida, Araneae) of the Dinarides
- 10:20** Maja Zagmajster  
SubBioDatabase – a tool for research and conservation of subterranean biodiversity of the whole Dinarides
- 10:40-11:10** **Coffee break**
- 11:10** Gordan Karaman  
New data of subterranean Amphipoda in the Dinaric karst of Croatia and adjacent regions
- 11:30** Slavko Polak  
Egon Pretner's (1896-1982) contribution to the knowledge of the subterranean beetles (Coleoptera) fauna of Croatia
- 11:50** Najla Baković  
Biodiversity of protozoa in Dinaric karst
- 12:10** Andrej Mock  
First data on the occurrence of tiny polydesmids (Diplopoda: Trichopolydesmidae) in Slovenia
- 13:30** **Field excursion in the area of town Ogulin**
- 21:00** **Dinner and overnight in apartment Bjelolasica, Jasenak, Ogulin**

## Sunday 25 September 2016

----- trip home -----

\* An asterisk identifies presenting author

# Abstracts

POSTER PRESENTATION

# Flying deeper underground? A new troglobiotic chironomid (Diptera) from the Lukina jama – Trojama cave system in Croatia

Trond Andersen<sup>1</sup>, Viktor Baranov<sup>2</sup>, Linn Katrine Hagenlund<sup>1</sup>, Marija Ivković<sup>3</sup>, Gunnar Mikalsen Kvifte<sup>1,4</sup> & Martina Pavlek<sup>5\*</sup>

<sup>1</sup>Department of Natural History, University Museum of Bergen, University of Bergen, Bergen, Norway

<sup>2</sup>Institute for Freshwater Ecology and Inland Fisheries, Berlin, Germany

<sup>3</sup>Department of Zoology, Division of Biology, Faculty of Science, University of Zagreb, Zagreb, Croatia

<sup>4</sup>Department of Zoology, Institute of Biology, University of Kassel, Kassel, Germany

<sup>5</sup>Department of Molecular Biology, Ruđer Bošković Institute, Zagreb, Croatia, and Croatian Biospeleological Society, Zagreb, Croatia; mpavlek@irb.hr

The Lukina jama – Trojama cave system, situated in the Northern Velebit National Park in Croatia, is the 14<sup>th</sup> deepest cave in the world and the deepest of the Dinaric Karst. Speleological research of this cave system started in 1992. Since then several expeditions were undertaken and biospeleological surveys resulted in altogether 54 animal taxa, 32 of which are true cave dwellers. Maybe the most extraordinary among them is the discovery of several females of a pale Chironomidae belonging to the subfamily Orthoclaadiinae collected in a chamber at -980 m. Next to the typical troglomorphic features like pale color, very long legs and strongly reduced eyes, in contrast to all other cave Diptera, it has retained large wings and appears to be capable of flying. All these features potentially make it the first flying troglobiont worldwide. Morphologically it doesn't fit within any described genus and shares some characteristics with the genera of "Metriocnemini" and "Orthoclaadiini" tribes. Molecular phylogenetic analysis also confirms its unique position and groups it with the genera *Tvetenia*, *Cardiocladius* and *Eukiefferiella* in the "tribe Metriocnemini". So far only females were collected making this species potentially parthenogenetic, which is not unusual among chironomids and is most often found in extreme or isolated habitats. This significant discovery confirms the position of the Dinarids as a highly important hotspot of subterranean biodiversity in general.



ORAL PRESENTATION

# Cave-dwelling millipedes (Myriapoda, Diplopoda) in the Dinaric Region: diversification and biogeographic features

Dragan Antić<sup>1\*</sup>, Tvrtko Dražina<sup>2,3</sup>, Sofija Pavković Lučić<sup>1</sup>, Luka Lučić<sup>1</sup> & Slobodan Makarov<sup>1</sup>

<sup>1</sup>University of Belgrade - Faculty of Biology, Belgrade, Serbia; dragan.antic@bio.bg.ac.rs

<sup>2</sup>Croatian Biospeleological Society, Zagreb, Croatia

<sup>3</sup>Division of Zoology, Department of Biology, Faculty of Science, University of Zagreb, Croatia

Millipedes are one of the ancient arthropods and probably represent the earliest terrestrial fossils, known from mid Silurian. With more than 12.000 described species (estimates number is even 80.000) represents one of the most diverse land arthropods. There are few main centres of millipede's biodiversity; Balkan Peninsula, especially Dinaric Karst, is one of them. Diverse and rich underground habitats in Dinarids are inhabit with numerous endemic or relict diplopod taxa; mostly of them are cave-dweller. Endemism is not restricted to species level only; even one family and few subfamilies are endemic for the region (Heterolatzeliidae, Acherosomatinae, Biokoviellinae, or Macrochaetosomatinae). Within polydesmoid, juliforms, and especially chordeumatidans exist numerous various Dinaric phyletic lineages of different origin and ages. Recent studies showed that our understanding of millipedes biodiversity in underground habitats in Dinaric region is still fragmentary, even in the genus level (e.g. recently described monotypic genera *Balkanodesmus* Antić and Reip, 2014, *Solentanodesmus* Antić and Reip, 2014, or *Velebitodesmus* Antić and Reip, 2014). Moreover, molecular studies confirm that at least in some julids (e.g. *Typhloiulus*) exist clear endemic Dinaric phyletic lineages. Great biodiversity of millipedes in Dinaric Karst is affected by complex geological history: continuity of the continental phase in different parts of this area, transgression or regression of marine basins, evolution of the Karst relief, and succession of the paleoclimatic changes.

ORAL PRESENTATION

# Origin and diversification of the cave-dwelling spider genus *Stalita* in the Dinaric karst

Miquel A. Arnedo<sup>1\*</sup> & Fulvio Gasparo<sup>2</sup>

<sup>1</sup>Department of Evolutionary Biology, Ecology and Environmental Sciences & Biodiversity Research Institute, Universitat de Barcelona, Catalonia, Spain; marnedo@gmail.com

<sup>2</sup>Commissione Grotte 'E. Boegan' Società Alpina delle Giulie, C.A.I., Trieste, Italy

Because of their size and beautiful deep red and orange colours, Dysderid spiders are among the most spectacular cave-dwelling invertebrates in European caves. The dysderid genus *Stalita* is restricted for the most part to the Dinaric limestones, where nine species have been described to date. The taxonomy of the genus has been a matter of debate and some authors have suggested to further split the group into as many as four different genera. *Stalita* belongs to the subfamily Rhodinae, which also includes the mostly epigeal genus *Rhode*, distributed across the central and western Mediterranean basin, and the monotypic cave-dwelling genus *Speleoharpactea*, circumscribed to the eastern Iberian Peninsula. The lack of an explicit, quantitative phylogenetic hypothesis about the relationships between *Stalita* species and within the whole subfamily Rhodinae has hampered so far our understanding of the origins and evolution of this fascinating group of obligate cave-dwellers. Here we present the preliminary results of a multilocus phylogenetic analysis of the group that combines both mitochondrial and nuclear genes and an almost complete sample of *Stalita* species along, with representatives of the remaining Rhodinae and other dysderid genera.

ORAL PRESENTATION

# Biodiversity of protozoa in Dinaric karst

**Najla Baković**

Croatian Biospeleological Society, Zagreb, Croatia; najla.bakovic@gmail.com

The research of protozoa in karst subterranean habitats in Croatia and Bosnia and Herzegovina started in 2011. Samples from twenty four caves and pits were examined, including two marine caves and one anchialine cave. It included samples from various microhabitats such as hygropetric, river sediments, sinter pools, mud puddles, etc. Completely new methodology was developed to enable samplings on oligotrophic environments. Till now more than seventy species of protozoa has been detected, but their biodiversity is probably much greater especially if we consider a cryptic biodiversity of these organisms. The most diverse group of detected protozoa are testate amoebas with more than forty species. Other recorded groups are: ciliates, naked amoebas, nanoflagellates, heliozoans, hoanoflagellates and foraminifers. The taxa determined to the species level showed that these organisms are not new to the science, but they are already described on the surface habitats. Greatest abundance and biodiversity is recorded on microhabitats rich in bat guano. The most intensively studied was Veternica cave near city of Zagreb (Croatia) with total eighty four examined samples. On almost all microhabitats the invertebrates such as rotifers, nematodes, crustaceans, gastrotrichs, oligochaetas and some insect's larvae were detected. Bacteria were also omnipresent on all microhabitats. This shows the important role of protozoa as trophic link between the bacteria and animals inside subterranean habitats.

POSTER PRESENTATION

# Croatian Cave Cadaster – future tool in biospeleological research

Jana Bedek\*<sup>1</sup>, Kazimir Miculinić<sup>1</sup>, Ana Komerički<sup>1</sup> & Luka Katušić<sup>2</sup>

<sup>1</sup>Croatian Agency for Environment and Nature, Zagreb, Croatia - external associates; jana.bedek@dzzp.hr

<sup>2</sup>Croatian Agency for Environment and Nature, Zagreb, Croatia

Long lasting exploration of caves in Croatia, during more than 100 years, resulted in approximately 10.000 explored caves so far. The data were scattered in archives of many caving clubs, some of them none existing anymore, and partly published in thousands of different publications. Unavailability and different quality of existing data, data obsolescence, high degree of synonymy, together with great need for systematically organized data led to establishing a Croatian Cave Cadaster (Cadaster) in 2015. It was established by Croatian Agency for Environment and Nature (CAEN), providing the financing, technical support and coordination, and different Croatian caving clubs, collecting and verifying of the data. All together 18 caving clubs have been involved with Cadaster so far. The Cadaster is part of database CroSpeleo of the Nature Protection Information System (NPIS). Beside the caving community, the Cadaster is in its full extent available to Croatian Nature Protection Sector and public institutions dealing with protecting life and property. Generalized data are available to public through web portal of NPIS – Bioportal (<http://www.bioportal.hr/>).

Many different attributes are gathered in Cadaster, basic cave data including the cave maps, cave diving data, paleontological, archeological, geological, geomorphological, hydrological, macroclimate data etc. Although there are large variations in fulfillment of different attributes, the potential of their use will rise with each new entry and at the same time will trigger better fulfilment of each database attribute.

In order to ensure high quality data, a complex methodology of data gathering is developed. Data verification is a complicated process involving all caving clubs, which requires a lot of time. So far the data for 1007 caves are gathered, which is about 10% of all explored caves in Croatia, assuming that the estimate of 10.000 explored caves is correct. At this rate it will take around a decade to complete the Cadaster, but high reliability of gathered data is of utmost importance.

The usability of the Cadaster in biospeleological research is various, and the potential will be fulfilled after its linkage to other NPIS theme database CroFauna. The CroFauna database will gather faunistical data, both unpublished and literature. That way the Cadaster will enable many different analyses and be tool in research planning as well as in the conservation of caves and subterranean habitats.

ORAL PRESENTATION

# Croatian Biospeleological Society – the first 20 years

Jana Bedek\*<sup>1</sup> & Petra Žvorc<sup>1</sup>

<sup>1</sup> Croatian Biospeleological Society, Zagreb, Croatia; jana.bedek@hbsd.hr

The Croatian Biospeleological Society (CBSS) is a non-governmental organization. It has been founded on 21<sup>st</sup> of February 1996 at the Croatian Natural History Museum in Zagreb, which is its host ever since.

During the last 20 years the main goal of CBSS activities is to explore and protect subterranean and bat fauna and its habitats through implementation of numerous research including scientific research, conservation and monitoring projects, raising public awareness, influence in policy making processes and dissemination of the results through both scientific and popular publications.

Ever since the establishment members of the CBSS undertook autonomous researches as well as cooperating with Croatian Natural History Museum; Faculty of Science, University of Zagreb; Ruđer Bošković Institute and many speleological organizations and different NGOs in Croatia and neighbouring countries. The research projects were implemented in whole karstic area of Croatia as well in all other Dinaric countries. Among more than 60 different projects, some of them lasting more than ten years, the one which stand out is Research of the Cave Type Localities. It started in 2000 and implementing ever since, resulted with several publications and Biospeologica Dinarica Database <http://biospeologica-dinarica.org/>. The project was awarded on national level with the First prize for global contribution to ecology in 2002.

One of the most important accomplishments of 20 yearlong CBSS activity is formation of large biospeleological collection which at the moment harbours specimens from numerous invertebrate groups.

Poorly explored subterranean fauna indicate necessity of taxonomic research of different groups, usually in cooperation with globally recognized taxonomists. Up to date the majority of CBSS taxonomy papers cover Coleoptera, but also some less explored groups such as Diplopoda, Chilopoda, Collembola, Isopoda, Bivalve, etc. The fact that around quarter of the total number of cave taxa have been described in Croatia during this century shows that new species are being discovered continuously and that the state of knowledge about cave fauna in Croatia will surely be extended as a result of a future taxonomic work. Especially with increased research of other less documented invertebrate groups, such as Araneae, Pseudoscorpiones, Acari, Diplura, ect..

The organization of different meetings at the local and international level was started already in September of 1999 with The XIV<sup>th</sup> International Symposium of Biospeleology held in Makarska, organized in cooperation with Croatian Natural History Museum and International Society of Subterranean Biology. In October of 2012 the 2<sup>nd</sup> Symposium on "Anchialine Ecosystems", held in Cavtat, was organized in cooperation with the Ruđer Bošković Institute. The XIII<sup>th</sup> European Bat Research Symposium was held in September 2014 in Šibenik, organized by CBSS. And the last, but not the least is the organisation of current 1<sup>st</sup> Dinaric Symposium on Subterranean Biology organized by CBSS and Ruđer Bošković Institute, which is inspired by the importance of Dinaric subterranean biodiversity and triggered with CBSS 20<sup>th</sup> anniversary. Hopefully it would be followed by the organisation of 2<sup>nd</sup> Dinaric Symposium on Subterranean Biology in some other Dinaric country within following few years.

ORAL PRESENTATION

# Testing the uniqueness of fauna in deep caves

Špela Borko<sup>1\*</sup>, Teo Deličić<sup>1</sup> & Peter Trontelj<sup>1</sup>

<sup>1</sup>Department of Biology, Biotechnical Faculty, University of Ljubljana, Ljubljana, Slovenia;  
borko.spela@gmail.com

Recent advances in speleology, sports and equipment have allowed speleobiologists to explore the fauna of even the deepest caves in the world. Titles like "The deepest living animals" have made the news in popular media, reaching a wider audience than any other speleobiological research before. Yet, does good promotion of our science automatically imply good science? How justified is the assumption of a unique fauna deep inside a limestone massif that is fractured and opened to the surface in all directions? According to the Giachino-Vailati model, a deep section of a vertical cave is equivalent to the distal part of a long horizontal cave at the same altitude. Indirect influence from high-altitude entrances (cold air dropping, precipitation, low organic input) might nevertheless cause some heterogeneity inside the massif. We tested the hypothesis of a unique deep cave fauna by surveying 10 caves of various depth and at various altitudes at the karst massif of Trnovski gozd, Slovenia. Across the vertical extent of more than 800 meters we collected 10.000 specimens from over 60 mostly terrestrial taxa, some of them new to science. Faunal assemblages from different depth zones formed three distinct groups: 1–inner parts of the massif; 2–high-altitude entrance parts; 3–caves at lower altitudes or with specific geomorphology. Assemblages of the first group started already at about 50 meters of depth and were not restricted to the deepest caves. Diversity of cave fauna increased with depth of the cave. When looking only at deep vertical caves, a few species were found exclusively in the deepest zones. In other caves, however, the same species occurred close to the surface. We conclude that vertical distance from the cave entrance is probably not as important in determining the qualitative and quantitative composition of subterranean communities as suggested by some recent publications.

POSTER PRESENTATION

# Activities of the Biospeleology section of the Biology Student Association – BIUS from 2010 until now

Kristijan Cindrić<sup>1,2\*</sup>, Mateja Jagić<sup>2</sup> & Nikolina Kuharić<sup>2</sup>

<sup>1</sup>Biology Student Association – BIUS, Rooseveltov trg 6, 10000 Zagreb, Croatia; kcindric@gmail.com

<sup>2</sup>Croatian biospeleological society, Demetrova 1, 10000 Zagreb, Croatia

Biology Student Association – BIUS was established in 1999 raising the possibility of biology students expressing their curiosity, and thereby creating a base for future scientific development. One of the first BIUS's projects was the International summer biology camp "Paklenica '99", in which around 40 students participated divided by interest groups. One of those groups was Underground biotope group. The following year the group was renamed to Biospeleology section, a very strong collaboration with the Croatian biospeleological society (CBSS) was established and the exploring of the underground life began.

In 17 years of the section's existence, 15 major BIUS's field researches were conducted, as well as several smaller projects, over hundred speleological objects, both known and newly discovered, were biospeleologically explored, hundreds of troglobiont and troglophile organisms, including new species for science were discovered, and as a result, many experts in biospeleology, scientists and active members of CBSS were made.

In the last six years BIUS's field trips were more than suitable for biospeleological research, therefore the area of the river Zrmanja and southeast parts of Velebit mountain, as well as the island Hvar, the Dinara mountain, the area of the Cave Park Grabovača and the Nature Park Papuk were explored. The astonishing biodiversity of Dinarides and surrounding area is confirmed with every conducted field trip and collected fauna is characterized by various and numerous species which allows students to learn more about taxonomy and systematics, and to decide to engage in research of some particular systematic group.

Apart from the annual field research projects organized by BIUS, the members of the Biospeleology section carry out their own projects at sites near Zagreb and further, such as the island of Šolta and Tounj near the town of Ogulin. Also, they take part in another crucial aspect of science, apart from the biological aspects, writing projects and organizing several - day field researches. Section activities also include partaking in popular scientific events such as Night of Biology, Scientific Picnic and other similar manifestations with the purpose of approaching the life of the underground to the general public.

POSTER PRESENTATION

# On the first finding of *Absoloniella reitteri* (Müller, 1912) after its original description (Coleoptera, Curculionidae)

Andrea Colla<sup>1\*</sup> & Roberto Caldara<sup>2</sup>

<sup>1</sup>Museo Civico di Storia Naturale di Trieste; andrea.colla@comune.trieste.it

<sup>2</sup>Centro di Entomologia Alpina, Università degli Studi di Milano roberto.caldara@gmail.com

*Absoloniella reitteri* (Müller, 1912) (formerly *Caulomorphus*), was described on remains of a single specimen collected in the cave Skuretova Jama, in the Karst of Trieste. Unfortunately, this specimen was subsequently lost and the type locality is now unaccessible, so the taxon was unknown to all authors after its original description up to now. Only recently two complete adult specimens, well corresponding to Müller's description, were collected in another cave (Grotta dei Partigiani), about 5 km far from the type locality. This interesting collection allows at last to clarify the systematic position of this "mysterious" taxon in the genus *Absoloniella*. The Authors are preparing a work where these taxonomical aspects will be discussed, with a detailed redescription of the rare blind species.



POSTER PRESENTATION

# Conservation of the underground habitats by protection of the Narrow-necked blind cave beetle (*Leptodirus hochenwartii* Schmidt, 1832)

Tamara Čuković<sup>1</sup>, Tvrtko Dražina<sup>1,2</sup>, Petra Bregović<sup>1</sup>, Branko Jalžić<sup>1</sup>, Helena Bilandžija<sup>1,3</sup>

<sup>1</sup>Croatian Biospeleological Society, Zagreb, Croatia

<sup>2</sup>Division of Zoology, Department of Biology, Faculty of Science, University of Zagreb, Croatia

<sup>3</sup>Department of Molecular Biology, Ruđer Bošković Institute, Zagreb, Croatia

Narrow-necked blind cave beetle (*Leptodirus hochenwartii* Schmidt, 1832) bears the title of the first described troglobiotic invertebrate and the year of its description is considered as the beginning of the science of biospeleology. Along with its attractive appearance and historical importance, this species is important from the nature protection perspective. *L. hochenwartii* has entered the legislation of the European Union and is listed in the Habitats directive of the ecological network Natura 2000. Since 2008 members of the Croatian Biospeleological Society (CBSS) are actively working on research and conservation of this species. Results of this work are published online as part of the monitoring program for *L. hochenwartii* in Croatia. To date the species has been found in over 50 caves in Croatia: Žumberak Mt, Gorski kotar, Učka Mt, Čićarija Mt and Velebit Mt. During 2014 and 2015 monitoring has been conducted in Žumberak Mt and Gorski kotar. During this monitoring program, *L. hochenwartii* was recorded in only seven out of 18 caves. The results of the survey showed that the population of Narrow-necked blind cave beetle is threatened, especially due to pollution of its subterranean habitats by solid waste and garbage disposal. Illegal collections of subterranean fauna in some caves possess an additional threat. In order to evaluate the conservation status of the species, permanent monitoring covering the entire range of the species is needed. Narrow-necked blind cave beetle represents a powerful tool in the conservation efforts since by protecting this species the entire subterranean system and accompanying fauna is protected.

ORAL PRESENTATION

# Molecular phylogeny of the hygropetricolous cave beetle genus *Hadesia*

Teo Delić<sup>1\*</sup>, Slavko Polak<sup>2</sup> & Peter Trontelj<sup>1</sup>

<sup>1</sup>Department of Biology, Biotechnical Faculty, University of Ljubljana, Ljubljana, Slovenia; teo.delic@bf.uni-lj.si

<sup>2</sup>Notranjska museum Postojna, Institute Znanje Postojna, Postojna, Slovenia

Since the beginning of the 20<sup>th</sup> century, the Dinaric Karst has been widely recognized for its rich and highly diverse subterranean coleopteran fauna. A significant part of this richness can be attributed to the large tribe Leptodirini (Leiodidae; Cholevinae), known for its numerous subterranean species, some of them being morphologically highly evolved and ecologically specialized. Among them, a special place belongs to *Hadesia*, an elusive and charismatic genus of cave beetles found in the southeastern Dinaric Karst. It is a typical representative of the Dinaric subterranean fauna and the model upon which the ultra-specialized ecomorphological form of semi-aquatic, hygropetricolous filter feeders became known. Our recent cave explorations in western Montenegro resulted in the collection of individuals superficially resembling one of the four described *Hadesia* species, but differing in morphological details and DNA sequences. We were interested in determining the taxonomic status of the newly discovered population as well as its phylogenetic position within the genus. Based on morphology and DNA sequence data from two nuclear and two mitochondrial genes and using multispecies coalescent methods, we demonstrate that *Hadesia* is a genus counting five clearly delimited and narrowly distributed species. Molecular dating suggests that the genus emerged about three million years ago, during the warm and wet mid-Pliocene, and diversified allopatrically, through range fragmentation caused by Pleistocene habitat reduction.

ORAL PRESENTATION

# Thermal adaptation and ecological speciation in subterranean fauna

Teo Delić<sup>1\*</sup>, Peter Trontelj<sup>1</sup> & Cene Fišer<sup>1</sup>

<sup>1</sup>Department of Biology, Biotechnical Faculty, University of Ljubljana, Ljubljana, Slovenia; teo.delic@bf.uni-lj.si

In northern latitudes, the distribution of subterranean taxa has been strongly influenced by historical interchanges of glacial and interglacial periods. According to the prevailing view, their restricted geographical distribution is a consequence of low dispersal ability and thermal stability of the subterranean environment, selecting against thermal adaptability. Most of the subterranean taxa have small geographical ranges; therefore they don't offer opportunity for testing of thermal adaptation. The exception are species found in mountainous areas, spanning wide altitudinal ranges, but these are exceedingly rare, especially among stygobionts. One of them is *Niphargus stygius*, a subterranean amphipod from the north-western Dinaric Karst and the southern Julian Alps. Reaching from the high Alps to the sea level, its populations face mean annual temperatures from 0 to 14 °C. *N. stygius* has a complex phylogeographic structure comprising four morphologically cryptic species that evolved during the Pleistocene. These cryptic species have a parapatric distribution with several cases of sympatry and even syntopy. Analyses of the past population dynamics indicate modest population growth during the last 20,000 years, following the end of the Last Glacial Maximum. Ecophysiological measurements showed different stress response when exposed to different temperatures, suggesting that the cryptic species are thermally adapted to different thermal optima. In contrast with the traditional view that presumes species decline during Pleistocene glaciations, our results imply that these climate changes in altitudinally structured habitats contributed to the emergence of new subterranean species through the process of thermal adaptation.

ORAL PRESENTATION

# Evolution of behavioral response to light in subterranean populations of the freshwater isopod *Asellus aquaticus*

Žiga Fišer<sup>1\*</sup>, Zarja Muršič<sup>1</sup> & Peter Trontelj<sup>1</sup>

<sup>1</sup>Department of Biology, Biotechnical Faculty, University of Ljubljana, Slovenia; fiser.ziga@gmail.com

Despite having reduced eyes and pigments, almost all subterranean species are able to detect and respond to light. Nevertheless, it remains largely unknown how the behavioral response to light changes when surface species adapt to the subterranean environment and evolve subterranean populations or species. Previous studies have failed to address this properly either because they focused on subterranean species that lack a living surface ancestor or because they applied inadequate behavioral experiments. In our study, we measured the behavioral response to light in several subterranean populations of the freshwater isopod *Asellus aquaticus* and their ancestral surface populations. We measured each individual's behavior in darkness (control) and at five different light intensities. A novel approach, i.e. fitting a modified logistic curve to the data using nonlinear mixed models, allowed us to investigate this behavioral trait from a quantitative population genetics perspective. The results show that the response to light of subterranean populations differs substantially from the response of their ancestral surface populations, albeit not in the same way. Compared to surface populations that exhibited a similar, moderately photophobic response, subterranean populations displayed a stronger, weaker and even delayed photophobia. Our results suggest a nonconvergent evolution of the behavioral response to light during the adaptation to the subterranean environment.

ORAL PRESENTATION

# Species diversity in the northwestern part of the Dinaric Karst in Italy

Fulvio Gasparo<sup>1</sup> & Fabio Stoch<sup>2\*</sup>

<sup>1</sup>Commissione Grotte 'E. Boegan', Società Alpina delle Giulie, C.A.I., Trieste, Italy

<sup>2</sup>Université Libre de Bruxelles, Evolutionary Biology & Ecology, Bruxelles, Belgium; fabio.stoch@gmail.com

Northeastern Italy includes a small part of the north-western Dinaric Karst region (the so-called Classic Karst), delimited by the course of the Isonzo-Soča River, the Adriatic Sea and the Slovenian border. The extension of the carbonatic outcrops is just 211 km<sup>2</sup>; nevertheless, the area is very rich in caves (3,186 caves known up to 30 June 2016), hosting an interesting and quite rich cave fauna. Studies on cave dwelling fauna began in the late nineteenth century, but had the greatest development in the last two decades of the past century and still continue, especially for stygofauna.

A database including the distribution of 384 species in 223 caves was recently assembled; one third, i.e. 123 species, were classified as obligate subterranean (33 of them being terrestrial troglobionts, while about 90 are stygobionts). Over 100 species can be considered endemic or subendemic to the Classic Italian-Slovenian Karst. The knowledge on the fauna of this small karstic area can be considered quite advanced, with the exception of some groups (mites, springtails, planarians); only a small part of them were studied to date. However, while our knowledge of terrestrial cave fauna is quite exhaustive, during recent monitoring programs carried out on groundwater fauna, a dozen of morphologically distinguishable stygobiotic species new to Science were collected, especially copepods and amphipods. Moreover, the application of molecular methods (carried out up to now on malacostracans) using DNA markers allowed the identification of a small number of cryptic species in urgent need of description. Notwithstanding the difficulty in assessing species richness of obligate cave-dwelling fauna because of the highly localized distribution of species and difficulties in taxonomic analyses, results obtained up to now allow to discuss the contribution of historical and ecological factors in shaping subterranean biodiversity in the region, as well as to assess its conservation value.

ORAL PRESENTATION

# Searching for black *Proteus* (*Proteus anguinus parkelj*) in karst groundwater with the help of eDNA

Špela Gorički<sup>1\*</sup>, David Stanković<sup>1,2</sup>, Magdalena Năpăruș-Aljančič<sup>1</sup>, Aleš Snoj<sup>3</sup> & Gregor Aljančič<sup>1</sup>

<sup>1</sup>Tular Cave Laboratory, Society for Cave Biology, Kranj, Slovenia; goricki.spela@gmail.com

<sup>2</sup>Department of Life Sciences, University of Trieste, Trieste, Italy

<sup>3</sup>Department of Animal Science, Biotechnical faculty, University of Ljubljana, Ljubljana, Slovenia

The olm (*Proteus anguinus*) is a specialized, blind and depigmented subterranean salamander inhabiting groundwaters of the Dinaric karst. In Bela krajina, southeastern Slovenia, a unique black population (*Proteus anguinus parkelj*) is known from four localities (all springs) in the very proximity of a white, troglomorphic population (*Proteus anguinus anguinus*). The detailed distribution of these populations was the focus of our work. Because its habitat is largely inaccessible, the survey of *Proteus*' distribution requires a special approach. Several techniques were employed, including traps and visual observation in the dark using night goggles, but the survey predominantly served to introduce a novel approach – analysis of traces of *Proteus* DNA released into water (environmental DNA or eDNA).

To detect *Proteus* eDNA in samples of spring water and to discriminate between the black and white subspecies, we developed specific TaqMan probes and PCR primers, homologous to variable regions of *Proteus* mitochondrial DNA. Of the 19 water samples collected and filtered, six subsequently tested positive for *Proteus* DNA, five of which were also positive for black *Proteus*. All five are new localities, where *Proteus* has neither previously nor during the survey been sighted or otherwise detected. At one of these sites we found both black and white *Proteus* eDNA syntopically. These results are consistent with known hydrogeological patterns, and suggest a possible contact or parapatry of the subspecies. Along with detection of *Proteus* eDNA in spring and cave water samples from southern Herzegovina and Montenegro, this survey represents the first successful application of the eDNA approach in detection of a subterranean organism. When used in combination with information from phylogeographic and population genetic analyses, eDNA data can aid in the advancement of our knowledge of species evolution and systematics, as well as help establish more efficient conservation measures.

POSTER PRESENTATION

# The CAVELAB project, an interdisciplinary research for the study of cave ecosystems and their potentialities for the study of global change

Marco Isaia<sup>1\*</sup>, Stefano Mammola<sup>1</sup>, Mauro Paschetta<sup>1</sup>, Alberto Chiarle<sup>1</sup>, Giovanni Badino<sup>2</sup>, Silvia Berto<sup>3</sup>, Francesca Bona<sup>1</sup>, Massimo Meregalli<sup>1</sup>, Luigi Motta<sup>4</sup>, Michele Motta<sup>4</sup>, Davide Vione<sup>3</sup> & Alfredo Vizzini<sup>1</sup>

<sup>1</sup>Department of Life Science and System Biology, University of Torino, Italy; marco.isaia@unito.it

<sup>2</sup>Department of Physics, University of Torino, Italy

<sup>3</sup>Department of Chemistry, University of Torino, Italy

<sup>4</sup>Department of Earth Science, University of Torino, Italy

Cave ecosystems offer unique opportunities for ecological studies because they are characterized by low abundance and diversity of organisms, they receive poor energy inputs and they are easily modeled. Furthermore, they are widely considered as stable, as they are light-deficient and have almost constant temperature. The fact that caves are stable and semi-closed systems them ideal sites where to study the influence of temperature on ecosystems processes, functions and biodiversity, which is the core issue of the CAVELAB project. We created a multidisciplinary research team in order to provide a deep understanding and a precise characterization of the Alpine cave ecosystem, from both an abiotic and biotic point of view, also by means of innovative technology developed within the project. In the frame of one of the work package developed within the project, we aimed at detecting potential organisms useful for monitoring the effects induced by global warming. As a first approximation it is widely accepted that a cave has a temperature almost equal to the local yearly average temperature. Increases in outside temperature can thus easily be detected inside caves and cave dwelling organisms, showing low tolerance to temperature variations, may be affected by such variations. Altering cave microclimate, global warming may potentially cause local extinctions. Western Italian Alps represent a unique area for such studies, with a rich and peculiar assemblage of species, especially among the cave dwelling fauna. Such richness is the result of an intricate biogeographical history, mainly characterized by complex tectonic dynamic and glacialism. We characterized 36 cave ecosystems, considering direct and indirect factors at a local and global scale, like microclimate, availability of energy sources, anthropic perturbations, climate and past glaciations dynamics. Such factors were related via Regression Models to the presence of Linyphiid spiders belonging to the genus *Troglohyphantes* and a strong relation with glacial history and cave internal temperature was detected. Focusing on the results, we address the role of the cave ecosystems in understanding and monitoring the effects induced by global warming. A special focus on the regional scales (populations extinctions or expansions, future scenarios of species distribution, decline of endemic species) is given.

ORAL PRESENTATION

# Climate change drives subterranean spiders to extinction: the response of *Troglohyphantes* spiders to global warming

Marco Isaia<sup>1\*</sup> & Stefano Mammola<sup>1</sup>

<sup>1</sup>Department of Life Sciences and System Biology, University of Turin, Torino, Italy; marco.isaia@unito.it

The fact that the caves are semi-closed systems with an almost constant temperature makes them almost ideal sites where to study where to study the effects of the ongoing global warming on biological communities. In spite of that, the underlying mechanisms behind the response of specialized subterranean species to global warming are still largely undiscussed. By means of two years observations data, we characterize the thermic conditions of 33 caves in the Western Alps, and relate the hypogean microclimate to the occurrence of subterranean-adapted *Troglohyphantes* spiders. Regression analysis points out a specific response to temperature as well as a significant effect of the past Pleistocene glaciations on their present distribution. In a second step, we investigate the relationship between temperatures recorded in monitored caves and the corresponding external temperature. We emphasize the mechanisms for which the constant temperature recorded inside corresponds in good approximation to the mean value of the annual temperature outside and use this direct relation to extend the results to a wider dataset, including records from over 350 caves in the Western Italian Alps. Specifically, we employ Ecological Niche Modeling techniques to predict habitat suitability both in the Last Glacial Maximum and in future global warming scenarios. In light of IPCC's projections of global average temperature increases, we assess the general sensitiveness of our model species to future increase of temperature, pointing out a future decline for hypogean adapted species.



POSTER PRESENTATION

# Comprehensive Database of the Cave Type Localities of Croatian Fauna

**Branko Jalžić<sup>1</sup>, Petra Bregović<sup>1\*</sup>, Tamara Čuković<sup>1</sup>, Anđela Ćukušić<sup>1</sup>, Dajana Hmura<sup>1</sup>, Petra Kutleša<sup>1</sup> & Martina Pavlek<sup>1</sup>**

<sup>1</sup>Croatian Biospeleological Society, Zagreb, Croatia; bregovicpetra@gmail.com

More than a decade the Croatian Biospeleological Society is dealing with collecting data on the Croatian cave type localities. This continuous work has started in 2000 with the idea to enhance further biospeleological research on Croatian cave fauna and to raise public awareness about this valuable natural heritage. When Volume 1 of The Cave Type Localities Atlas of Croatian Fauna was published in 2010, 254 type localities with a total of 399 described taxa have been listed there. Since then, the number of cave type localities has respectably increased to 290, while the number of described taxa has increased to 460. It is also important to point out that 190 localities with 273 taxa have been presented in two published volumes of The Cave Type Localities Atlas of Croatian Fauna in detail. The data on cave type localities of Croatia are also available in a public database Biospeologica Dinarica (<http://biospeologicadinarica.org>). The importance of highly diverse Croatian subterranean fauna has been recognized on a global level, as Croatia is part of Dinarides which is shown to be a world hotspot of subterranean biodiversity. The number of endemic species in Croatia is extremely high, so they deserve special conservation attention. The database of cave type localities of Croatian fauna includes literature data, maps and photos of localities, GPS coordinates and photographs of described taxa in situ. Intensive biospeleological research in last few decades are showing that subterranean fauna is still largely unexplored, and new taxa are frequently being discovered. In this context, it is important to continue laborious field work research and collection of data on the cave type localities to confirm its particular scientific value for conservation of the entire Dinaric karst area.

ORAL PRESENTATION

# New data of subterranean Amphipoda in the Dinaric karst of Croatia and adjacent regions

Gordan S. Karaman

Montenegrin Academy of Sciences and Arts, Podgorica, Crna Gora; karaman@t-com.me

Despite the fact that numerous scientists have been studied subterranean Amphipoda in the Dinaric karst of Croatia (Jurinac, Meštrov, Schäferna, S. Karaman, Sket, G. Karaman, Gottstein, etc.), the recent discoveries of the subterranean Amphipoda in numerous caves and springs in Croatia and adjacent regions show that this fauna is very rich and still only partially known.

During our studies of material of Amphipoda collected by us and by various speleologists and scientists from Croatia, Bosnia and Herzegovina, etc., especially by the Croatian Biospeleological Society (CBSS), Mg. Roman Ozimec from Zagreb, Tonči Radža and the Speleological Society "Špiljar" from Split, by Prof. Dr. Sanja Gottstein from the University of Zagreb, etc., numerous known and new species have been discovered and described [*Typhlogammarus mrazeki* Schäferna 1906, *Accubogammarus algor* G. Kar. 1973, *Niphargus hebereri* Schell. 1933, *Niphargus echion* G. Karaman & Gottstein-Matočec 2006, *Niphargus aulicus* G. Karaman 1991, *Hadzia fragilis* S. Karaman, 1932, etc. Some new data regarding the Amphipoda fauna from Dinaric karst of Croatia and adjacent regions are presented here.

ORAL PRESENTATION

# Complexity of the Dinaric cave fauna: the case of the genera *Cyphonethes* Verhoeff, 1926 and *Titanethes* Schioedte, 1849 (Isopoda: Oniscoidea: Trichoniscidae)

Ivo Karaman<sup>1\*</sup> & Mladen Horvatić<sup>1</sup>

<sup>1</sup>Faculty of Sciences, University of Novi Sad, Novi Sad, Serbia; ivo.karaman@dbe.uns.ac.rs

The genus *Titanethes*, established by Schioedte 1849, with its large species *Titanethes albus* (C. Koch, 1841), a true icon of Dinaric subterranean fauna, is one of the earliest described troglobite in general and certainly the first described cave woodlice. Since its description the genus *Titanethes* had a pretty dynamic history. A number of species of different generic affiliation has been described in this genus and later transferred to the corresponding genera. According to the current composition, the genus consists of three species: *Titanethes albus* (C. Koch, 1841), *Titanethes biseriatus* Verhoeff, 1900 and *Titanethes dahli* Verhoeff, 1926. Our study recognized only one species (or species complex) in the genus *Titanethes* and shows its closer relation to the west European subterranean genus *Spelaeonethes*, than to the Dinaric genus *Cyphonethes*. The genus *Cyphonethes* with one species *Cyphonethes herzegowinensis* (Verhoeff, 1900) (striking by its body dimensions too) was isolated from the genus *Titanethes* by Verhoeff 1926 (on subgeneric level) and raised to the generic level by Tabacaru (1996). Our study within the genus *Cyphonethes* distinguishes three species, one of them is new to the science. The genus shows its close relation to *Cetinjella monasterii* n.g. n.sp. from the same region - southeastern Dinarides. The new genus is assumed to be a cave higropetric inhabitant, based on pereopode structure and partly on slightly modified mouthparts. Specific water conducting system on the dorsal surface of pereionites in the new genus has not been recorded in Isopods up to now. Among other morphoanatomic characters, characteristics of male sexual tegumental glands were indicative of the closeness of mentioned genera and draws a clear distinction between *Spelaeonethes* and *Titanethes* on one side and *Cyphonethes* and *Cetinjella* n.g. on the other. *Spelaeonethes* and *Titanethes* species complex probably belong to the elements of paleoeuropean fauna, while species complex of the genera *Cyphonethes* and *Cetinjella* n.g. has a different origin that can be related to palaeogeographic history of the Adria microplate. Male sexual tegumental glands and following structures are synapomorphic characters with a tendency towards reduction under specific conditions.

ORAL PRESENTATION

# The faunistic diversity of cave spiders (Arachnida, Araneae) of the Dinarides

Marjan Komnenov

Skopje, Macedonia; mkomnenov@gmail.com

As results of complex history of the Balkan Peninsula, changes of names and borders of the countries, it was really challenge to prepare review of cave spiders occurring in the Dinarides. Until now there is no sublimite work especially devoted to the Dinarides. Despite the fact that Dinarides are known as having the world's highest diversity of subterranean fauna, the cave spider fauna remains still largely unexplored. In the last few years spider research in the Dinarides revealed more than 10 new species. Based on the critical analysis of all literature records, museum collections and original data, the cave spiders in the Dinarides are represented by 106 species included in 7 families: Agelenidae -7, Dysderidae - 25, Leptonetidae - 13, Linyphiidae - 48, Nesticidae - 7, Pholcidae - 3 and Tetragnathidae - 3. The genus with largest number of species is *Troglohyphantes* with 35 species, 18 of them troglobite. The largest fraction of troglobite species were encountered in the families Dysderidae - 23, Linyphiidae - 21, Nesticidae - 5 and Leptonetidae - 4. The extreme richness of troglobitic spiders in the Dinarides (54) leads to the assumption that this was a major center of speciation and evolution of species.

ORAL PRESENTATION

# New cave Collembola from the Dubrovnik region, Croatia

Lubomír Kováč<sup>1\*</sup> & Roman Ozimec<sup>2</sup>

<sup>1</sup>Dpt. of Zoology, Inst. of Biology and Ecology, P.J. Šafárik University, Košice, Slovakia; lubomir.kovac@upjs.sk

<sup>2</sup>Croatian Biospeleological Society, Zagreb, Croatia

During the period August 2014 – January 2015 an intensive sampling of cave fauna was conducted in caves of the continental area of Dubrovnik-Neretva County in Croatia. To protect the local communities, the sampling was limited to visual searching and subsequent hand collecting of specimens in caves. In total 632 individuals of Collembola belonging to 36 species were collected in 54 caves, most of them obligate cave forms (troglonites). Among the species detected, five were distinguished as new to science. *Acheroxenylla* n. sp. (Hypogastruridae), inhabiting Zadubravica jama, is the only cave representative of the genus. *Onychiuroides* n. sp. (Onychiuridae), collected in Aragonka, Jama na vrh Krčevina, Kuna špilja, Močiljska špilja and Špilja za Gromačkom vlakom, is morphologically similar to *O. bureschi* from Bulgarian caves. *Spinonychiurus* n. sp. (Onychiuridae) occupies Vranja jama, resembling bryophilous *S. vandeli* from central Pyrenees. Specimens of highly troglomorphic *Disparrhopalites* sp. detected in Kaverna 781 and Špilja od Punta need further study to confirm the taxonomic status of this peculiar species. The new species of the genus *Verhoeffiella*, differing from related *V. longicornis* in body macrochaetotaxy, inhabits Gusarska jama and Špilja Jezero. Local endemic species *Tyhlogastrura topali* was recorded in Vilina špilja-Ombra spring system. This study underlines still a great potential in revealing diversity of Collembola in Croatian caves, especially in Mediterranean region.

ORAL PRESENTATION

# History of subterranean fauna: dragon, photo-model and bio-indicator

Ivo Lučić

Speleological Society Vjetrenica – Popovo polje, Ravno; ivolucic3@gmail.com

Within the natural sciences circles the discussion on underground fauna is quite reasonable and meaningful, but when we address the broader audience we have to be more cautious. In traditional culture the subterranean fauna was an unknown terrain which was connected with strong mythological notions, mostly one of hell and nothingness. In modern times subterranean has become a source of underground resources in mining, water management and tourism, and most recently it started to obtain certain environmental significance. Newly discovered subterranean species were to some extent attributed with the characteristics of that Underworld. This presentation offers cultural clue to better understanding of underground spaces and subterranean fauna, and provides instructions for thoughtful transfer knowledge from professional circles into general audience.

ORAL PRESENTATION

# Potential and limitation of cave Collembola research in Dinaric karst

Marko Lukić

Ruder Bošković Institute, Zagreb, Croatia; marko.lukic@hbsd.hr  
Croatian Biospeleological Society, Zagreb, Croatia

Cave Collembola remain heavily understudied and undersampled during the last century in the Dinaric Karst which hosts the world's richest subterranean fauna. Only 28 species from 14 genera have been described to date from caves of Dinaric karst with scarce distributional data. Extensive Collembola sampling during last 10 years and analysis of part of Croatian Biospeleological Society Collection resulted in discovery of dozens of new species and different distributional patterns of genera and species. Our findings based on morphological study and preliminary barcoding point out to a diversity of Collembola higher than expected. Further molecular and morphological study has recently been initiated on cave restricted subgenus *Heteromurus* (*Verhoeffiella*). We have discovered strong diversification within the subgenus with more than 30 new species. Considering this great taxonomic diversity of a single genus and that some of the genera and families of Collembola, that are usually well diversified in other karst regions, are almost completely unstudied we can expect that Collembola will be one of the most diversified group of terrestrial cave fauna in Dinarides together with Coleoptera, Araneae, Pseudoscorpiones and Oniscidea. However the progress of Collembola research is likely to be rather slow due to frequently unresolved and difficult taxonomy of the group and lack of taxonomist and collembologists in the region. There are further problems in Collembola research: techniques used in morphological studies, like clearing and mounting the specimens on permanent slides are rather time consuming, old material is rather difficult to study and to mount on the slides, that small size Collembolan are difficult to collect in the field research and that although Collembola are abundant in caves there are certain problems of collecting enough of adult specimens to study. Despite these withdraws Collembola are probably excellent model for evolutionary, biogeographical and even laboratory studies as they are very abundant and diversified in all caves with high diversity of troglomorphic features.

ORAL PRESENTATION

# The caves of the Sarajevo Canton: conservation and protection

Lada Lukić Bilela<sup>1,2\*</sup>, Damir Smajić<sup>2</sup> & Roman Ozimec<sup>3</sup>

<sup>1</sup>Faculty of Science, University of Sarajevo, Sarajevo, Bosnia and Herzegovina; llbilela@gmail.com; llbilela@pmf.unsa.ba

<sup>2</sup>Biospeleological Society in Bosnia and Herzegovina, Sarajevo, Bosnia and Herzegovina

<sup>3</sup>ADIPA–Croatian Society for Natural History Diversity Research & Conservation, Zagreb; Croatia

The Canton of Sarajevo is located in the central part of Bosnia and Herzegovina with the area of 1277,3 km<sup>2</sup> which includes only 4,9% of the territory of Federation of B&H. Sarajevo is arranged as a canton with nine municipalities, while speleological objects are situated in following: Stari Grad, Centar, Hadžići, Ilijaš, Ilidža and Trnovo. The List of geomorphologic natural monuments of Cantonal Institute for Protection of Cultural and Natural Heritage, include 45 speleological objects, but during the reconnaissance of the terrain we found at least ten, mostly pits.

Most of these speleological objects are inhabited by several endemic, rare, endangered and protected cave-dweller organisms, mostly animals. Megara cave at Bjelašnica Mt. is a paleontological site and type locality, as well as Klokočevica, and numerous caves in Treskavica Mt. Interestingly, poorly known and inaccessible cave below Uževica rock (Ozren Mt.) in Municipality Centar was found as recently used bear's winter den. Some of caves are extremely valuable as a part of cultural historical heritage, like Pećina ispod Šehove Korije Cave which belonged to Isa Bey's Tekke and served for Sufi Dervishes solitude. However, some of caves from the List were anthropogenized or even not speleological objects at all (Mrča jama). An attractive cave above Bentbaša water gate in Baščaršija now serves as restaurant, some of caves at slopes of Trebević Mt. were used as lumber rooms but some of these caves were, due to misuse, sealed by Canton Sarajevo Ministry of Internal Affairs.

The majority of the Sarajevo Canton caves are biospeleologically unexplored and cave habitats are endangered due to various anthropogenic influences. Therefore, future biospeleological research in Bosnia and Herzegovina should contribute to proposing new directives for cave and karst conservation and sensitizing the public for the importance and vulnerability of caves and cave organisms in environmental protection.



ORAL PRESENTATION

# Niche overlap and competition in subterranean spiders

Stefano Mammola<sup>1\*</sup> & Marco Isaia<sup>1</sup>

<sup>1</sup>Department of Life Sciences and Systems Biology, University of Turin, Torino, Italy; stefano.mammola@unito.it

The geometry of the Hutchinson's hypervolume derives from multiple selective pressures defined, on one side by the physiological tolerance of the species, and on the other, by intra- and interspecific competition. The quantification of these evolutionary forces is essential for the understanding of the coexistence of top predators at a very local scale. We address this topic by investigating the ecological niche of three spider species showing different adaptations to subterranean life (*Meta menardi*, *Pimoa graphitica* and *Troglohyphantes vignai*), occurring syntopically in different hypogean sites of the Western Italian Alps. We surveyed different populations of our model organisms over one year, monitoring monthly their spatial and temporal dynamics in the caves and the associated physical and ecological variables. We quantified the ecological niche of the three species through multi regression techniques (GLMMs) and assessed interspecific competition by evaluating the overlap between their n-dimensional niche hypervolumes. We detected a remarkable overlap between the microclimatic and trophic niche of *M. menardi* and *Pimoa* n.sp. However, the former -- being larger in size -- resulted the best competitor in the vicinity of the surface, causing the latter to readjust its spatial niche slightly towards the internal part of the cave, where prey availability was scarcer. On the other hand, lacking true competitors in the inner sections of the cave, *T. vignai* realized its niche as a trade-off between optimal microclimatic conditions and trophic availability. With this work, we aim at providing new insights about the complex relationships among subterranean species, demonstrating that energy-poor environments such as caves maintain the potential for diversification of top predators via niches differentiation.

ORAL PRESENTATION

# First data on the occurrence of tiny polydesmids (Diplopoda: Trichopolydesmidae) in Slovenia

**Andrej Mock**

Pavol Jozef Šafárik University in Košice, Slovakia; andrej.mock@upjs.sk

The tiniest and spidery polydesmids – some of them rich hardly 3 mm – from the family Trichopolydesmidae were almost neglected during decades of the modern research of soil and underground habitats in the Southern Europe and its records were usually accidental. Nowadays rapid increase of the knowledge on these small creatures are noticed due to new detailed research of complete spectrum of microhabitats in caves, sometimes in the localities biologically well examined in the past. New descriptions are coming from the humid soil habitats in the Tropical Asia as same as from underground of the arid karst regions like Caucasus, Crimea or Dinarides. Many local paleoendemics were recognized among them. All blind and colorless with dense dorsal setae have morphological adaptations for cave dwelling (long appendages and tergal structures etc.) or typical habitus of edaphobionts. More accurate taxonomy and classification were proposed by several authors recently.

Short investigation on the cave fauna near Postojna in the spring and autumn of 2014 brought repeated samples of the trichopolydesmids, first from the territory of Slovenia and the westernmost edge of Dinaric Alps. Adult males and females were sampled what facilitates to describe this taxon. The results will be presented.

ORAL PRESENTATION

# The Biospeleological Museum Vjetrenica: a new model for biospeleology promotion

Roman Ozimec<sup>1,2\*</sup>, Lada Lukić Bilela<sup>3,4</sup>, Branko Jalžić<sup>2</sup> & Ana Soldo<sup>5</sup>

<sup>1</sup>ADIPA–Croatian Society for Natural History Diversity Research & Conservation, Zagreb; Croatia; roman.ozimec@zg.t-com.hr; ozimec.roman@gmail.com

<sup>2</sup>Croatian Biospeleological Society, Zagreb, Croatia

<sup>3</sup>Faculty of Science, University of Sarajevo, Sarajevo, Bosnia and Herzegovina

<sup>4</sup>BIOSPELD-Biospeleological Society in Bosnia and Herzegovina, Sarajevo, Bosnia and Herzegovina

<sup>5</sup>Public enterprise "Vjetrenica-Popovo polje", Trg don Ivana Musića 1, 88370 Ravno, Bosnia and Herzegovina

Vjetrenica cave near Zavala on Popovo polje field in Bosnia and Herzegovina is, with the Postojna Cave in Slovenia, at the very top of Europe and the world with the biodiversity of cave organisms. Therefore, it is designed and implemented project Biospeleological Museum Vjetrenica, with the main sponsor of the Federal Ministry of Environment and Tourism of B&H. For the project was carried out collection, processing, preparation and appropriate presentation of exhibits found in the cave Vjetrenica or related to caving, biospeleological and other studies of the cave, as well as the adjacent karst area of Popovo polje field. However, the basis of the Museum is numerous written synthesis realized on the basis of previous studies of the cave, which include all the elements of Vjetrenica cave, with many recent and old photographs, drawings or blueprints. The museum is designed and set up with the 16 thematic sections, where for each made bilingual Croatian-English thematic poster, and some units are accompanied by material and exhibits. Mounted units are: Karst, Dinarides, Popovo polje field, Speleological objects of Popovo polje field, Vjetrenica: homage to the researchers, Vjetrenica: identity card, Vjetrenica: history of research, Drafts of Vjetrenica, Paleontology, Archeology, Habitats, Hygropetric, Cave organisms, Check list of Vjetrenica cave organisms, Vjetrenica today and, as the final futuristic poster, Vjetrenica tomorrow. All this is made by the team of 9 experts and by photos and drawings of 16 authors. The Museum was opened on May 3 2016, as the first, born stadium of expected three evolution phases. Ultimately, the Museum should become a first part of future international WIKI (Vjetrenica Virtual International Karst Institute), whose establishment is planned already for this year 2016. Institute should organize international research camps, schools and workshops from different scientific branches: karstology, geology, hydrology, speleology, paleontology, geography, biology, archeology, ethnology, agronomy, forestry, included the library Bibliotheca Vjetrenicae, Cave-laboratory, but also a digital Speleological cadaster of the wider area of Popovo polje field, networked with similar institutions in B&H and neighboring Croatia and Montenegro. The Museum is the first step in systematical work to promote south Dinaric karst biogeographical region, while preserving and improving all elements of human activity on the karst.

POSTER PRESENTATION

# Development of bats research in Bosnia and Herzegovina during the last ten years

Jasmin Pašić<sup>1\*</sup>, Primož Presetnik<sup>2</sup> & Jasminko Mulaomerović<sup>1</sup>

<sup>1</sup>Center for Karst and Speleology, Sarajevo, Bosnia and Herzegovina; pashic@gmail.com

<sup>2</sup>Centre for Cartography of Fauna and Flora, Ljubljana, Slovenia

After exploring the bats in Bosnia and Herzegovina before WWII, then in the sixties of the 20th century by European researchers and researchers from the former Yugoslavia, renewed interest arises after the call of UNEP / EUROBATS Secretariat to Bosnia and Herzegovina ten years ago, to participate as an "observer" at the meetings of the Advisory Committee. At those meetings a number of contacts were exchanged between the European researchers, but primarily from the region. In the meantime, field data collected as part of the exploration are becoming more numerous, but there are also people who are placing the bats in the focus of their research. As the regional cooperation intensified, so the investigation became more numerous and systematic. There was a need to publish the collected data to become more accessible to the wider professional community. The Center for Karst and Speleology from Sarajevo launched the Bulletin as a supplement to the journal "Naš Krš", with more enviable track. However, appetites have increased, and in 2016 a journal of regional character called "Hypsugo" was started. Redaction is made up of experts from Slovenia, Serbia, Croatia, Montenegro, Albania, and of course, Bosnia and Herzegovina. This poster shows in detail the evolution of events and the development of bats research in BiH during the last ten years.

POSTER PRESENTATION

# Overview of cave spiders in Croatia- 150 years of research

**Martina Pavlek**

Department of Molecular Biology, Ruđer Bošković Institute, Zagreb, Croatia  
Croatian Biospeleological Society, Zagreb, Croatia; [martina.pavlek@irb.hr](mailto:martina.pavlek@irb.hr)

Cave spider research in Croatia goes back to 1862. when Keyserling described first troglomorphic species for Croatia, *Hadites tegenarioides*. Władysław Kulczyński described three and Josef Kratochvil, a famous Czech arachnologist, described 14 cave species, some of them with Karel Absolon and František Miller. Most recent explorer was Christa Deeleman-Reinhold who described six species. From the faunistic point of view, except for already mentioned authors, Paolo Marcello Brignoli also contributed. At the present time researchers from Croatian Biospeleological Society (CBSS) perform systematic work in this field. Of approximately 9000 explored caves in Croatian karst (prediction is three times as much), CBSS collection holds spider material from about 1000 of them. At the moment 115 hypogean taxa are recorded from caves in Croatia, 90 of which are true cave taxa (43 troglomorphic, 47 troglomorphic), 9 are subtroglomorphic and 16 microcavernicolous. Most abundant families are Linyphiidae (46 species), Dysderidae (16), Agelenidae (13) and Leptonetidae (10). 35 species are described from Croatia and 27 are endemic. Of 90 cave taxa, 23 (13 troglomorphic) are probably new for science and waiting to be described.

ORAL PRESENTATION

# Egon Pretner's (1896-1982) contribution to the knowledge of the subterranean beetles (Coleoptera) fauna of Croatia

Slavko Polak

Notranjska museum Postojna, Institute Znanje Postojna, Postojna, Slovenia; slavko.polak@notranjski-muzej.si

Egon Pretner (1896-1982) was a Slovenian speleobiologist earned a worldwide reputation owing to his achievements in the research of cave beetles in Slovenia and Western Balkans countries. He has born in Trieste where he finished primary and secondary school. At this time professor dr. Josef (Giuseppe) Müller encouraged his interest for cave beetles and Hydrenas. Later he studied law in Zagreb and worked as a commercialist. After World War II, he was employed at Postojna caves company and in 1952 at the Karst research institute in Postojna ZRC SAZU, where he dedicated his life to cave beetle studies. He regularly organized or participated cave exploring excursions in late fifties, sixties and early seventies. Beside most Slovene cavers and biologists, he accompanied the numerous foreign scientists who explored Balkan caves as an excellent field guide. With arachnologist Christa Deeleman – Reinhold, he explored Dinaric karst caves almost on the annual basis. After he has gathered published data and check cave beetle collections of his senior entomologists he prepared some significant published contributions and conference presentations. Subterranean beetle fauna of Croatia overview, that was published as Yugoslav Academy of Science and Arts monograph (JAZU) in 1973 is one of the most comprehensive. This and his other publications, as well as his extend collection, are still the basic guide to the present day subterranean beetle studies of the Dinaric karst. Since he was able to speak most main European languages, he succeeded to decode secret Leo Weirather cave beetle localities.

He acquired an extensive and valuable own collection of cave beetles, but was also tireless in gathering other groups of cave fauna which he then selflessly left to numerous domestic and foreign scientists to do scientific research. As part of his work, he visited an enviable number of caves - 1500, some of them he visited on a regular basis. He kept a meticulous diary of his work, which today makes it possible for us to list all of his visits to the caves of the Karst underground world with certainty. The number is almost incredible: 3600 visits. In Croatia alone, he made approximately 600 cave visits in more than 150 different Croatian caves.

ORAL PRESENTATION

# Dinaric species in peninsular Italy: a molecular perspective in explaining trans-Adriatic distribution in the genus *Niphargus* (Crustacea, Amphipoda)

Fabio Stoch<sup>1\*</sup>, Teo Delić<sup>2</sup>, Cene Fišer<sup>2</sup> & Jean-François Flot<sup>1</sup>

<sup>1</sup>Université Libre de Bruxelles, Evolutionary Biology & Ecology, Bruxelles, Belgium fabio.stoch@gmail.com

<sup>2</sup>Department of Biology, Biotechnical Faculty, University of Ljubljana, Ljubljana, Slovenia

Species distributed on both sides of the Adriatic Sea are well known and quite well documented especially in the entomological literature. However, the discovery of the presence of morphologically similar, obligate subterranean cave water species along the Dinaric Karst as well as along peninsular Italy, both in Adriatic and Thyrrhenian karstic watersheds, is quite surprising. In the present research we focused on a clade of predominantly large-bodied *Niphargus* species distributed on both sides of the Adriatic Sea. The target species are specialized dwellers of the phreatic karstic zones, with small distribution ranges both in the Dinarides and in Italy, which imply their poor dispersal abilities. How these ecologically specialized species live on both sides of the Adriatic Sea is an intriguing question that can be framed within at least three testable scenarios: (i) *convergence*, assuming that Dinaric and Italic species are phylogenetically unrelated and attained their morphological similarity convergently; (ii) *vicariance*, postulating that Italo-Dinaric species share widespread ancestors which broad areal was splitted by the Adriatic Sea, and (iii) *dispersal*, hypothesizing that the clade originated on only one peninsula and dispersed across the Adriatic basin during marine regressions (from Messinian to later Pleistocene glaciations). Here we present the first results of a molecular approach as an attempt to explain trans-Adriatic distribution in *Niphargus*. Specimens were collected from Dinaric Karst and peninsular Italy and two markers (the nuclear 28S, and the mitochondrial COI) were sequenced. Phylogenies were constructed from each marker and compared to reconstruct the speciation events in time and space. The preliminary results of this ongoing project cast a new light on the diversity of this *Niphargus* clade, revealing several cryptic species, excluding morphological convergence, and suggesting multiple dispersal/vicariance events. Recent dispersal events might explain at least the presence of a subclade, which shares the same sequence of the nuclear 28S marker, including the Dinaric *N. hebereri* species complex and several northern and central Apenninic morphospecies.

ORAL PRESENTATION

# The cave species of the centipede genus *Lithobius* Leach, 1814 (Chilopoda: Lithobiomorpha: Lithobiidae) originally described from Dinarides

Dalibor Z. Stojanović<sup>1\*</sup>, Boris D. Dudić<sup>2</sup>, Vladimir T. Tomić<sup>2</sup> & Bojan M. Mitić<sup>2</sup>

<sup>1</sup>State University of Novi Pazar, Department of Biomedical Sciences, 36300 Novi Pazar, Serbia; dstojanovic@np.ac.rs

<sup>2</sup>University of Belgrade – Faculty of Biology, Institute of Zoology, 11000 Belgrade, Serbia

The centipede genus *Lithobius* Leach, 1814 includes more than 500 species/subspecies arranged in eight subgenera. Many of these species are described from the karst regions and caves environments, as a troglobitic or troglaphylus forms. Along the Dinaric mountain chain, a significant diversity of this genus is recorded. Most of the species are epigeic, but some of them have the cavernicolous features. If we accept the opinion that the reduction of ocelli in some *Lithobius* species is the most recognizable character indicating their adaptation to subterranean way of life, we can separate at least eight troglobitic species originally described from Dinarides: *Lithobius (Lithobius) jugoslavicus* (Hoffer, 1937); *L. (L.) matulici* Verhoeff, 1899; *L. (L.) sketi* Matic & Darabanțu 1968; *L. (L.) troglomontanus* (Folkmanová, 1940); *L. (Monotarsobius) zveri* (Matic & Stenzer, 1977); *L. (Sigibius) apfelbecki* Verhoeff, 1900; *L. (S.) reiseri* Verhoeff, 1900; and *L. (Thracolithobius) remyi* Jawłowski, 1933. Three species described from the Dinaric caves have ocelli and they can be defined as troglaphylus organisms, namely: *L. (L.) stygius* Latzel, 1880; *L. (S.) absoloni* (Folkmanová, 1935); and *L. (S.) trebinjanus* Verhoeff, 1900. Also, there are seven valid epigeic species originally described from Dinarides: *L. (L.) aspersus* Attems, 1899; *L. (L.) lapadensis* Verhoeff, 1900; *L. (L.) mucronatus* Verhoeff, 1937; *L. (L.) peregrinus* Latzel, 1880; *L. (L.) pygmaeus* Latzel, 1880; *L. (L.) simplex* Folkmanová, 1946; and *L. (M.) hadzii* Matic & Darabanțu, 1968. The greatest number of type localities of the *Lithobius* species from Dinarides is recorded in Bosnia and Herzegovina (ten sites), Croatia (four sites), Slovenia and Montenegro (two sites each).



ORAL PRESENTATION

# SubBioDatabase – a tool for research and conservation of subterranean biodiversity of the whole Dinarides

Maja Zagmajster

Subterranean Biology Lab, Department of Biology, Biotechnical Faculty, University of Ljubljana, Slovenia;  
maja.zagmajster@bf.uni-lj.si

Dinarides are a globally important region in subterranean biodiversity: this is the area of the first discoveries of subterranean animals, which led to the birth of speleobiology; it is a world hotspot in subterranean species richness; it is the home to the only subterranean representatives of some taxa in the world. Every year, new species and new distributional data on subterranean species are being gathered for the Dinarides, due to ongoing field work studies, but also due to implementation of new techniques in species descriptions. The data on subterranean species distribution are scattered in numerous literature sources, reports as well as public and private collections. It is only when such large amount of records are put together, that we get a powerful tool for scientific research as well as conservation of the region. *SubBioDatabase* - a database on subterranean biodiversity, contains data on subterranean biodiversity of the Dinarides and neighboring areas, managed by Subterranean Biology Lab (SubBioLab) at the Department of Biology at University of Ljubljana in Slovenia. The relational database contains spatially defined occurrence data for subterranean taxa, coming from published and own field work studies, as well as molecular data for taxonomic groups studied by the lab. The database can serve as a platform for international cooperation in various scientific studies, as well as in initiatives for conservation of subterranean fauna of the Dinarides, which should be treated as one region beyond national/administrative borders.

# List of poster presentations

- Trond Andersen, Viktor Baranov, Linn Katrine Hagenlund, Marija Ivković, Gunnar Mikalsen Kvifte & Martina Pavlek\*:  
Flying deeper underground? A new troglobiotic chironomid (Diptera) from the Lukina jama – Trojama cave system in Croatia
- Jana Bedek\*, Kazimir Miculinić, Ana Komerički & Luka Katušić:  
Croatian Cave Cadaster – future tool in biospeleological research
- Kristijan Cindrić\*, Mateja Jagić & Nikolina Kuharić: Activities of the Biospeleology section of the Biology Student Association – BIUS from 2010 until now
- Andrea Colla\* & Roberto Caldara:  
On the first finding of *Absoloniella reitteri* (Müller, 1912) after its original description (Coleoptera, Curculionidae)
- Tamara Čuković\*, Tvrtko Dražina, Petra Bregović, Branko Jalžić & Helena Bilandžija:  
Protection of underground by protection of the Narrow-necked blind cave beetle (*Leptodirus hochenwartii* Schmidt, 1832)
- Marco Isaia\*, Stefano Mammola, Mauro Paschetta, Alberto Chiarle, Giovanni Badino, Silvia Berto, Francesca Bona, Massimo Meregalli, Luigi Motta, Michele Motta, Davide Vione & Alfredo Vizzini:  
The CAVELAB project, an interdisciplinary research for the study of cave ecosystems and their potentialities for the study of global change
- Branko Jalžić, Petra Bregović\*, Tamara Čuković, Anđela Čukušić, Dajana Hmura, Petra Kutleša & Martina Pavlek:  
Comprehensive Database of the Cave Type Localities of Croatian Fauna
- Jasmin Pašić\*, Primož Presetnik & Jasminko Mulaomerović:  
Development of bats research in Bosnia and Herzegovina during the last ten years
- Martina Pavlek:  
Overview of cave spiders in Croatia- 150 years of research

# Author index

- Aljančič, Gregor ■ 22
- Andersen, Trond ■ 8
  - Antić, Dragan ■ 9
- Arnedo, Miquel A. ■ 10
- Badino, Giovanni ■ 23
  - Baković, Najla ■ 11
- Baranov, Viktor ■ 8
  - Bedek, Jana ■ 12, 13
  - Berto, Silvia ■ 23
- Bilandžija, Helena ■ 17
- Bona, Francesca ■ 23
  - Borko, Špela ■ 14
- Bregović, Petra ■ 17, 25
- Caldara, Roberto ■ 16
- Chiarle, Alberto ■ 23
- Cindrić, Kristijan ■ 15
  - Colla, Andrea ■ 16
- Čuković, Tamara ■ 17, 25
- Čukušić, Anđela ■ 25
  - Delić, Teo ■ 14, 18, 19, 39
- Dražina, Tvrtko ■ 9, 17
- Dudić, Boris D. ■ 40
  - Fišer, Cene ■ 19, 39
  - Fišer, Žiga ■ 20
- Flot, Jean-François ■ 39
- Gasparo, Fulvio ■ 10, 21
  - Gorički, Špela ■ 22
- Hagenlund, Linn Katrine ■ 8
- Hmura, Dajana ■ 25
- Horvatović, Mladen ■ 27
  - Isaia, Marco ■ 23, 24, 33
- Ivković, Marija ■ 8
- Jagić, Mateja ■ 15
- Jalžić, Branko ■ 17, 25, 35
- Karaman, Gordan S. ■ 26
  - Karaman, Ivo ■ 27
  - Katušić, Luka ■ 12
  - Komerički, Ana ■ 12
- Komnenov, Marjan ■ 28
- Kováč, Lubomír ■ 29
- Kuharić, Nikolina ■ 15
- Kutleša, Petra ■ 25

# Author index

- Kvifte, Gunnar Mikalsen ■ 8
- Lučić, Luka ■ 9
- Lučić, Ivo ■ 30
- Lukić, Marko ■ 31
- Lukić Bilela, Lada ■ 32, 35
- Makarov, Slobodan ■ 9
- Mammola, Stefano ■ 23, 24, 33
- Meregalli, Massimo ■ 23
- Miculinić, Kazimir ■ 12
- Mitić, Bojan M. ■ 40
- Mock, Andrej ■ 34
- Motta, Luigi ■ 23
- Motta, Michele ■ 23
- Mulaomerović, Jasminko ■ 36
- Muršič, Zarja ■ 20
- Năpăruș-Aljančić , Magdalena ■ 22
- Ozimec, Roman ■ 29, 32, 35
- Paschetta, Mauro ■ 23
- Pašić, Jasmin ■ 36
- Pavković Lučić, Sofija ■ 9
- Pavlek, Martina ■ 8, 25, 37
- Polak, Slavko ■ 18, 38
- Presetnik, Primož ■ 36
- Smajić, Damir ■ 32
- Snoj, Aleš ■ 22
- Soldo, Ana ■ 35
- Stanković, David ■ 22
- Stoch, Fabio ■ 21, 39
- Stojanović, Dalibor Z. ■ 40
- Tomić, Vladimir T. ■ 40
- Trontelj, Peter ■ 14, 18, 19, 20
- Vione, Davide ■ 23
- Vizzini, Alfredo ■ 23
- Zagmajster, Maja ■ 41
- Žvorc, Petra ■ 13



# 1<sup>st</sup> Dinaric Symposium on Subterranean Biology

23<sup>rd</sup> - 24<sup>th</sup> September 2016

Zagreb, Croatia