



August 20th-25th, 2017
University of Nottingham – UK

with thanks to:



Organising Committee

Sara Goodacre, *University of Nottingham, UK*

Dmitri Logunov, *Manchester Museum, UK*

Geoff Oxford, *University of York, UK*

Tony Russell-Smith, *British Arachnological Society, UK*

Yuri Marusik, *Russian Academy of Science, Russia*

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Congress logo designed by Michelle Strickland.

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Foreword

We are delighted to welcome you to the University of Nottingham for the 30th European Congress of Arachnology. We hope that whilst you are here, you will enjoy exploring some of the parks and gardens in the University's landscaped settings, which feature long-established woodland as well as contemporary areas such as the 'Millennium Garden'. There will be a guided tour in the evening of Tuesday 22nd August to show you different parts of the campus that you might enjoy exploring during the time that you are here.

Registration

Registration will be from 8.15am in room A13 in the Pope Building (see map below). We will have information here about the congress itself as well as the city of Nottingham in general. Someone should be at this registration point throughout the week to answer your questions. Please do come and find us if you have any queries. We want to make your stay in Nottingham as enjoyable as possible.

Plenary Talks

These will take place in the Pope Building in Lecture Hall C14 at the start of each conference day.

Information for Speakers

Lectures will take place in the Pope Building, in Lecture Halls C14 and C16. Each speaker will have 20 minutes (15 minutes talk + 5 minutes for questions). Please prepare talks in Powerpoint or PDF format and load onto the computers in lecture theatres using a USB pen before the session begins. Mac users please check that your presentation is compatible with Windows.

Posters

Please make posters A0 portrait size. Posters will be exhibited in rooms A13 and A14 in the Pope Building. Please bring them here on the morning of the first day of the congress (Monday 21st). There will be a map in these rooms showing where you should hang your poster. Please take posters down during the morning session of Friday 25th August.

Arrival Information and Transport

Parking is in the main visitor's car park (post-code for sat nav is NG7 2QL). There are also tram and bus services to/from the city centre. **Please note that the correct tram stop is 'The University of Nottingham' and not 'Nottingham Trent University', which is another university in the city centre.** Tram ticket machines take coins or cards (single journeys ~£2). Bus tickets cost about the same and are bought on board. Some buses do not give change. For those staying at Hugh Stewart Hall, please make your way to the hall's reception (accessible from the top left-hand corner of the visitors' carpark.)

<https://saragoodacre.wixsite.com/eca-2017/getting-from-the-city-to-campus>

Evening Entertainments

The evening BBQ on the night of the 21st August and the conference dinner on the evening of the 24th August will both take place in Hugh Stewart Hall of Residence. There will be an excursion into Nottingham city centre on Tuesday 22nd August to show you some of Nottingham's finest pubs. The *Russian Party*, a highlight of the congress, will be held on Wednesday 23rd in the ESCL building next to the lecture theatre venue. Finally, a 'Ceilidh' will be held in A13/A14 of the Pope building after the conference dinner on the evening of the 24th.

The Venue

See map on page 3.

Talks, Posters and Lunches

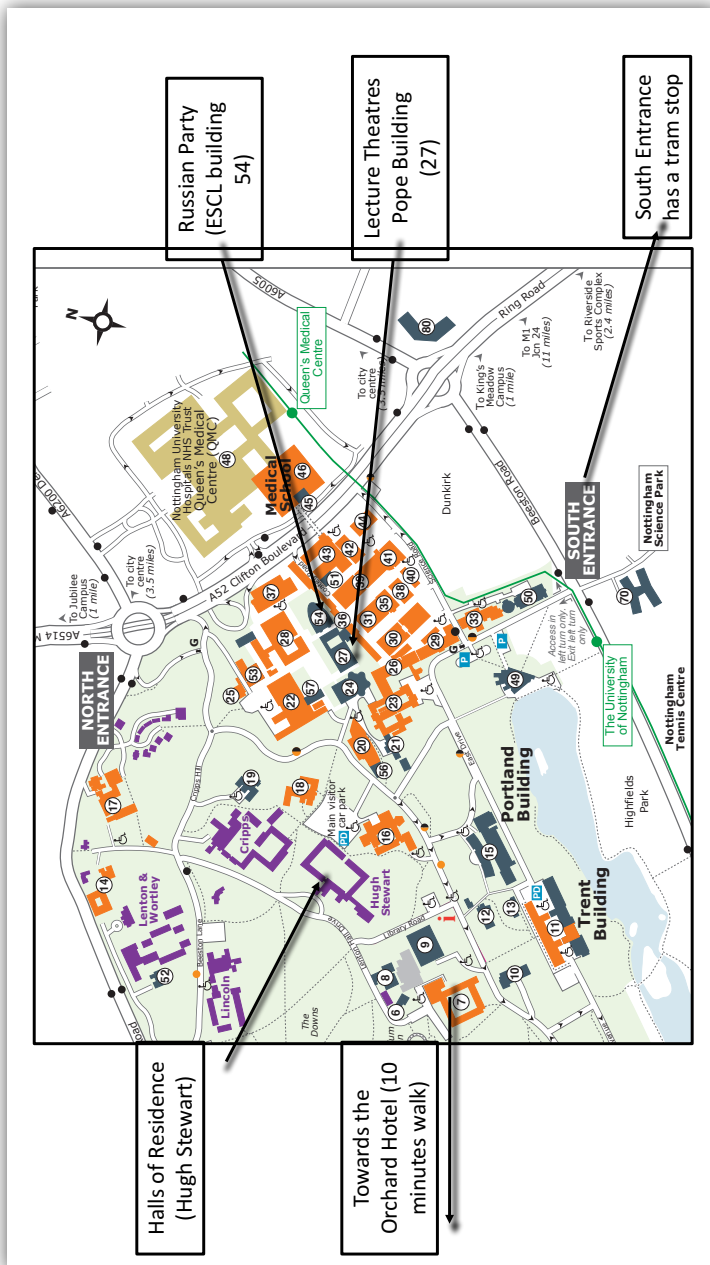
Talks will take place in the Pope Building in lecture theatres C14 and C16. Posters displays and lunches will be in the same building in rooms A13 and A14.

Excursions

Excursion day is Wednesday 23rd August. Further information about the different excursions will be provided at registration.

Post-congress Event

There will be an excursion to visit the local Attenborough Nature Reserve on the morning of Saturday 26th. Details will be provided at registration.



Programme Schedule

Monday, August 21

Congress opening

Lecture Hall C14

Chair: Sara GOODACRE & Dmitri LOGUNOV

9:00–9:20

Mayor's welcoming speech

9:20–10:00

Torbjorn Kronestedt and **Christian Komposch**

Slide show: old and modern days of European arachnology

10:00–11:00

Yael LUBIN (Israel) – **Plenary lecture**

The other spider societies

11:00–11:40

Coffee break

Session – Behavioural ecology

Lecture Hall C14

Chair: Yael LUBIN

11:40–12:00

Marlis DUMKE (Australia)

The maintenance of cooperation and equal sex ratios in a socially foraging spider

12:00–12:20

Onno PREIK (Germany)

Decrypting female choice: investigation of possible post-copulatory cryptic female choice mechanisms in *Argiope bruennichi* (Scopoli, 1772)

12:20–12:40

André WALTER (Denmark)

Kin-mediated differences in group feeding performance in sub-social *Stegodyphus africanus* spiders (Araneae, Eresidae)

12:40–13:00

Petr DOLEJŠ (Czech Republic)

Reproduction and ontogeny of *Zorocrates guerrensis* Gertsch & Davis, 1940 (Araneae: Zoropsidae)

13:00–14:00

Lunch

Parallel session 01 – Taxonomy and phylogeny

Lecture Hall C14

Chair: Yuri MARUSIK

14:00–14:20

Matjaž KUNTNER (Slovenia)

Nephilid spider phylogenomics: complex evolution of sexual size dimorphism

14:20–14:40	Christian Louis Bonatto PAESE (UK) Characterisation of the role of HES (hairy/enhancer-of-split) gene family members during embryogenesis of the spider <i>Parasteatoda tepidariorum</i>
14:40–15:00	Francisco Emmanuel Méndez CASTRO (Germany) Spatial patterns of diversity for the conservation of epiphyte-dwelling spiders: an island biogeography approach concerning isolation processes
15:00–15:20	Stefano MAMMOLA (Italy) Aesthetic impact of <i>Brigittea civica</i> webs on historical buildings in the down-town district of Turin (NW Italy)

Parallel session 02 – Databases and engagement

Lecture Hall C16

Chair: Geoff OXFORD

14:00–14:20	Christian KROPF and Wolfgang NENTWIG (Switzerland) Ideas concerning the future development of WSC, Araneae and VINST
14:20–14:40	Vladimir OVTCHARENKO (USA) A comprehensive Database of Ground Spiders (Gnaphosidae) from Asia and Australia
14:40–15:00	Arthur E. DECAE (The Netherlands) The second best builders on the planet
15:00–15:20	Sarah PIERCE (UK) Open Air Laboratories: How to engage one million participants in citizen science?
15:20–16:00	<i>Coffee break</i>

Parallel session 01 – Taxonomy

Lecture Hall C14

Chair: Peter KOOMEN

16:00–16:20	Matyas HÍRMAN (Czech Republic) Same but different! Karyotype variability of the suborder Cyphophthalmi in the Balkan Peninsula (Arachnida: Opiliones)
16:20–16:40	Michael SEITER (Austria) Different approaches to whip spider taxonomy (Arachnida: Amblypygi)
16:40–17:00	Shou-Wang LIN (Germany) Knocking trees, spiders fall: fourteen new species of <i>Shaanxinus</i>

	Tanasevitch, 2006 (Araneae, Linyphiidae, Erigoninae) from Taiwan and Vietnam
17:00–17:20	Stanislav KORENKO (Czech Republic) Resurrection of the spider parasitoid genus <i>Millironia</i> Baltazar 1964 (Ichneumonidae, Ephialtini)

Parallel session 02 – Predatory effect of spiders	Lecture Hall C16
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Chair: Robert BOSMANS

16:00–16:30	Ferenc SAMU (Hungary) The significance of non-consumptive effect of spiders in biological control
16:30–16:50	Radek MICHALKO (Czech Republic) Neem application alters the relationship between predatory activity and behavioural predictability along a prey density gradient in the spider <i>Oxyopes lineatipes</i>
16:50–17:10	Roman BUCHER (Germany) Effects of resource pulses on spider top-down control – numerical response and prey choice
17:10–17:30	Hafiz Muhammad TAHIR (Pakistan) Non-consumptive effect of spiders on the foraging behaviour of herbivorous insects

Tuesday, August 22

Plenary session – Silk	Lecture Hall C14
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Chair: Matjaz KUNTNER

9:00–10:00	Fritz VOLLRATH (UK) – Plenary lecture Spiders webs and their silks
10:00–10:20	Erica MORLEY (UK) Ballooning spiders: sensory mechanisms and electric flight?
10:20–10:40	Anna-Christin JOEL (Germany) Nanofibrous adhesion of the capture threads of cribellate spiders
10:40–11:00	Michelle STRICKLAND (UK) Diversity of silks and spinning apparatus of the water spider <i>Argyroneta aquatica</i> (Araneae, Cybaeidae)
11:00–11:40	<i>Coffee break</i>

Parallel session 01 – Taxonomy

Lecture Hall C14

Chair: Dmitri LOGUNOV**11:40–12:00****Yuri M. MARUSIK** (Russia)

Typified and non-typified names in spider systematics

12:00–12:20**Łukasz TRĘBICKI** (Poland)Phylogenetic analysis of the Australasian genus *Cytaea* (Araneae: Salticidae) based on morphology and molecular markers; preliminary results**12:20–12:40****Nilani KANESHARATNAM** (Sri Lanka)

Molecular and morphological data reveals a cryptic radiation of shiny South Asian jumping spiders

12:40–13:00**Ilesha Sandunika ILEPERUMA ARACHCHI** (Sri Lanka)

Unravelling the phylogeny of two closely related crab spider genera in Sri Lanka (Araneae: Thomisidae)

Parallel session 02 – Diversity and faunistics

Lecture Hall C16

Chair: Efrat GAVRISH-REGEV**11:40–12:00****Robert BOSMANS** (Belgium)Assessing biodiversity in the Mediterranean region: the case of the genus *Haplodrassus* Chamberlin, 1922 (Araneae: Gnaphosidae)**12:00–12:20****Jesús HERNÁNDEZ-CORRAL** (Spain)Diversity and ecology of Araneae in hollows of *Quercus pyrenaica* in the western Iberian peninsula**12:20–12:40****Peter KOOMEN** (The Netherlands)

High altitude jumping spiders (Salticidae) of Kinabalu Mountain, Borneo, Malaysia-Sabah

12:40–13:00**Muhammad AHSAN** (Pakistan)

Diversity and ecology of the scorpion fauna of Punjab, Pakistan

13:00–14:00*Lunch***Parallel session 01 – Diversity and faunistics**

Lecture Hall C14

Chair: Milan ŘEZÁČ**14:00–14:20****Marco ISAIA** (Italy)

Spiders in caves: the CAWEB project

14:20–14:40**Stefan FOORD** (South Africa)

Landuse change in savannas disproportionally reduces functional

	diversity of invertebrate predators at the highest trophic levels: spiders as an example
14:40–15:00	Yuri MARUSIK (Russia) A reconstruction of the mammoth "steppes" in Northeastern Siberia and Beringian exchanges
15:00–15:20	Astri LEROY (South Africa) Spiders (Araneae) at Brenturst Garden, a city garden in Johannesburg, South Africa

Parallel session 02 – Taxonomy and phylogeny	Lecture Hall C16
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Chair: Cristian KROPF

14:00–14:20	Cor VINK (New Zealand) The spider tree of life. What does it mean for the New Zealand fauna?
14:20–14:40	Richard GALLON (UK) A revision of the Southern African spider genus <i>Brachionopus</i> Pocock, 1897 with notes on <i>Harpactirella</i> Purcell, 1902 (Theraphosidae; Harpactirinae)
14:40–15:00	Sasanka RANASINGHE (Sri Lanka) Molecular phylogeny of the spider family Oonopidae (Araneae, goblin spiders)
15:00–15:20	Nusrat MAJEED (Pakistan) DNA barcoding of jumping spiders from Pakistan

15:20–16:00 *Coffee break*

Session – Biogeography	Lecture Hall C14
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Chair: Marco ISAIA

16:00–16:20	Jagoba MALUMBRES-OLARTE (Catalonia) The same but different: how climate, geography and habitat shape mega-diverse spider communities
16:20–16:40	Yuri MARUSIK (Russia) Palearctic and Nearctic vs. Holarctic: how does spider distribution correlate with zoogeographic regions?
16:40–17:00	Igor ARMIACH (Israel) Evippinae (Araneae, Lycosidae) in Israel – taxonomy and biogeography in a desert crossroads
17:00–17:20	Christian KOMPOSCH (Austria) “The Times They Are A Changing” – An Alpine transect in the

light of faunal change

17:20–19:00 *Poster Session*

Wednesday, August 23

Excursion day

Thursday, August 24

Plenary session – Taxonomy and evolution

Lecture Hall C14

Chair: Sara GOODACRE

9:00–10:00

Alistair P. McGREGOR (UK) – **Plenary lecture**

Arachnid evolution and development: insights from the spider
Parasteatoda tepidariorum (C. L. Koch, 1841)

10:00–10:20

Miquel ARNEDO (Catalonia)

A DNA barcode analysis of a species radiation: using genetic data
to inform species delimitation in the woodlouse-
hunter *Dysdera* spiders of the Canary Islands

10:20–10:40

Geoff OXFORD (UK)

Molecules vs. morphology - is *Eratigena* (*Tegenaria*)
atrica (Agelenidae) one species or three?

10:40–11:00

Christoph MUSTER (Germany)

Micaria pulicaria – a complex of cryptic species?

11:00–11:40 *Coffee break*

Session – Taxonomy

Lecture Hall C14

Chair: Theo BLICK

11:40–12:00

Adrià Bellvert BANTÍ (Catalonia)

A happy family: adaptive radiation of the spider genus *Theridion*
in the Hawaiian Islands

12:00–12:20

Abida BUTT (Pakistan):

Effect of habitat variations and insecticide application on density
and diversity of spiders in a rice agroecosystem

12:20–12:40

Muhammad MUKHTAR (Pakistan)

Insecticide resistance in orb-web spiders

12:40–13:00 **Yuri MARUSIK** (Russia)
Amazing characters found in the Afrotropical Chediminae
(Araneae: Palpimanidae)

13:00–13:20 **Conference photo**

13:20–14:00 *Lunch*

Session – Bionomics and mimicry

Lecture Hall C14

Chair: Petr DOLEJŠ

14:00–14:20 **Rebecca WILSON** (USA)
Investigating the influence of biogenic amines on the circadian
rhythmicity of anti-predator behaviour in orb-weaving spiders

14:20–14:40 **Ondřej MICHÁLEK** (Czech Republic)
Silk or venom? Alternative capture traits employed by
myrmecophagous specialist and generalist spider

14:40–15:00 **Stano PEKÁR** (Czech Republic)
The golden mimicry complex uses a spectrum of defences to
deter a community of predators

15:00–15:20 **Jan RAŠKA** (Czech Republic)
Do ladybird spiders really mimic ladybirds?

15:20–16:00 *Coffee break*

Session – Cytology, infections

Lecture Hall C14

Chair: Stano PEKÁR

16:00–16:20 **Philip STEINHOFF** (Germany)
Living in caves: a comparative morphological analysis of the
central nervous system in *Pinelema* spiders

16:20–16:40 **Alastair GIBBONS** (UK)
They've breached the walls: intra and extra cellular microbes of
spiders

16:40–17:00 **Antje HUNDERTMARK** (UK)
Wolbachia infections in *Nephila senegalensis*: Where have all
the good men gone?

17:00–17:20 **Jana PLÍŠKOVÁ** (Czech Republic)
Utilization of molecular cytogenetic markers in the study of
karyotype dynamics in the family Buthidae (Arachnida,
Scorpiones)

17:20–19:00 **Poster Session**

Friday, August 25

Plenary session – Behavioural ecology

Lecture Hall C14

Chair: Seppo KOPONEN

9:00–10:00 **Cristina TUNI** (Germany) – **Plenary lecture**

A journey inside the nuptial gift of a spider

10:00–10:20 **J. Andrew ROBERTS** (USA)

Running for cover: increasingly risk prone behaviour of male wolf spiders

10:20–10:40 **Lenka SENTENSKÁ** (Czech Republic)

Sensory organ found in the male pedipalp of an entelegyne spider

10:40–11:00 **Victoria SMITH** (New Zealand)

How to trap a master trapper: the various methods of catching Idiopidae

11:00–11:40 *Coffee break*

Session – Recording schemes

Lecture Hall C14

Chair: Anthony RUSSELL-SMITH

11:40–12:20 **Peter HARVEY** (UK)

Spider Recording Scheme in Britain

12:20–12:40 **Maria CHATZAKI** (Greece)

The project SPIDOnetGR 2014–2015, Greece: revisited in 2017

12:40–13:00 **Samuel DANFLOUS** (France)

Mapping the spiders and harvestmen of the Midi-Pyrénées (France)

13:00–13:20 **Theo BLICK** (Germany)

The new German Red Data Lists of Arachnids and the German online maps of the Arachnologische Gesellschaft – with Examples of Spiders from the Strict Forest Reserves in Hesse

13:20–14:20 *Lunch*

Session – Taxonomy and diversity

Lecture Hall C14

Chair: Ferenc SAMU

14:20–14:40 **Yuri MARUSIK** (Russia)

A discovery of hidden species related to *Pardosa pontica* (Thorell, 1875) in northern Iran

14:40–15:00	<i>Ejgil GRAVESEN</i> (Denmark) Greenland glacier retreat: exploring arctic arthropod food webs in a glacier foreland area near Nuuk in West Greenland
15:00–15:20	<i>Konrad WIŚNIEWSKI</i> (Poland) Prescribed burning as a method of protecting heathlands in Poland – a spider perspective
15:20–15:40	<i>Ibrahim SALMAN</i> (Israel) New insights in explaining spider diversity in pomegranate orchards
15:40–16:00	<i>Coffee break</i>

Session – Morphology and physiology		Lecture Hall C14
Chair: Christian KOMPOSCH		
16:00–16:20	<i>Boris ZAKHAROV</i> (USA) Comparative morphology of venom glands in ground spiders (Araneae, Gnaphosidae)	
16:20–16:40	<i>Eva LIZNAROVA</i> (Czech Republic) Is venom of prey-specialised spiders more effective in paralysis of focal prey?	
16:40–17:00	<i>Nicolas LANGENEGGER</i> (Switzerland) Proteases involved in the maturing of spider venom toxin precursors	
17:00–17:20	<i>Leah ASHLEY</i> (UK) Silk processing: Is there methylation of silk in the underwater spider <i>Argyroneta aquatica</i> ?	
17:20–19:00	<i>Closing ceremony/ESA meeting, etc.</i>	

Poster presentations

1. **Youssef ALIOUA** (Algeria), **Salah Eddine SADINE** (Algeria), **Samia BISSATI** (Algeria), **Ourida KHERBOUCHE** (Algeria), **Robert BOSMANS** (Belgium) and **Wilson Roberto LOURENÇO** (France): Diversity of spiders (Araneae) and scorpions (Scorpiones) of the Ramsar site "Sebkhet El Melah" in the Sahara Desert of Algeria.
2. **Narmin Ilgar BEYDIZADE** (Azerbaijan): New data on the spider fauna (Araneae) of Nakhchivan Autonomous Republic, Azerbaijan.
3. **Robert BOSMANS** and **Pierre OGER** (Belgium): New data in some dimorphic dwarf spiders (Araneae: Linyphiidae: Erigoninae).
4. **Angelika DAWIDOWICZ** and **Konrad WIŚNIEWSKI** (Poland): Spider assemblages of plants after application of prescribed burning in a heathland in western Poland (Arachnida: Araneae).
5. **Miriam FRUTIGER**, **Stefan BACHOFNER** and **Christian KROPP** (Switzerland): How do cribellate orb-weavers avoid adhering to their web? Testing for an anti-adhesive surface coating in *Uloborus plumipes* (Araneae, Uloboridae).
6. **Anne-Sarah GANSKE** (Germany), **Hong-Lei WANG** (Sweden), **Dan-Dan ZHANG** (Sweden), **Christer LÖFSTEDT** (Sweden) and **Gabriele UHL** (Germany): How do spiders taste and smell? – An electrophysiological approach.
7. **Efrat GAVISH-REGEV**, **Igor ARMIACH**, **Tanya LEVY**, **Marija MAJER**, **Ibrahim SALMAN**, **Nitzan SEGEV** and **Yael LUBIN** (Israel): *Sahastata nigra* (Simon, 1897), a new record for Israel and a potential indicator of habitat recovery.
8. **André Marsola GIROTI** (Brazil), **Antonio Domingos BRESCOVIT** (Brazil) and **Peter MICHALIK** (Germany): The evolution of female genitalia in tube-dwelling spiders (Araneae, Synspermiata, Segestriidae).
9. **Matjaž GREGORIČ** (Slovenia), **Matjaž KUNTNER** (Slovenia) and **Ingi AGNARSSON** (USA): Occupancy of a habitat patch depends on patch size and connectedness: the distribution of argyrodine kleptoparasites in webs of Nephilidae.
10. **Luis GUARIENTO**, **Maria Chiara BONVICINI**, **G. GARDINI**, **P. PANTINI** and **P. NICOLOSI** (Italy): Giovanni Canestrini's heritage at the Zoology Museum of Padua University: rediscovery of his arachnological collection.
11. **Pavel JUST** (Czech Republic), **K. JANKO** (Czech Republic), **C. MUSTER** (Germany) and **F. ŠŤÁHLAVSKÝ** (Czech Republic): Phylogeography and species delimitation of Alpine pseudoscorpion *Roncus alpines* (Pseudoscorpiones: Neobisiidae).

12. **Michael KLOCKMANN, Marina WOLZ, Torben SCHMITZ** and **Gabriele UHL** (Germany): Phenotypic plasticity and genetic adaptation in a rapidly range-expanding spider.
13. **Seppo KOPONEN** (Finland): Alpine spiders in subarctic Finnish Lapland.
14. **Tomáš KREJČÍ, Milan ŘEZÁČ** and **Tomáš KADLEC** (Czech Republic): *Zodariion ohridense* (Araneae: Zodariidae) – a new record for Central Europe.
15. **Tanya LEVY** (Israel): Criminal Life: stealth, theft and predation in the Argyrodinae (Theridiidae) in Israel.
16. **Ondřej MACHAČ, Ivan Hadrián TUF, Pavel ŠEBEK** and **Lukáš ČÍŽEK** (Czech Republic): Distribution of spiders obtained by window flight traps on trunks in oak forests mosaic in Podyjí National Park.
17. **János NOVÁK** (Czech Republic) and **Mark S. HARVEY** (Australia): New records of Geogarypidae (Arachnida: Pseudoscorpiones) from the Indo-Malayan region and New Guinea, with two new species.
18. **Břetislav NOVOTNÝ** and **Vladimír HULA** (Czech Republic): Is araneophagy a reason for the spread of the Daddy Long-legs spider *Pholcus phalangoides*?
19. **Daniel Ogonna NWANKWO** (Nigeria): Preliminary studies on the spider fauna in Nigeria (Arachnida; Araneae).
20. **Hirotsugu ONO** (Japan) and **Mu Mu AUNG** (Myanmar): Occurrence of a primitively segmented spider (Mesothelae, Liphistiidae) on Lampi Island of the Myeik Archipelago, Tanintharyi Region, southern Myanmar.
21. **Malika OUTEMZABET, Lynda OUTEMZABET** and **Ourida KHERBOUCHE-ABROUS** (Algeria): Distribution of spiders (Arthropods, Arachnida) according to vegetation in Algiers ecosystems.
22. **Eva PITTA** (Cyprus, Greece), **Konstantina ZOGRFOU** (Greece), **Sylvia ZAKKAK** (Greece) and **Maria CHATZAKI** (Greece): Ground spider communities' variation along a climatic gradient at micro-scale in NE Greece.
23. **Jana PLÍŠKOVÁ** (Czech Republic), **Jiří ŠMÍD** (Czech Republic), **Petr NGUYEN** (Czech Republic) and **František ŠTÁHLAVSKÝ** (Czech Republic): Cryptic diversity, endemism and biogeographical history in Alpine scorpions (Euscorpiidae: *Euscorpius*).
24. **Milan ŘEZÁČ** (Czech Republic), **Miquel A. ARNEDO** (Catalonia), **Vera OPATOVA** (Czech Republic, USA), **Jana MUSILOVÁ** (Czech Republic), **Veronika ŘEZÁČOVÁ** (Czech Republic) and **Jiří KRÁL** (Czech Republic): Taxonomic revision and insights into the speciation mode of the spider *Dysdera erythrina* species-complex (Araneae : Dysderidae): sibling species with sympatric distributions.
25. **Milan ŘEZÁČ** (Czech Republic), **Tomaš KREJČÍ** (Czech Republic), **Sara L. GOODACRE** (UK), **Charles HADDAD** (South Africa) and **Veronika ŘEZÁČOVÁ**

- (Czech Republic): Morphological and functional diversity of minor ampullate glands in spiders from the superfamily Amaurobioidea (Entelegynae: RTA clade).
26. **Ferenc SAMU, Péter ÓDOR and Zoltán ELEK** (Hungary): The effects of four forestry treatments on the community structure of spiders.
 27. **Miroslav ŠARIĆ and Jovana TOMIĆ** (Serbia): Histology and structural analysis of venom glands of *Mesobuthus gibbosus* (Brullé, 1832) (Scorpiones, Buthidae).
 28. **Nitzan SEGEV, Oded BERGER-TAL and Efrat GAVISH-REGEV** (Israel): Intraguild predation in an extreme arid desert: antlions and scorpions in the 'Arava.
 29. **Rimma R. SEYFULINA, D.I. KOROBUSHKIN, A.Yu. GORBUNOVA and A.V. PONOMAREV** (Russia): Epigeic spider assemblage in burned forests across European Russia.
 30. **Monica SHEFFER** (UK): Niche partitioning in Hawaiian spiders.
 31. **Hana SOUALAH-ALILA, Bouthaina KHELIFI, Chaima DRAOUT and Noureddine GUEZGOUZ** (Algeria): Spiders and wetlands: biodiversity and specificity of Souk Ahras (North-East of Algeria).
 32. **Nina ŠRAMEL, Danijel KABLAR, Matjaž KUNTNER and Simona KRALI-FIŠER** (Slovenia): Body size and personality affect reproduction in raft spiders (*Dolomedes fimbriatus*).
 33. **Kristína Štempáková and Vladimír HULA** (Czech Republic): Overwintering of spiders in terrestrial molluscs shells in eastern Slovakia.
 34. **Polychronis TATSIS, Fotini PAPACHRISTOU, Maria PANAGOPOULOU, Katerina Rosalia KATSANI, Ekaterini CHATZAKI and Maria CHATZAKI** (Greece): The venom of the trap-door spider *Cyrtocarenum* Ausserer, 1871: isolation and *in vitro* anti-proliferative effect on a breast cancer cell line.
 35. **Jovana TOMIĆ and Miroslav ŠARIĆ** (Serbia): Histology and structural analysis of the venom glands of the tarantula *Brachypelma albopilosum* (Valerio, 1980) (Araneae, Theraphosidae).
 36. **Eva TURK, Matjaž KUNTNER and Simona KRALI-FIŠER** (Slovenia): Cross-sex genetic correlation does not extend to sexual size dimorphism in spiders
 37. **Karin URFER and Christian KROPF** (Switzerland): Barcoding failure in the *Pardosa lugubris* group: hybrid introgression caused by *Wolbachia*?
 38. **Zeyhan UYAR** (Turkey) and **Petr DOLEJŠ** (Czech Republic): Wolf spiders of Northwest Anatolia (Araneae: Lycosidae), with an updated checklist of lycosids in Turkey.
 39. **Bram VANTHOURNOUT** (Belgium): SPISCAN: revealing spider evolution through 3D-scanning.

40. **Berretima WAHIBA** (Algeria): Biosystematics of the spiders in some oases of the north of the Algerian Sahara.
41. **André WALTER, Jesper BECHSGAARD, Carsten SCAVENIUS, Thomas S. DYRLUND, Kristian W. SANGGAARD, Jan J. ENGHILD and Trine BILDE** (Denmark): Characterisation of protein families in spider digestive fluids and their role in extra-oral digestion.
42. **Steven H. WILLIAMS** (UK): The phylogeny and biogeography of the genus *Gasteracantha* Sundevall, 1833 (Aranea: Araneidae).
43. **Paul YOWARD** (UK): Consequences for the use of the comparative method and presumed sexually selected traits in spiders.
44. **Paul YOWARD** (UK): Why do some Entelegyne females seem to multiply mate with one male? Quantitative analysis and fitness consequences of mating behaviour in *Zygiella x-notata*.

Abstracts

Diversity and ecology of the scorpion fauna of Punjab, Pakistan

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In the present study, the diversity and distribution of the scorpion fauna of Punjab, Pakistan was examined. In total 4311 scorpion specimens representing three families, eight genera and 12 species were collected from Punjab, and Islamabad, Pakistan. Out of the total catch, *Hottentotta tamulus* (Fabricius, 1798) (27.67%) and *Odontobuthus odonturus* (Pocock, 1897) (18.02%) were the two most abundant species. *Scorpiops pseudomontanus* comprised 10.85% of the total sample. The total share of all abundant species, i.e., *Androctonus finitimus* (Pocock, 1897), *Compsobuthus rugosulus* (Pocock, 1900), *Orthochirus flavescens* (Pocock, 1897), *Compsobuthus atrostriatus* (Pocock, 1897), *Scorpiops hardwickii* (Gervais, 1843) and *Heterometrus latimanus* (Pocock, 1894) was 40.76%. *Chearilus truncatus* Karsch, 1879 *Orthochirus pallidus* (Pocock, 1897) and *Orthochirus fuscipes* (Pocock, 1900) contributed 0.78 %, 0.88% and 0.97%, respectively, to the total catch. The highest number of scorpions occurred in Sargodha Division (29.19%) followed by Rawalpindi Division (26.62%) and Faisalabad Division (22.45%). Five types of scorpion habitats i.e., sandy area with vegetation, rocky area with vegetation, agriculture fields, muddy areas and grassy fields were present in the study areas. Species abundance peaked in vegetated sandy areas, although richness and diversity were highest in rocky areas with vegetation. The highest evenness values were recorded in the grassy fields.

Keywords: diversity, richness, Scorpiones, scorpion habitats.

Diversity of spiders (Araneae) and scorpions (Scorpiones) of the Ramsar site 'Sebkhet El Melah' in the Sahara Desert of Algeria

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Soil and climatic characteristics of the Algerian Sahara Desert limit the survival of many organisms. Within this hot, arid ecoregion, wetlands, although sporadic, represent highly diverse ecosystems. Our work concerns the assessment of spider and scorpion diversity in Sebkhet El Melah (El-Meniaa, Ghardaïa), one of the most important Ramsar sites in Algeria and North Africa. A pioneer study of the Arachnida fauna in this region allowed us to identify a total of 11 families of spiders and one family of scorpions. We note the dominance of the family Araneidae (Araneae) with four genera and four species. Whereas the family Buthidae (Scorpiones) is represented by three genera and five species. A revision of the sampled species was rewarded by the recording of *Larina chloris* (Arachnida: Araneidae) for the first time in Algeria, and the discovery of a new scorpion species *Buthacus elmenia* (Scorpiones: Buthidae) around the Sebkh.

Keywords: Arachnida, Araneidae, Buthidae, ecoregion, North Africa, Sebkh.

Evippinae (Araneae, Lycosidae) in Israel – taxonomy and biogeography in a desert crossroads

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The Evippinae is a subfamily of the old world Lycosidae, specialized for life in arid conditions. Their nocturnal activity, pale coloration and long, spiny, pseudo-articulated legs, make them well adapted for dune and hamada environments. Despite being an arid country situated in the center of the subfamily's global distribution, Israel's Evippinae have not previously been studied taxonomically. Based on historical collections and material from current expeditions, I have constructed the first synopsis of Evippinae in Israel. The work resulted in five species in two genera, including the first record of the genus *Evippomma* in the Middle East and a species in the genus *Evippa* new to science. The study reveals new evidence on ecology and life history, tying the Evippinae found in Israel to populations in Africa and central Asia. It also points to possible cases of vicariance between two of the species, and a niche expansion of the northernmost species, pushing into wetter climates along the coastal dunes.

Keywords: ecology, fauna, life-history, taxonomy, wolf-spiders.

A DNA barcode analysis of a species radiation: using genetic data to inform species delimitation in the *Dysdera* spiders of the Canary Islands

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The use of DNA barcodes, a standardized small fragment of mtDNA, as species identifiers has greatly contributed to the ease of identification and led to the discovery of new candidate species. Although DNA barcodes on their own do not provide sufficient evidence for species delimitation, divergent DNA barcodes may hint at the existence of potentially overlooked species that should be further delimited using phenotypic data and additional nuclear markers. The use of DNA barcodes for species identification and discovery relies on the existence of barcodes gaps, a close to bimodal distribution of pair-wise divergences that allowed unambiguous separation of intra- and inter-specific divergences. Because of low genetic divergences, and the short time for complete lineage sorting, adaptive radiations and other forms of rapid diversification usually pose challenges to the use of single marker delimitation approaches. The genus *Dysdera* is among the most diverse spider groups in the Mediterranean Basin, where more than 250 species have been documented so far. The genus has colonized and highly diversified on some of the Macaronesian archipelagoes, in the eastern Atlantic Ocean. Approximately 50 endemic *Dysdera* species has been recorded on the Canary Islands, and many await formal description. Multi-locus phylogenetic analyses suggest that most of the Canarian species stem from single colonization events and hence that they are the result of local diversification processes. In this talk we will present the results of a large DNA barcode analysis of Canarian *Dysdera*. We have generated more than 500 barcodes obtained from a thorough sampling of *Dysdera* individuals collected across most terrestrial ecosystems on the islands. We use these data to specifically address (1) whether morphologically diagnosable species are also well defined on the basis of DNA barcodes, and (2) whether DNA barcodes reveal the existence of previously overlooked lineages. Results of this analysis will help us to accelerate the inventory of *Dysdera* species in the Canaries and to identify patterns of intra-specific genetic divergence within the archipelago. These results will contribute to improving our understanding of one of the most dramatic example of island diversification among spiders.

Keywords: Araneae, Macaronesian archipelago, species identification.

Silk processing: Is there methylation of silk in the underwater spider *Argyroneta aquatica*?

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Spider silk is widely considered as one of nature's most extraordinary materials, endowed with toughness that exceeds Kevlar and strength that outcompetes high-tensile steel based on density. It also exhibits biocompatibility (non-pyrogenic and low immunogenicity) and biodegradability. Although silk, in particular major ampullate silk (MaS) has been studied to determine its protein composition, information regarding processing of native silk, including post-translational modifications (PTM), are almost entirely absent. We have used the unusual spider *Argyroneta aquatica*, which spends its entire life submerged underwater, to attain a better understanding about native silk processing, focussing on the protein arginine methyltransferase (PRMT) class of PTM enzymes. We showed RNA extraction from either *A. aquatica* abdomen or silk glands resulted in a comparable number of predicted silk sequences. We also identified sequences within the silk glands of *A. aquatica* accounting for all but four PRMT types and in agreement with the literature identified the four PRMT signature motifs conserved across the phylogenetic kingdom. Furthermore, arginine residues in the repeat region of MaS were found to be a likely target for methylation. These findings enhance our knowledge of native silk processing and may be of importance for the commercial production of silk.

Keywords: Araneae, biocompatibility, native silk, protein, arginine methyltransferase, silk glands.

A happy family: adaptive radiation of the spider genus *Theridion* in the Hawaiian Islands

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The endemic *Theridion* spiders of the Hawaiian archipelago, among which is the iconic Happy face spider (*Theridion grallator* Simon 1900), were first described by the French arachnologist Eugene Simon at the turn of the 20th century. For over 100 years, no further taxonomic study has been conducted on the group. Following the examination of the largest collection of Hawaiian *Theridion* specimens assembled to date, we have been able to discover seven new species, provide new diagnosis for former species and illustrate for the first time some of the males and females never described before. Most species are easily diagnosed on the basis of male and female genitalia, but we also reveal the existence of additional somatic characters that differ among the species, including cheliceral teeth, leg length and body size. Phylogenetic analyses of mitochondrial and nuclear markers reveal low levels of genetic divergence among endemics but supports the delimitation of all morphologically diagnosable species. Finally, we construct a complete distribution map of the different species based on 50 years of field collections. Many species have overlapping distribution ranges and some co-occur in the same localities. The somatic differences detected among coexisting species point towards the existence of ecological segregation among them and suggest the group may be an example of adaptive radiation.

Keywords: Araneae, distribution maps, endemics, molecular phylogeny, somatic characters.

A reconstruction of the mammoth "steppes" in Northeastern Siberia and Beringian exchanges

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The mammoth steppe, or tundra-steppe, was a biome that was thought to have been disappeared at the end of Pleistocene. The term 'tundra-steppe' was suggested by Tugarinov (1929) when he found remains of saiga antelope (*Pantholops hodgsonii*), ground and large squirrels (*Urocitellus*, *Mormota*) together with the remains of tundra dwelling species (reindeer, polar fox, etc) in the same Pleistocene deposits located in the tundra zone. Later, many other mammals, such as mammoths, rhinoceroses and horses, were found in such deposits. These finds led to many contradicting speculations regarding reconstructions of the environment in which steppe and tundra dwellers could have coexisted. Finds of many deposits with insects remains (elytra, heads) in the arctic and northern taiga in 1970s and later allow us to better understand the environmental composition and climate in the Pleistocene. In this presentation we will demonstrate how these latest reconstructions were made and how the modern distribution of spiders corroborates such reconstructions.

Keywords: Araneae, environmental reconstruction, Pleistocene, spider distribution, tundra-steppe.

New data on the spider fauna (Araneae) of Nakhchivan Autonomous Republic, Azerbaijan

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The spider fauna of Nakhchivan is poorly known, with only 31 species in 12 families recorded/described to date. The present study is based on new material collected by the author during field trips to Nakhchivan in 2003, 2012 and 2017. The material collected has been provisionally sorted and belongs to 185 species in 28 families; about one fifth of the collection remains undetermined. The family Hersiliidae (*Hersiliola cf. turcica*, 4 juv. ♀♀) is recorded from the fauna of Azerbaijan (Nakhchivan, Culfa district) for the first time. Four spider families – Palpimanidae (*Palpimanus sp.*, Kengerli and Ordubad districts), Anyphaenidae (*Anyphaena accentuata*, Shakhbuz district), Titanoeidae (*Nurscia albomaculata*, *Titanoeca schineri*, *T. quadriguttata*), Agelenidae (*Tegenaria domestica*, Shakhbuz and Culfa district, Gulustan) and Pisauridae (*Pisaura novicia*, Shakhbuz and Culfa district, Gulustan) are new to the fauna of Nakhchivan. The genus *Artemia sp.* (1 juv. ♀, Pholcidae; Ordubad district) is new to the Caucasian fauna. Representatives of five genera are first records for the spider fauna of Azerbaijan: *Olios sericeus* (1♂) from Aghstafa and Shemkir districts; *Micrommata virescens* (1 juv. ♀) from west Azerbaijan; *Poecilochroa variana* (1♂) and *Gnaphosa steppica* (1♂) from Aghdara, Ordubad district; *Nomisia celerrima* (1♂) from Gomur, Shakhbuz district; and *Cyclosa algerica* (1♀) from Gomur, Shakhbuz district. Representatives of the following spider families have not been found yet but seem to occur in Nakhchivan: Phyxelididae, Cithaeronidae, Hersiliidae, Leptonetidae, Mysmenidae, Nesticidae, Palpimanidae, Prodidomidae and Theridiosomatidae.

Keywords: Caucasus, faunistic list, faunistic records.

The new German Red Data Lists of arachnids and the German online maps of the Arachnologische Gesellschaft – with examples of spiders from the Strict Forest Reserves in Hesse

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Mapping of German arachnids was started by Aloysius Staudt in 1997 for the Arachnologische Gesellschaft and the maps have been online since 2001. In 2016, new German checklists and Red Data Lists of spiders, harvestmen and pseudoscorpions were published and the maps, organized now by Michael Hohner, providing more detailed information than before. These maps will be demonstrated to the audience. Spider species from the Strict Forest Reserves in Hesse are used as examples. A printing tool is also provided that allows easy preparation of maps for publication (this was also available for Aloys' maps). The species lists together with their background and principles are briefly outlined. Currently, 992 spider species, 52 harvestmen and 50 pseudoscorpions are included. Only (sub-)species, which are established in Germany (i.e. which reproduce independently) are listed and evaluated. Established introduced species are included, but not evaluated. The mapping uses a grid system of approximately 11x11 km cells and the Red Data List assigns all species to one of six frequency classes (from extremely rare to very abundant) based on the number of grid squares in which they are recorded. Distribution ranges within Germany are given and species are listed for which Germany has particular responsibility, either because a large part of their range or records lies within Germany or because of their occurrence in highly isolated areas. Among spiders (the largest order) seven species are considered 'extinct or lost', seven 'critically endangered', 152 'endangered' and 95 'vulnerable'. Furthermore 49 are considered 'generally threatened', 77 'extremely rare', 52 'near threatened' and 32 'data deficient'.

Keywords: Araneae, conservation, mapping, Opiliones, Pseudoscorpiones.

Assessing biodiversity in the Mediterranean region: the case of the genus *Haplodrassus* Chamberlin, 1922 (Araneae: Gnaphosidae)

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The genus *Haplodrassus* currently comprises 72 species. The majority occur in the Palaearctic region (62), with a few in the Nearctic (6) and Oriental (5) regions. Eight species have been cited in the Maghreb. They are: *Haplodrassus dalmatensis* (L. Koch), *H. macellinus* (Thorell), *H. macellinus hebes* (Thorell), *H. parvicorpus* (Roewer), *H. pugnans* (Simon), *H. seditiosus* (Caporiacco), *H. severus* (C. L. Koch) and *H. signifer* (C. L. Koch), of which only *H. seditiosus* (Caporiacco) is limited to the Maghreb. All records of these species in the Maghreb and all available material was critically examined. New material was collected in Morocco, Algeria and Tunisia. Does the known biodiversity of eight species in the Maghreb corresponds to reality?

Keywords: biodiversity, ground spiders, the Maghreb, zoogeographical analysis.

New data on some dimorphic dwarf spiders (Araneae: Linyphiidae: Erigoninae)

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Dimorphic erigonid spiders were often considered separate species in the past. The best known case is of *Oedothorax gibbosus* (Blackwall, 1841) and *Oe. gibbosus* forma *tuberosus* (Blackwall, 1841), which were considered as two separate species in older works. After a detailed study of the male palps of *Oedothorax gibbosus* and *Oe. tuberosus*, it was concluded that all sclerites of the male palp of both were completely identical and should be synonymized, a conclusion supported by subsequent breeding experiments. Spiderlings were reared from the same egg-sac and both forms obtained. The couples *Troxochrus scabriculus* (Westring, 1851) - *T. cirrifrons* (O. P.-Cambridge, 1871) and *Diplocephalus connatus* Bertkau, 1889 - *D. jacksoni* (O.P.-Cambridge, 1903) are other dimorphic species. Dimorphism of *Pelecopsis mengei* and of *Pelecopsis oranensis* (Simon, 1884) from Algeria have also been reported. In the present contribution, a new case of dimorphism is reported and the case of some *Diplocephalus* species is discussed.

Keywords: dimorphism, erigonid spiders, male palps, synonymy.

Effects of resource pulses on spider top-down control – numerical response and prey choice

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Subsidies from adjacent ecosystems can alter recipient food webs and ecosystem functions, such as herbivory. Emerging aquatic insects from streams can provide important prey in the riparian zone. Such aquatic subsidies can enhance predator abundances or cause predators to switch prey. This can lead to an increase or decrease of *in situ* herbivores, which in turn affects herbivory. We examined the effects of aquatic subsidies on spider abundance by sampling arthropods on plants situated at different distances from water. In addition, we performed a six-week experiment in a simplified terrestrial food web consisting of two types of herbivores, plants, and spiders. Here, we focused on the prey choice of the spiders in the presence/absence of aquatic prey. In accordance with predator switching, survival of leafhoppers increased in the presence of aquatic subsidies. By contrast, the presence of aquatic subsidies indirectly reduced weevils and herbivory. Spider abundance did not change along the water-land gradient. Our study demonstrates that effects of aquatic subsidies on terrestrial predators can propagate through the food web in contrasting ways. Thereby, the outcome of the trophic cascade is determined by the prey species involved and the prey choice of the spiders.

Key words: Araneae, arthropods, food web, herbivory, leafhoppers, predator, trophic cascade.

Effect of habitat variation and insecticide application on density and diversity of spiders (Araneae) in a rice agroecosystem

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The aim of the present work was to investigate the roles of microhabitat variation and insecticide application on the diversity and density of spiders residing in flooded rice fields. For the study, 12 conventional rice fields of three habitat types were selected: monoculture rice fields, polyculture rice fields and monoculture rice fields with refugia (loose baskets of straw and leaves). A total of 4,316 spiders belonging to eight families, 15 genera and 34 species were collected using pitfall traps and a vacuum sampler. The overall abundance and evenness was affected by habitat type. However, the overall species richness was the same in all fields studied. The abundance of different functional groups was highest in polyculture rice fields than in other field types. The abundance of ground-dwelling spiders varied between polyculture rice fields and monoculture rice fields with refugia. To evaluate the effects of insecticides (Lambda Cyhalothrin, Imidacloprid, Monomehyppo and Cartap) on spider biodiversity, twenty fields were selected and sprayed once at the recommended field dose. Spiders were collected from these fields one day before spray and two days, eight days fifteen days and twenty one days after spray. Analysis of data revealed that foliage spiders are more susceptible to insecticides compared to ground spiders. Lambda Cyhalothrin and Imidacloprid had pronounced effects on the densities of both ground and foliage spiders compared to Cartap and Monomehyppo. The abundance of foliage spiders in sprayed fields remained low compared to untreated habitats during the study period. However, ground spiders restored their abundance in treated fields within fifteen days. Diversity of spiders showed a decreasing trend following pesticide application but then recovery as the season progressed. Significant differences in diversity of spider species as a result of the use of insecticides were not detected.

Key Words: landscape structure, microhabitat, monoculture, polyculture.

Spatial patterns of diversity for the conservation of epiphyte-dwelling spiders: an island biogeography approach concerning isolation processes

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Epiphytes are important floral components of tropical ecosystems and play a key ecological function as diversity amplifiers because they provide microhabitats suitable for the establishment of invertebrate communities. One invertebrate group closely associated with epiphytes are spiders, which not only protect these plants by reducing herbivory, but also provide them with nutrients through their excrement. Epiphytic plants living on trees and can be considered habitat islands separated by air and canopy. Spiders inhabiting epiphyte islands are subject to ecological relationships dependent on geographic-spatial position, species-habitat size dynamics and species-isolation gradients of their hosts. Spiders can perform different kinds of locomotion in order to disperse and navigate within their environment. Isolation processes involve the dispersal abilities of given taxa and isolation matrix properties such as air/ocean currents and step-stones. In this study, we tested two kinds of spider's locomotion – cursorial and aerial. The cursorial mode is displayed when spiders walk, run or jump along the tree branches to get from one epiphyte island to another. The aerial mode refers to the ability of spiders to move from one epiphyte island to another in a Euclidean fashion, this could be achieved by base jumping, ballooning or by the used of silk bridges established between two plants. We collected 314 epiphyte islands inhabited by 7480 spiders. Spiders were grouped in 164 morphospecies representing 48 genera and 26 families. We found that spider diversity increased with island size and that this effect was controlled by distance between epiphyte islands. Cursorial distance explained more of the diversity patterns than did aerial distance (Euclidean), suggesting that at the community level spiders are more likely to move from one epiphyte to another following the paths set by tree branches. This is the first study presenting evidence of species-isolation processes driving the diversity of epiphyte-dwelling spider communities. The three-dimensional structure and high spider diversity of epiphyte communities presents an excellent opportunity for further testing the generality of island-biogeographic theory predictions.

Key words: canopy spiders, dispersal abilities, habitat islands, morphospecies.

The project SPIDOnetGR 2014–2015, Greece: revisited in 2017

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Accelerating taxonomic knowledge of biodiversity on a national level is one of the basic demands of current environmental policies in Europe and worldwide. SPIDOnetGR was a two year project (2014-2015) addressing this need in Greece. One of the project's aims was to synthesize old and new arachnological knowledge from a multidisciplinary perspective and organize it into a European-wide electronic database in order to increase its visibility and make it accessible to a wider spectrum of users. Starting from the personal database of the author which included approximately 3,000 entries organized in Access, the new database now includes about 14,000 records and 1,400 species. Much effort was put into updating the nomenclatural status of the species and geocoding the geographical information given in the relevant sources, most of which came from old literature that lacked accuracy. The new catalogue was incorporated into Araneae - The website Spiders of Europe (<http://www.araneae.unibe.ch/spidonet>). All existing records may now be browsed via a simple searching tool and visualized in updated maps. Additional information of the species status, related literature and accuracy of the geocoded reference is also available. The database of the new portal is to be updated every five years. In parallel, the "European year of spider diversity research", a module developed within the framework of the same project and supported by the European Society of Arachnology, helped establishing a dynamic research network which would simultaneously focus on the same general objective – taxonomic research on a country-wide basis. This initiative, in combination with the rich arachnological material collected during the project years, will enrich the Greek checklist in a speedy and efficient way.

Keywords: Araneae, biodiversity, checklist, database, geocoding, taxonomic knowledge.

Mapping the spiders and harvestmen of the Midi-Pyrénées (France)

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The spider and harvestmen recording scheme of the Midi-Pyrénées region currently maps 907 species, based on over 70,000 recent records. This large administrative region includes several biogeographical zones: Pyrénées, Massif Central, Causses, plain. The main constraint is the current number of arachnologists involved in both sampling and identification. Digitizing literature records is currently under way. Several dozen taxa cited are still being searched for in the field to confirm their presence in our region, especially in the Pyrénées. Some will turn out to be misidentifications and appropriate collections will be checked when possible. Surveying this large and varied region results in regular discoveries of specimens or taxa, bringing to light various taxonomic inquiries: undescribed sexes or species, possible synonymies, overlooked/confused taxa, etc. Several of these cases will be chosen to illustrate the broader consequences of this recording scheme. Examples will include the subterranean fauna.

Keywords: Araneae, literature records, Opiliones, recording scheme, taxa.

Spider assemblages of plants after application of prescribed burning in a heathland in western Poland (Arachnida: Araneae)

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The dry, large-area heathlands in Poland are considered valuable habitats, although they are of anthropogenic origin. These habitats require active protection because they undergo succession by encroaching trees or turn into grasslands. One method of rejuvenating heather is prescribed burning. This method was applied in western Poland for the first time in 2015, in the heathlands of the Przemkowski Landscape Park. The main goal of this study was to compare spider assemblages in the burned plot with those from other major, open habitats in the area, with special reference to colonization of the burned plot by invertebrates and the dynamics of the assemblages in successive years after the fire. Three plots were investigated: one where prescribed burning was applied, an old heath patch and *Molinia caerulea* grassland. We used a sweep net, beating net and beating onto a small metal bowl as sampling methods. The spider assemblages of each plant microhabitat (pine trees, heather, *Molinia*) were different both in species composition and representative spider families. Comparison of similar microhabitats between the plots however did not provide clear differences. For instance, assemblages inhabiting pine trees in a burned and unburned plot were different when adult spiders were analysed but the participation of ecological groups was similar on the living and burned pines. Few spider species inhabited exclusively one type of plot (e.g. two *Dendryphantès* species in an unburned plot). Results obtained with different sampling methods (in the case of pine trees – sweep and beating nets) did not give clear differences when ecological groups were considered, although the numbers of some taxa were biased according to the method used. The burned plot seemed to host equally diverse assemblages as the old heather. We discuss our results in the context of problems concerning heathland protection.

Keywords: colonization, dynamics, invertebrates, microhabitat, species composition.

The second best builders on the planet

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Because humans are the greatest builders and architects on earth we have a special interest in all sorts of construction work, including the building achievements of other species. With beavers, birds, bees, wasps, ants and termites, spiders are commonly ranked among the most skilled builders in the animal kingdom. While beavers, birds, bees, wasps, ants and termites are principally admired for their skills in building intricate shelters and other protective structures, spiders are particularly known for the construction of offensive structures, more specifically webs for catching prey. It is argued here that, although still ranking among the magnificent animal builders, the great majority of spider species have actually lost most of their building skills during their evolutionary history and that the really preeminent spider building skills, still preserved in the most primitive surviving spider species, are largely overlooked in current biology.

Keywords: Araneae, building skills, constructions, evolution, webs.

Reproduction and ontogeny of *Zorocrates guerrerensis* Gertsch & Davis, 1940 (Araneae: Zoropsidae)

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Zorocrates guerrerensis is a Mexican cribellate spider that has been moved from the family Zorocratidae into Zoropsidae: Tengellinae. Other than taxonomical revisions, no information about its biology is available. Our aim was thus to investigate its life cycle and reproduction. Fourteen spiderlings were reared from the egg sac. They were held separately in plastic tubes, date of each moult was recorded and the lengths of all shed carapaces were measured using a stereomicroscope equipped with an ocular micrometer. After reaching adulthood, mating of nine females and four males was observed in Petri dishes under laboratory conditions and recorded using a digital Panasonic NV-GS400 video camera. Males reached adulthood in the 10th or 11th instar, females in the 10th to 12th instar. Relative growth between each instar was 18.1%. Males were 11.7% smaller than females. Both males and females can mate more than once; the species is thus polyandrous and polygynous. The first contact occurred after 47 seconds on average after introducing the male into the arena with a female. The males did not display any courtship but contacted the females using their front legs. Further communication within the pair was tactile, involving jerky movements and opisthosomal vibrations by the male. The mating position was “Type 3”. Copulation always consisted of two insertions of the palp into the epigyne, with one hematodochal expansion during each insertion. The insertions lasted on average 89 seconds and 109 seconds, respectively. However, flubs (unsuccessful insertions) were observed in four cases. The whole copulation event lasted an average of 5 minutes; matings with virgin females were longer than those with mated females. Fertilised females constructed up to four egg-sacs, from which 23–78 spiderlings emerged. Thus, reproductive behaviour was observed for the first time in *Z. guerrerensis*. As the morphological evidence for including the genus into the Zoropsidae is rather weak, behavioural data could contribute to resolving its true taxonomical placement.

This work was financially supported by Ministry of Culture of the Czech Republic (DKRVO 2017/15, National Museum, 00023272).

Keywords: copulation, cribellate spiders, polyandrous, polygynous, reproductive behaviour.

The maintenance of cooperation and equal sex ratios in a socially foraging spider

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Animals that forage in groups can benefit greatly from the pooling of individual efforts to obtain food. However, social foraging is also highly fragile to the emergence of exploitative behaviour: when only a few individuals acquire a collective food source, group members will achieve the highest immediate payoff by defecting, which is avoiding the costs of searching for food but reaping the benefits of being fed. Defective behaviour should consequently spread in social groups. Paradoxically, cooperation has prevailed in numerous species, and the mechanisms behind the maintenance of cooperation are subject to ongoing debate. We demonstrate a possible mechanism in the subsocial crab spider *Australomisidia ergandros*. In this spider, individuals exhibit either a cooperative or a defective feeding type. We manipulated the feeding-type composition of groups (all cooperators or all defectors) and documented social foraging and individual fitness payoffs over three weeks. Defector groups had significantly lower survival because prey, even though often attacked, was rarely shared among group members. In groups of cooperators, on the other hand, former prey sharers were able to switch to being fed. We therefore propose that selection acts primarily against ‘unconditional’ defectors, thus limiting their spread in groups. With a social network approach, we further explored possible origins of feeding-type variation in *A. ergandros* – and found cooperative tendencies to be sex-dependent. These dynamics may contribute to explaining the evolution of equal sex ratios in this and perhaps other socially foraging spider species.

Keywords: Araneae, co-operators, defective behaviour, exploitative behaviour, subsocial spiders.

Land use change in savannas disproportionately reduces functional diversity of invertebrate predators at the highest trophic levels: spiders as an example

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Predators play a disproportionate role in ensuring the integrity of food webs and influencing ecological processes and services upon which humans rely, but are soon eliminated after perturbations. Spiders impact invertebrate population dynamics, stabilise food webs, and prevent trophic cascades in natural and agricultural systems, mitigating against crop pests, poor yields and crop failures. Africa's savannas are undergoing continent-wide conversion from low-density rangelands to villages and croplands as human populations burgeon. Despite limited research, and evidence of deleterious impacts to biodiversity, African savannas are earmarked for cropland by prominent international organisations. Given the beneficial impacts of spiders on agroecosystems and that functional diversity (FD) reflects ecosystem pattern and processes better than taxonomic diversity, we evaluated impacts of large-scale land use change. We surveyed spiders using pitfall traps at 42 sites (14 replicates each in rangeland, cropland, and villages) in South African savannas and investigated the effects of land use, season, and habitat variables on spider taxonomic and functional diversity. Species richness was lowest in villages and FD was lowest in cropland. Functional traits varied with land use, with reduced representation of traits for hunting larger invertebrates and dispersal, and fewer specialists, in croplands. The findings suggest that even when cropland does not impact taxonomic diversity, loss of FD can be marked. As savanna systems transform, impacts to invertebrate population dynamics may increase the possibility of trophic cascades in natural and agricultural systems, influencing conservation efforts, farming communities, and human wellbeing, at a range of scales across the world's largest savanna systems.

Keywords: agroecosystem, Araneae, ecology, food webs, population dynamics, species richness.

How do cribellate orb-weavers avoid adhering to their web? Testing for an anti-adhesive surface coating in *Uloborus plumipes* (Araneae, Uloboridae)

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The cribellate spider *Uloborus plumipes* does not adhere to its web when it touches the capture spiral with any body part. We tested for an organic surface coating with protective properties that had been suggested before for araneid orb weavers. We pulled legs of *U. plumipes*, either untreated ones, or legs washed with an organic solvent (CS₂) or with purified water, and legs of house crickets (*Acheta domesticus*) off a cribellar thread of a web of *U. plumipes* and measured indirectly the strength of adhesion. We found that spider legs adhered significantly less strongly to the capture thread than cricket legs, suggesting a protective mechanism in the spiders. We found no difference in the strength of adhesion between any of the experimental groups of spider legs and therefore conclude that the spider's protective mechanism must be something other than an organic surface coating.

Keywords: protective properties, strength of adhesion.

A revision of the Southern African spider genus *Brachionopus* Pocock, 1897 with notes on *Harpactirella* Purcell, 1902 (Theraphosidae; Harpactirinae)

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The theraphosid spider genus *Brachionopus* Pocock, 1897 is revised and its distinction from structurally similar *Harpactirella* Purcell, 1902 species addressed. *Brachionopus pretoriae* Purcell, 1904 is transferred to *Harpactirella*. The holotype 'female' of *Brachionopus annulatus* Purcell, 1903 is an immature male and shown to be identical with *Brachionopus robustus* Pocock, 1897. Type material of *Brachionopus leptopelmiformis* Strand, 1907 is lost and its type location imprecise; it is therefore treated as *nomen dubium*. Previously unknown males of *Harpactirella pretoriae* and *Brachionopus tristis* Purcell, 1903 are described, along with a new species of *Brachionopus* and two new *Harpactirella* species.

Keywords: Araneae, description, new species, *nomen dubium*, synonymy.

How do spiders taste and smell? – An electrophysiological approach

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A wealth of behavioural studies clearly shows that spiders detect prey, predators and mating partners by chemical signals. So far, the reception of chemicals is assumed to be processed by trichoid cuticular sensory structures, so called tip-pore sensilla. Microanatomical investigations revealed that they possess an s-shaped shaft, protrude from the leg axis at a steep angle and possess a pore at their tip. In the araneid spider *Argiope bruennichi*, for which the sex pheromone has been identified, only tip-pore sensilla could be recognised as candidate sensory organs for gustation as well as olfaction. An ultrastructural analysis of the sensilla showed that 19, supposedly chemoreceptive, dendrites run inside the shaft towards the tip. Furthermore, there are two tubular bodies in the sensillum socket that strongly suggest an additional mechanoreceptive function of the sensilla. Building on the morphological data and previous studies on gustation in spiders we explore the chemical senses of *A. bruennichi* by using electrophysiological methods. Here, we give a first insight into gustatory and olfactory single sensillum recordings using different chemicals (e.g. citric acid, sodium chloride, caffeine) and the species-specific sex pheromone compound.

Keywords: Araneae, behaviour, chemical signals, chemoreception, microanatomy, sensilla.

***Sahastata nigra* (Simon, 1897), a new record for Israel and a potential indicator of habitat recovery**

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In December 2014, some five million litres of crude oil flowed into the Avrona Nature Reserve, located in Israel's Arava valley. A long-term monitoring of arachnids was launched in May 2016, 17 months after the oil spill, as part of a large monitoring project of the Israel Nature Protection Authorities (INPA) and Israel's National Nature Assessment Program (HaMaarag). During the first year of monitoring (2016), we found a filistatid genus, *Sahastata* Benoit, 1968, not previously been recorded from Israel. Filistatidae is a small spider family with a worldwide distribution including 152 species in 19 genera. Previously only four species of three genera were recorded from Israel: *Filistata insidiatrix* (Forskål, 1775); *Pritha albimaculata* (O. Pickard-Cambridge, 1872); *Pritha tenuispina* (Strand, 1914); and *Zaitunia schmitzi* (Kulczyński, 1911). *Sahastata* includes five species, four are known only from their type-locality and sometimes from one additional locality (*Sahastata amethystina* Marusik & Zamani, 2016 and *S. sinuspersica* Marusik, Zamani & Mirshamsi, 2014 from Iran; *S. ashapuriae* Patel, 1978 from India; *S. sabaee* Brignoli, 1982 from Yemen), and the type species *Sahastata nigra* (Simon, 1897). *Sahastata nigra* has a wider distribution, being recorded from Africa (Algeria, Chad, Egypt, Eritrea, Kenya, Morocco, Niger, Somalia, Sudan and Saudi Arabia) and India, but not previously from the Levant *sensu stricto*. Here we report for the first time *Sahastata nigra* from Israel, with information on the habitat, burrows, prey and the effects of the 2014 oil spill, and an earlier oil spill from 1975, on its distribution in the Avrona nature reserve. Because *Sahastata* is a large spider with long-lived burrows, we suggest that this species may be a good indicator of habitat recovery.

Keywords: Arava valley, Levant, new spider record, reserve.

They've breached the walls: intra- and extra-cellular microbes of spiders

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Bacteria, fungi and arthropods are amongst the most diverse groups of organisms on the planet, yet in the majority of cases their ecological inter-relationships are largely unknown. In invertebrate animals, fungal growth on the surface is almost always hazardous but distinguishing between the host's indigenous micro-flora and other pathogenic or symbiotic microbes is a challenge. We know that fungi are ubiquitously present in our environments and can have highly specific associations with insects. Examples include entomopathogenic fungi, yeast symbiosis in insect guts and the promotion of fungal growths for plant processing. The incidence of intracellular bacteria, collectively termed endosymbionts, is estimated to infect more than 52% of arthropods. In spiders, endosymbionts have been linked to skewed sex ratios, differences in dispersal behaviour and pre-zygotic isolation. In other invertebrates this extends to parthenogenesis, feminisation and male-killing. This talk will highlight the identity of fungi and endosymbionts from two study systems; whip-spiders (*Damon diadema*) and spiders from agricultural landscapes.

Keywords: Araneae, bacteria, endosymbionts, entomopathogenic fungi, micro-flora, symbiosis.

The evolution of female genitalia in tube-dwelling spiders (Araneae, Synspermiata, Segestriidae)

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For decades the genitalia of spiders have been the subject of studies ranging from taxonomy and systematics to functional morphology and behaviour. The cuticular parts of male and female genitalia are well-known because of their taxon-specific characteristics, but adjacent soft tissue e.g. glands or muscles, are only rarely studied. However, these have demonstrated a remarkable structural diversity as, for example, shown by histological studies of the female genitalia of goblin spiders (Oonopidae, Dysderoidea), which are very complex with numerous muscles attached to different modified sclerites. To contribute towards the understanding of the genital evolution within Dysderoidea, we address for the first time the detailed internal morphology of the female genitalia of the family Segestriidae using Micro-computed X-ray Tomography (Micro-CT) and Scanning Electron Microscopy (SEM). We included four known segestriid genera in our analyses *Segestria* Latreille, *Ariadna* Audouin, *Gippsicola* Hogg and *Citharoceps* Chamberlin) and as outgroups several members of other Dysderoidea families. Based on the data collected, we revise the current terminology, conceptualize new genitalic characters and explore their evolution within Segestriidae. Furthermore, we provide hypotheses about possible functions of the genitalic structures.

Keywords: anatomy, cribellate spiders, Micro-computed X-ray Tomography, phylogeny.

Greenland glacier retreat: exploring arctic arthropod food webs in a glacier foreland area near Nuuk in West Greenland

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Arthropod food webs were explored in a glacier foreland area in Kobbefjord, near Nuuk in West Greenland during the summers of 2015 and 2016 using a combination of wet and dry pitfall traps. Arthropod predators and their potential arthropod prey were identified to family or species level. Specimens representing each arthropod species will be barcoded. Arthropod predators sampled individually in dry pitfall traps were analyzed for DNA gut content using a technique with predesigned primers targeting potential prey animals. All surface-active arthropods were sampled with “wet” pitfall traps during the two summers. Potential prey animals for the arthropod predators are collembolans, mites, flies and aphids. Structural Equation Modelling integrating biotic and abiotic parameters indicates both bottom-up and top-down food chains in the glacier foreland area. Spiders were found in bottom-up food chains with a very significant, positive relationship with the numbers of mites. The relationships between potential food animals and the harvestman, *Mitopus morio*, and the ground beetle, *Nebria rufescens*, revealed (in some instances) negative relationships, indicating top-down relations between the prey animals and these two arthropod predator species. Live arthropod predators (spiders, ground beetles and harvestmen) sampled in dry pitfall traps during the summer of 2015 have been analyzed for DNA gut content using 18S markers for Collembola, Diptera and aphids. Preliminary results show that Collembola was a common prey item, and spider consumption of Collembola increased in direct relationship to their abundance in each habitat type - which was either gravel, bare ground or vegetated patches. DNA from the aphid *Thecabius populimonilis* was only detected in beetles and harvestmen from bare ground patches where aphid abundance was very low and there were no vascular plants (*Salix herbacea*) for them to feed on. No aphid DNA was found in the beetles or harvestmen from the vegetated patches where all potential prey-animal densities were relatively high compared to the bare ground patches where the densities of all potential prey animals were low. An explanation for this could be that aphids are “easier” prey for the predators in the open, bare ground patches compared to the other potential prey animals.

Keywords: Araneae, food chain, predators, spiders, surface-active arthropods.

Occupancy of a habitat patch depends on patch size and connectedness: the distribution of argyrodine kleptoparasites in webs of Nephilidae

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The ideal free distribution states that if all individuals are free to move among patches, then ideally, each will distribute to maximize gain. Habitat patches can be distributed so that movement can no longer be considered free, for example when patches are isolated. Challenges stemming from patch delimitation and detection rate of occupants further complicates efforts to resolve such patterns. Here we utilize webs of different species of Nephilidae and the obligate argyrodine kleptoparasites that are associated with these webs, to examine how the abundance of kleptoparasites fits the ideal free distribution under different patterns of patch size and connectedness. We find that the expected correlation between web size and abundance of kleptoparasites remains across the different patch distribution patterns, but that the strength of the correlation diminishes when patches are rare and isolated.

Keywords: Araneae, *Argyrodes*, free distribution, Nephilidae.

Giovanni Canestrini's heritage at the Zoology Museum of Padua University: rediscovery of his arachnological collection

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Giovanni Canestrini was one of the most eminent Italian zoologists of the XIX century. He was a convinced evolutionist, in contact with Darwin, and distinguished himself by his tireless efforts to spread the evolutionary theory in Italy and for publishing the first Italian edition of “On the origin of species”. Among his many interests he was the pioneer of Italian arachnology, studying in particular Italian spiders, harvestmen and mites. Now the remains of Canestrini's arachnid collection and related historical catalogues, preserved at the Zoology Museum of Padua University, are the subject of an extensive revision project, the preliminary results of which are presented here. In addition, the presence of type specimens in the collection, including spider samples exchanged with famous European arachnologists, allows us to clarify the taxonomic status of certain problematic taxa.

Keywords: Araneae, curation, Italy, museum, spiders.

Spider Recording Scheme in Britain

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A snapshot of the Spider Recording Scheme (SRS) in Britain is provided with a brief history of the scheme, how it is set up, how it links to the SRS website and how it is run under the auspices of the British Arachnological Society. The SRS was launched in 1987, with the late Clifford Smith as first national organiser. It was largely due to his fore-sight, enthusiasm and support for the participants that the scheme has been such a success. The advantages of a decentralised scheme with local area organisers has been central to its success, as is a system for ensuring feedback to, and support for all, participants. Phase 2 of the scheme followed the publication of the *Provisional Atlas of British Spiders* in 2002 and, following extensive consultation, this has placed much greater emphasis on recording autecological information with the aim of establishing a profile of the ecological characteristics of each British spider species. The use of dedicated recording and mapping software feeds into a centralised SRS database linked to a database-driven website which provides up-to-date spider distribution mapping with autecological data and analyses. The inclusion of habitat and other ecological information for each record greatly enhances its value and allows analysis of habitat and other requirements of the species concerned.

Keywords: Araneae, British Arachnological Society, centralised database, history, Provisional Atlas.

Diversity and ecology of Araneae in hollows of *Quercus pyrenaica* in the western Iberian Peninsula

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Hollows in mature trees provide a fascinating microcosm of life. They contain a diversity of microhabitats, providing shelter and resources for a rich saproxylic fauna with many species endemic or rare. Amongst the invertebrate fauna, spiders are frequent inhabitants of tree hollows. The predatory habits of spiders place them at the top of the food chain, so they depend on the rest of the links for their survival. For this reason, they are a sensitive indicator group within the saproxylic diversity of tree hollows, and consequently provide a useful tool for evaluating the quality of the forest and for the management of Natural Areas. However, to date there have been few studies that include Order Araneae within the saproxylic fauna associated with tree hollows in forests. Although spiders are generally considered generalist predators, recent studies indicate that certain families specialize with respect to both the selection of their prey and the habitat they are found in. For this reason, this research aims primarily to study the diversity of spiders associated with tree hollows and the factors that determine the spatial and temporal segregation of the species present. Our study focuses on the *Quercus pyrenaica* forests in the west of the Iberian Peninsula within two natural areas in the south of the province of Salamanca. Twenty one emergence traps were attached to the entrances of tree hollows and the collecting tubes replaced once a month for a year. The results show a high diversity of spiders in this peculiar microhabitat, recording a total of 26 families and 83 species. Four families predominated with respect to the number of specimens, while two families contributed the greatest diversity. The results also show interesting space-time distribution patterns for the species. Because of the numerical and functional importance of Araneae in tree hollows, more studies of this kind are need in order to generate indicators for the correct management of forests in general, and *Quercus* forests in particular. They could also reveal the importance of interspecific relationships within these microcosms.

Financial support was provided by the Spanish Ministry of Economy and Competitiveness (CGL2011-23658).

Keywords: bioindicator, conservation, Salamanca, saproxylic, spiders.

Same but different! Karyotype variability of the suborder Cyphophthalmi in the Balkan Peninsula (Arachnida: Opiliones)

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The suborder Cyphophthalmi is a basal group of harvestmen (Opiliones) distributed across all continents except Antarctica. Currently, about 200 species are described. However, molecular phylogenetic analyses carried out in recent years have discovered hidden species diversity within this morphologically rather uniform group. The suborder is divided into six families, occurring mostly in different biogeographical areas. The most convenient family for our study is Sironidae (ca. 50 species), with representatives in Europe, North America and Japan. The hidden species diversity of the Cyphophthalmi is very likely caused by its low ability to spread and the long-term isolation of its populations. For this reason we focused on karyotype variability, which could also reflect isolation of single lineages. We chose to study the region of the Balkan Peninsula, where there is a substantial number of *Cyphophthalmus* species. Furthermore, during the Pleistocene era the area was glaciated, which created many refugia and thus a high degree of genetic isolation. Our results demonstrate that karyotypic differentiation of the Cyphophthalmi occurred in this area and that karyotypes are not as uniform as recently published data suggest. We discovered diploid chromosome numbers ranges from 24 to 30. We used fluorescent *in situ* hybridization (FISH) with specific chromosome probes that can enhance the resolution of small-sized chromosome. On the Balkan Peninsula we found four specific lineages (Dinaric, Aegean, Gjorgjevici and Volos) with specific diploid numbers. Combining the results from our cytogenetic and phylogenetic analysis with past morphological analysis shows that there is a much higher diversity of lineages on the Balkan Peninsula than expected. We can also recognize the locations of possibility refugia during the last glaciation and predict the evolution of the genus *Cyphophthalmus* on the Balkan Peninsula.

Keywords: biogeography, chromosomes, harvestmen, molecular phylogenetic analysis, refugia.

***Wolbachia* infections in *Nephila senegalensis*: Where have all the good men gone?**

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Wolbachia pipientis is a widespread bacterial endosymbiont of various arthropod species. Numerous studies have shown that spiders are not immune to these endosymbiont infections. We present the first finding of *Wolbachia* in the golden orb-web spider *Nephila senegalensis*. The infection with *Wolbachia* is widespread in populations on *N. senegalensis* in Southern Africa and is persistent over time. Infected females show an elevated fecundity compared to uninfected individuals. The cause of the sex ratio distortion remains hidden so far. None of the three known sex ratio distorting phenotypes induced by *Wolbachia* are consistent with the skewed sex ratio in *N. senegalensis*. Further studies are needed to fully explore the effect of *Wolbachia* on this spider species.

Keywords: Araneae, bacterial endosymbiont, golden orb-web spider, sex ratio.

Unravelling the phylogeny of two closely related crab spider genera in Sri Lanka (Araneae: Thomisidae)

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Members of the genera *Tmarus* (Simon, 1875) and *Peritraeus* (Simon, 1895) are morphologically very similar crab spiders, which makes them difficult to identify without thorough observation. *Peritraeus* was thought to be endemic to Sri Lanka with *P. hystrix* the only species in the genus, recorded about 127 years ago. This species was rediscovered from Kandy (its type locality) during this study. *Tmarus* is a speciose genus that currently contains 222 species distributed worldwide, with 38 species recorded from the Asian region. The objective of this study was to assess the monophyly of *Peritraeus* and describe its relationship to *Tmarus* using a multi-locus molecular phylogeny of these two genera, close relatives and representatives of other branches of the thomisid tree of life. Field work was conducted in 80 localities covering 20 districts in Sri Lanka. Additional material was loaned from museums. Partial fragments of nuclear Histone 3 (H3) and 28S rDNA (28S) and mitochondrial genes, cytochrome c oxidase subunit 1 (COI) and a section spanning 16S and NADH dehydrogenase subunit 1 (16S-NAD1) were amplified. Twenty-six in-group and 11 out-group taxa were included in the final analysis. A maximum-likelihood (ML) tree was inferred with MEGA and parsimony analysis performed in TNT. Two species of *Peritraeus* and three species of *Tmarus* were recorded. *Peritraeus* was distributed in both dry and wet zones of the country, whereas *Tmarus* was restricted to montane and sub-montane forests of the central highlands. Our molecular analysis of the combined data set (1833 bp) recovered a strongly supported monophyletic *Tmarus*. Further, both ML and parsimony analysis suggest that *Peritraeus* is a clade within *Tmarus*. Thus, it is concluded that *Peritraeus* spp. should be transferred to *Tmarus*. Further, four species of *Tmarus* new to science discovered during this study will be formally described in a future publication.

Keywords: molecular phylogeny, monophyly, parsimony analysis, *Peritraeus*, *Tmarus*.

Nanofibrous adhesion of the capture threads of cribellate spiders

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To survive, web-building spiders rely on their capture threads to restrain prey. Many species cover their threads with viscoelastic glue droplets for this task. Cribellate spiders, in contrast, use a wool of nanofibres as adhesive. Previous studies hypothesized that prey is restrained by van der Waals' forces and entrapment in the nanofibres. The large discrepancy when comparing the adhesive force on artificial surfaces versus prey implied that the real mechanism was still elusive. We therefore re-examined the adhesive mechanism of capture threads of several distantly related cribellate spider species including possible interactions of cribellate nanofibres with cuticular surface features of prey insects. Characterizing the adhesion area, we observed that epicuticular waxes of insect prey infiltrate the wool of nanofibres, probably induced by capillary forces. The fibre-reinforced composite thus formed led to an adhesion between prey and thread eight times stronger than that between thread and wax-free surfaces. Thus cribellate spiders employ the originally protective coating of their insect prey as a fatal component of their adhesive and the insect facilitates its own capture. We suggest an evolutionary arms race with prey changing the properties of their cuticular waxes to escape the cribellate capture threads that eventually favoured spider threads with viscous glue.

Keywords: adhesive mechanism, Araneae, der Waals' forces, epicuticular wax, nanofibres, viscous glue.

Phylogeography and species delimitation of Alpine pseudoscorpion *Roncus alpinus* (Pseudoscorpiones: Neobisiidae)

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Pseudoscorpions represent the fourth largest order of arachnids. However, their taxonomy is still based mostly on their morphology and morphometry, frequently without detailed knowledge of the variability of these characters. That is a reason why the true diversity might, in fact, be largely misrepresented. Recently, some advanced methods (such as DNA analysis, cytogenetics or geometric morphometry) have emerged, and when we combine these in an integrative approach, our understanding of the real species diversity and their relationships can be estimated more precisely. In our study, we focus on *Roncus alpinus* Koch, 1873 (Neobisiidae). This is an endemic Alpine species with a distribution covering large parts of this mountain range. High mountain regions, such as Alps, are traditionally known for their high biodiversity and endemism, which is caused by a combination of several factors. Altitudinal zonation and climatic oscillations in the Pliocene-Pleistocene may have had a significant effect on species with low dispersal abilities and specific ecological preferences, and which results in complex phylogeographic patterns for many pseudoscorpions. Based on our results, which combined DNA analysis and geometric morphometry, we argue that *R. alpinus* might be a complex of several cryptic species. We would therefore like to emphasize the importance of multidisciplinary approaches in species delimitation of pseudoscorpions. This work was supported by Grant Agency of the Charles University (GAUK 727916).

Keywords: Alps, altitudinal zonation, cryptic species, endemic species, taxonomy, variability.

Molecular and morphological data reveal a cryptic radiation of shiny South Asian jumping spiders (Araneae: Salticidae)

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Chrysillines are small to medium sized, shiny foliage-dwellers. Recent field work in Sri Lanka yielded “similar-looking” groups of species that were initially identified as members of genera *Chrysilla* Thorell, 1887 and *Phintella* Strand, in Bösenberg & Strand 1906. However, detailed drawings of genitalia revealed that some of these morphospecies might not belong to either genus. In order to study their generic placement we analysed three genetic markers and morphology. Our data comprised 23 somatic and 33 genitalic characters (19 palpal and 14 epigynal) for 17 taxa. Partial fragments of mitochondrial protein-encoding gene cytochrome c oxidase subunit I (CO1, ~600 bp) and two nuclear ribosomal genes, 18S rRNA (18S, ~1600 bp) and 28S rRNA (28S, ~800 bp). Maximum likelihood and parsimony analysis were performed for single-gene sequences, as well as for the concatenated gene matrix of 3 kb. Our results suggest that part of our morphospecies complex comprises three evolutionary lineages, *Phintella* and two new ones. The two new genera and seven new species discovered will be described in a future publication. *Phintella vittata*, *Chrysilla lauta* and *C. volupe* will be redescribed based on new material from Sri Lanka. All trees support the placement of the two new genera under the tribe Chrysillini. All trees, except for the ML and MP single-gene trees of CO1, corroborated the monophyly of *Phintella* and its placement as sister to the proposed two new genera.

Keywords: Chrysillines, cryptic species, monophyly, new genera, phylogeny, synapomorphies.

Phenotypic plasticity and genetic adaptation in a rapidly range-expanding spider

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Global climate change can result in poleward range expansions. A new and promising model species for rapid range expansion is the orb-weaving spider *Argiope bruennichi*, which has spread from the Mediterranean region into continental climates and up to Baltic countries in less than 100 years. Consequently, its current distribution covers very different climates and environments. We collected mated females from three populations in each of the northern range limit (Estonia), the original range (Southern France) and from genetically distinct populations on the Azores Island, Sao Miguel. After oviposition, the spiderlings overwinter in egg sacs that were allocated to a common garden treatment with simulated winter conditions from all regions. We investigated the effects of origin and winter conditions on survival probability, dispersal propensity, body weight, and temperature stress resistance of the spiderlings. By performing large-scale ballooning tests, we particularly explored dispersal behavior as a prerequisite for rapid range expansion. Overall, we found large effects of origin and winter treatment on all traits investigated, highlighting the importance of the interplay between phenotypic plasticity and genetic adaptation for range expansion.

Keywords: Araneae, Araneidae, *Argiope bruennichi*, phenotypic plasticity, winter survival.

“The Times They Are A Changing” – An Alpine transect in the light of faunal change

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1964 – The American poetic songwriter and singer Bob Dylan released this special song in the USA. At the same time the Austrian naturalist Albert Ausobsky started to collect harvestmen intensively. A half century later the Nobel Prize in literature is awarded to Dylan; in the Alps of Carinthia and Salzburg we followed exactly the path of Ausobsky's harvestman-collecting activity. Two years ago at the Congress in Brno I reported on the unique “window on the past”: the special harvestman collection of Albert Ausobsky. It comprises 17,000 specimens belonging to 7,350 series. As well as this collecting-intensity over 10 years, the exact geographical positioning and habitat information yielded outstanding data and a perfect basis for long term-monitoring. In 2016 we had the opportunity to monitor the harvestman fauna of an alpine transect along the Großglockner-Hochalpen-Straße. The results of this long-term monitoring are predictable and astonishing at the same time: the loss of natural-like habitats at lower altitudes is unsurprising. In contrast, the dramatic change in the harvestmen communities can be clearly demonstrated for the first time. The invasive alien species *Opilio canestrinii* has conquered the walls of the cities and buildings and totally replaced *Opilio parietinus*. The obvious spreading of *Leiobunum limbatum*, *Nelima sempronii* and *Leiobunum rotundum* within the last decades can be interpreted as evidence for the effect of climate warming and globalisation, respectively. Furthermore these results question the autochthonous status of these three species.

Keywords: Araneae, fauna, harvestman, invasive species, monitoring, Opiliones.

High altitude jumping spiders (Salticidae) of Kinabalu Mountain, Borneo, Malaysia-Sabah

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Spiders are everywhere. This statement even holds true for the summit of the Kinabalu Mountain in Malaysian Borneo, as was confirmed during the Kinabalu-Crocker Scientific Expedition of 2012. Jumping spiders could be encountered up to altitudes of 3350 m, living under harsh conditions: bare rocks, toxic soil, sparse vegetation, and frosty nights. It is not self-evident that the jumping spiders are adapted to such exceptional environments. The mountain is relatively young (about 2 million years) and surrounded by tropical forests. Mountains of the same size are at least 2700 km away. Where did the Kinabalu summit jumpers come from?

Keywords: Araneae, new records, faunistics, mountain fauna.

Alpine spiders in subarctic Finnish Lapland

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Subarctic zone of Finnish Lapland (15,000 km²) is situated north of the coniferous (pine) forest line. Dominating ecosystems are mountain birch woodlands, isolated pine formations, mires and treeless alpine fells (low mountains). About 260 species of spiders have been reported in this area, i.e. 40 % of the 650 known species in Finland. In the treeless alpine zone the number of species known is 110. Near the highest peak of Finland (Mount Halti, 1324 m a.s.l.), the following eight linyphiid and one lycosid species are known above 1200 m: *Agyneta nigripes*, *Collinsia holmgreni*, *Erigone arctica*, *Horcotes strandi*, *Improphantes complicatus*, *Mecynargus borealis*, *Mughiphantes whymperi*, *Oreoneta sinuosa* and *Pardosa eiseni*. In the high alpine zone (900 - 1000 m) in Kilpisjärvi, 27 species of spiders have been reported. Most of them are linyphiids, with only one gnaphosid and three lycosid species occurred there. For comparison, in the Kevo area, 44 species are known at a low alpine site (at only 320 m), and here besides 24 linyphiid species, representatives of Lycosidae (6), Gnaphosidae (4), Thomisidae (4), Salticidae (2) Hahniidae (1), Miturgidae (1), Araneidae (1) and Tetragnathidae (1) have been found.

Keywords: alpine zone, Araneae, Finland, Linyphiidae, subarctic zone.

Resurrection of the spider parasitoid genus *Millironia* Baltazar 1964 (Ichneumonidae, Ephialtini)

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Host-parasitoid interactions of Australasian parasitoid wasps recently assigned in the genus *Eriostethus* Morley 1914 were studied for the first time in Australian Queensland. Our study revealed considerable differences between *Eriostethus minimus* Gauld, 1984 and *E. perkinsi* (Baltazar, 1964) in behavioural (host association and host manipulation), molecular (COI sequences) and morphological traits. *Eriostethus minimus* was associated with 3D tangle-web-building spiders from the family Theridiidae, but *E. perkinsi* with 2D orb-web-weaving spiders from the family Araneidae. Differences observed in behaviour, morphology and COI sequence distances between the species studied call for an extensive revision of the genus *Eriostethus* and a re-evaluation of the classification provided by Baltazar (1964), which found two different genera (*Eriostethus* s.str. and *Millironia*) within the recently accepted genus *Eriostethus* (*sensu* Gauld, 1984).

Keywords: Araneae, behaviour, COI sequences, host-parasitoid interactions, morphology, revision.

***Zodarion ohridense* (Araneae: Zodariidae) – a new record for Central Europe**

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The family Zodariidae comprises 1126 species in 84 genera. The most species-rich genus, *Zodarion*, comprises 158 species, 100 of which occur in Europe. Representatives of *Zodarion* are obligatory ant-eaters (each species being specialized on a certain group of ants), shelter themselves in silken retreats camouflaged by soil particles and morphologically, chemically and behaviourally mimic ants. The centre of the distribution area for this genus is the Mediterranean: so far only four species – *Zodarion germanicum* (C. L. Koch, 1837), *Zodarion hamatum* Wiehle, 1964, *Zodarion italicum* (Canestrini, 1868) and *Zodarion rubidum* Simon, 1914 – are known to extend into Central Europe. Here we present a record of a fifth species of *Zodarion* in Central Europe, *Zodarion ohridense* Wunderlich, 1973, introduced to an abandoned stone quarry near Kolín in Czech Republic.

Keywords: ant-eaters, faunistic records, introduced species.

Ideas concerning the future development of WSC, Araneae and VINST

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For decades the World Spider Catalog has been a well-established institution and three years ago was offered as a true, internet-based database. It also includes 99.5 % of the taxonomically relevant global spider literature as PDFs. Araneae is an identification key to European spiders, with sections for barcoding, faunistics and photographs and is available as a true, internet-based database. Both databases are increasingly used by the scientific community with up to 1000 and 500 daily users, respectively, and both profit from the support of the scientific community. The Virtual Institute of Spider Taxonomic Research (VINST) intends to encourage taxonomic research by providing PhD grants in order to enhance the number of described spider species but so far, due to lack of funding, it is not yet active. In this presentation we explain the current situation of these three institutions and provide some ideas on their future development and possible interactions. With this presentation we also hope to fuel a discussion on contribution and support possibilities for our commonly used resources, during this congress and beyond.

Keywords: database, descriptions, identification key, spider literature, spiders, taxonomic research.

Nephilid spider phylogenomics: complex evolution of sexual size dimorphism

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Golden orb spiders *Nephila*, and relatives in the family Nephilidae, are biological models, notably for the evolution of sexual size dimorphism (SSD). SSD is defined as the female-to-male size ratio. All values over 2.0 are extreme (eSSD) and rare in animals, but in nephilids eSSD is the norm. We report on phylogenomic research intended to arrive at a robust and reliable species-level phylogeny of Nephilidae in order to test hypotheses specific to body- and web-size evolution in a comparative framework. We combine anchored hybrid enrichment, a phylogenomic pipeline designed to resolve both deep and shallow phylogenetic hierarchies, with data from a prior six-gene phylogeny. Phylogenetic optimizations reveal complex patterns of size evolution in nephilids: female and male body lengths are inferred to increase on 26 and 24, and to decrease on 28 and 30 occasions, respectively. SSD (average 4.80; range 1.36-11.44) increased on 24 and decreases on 30 occasions, and is extreme in nearly all terminals and deeper phylogenetic nodes; the exceptions are three island species that independently evolve moderate SSD on Madagascar, Comoros, and Sri Lanka. An exaggerated SSD>5.0 is reconstructed at the nephilid root. Such eSSD is retained or further exaggerated in the tropical *Nephila*, *Nephilengys*, and *Nephilingis*. Combined, our results refute the validity of Cope's Rule (phyletic size increase) in golden orb spiders, but support the hypotheses of disentangled male and female size evolution, and of correlated female body and web size evolution. We conclude that SSD, a complex phenotypic outcome of independently and rapidly evolving body sizes of each gender, is more pronounced in the tropical clades and species, and less extreme on islands.

Keywords: Araneae, body and web size evolution, Nephilidae, sexual size dimorphism.

Proteases involved in the maturing of spider venom toxin precursors

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Comparison of transcriptomic and proteomic data indicates that spider venom neurotoxins and cytolytic peptides are expressed as precursors. These precursors are post-translationally processed by proteases to yield the active mature peptides. The identification of the proteases responsible for venom peptide precursor processing was still pending. We describe the purification of a venom toxin precursor processing protease from the venom of the spider *Cupiennius salei*. The chymotrypsin-like serine protease is a 28 kDa heterodimer. We demonstrate the protease's function in pro-peptide removal from neurotoxic precursors and provide evidence for its involvement in the generation of heterodimeric neurotoxins, as well as cytolytic peptides. Furthermore, the importance of the isolated enzyme is demonstrated by providing sequences of homologue proteins from multiple spiders in different families.

Keywords: Araneae, *Cupiennius salei*, cytolytic peptides, enzyme, neurotoxins.

Spiders (Araneae) at Brenturst Garden, a city garden in Johannesburg, South Africa

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Brenthurst Garden is 16 ha (45 acres) in extent situated close to Johannesburg City Centre, in South Africa. As a showpiece urban garden incorporating “gardening with nature”, surveys of wildlife have been carried out with lists and publications available to visitors. A spider survey was initiated in February 2011 and continued through to the southern summer of 2012. Adult spiders were collected, photographed, catalogued and voucher specimens deposited in the National Collection of Arachnida in Pretoria, South Africa. In total 38 species in 24 genera in 19 families were recorded. A checklist of spiders and an illustrated booklet are now available to the public who visit the garden and a loose-leaf reference handbook with photographs was made for the garden guides, who were taught basic spider identification.

Keywords: gardening with nature, urban garden.

Criminal Life: stealth, theft and predation in the Argyrodinae (Theridiidae) in Israel

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The diverse spider family Theridiidae is well represented in Israel and was studied taxonomically by G. Levy. One interesting theridiid subfamily, Argyrodinae, is known for specialized feeding behaviors including kleptoparasitism and araneophagy. Despite extensive phylogenetic research, there are still uncertainties concerning their phylogeny and evolution of specialized traits associated with foraging. Although the Argyrodinae is considered monophyletic, only three of the eight genera are monophyletic, while *Argyrodes* itself is paraphyletic. Three Argyrodinae species have been reported from the Levant area so far. Only two argyrodine species were previously known from Israel; *Argyrodes argyrodes* (Walckenaer, 1841), which had not been found since its first discovery by O. Pickard-Cambridge in Tiberias in 1865, and *Neospintharus syriacus* (O. Pickard-Cambridge, 1872). My recent phylogenetic research on the evolution of foraging behaviour in the Argyrodinae, reveals the rediscovery of *A. argyrodes* in Israel, as well as the first record in Israel of *Rhomphaea longicaudata* (O. Pickard-Cambridge, 1872) and *Rhomphaea* cf. *barycephala* (Roberts, 1983). Here I present up-to-date information on these species and their natural history.

Keywords: araneophagy, bionomics, foraging behaviour, kleptoparasitism.

Knocking trees, spiders fall: fourteen new species of *Shaanxinus* Tanasevitch, 2006 (Araneae, Linyphiidae, Erigoninae) from Taiwan and Vietnam

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Male dwarf spiders (Erigoninae) show a great diversity in their sexually-dimorphic prosomal structures. These external modifications are accompanied by glandular secretory tissues, the products of which function as a nuptial gift during copulation. Sexual selection on these traits might be one of the reasons why this group is the most diverse subfamily in the Linyphiidae, representing the largest spider family in the northern hemisphere. Consequently, Erigonines are an ideal group for studying the impact of sexual selection on character evolution and species diversification. However, the erigonine diversity in East Asia is still poorly assessed and phylogenetic relationships are unclear. For instance, only 12 erigonine species are currently known for Taiwan, where most genera are represented by a single species. Surveys of Taiwanese dwarf spiders were conducted in 2014, 2015 and 2017, during which 13 undescribed arboreal species of the genus *Shaanxinus* Tanasevitch, 2006 were collected by tree-branch-knocking. In addition, one undescribed *Shaanxinus* species from Vietnam was found during the inspection of undetermined museum material. Previously, only two Chinese species of this genus have been described. We present intrageneric relationships of *Shaanxinus*, inferred from morphological characters based mainly on male secondary sexual traits. The monophyly of species, as well as male-female matching, were confirmed by the use of three genetic markers: COI, 16S and 28S. Furthermore, we present the internal dimension of male prosomal glandular tissues in three species reconstructed using micro-CT. Considering the species richness of this group in Taiwan, we expect to find many more *Shaanxinus* species and other dwarf spiders in Taiwan and on continental East Asia if suitable collecting methods are applied. Increased knowledge of species diversity and their phylogenetic relationships will help to elucidate the evolution of male prosomal modifications and assess the role of sexual selection in diversification.

Keywords: descriptions, dwarf spiders, genetic markers, intrageneric relationships, sexual selection.

Is venom of prey-specialised spiders (Araneae) more effective in paralysis of focal prey?

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Prey-specialised spiders often focus on prey that is avoided by generalists species because it is difficult to handle or dangerous. Specialised spiders have evolved various adaptations that enable them to catch such prey effectively. One possible adaptation is a higher efficiency of venom on the focal prey, which prevents the prey's self-defence or even counterattack. We tested venom efficiency in several spider species that are specialised on hunting ants, termites or other spiders, and compared the efficacy with that of phylogenetically related generalists. We offered to each spider two prey types, one that was preferred by the specialist and one control prey. We measured paralysis latency (time from the spider bite to full prey paralysis), prey mass and spider body size. We found that the venom of three myrmecophagous specialist was more effective in ant paralysis when compared to a control prey (termite) and also when compared to the venom of three generalist spider species. The venom of two termitophagous specialist was more effective in termite paralysis when compared to that of two generalist species. The venom of three araneophagous specialist was more effective in spider paralysis when compared to the control (cricket) but the venom of three generalists was similarly efficient in paralysis of other spiders. We show that prey-specialised spiders have evolved more potent venom adapted to their focal prey, but which is less effective on alternative prey.

Keywords: araneophagy, generalists, self-defence, counter-attack, myrmecophagy, termitophagy.

The other spider societies

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The "other" social spiders are the territorial, permanently-social species (*sensu* Avilés 1997), otherwise known as colonial spiders. These are group-living spiders that share silk structures, but are generally regarded as non-cooperative. Borrowing from vertebrate sociobiology, Rypstra (1978) coined the name "foraging flocks." Previous work has demonstrated foraging advantages and protection from predators in colonial web-building species, but not always, and not for all individuals in the colony. A salient feature of colonial spiders is their behavioral flexibility. Some colonial species are ecologically successful opportunists, perhaps a consequence of their behavioral flexibility. I review earlier studies of colonial spiders, demonstrating that benefits of group living increase with colony size and that ecological conditions influence this relationship. These observations led us to suggest that colonial spiders will exhibit a strong Allee effect (negative density-dependence) in their dispersal behavior and mating system. I discuss these questions and their implications using colonial *Cyrtophora* as a case study.

Keywords: Allee effect, Araneae, behavioral flexibility, colonial web-building spiders, social species.

Distribution of spiders obtained by window flight traps on trunks in oak forest mosaics in Podyjí National Park

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Open oak forests are generally known for their rich invertebrate biodiversity, which includes spiders. We studied spiders from tree trunks in oak-dominated forests in the Podyjí National Park (Czech Republic) and analysed their distributions in forest mosaics. Twelve experimental clearings were created in closed-canopy forests within the core zone of the park in order to encourage populations of light-demanding species. Six of the clearings were connected to forest edges and open meadows, the remaining six clearings were within closed forest and isolated from open habitats. In the first season following the intervention, we sampled spiders in the clearings and in three control habitats (closed forest, forest edge and open forest) to observe changes in species richness and to record the colonization process. Sampling was with an unusual method for collecting spiders – two window flight interception traps (FITs) at each site. We recorded 627 spiders from 52 species. Eight spider species were threatened (i.e. included in the Czech Red List of spiders). The most abundant species were *Anyphaena accentuata*, *Clubiona pallidula*, *Nuctenea umbratica* and *Salticus zebraneus*. Notable species were *Heterotheridion nigrovariegatum*, *Diplocephalus erythropus*, *Cheiracanthium elegans*, *Leptorchestes berolinensis* and *Pannamomops affinis*, whose distribution is restricted to open oak forests. The opening of the forest canopy had no effect on the richness of spiders, which also did not differ among the different habitats. The composition of the open forest spider assemblages differed significantly from that of the other habitats. Threatened species were present in all habitats studied but did not show a clear preference. The exceptions were several species associated with open forest and forest edges. The diversity of spiders was unaffected by clearing. Window flight interception traps are a surprisingly effective method for sampling spiders.

Keywords: Araneae, clearings, fauna, forest edge, oak-dominated forest, spider richness.

DNA barcoding of jumping spiders from Pakistan (Araneae: Salticidae)

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Although the Salticidae constitute a highly diverse spider family, hardly any records have so far been collected from Pakistan. We conducted a targeted sampling programme to start cataloguing and barcoding the salticid fauna of the country from different geographical habitats. GPS points and micro- and macro-habitats were recorded for species distributions. Voucher specimens, identified to species level, were photographed to record habitus and sexual organs of both sexes and DNA barcodes (CO1 gene) were generated and molecular vouchers deposited. Our dataset added new records of 17 species and four new genera for Pakistan. Barcode sequences for twelve species from our dataset were new to the international nucleotide databases. Of these, two are incompletely described species (*Phintella indica* female and *Phintella incerta* female) and the DNA barcodes played a major role in the authentication of the opposite sex. In total, 88 new sequences were generated and 64 additional sequences of congeneric specimens were retrieved from GenBank and BOLD. The images and DNA barcodes generated by us comprised 26 species. As a useful identification tool, they represent a first attempt to catalogue and better understand salticid diversity for Pakistan. Our results indicate that DNA barcoding is highly suitable for identification and monitoring of Pakistan's salticid species, and may suggest the possible existence of cryptic species.

Keywords: classification, Pai Forest, salticid fauna, taxonomic identification.

The same but different: how climate, geography and habitat shape mega-diverse spider communities

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In ecology, one of the most powerful “tools” used to study spatial changes in communities and test the processes behind them are elevational gradients, because temperature and humidity levels both change with elevation. Mechanisms such as environmental filtering or competition have been suggested as the drivers of community assembly/structuring and also of general diversity trends, such as the decrease in the number of species with elevation. But how and why does this reduction happen? These are some of the questions we are investigating in our study of the spider communities of the Udzungwa Mountains, in the Eastern Arc Mountains (EAM), Tanzania. The EAM are classified as one of the World’s biodiversity hotspots and their forests are considered to be some of the oldest and most stable on the African continent, forming an “inland archipelago”. Elevations range from 300 to 2400 m.a.s.l. creating gradients in temperature and humidity, and allowing for a variety of habitat types. Although the little research conducted in the mountains of the EAM has revealed very high levels of biodiversity, no comprehensive study of the invertebrate communities has been conducted. By combining taxonomic and functional data on over 600 species, collected by thorough and standardised sampling within and between different elevations, we are learning that spider communities do not respond to altitudinal gradients in the same way as other organisms.

Keywords: Beta diversity, community assembly, Eastern Arc Mountains, functional structure, habitat, spiders, Udzungwa.

Aesthetic impact of *Brigittea civica* webs on historical buildings in the down-town district of Turin (NW Italy)

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Brigittea civica (Lucas) (Araneae: Dictynidae) is a synanthropic species, inhabiting urban environments and contaminating the wall surfaces of buildings with its discoidal web. Large aggregations of webs impact significantly the aesthetics of buildings, especially historical ones. However, the ecological factors determining habitat selection in these spiders are as yet poorly described. As part of a research project on urban decay funded by Compagnia di San Paolo, we studied the environmental factors driving the proliferation of *B. civica* webs in the arcades of the historical down-town district of Turin (NW Italy). We selected seventy squared sampling plots on the arcades' ceilings and, by means of photographic analysis, estimated the percentage of *B. civica* webs. In parallel, we collected several potential explanatory variables driving the density of webs—light intensity at night, temperature, distance from the main light sources and distance from the river. Regression analysis indicated a significant increase in the percentage of webs in those plots characterized by higher illuminance, with a major effect wherever the main source of light was a lamp post (incandescent light) rather than a light-emitting diode (LED) lamp. In fact, data in the literature suggest that incandescent light has a stronger attraction effect on nocturnal arthropods, which represent potential prey items for the species. We suggest that light is one of the major determinants of the increase density of *B. civica* webs. Future studies should investigate the effect of the different types of urban illumination systems—LED versus incandescent light—under laboratory conditions, in order to support conservation programs aimed at preserving the aesthetic appearance of historical buildings.

Key words: determinant, ecological factors, habitat, synathrope.

Spiders in caves: the CAWEB project

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World experts of different disciplines, from molecular biology to macroecology, recognize the value of cave ecosystems as ideal ecological and evolutionary laboratories. Among other subterranean taxa, spiders stand out as intriguing model organisms for their ecological role of top-predators, their unique adaptations to the hypogean medium and their sensitivity to anthropogenic disturbance. Here, we provide a general overview of the spider families recorded in hypogean habitats in Europe – 20 families including nearly 500 species, most of them with restricted distributions. We also review the different adaptations of hypogean spiders to subterranean life and summarize the information gathered so far about their origin, population structure, ecology and conservation status. Taxonomic knowledge on subterranean spiders in

Europe appears to be well, but not exhaustively documented. The origin of the European assemblages is mostly explained by past climate dynamics, although other factors are likely to be involved. Most of the macroecological issues related to spiders in European caves are based on qualitative assessments or have been quantified only at a sub-regional scale. In order to shed light on cave spiders' biogeography and the macroecological patterns driving the diversity of European subterranean spiders we created the CAWEB network, a spontaneous collaboration between subterranean arachnologists from 30 different European countries. We here present the team and provide some preliminary results, which highlight Southern Europe as an important hot-spot for the European subterranean spider diversity.

Keywords: Araneae, biogeography, ecology, model organisms, subterranean taxa.

Palaearctic and Nearctic vs. Holarctic: how does spider distribution correlate with zoogeographic regions?

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There are two main alternative opinions regarding the zoogeographic subdivision of the Northern Hemisphere. Some zoogeographers recognize the Holarctic Region with two main subdivisions: the Palaearctic and the Nearctic, while many others consider the Palaearctic and the Nearctic as separate biogeographic realms. In this presentation I will analyze the distribution of spiders in the northern half of Eurasia, northern Africa and North America in order to show how it corroborates different zoogeographical schemes. Special emphasis will be given to the spiders distributed in the boreal and tundra zones. Spiders of these zones are much better studied in both hemispheres than those in other ecozones.

Keywords: Araneae, Northern Hemisphere, subdivisions, zoogeography.

Typified and non-typified names in spider systematics

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Several types of names are used in the modern classification of spiders for suprageneric taxa. Such names can be divided into three main categories: typified, non-typified, and non-taxonomical. The typified names are based on the name of a genus, such as Gnaphosidae or Gnaphosinae, based on *Gnaphosa*. All names in family-group taxa (infratribe, subtribe, tribe, infrafamily, subfamily, family, superfamily, epifamily, etc.) are typified according to the rules of the International Code of Zoological Nomenclature (ICZN). While ICZN regulates species-, genus- and family-group names, it does not regulate the names of higher animal taxa (order, class, phylum). Among the order-group names in spiders (parvorder, infraorder, and higher) there are many non-typified names, such as Mesothelae, Opisthothelae, Haplogynae, Dionycha, Synspermiata, which are not based on the name of a genus (family). The third type of "name" is non-taxonomical, and is used chiefly by cladists: RTA-clade, Oval Calamistrum-clade, Marronoid-clade, Lost Trachea-clade, CY Spigot-clade, higher Araneoids. Some authors also use names such as "Classical Haplogynae". In this presentation we will discuss the problems arising from the use of non-typified and non-taxonomical names.

Keywords: Araneae, classification, difficulties, ICZN, taxonomy.

Arachnid evolution and development: insights from the spider *Parasteatoda tepidariorum* (C. L. Koch, 1841)

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Gene duplication plays an important role in the evolutionary diversification of organisms through changes in the regulation of developmental processes. There is increasing evidence for the large-scale duplication of genes in some chelicerate lineages including two rounds of whole genome duplication (WGD) in horseshoe crabs. To investigate this further we sequenced and analysed the genome of the spider *P. tepidariorum*. We found pervasive duplication of both coding and non-coding genes in this spider, including two clusters of Hox genes. Analysis of the synteny of the *P. tepidariorum* genome and comparison with the genomes of other chelicerates suggests that these patterns of gene duplication resulted from a WGD in the common ancestor of spiders and scorpions, and independent of the WGDs in horseshoe crabs. To understand how this WGD event influenced the evolution of spider development, we are studying expression and function of duplicated genes during *P. tepidariorum* embryogenesis. Our results suggest that sub- and neo-functionalisation of genes has greatly contributed to the evolution of the regulation of important developmental processes in this spider including maternal zygotic transition, segmentation, patterning and neurogenesis.

Keywords: Araneae, embryogenesis, evolutionary diversification, genes, genome, Theridiidae.

Silk or venom? Alternative capture traits employed by myrmecophagous specialist and generalist spider

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Predators that eat dangerous prey have evolved weapons effective in restraining that prey. Spider venom and silk represent two such traits. But utilization of such adaptations comes at a cost, as these substances are metabolically or ecologically expensive. Based on a possible trade-off, the utilization of only one effective capture strategy should be optimised if a predator is specialized on a single prey type. We investigated silk and venom utilization in *Callilepis* and *Nomisia*, two related spiders from the family Gnaphosidae that feed on ants but which employ different hunting strategies. We compared the trophic niche, hunting efficacy and time investment of venom *versus* silk utilization in both spiders. *Nomisia* restrained ants with silk followed by a bite, while *Callilepis* relied solely on its venom. *Callilepis* also subdued prey more quickly. DNA analysis of gut content revealed ants formed the majority of prey for both spiders in nature, but in the lab *Nomisia* accepted a variety of other prey types. It was less effective in subduing large ants than *Callilepis*, which accepted ants almost exclusively. We show that investment in venom allows *Callilepis* to be more efficient in overcoming ants than the use of both silk and venom in *Nomisia*. However, such specific adaptations may restrict specialised predators from utilizing alternative prey.

Keywords: adaptations, Araneae, capture strategy, Gnaphosidae, hunting efficacy, predator behaviour.

Neem application alters the relationship between predatory activity and behavioural predictability along a prey-density gradient in the spider *Oxyopes lineatipes*

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The predation pressure exerted by predators on pests depends not only on the mean behaviour of predators but also on the consistent between-individual variability (i.e. repeatability) and on the intra-individual variability (i.e. predictability) in their behaviour. We therefore need to investigate how management practices, such as applications of pesticides, influence the overall behavioural architecture of populations of natural enemies. We explored in laboratory experiments, how applications of Neem (insecticide) and plant extracts from *Embelia ribes* (insecticide, acaricide) influence the architecture of predatory activity (no. of prey killed per unit time) along a prey-density gradient in the lynx spider *Oxyopes lineatipes*. We did not observe any significant differences between the control treatment and the *Embelia* treatment. Neem reduced the predatory activity of *Oxyopes*. Although Neem did not influence the repeatability, it altered the relationship between mean and predictability in predatory activity. In the control treatment, individuals with high predatory activity were more predictable than individuals with low predatory activity at low to moderate prey densities, but less predictable at high prey density. In the Neem treatment, individuals with high predatory activity were less predictable than individuals with low predatory activity along the whole prey-density gradient. The results show that Neem, which has been considered as safe for non-target organisms, exhibited strong sub-lethal effects and modified the behavioural architecture of predatory activity in *Oxyopes*. Consequently, the application of Neem can reduce the biocontrol potential of *Oxyopes*.

Keywords: Araneae, biocontrol, insecticide, non-target organisms, Oxyopidae, predatory pressure.

Ballooning spiders: sensory mechanisms and electric flight?

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Some spiders and other wingless arthropods, such as caterpillars and spider mites, disperse aerially over hundreds of kilometres by ballooning. Technically a misnomer, ballooning involves the arthropod releasing strands of silk on which sufficient forces act to provide rapid lift and take off. Air movement and drag forces can generate the lift to make these animals air-borne, however an alternative hypothesis is that electrostatic forces could be used to generate lift. Under ecological conditions spiders and other arthropods will be subject to both air movements and electrostatic fields provided by the atmospheric potential gradient (APG). We test the ability of spiders to detect and respond behaviourally to electrostatic fields as well as examining putative receptors mechanically. We show that spiders attempt to disperse in response to electrostatic fields, indicating that this could be a meteorological cue for ballooning behaviour. Trichobothria are mechanically displaced by electrostatic fields as low as 100V/m, providing a putative electroreceptor, while also responding to air-flow stimuli. The mechanical response of trichobothria to electric fields and air-flow are distinct, presenting the possibility of discrimination between these two stimuli at the neural level. To date, finding meteorological predictors of spider ballooning behaviour has not provided clear results. APG may be an explanatory factor not only in spider dispersal, but also other ballooning arthropods as well as other species that use passive aerial dispersal mechanisms. Atmospheric electrostatics could provide better predictors of distribution in these species with impacts on agricultural pest management due to the importance of ballooning species both as pest and predators, and also nutrient and pathogen relocation.

Keywords: atmospheric potential gradient, electrostatic fields, electrostatics, trichobothria.

Insecticide resistance in orb-web spiders (Araneae: Araneidae)

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Various measures are used to control insect pests but synthetic insecticides are the most common. Frequent use of insecticides can lead to the development of resistance in insect pests and in other non-target organisms such as spiders. Spiders are important biological control agents, which can be used effectively to control insect pests. Resistance against insecticides in spiders is beneficial as resistant spiders can be used in insect pest management programs together with chemical pesticides. In the present study, biochemical estimations of enzymes that detoxify insecticides – glutathione s-transferase (GST), monooxygenase and non-specific esterase – were made to check whether there is any relationship between insecticide resistance and high levels of detoxifying enzymes. *Neoscona mokerjei* and *Neoscona theisi* (orb-web spiders) were used because of their abundance in the study area. In the laboratory, spiders were exposed to field doses of commonly used insecticides (Chlorpyrifos and Talstar), for one hour and then the percentage mortality calculated for each species. One way ANOVA (SPSS 13) was used to compare enzyme activity among control and insecticide-resistant spiders, and probit analyses were run in Minitab 14. The results of this study showed that both species were resistant to recommended field doses of the selected insecticides, although Talstar was more toxic to spiders than Chlorpyrifos. Elevated levels of monooxygenase, GST, and α - and β -esterases were observed. There were significant differences in enzymes activity between susceptible and resistant populations of spiders. It was concluded that high levels of insecticide-detoxifying enzymes may be associated with resistance in orb-web spiders.

Keywords: biological control, enzyme assays, integrated pest control.

***Micaria pulicaria* (Araneae: Gnaphosidae) – a complex of cryptic species?**

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High levels of intraspecific variation in spider genitalia are exceptional. If within-species variation approximates divergence between closely related congeners, species boundaries may be mistaken and cryptic species remain unrecognised. Here, we reveal such a pattern for the widespread Holarctic ground spider *Micaria pulicaria*. The genus *Micaria* has been thoroughly revised in the Palearctic region and in North America, yet the species delimitation with respect to *M. pulicaria* remained obscured. While historical authors (Westring, Menge) distinguished two closely related species, *M. nitens* Blackwall and *M. pulicaria* Sundevall, subsequent authors regarded these as synonyms. A deep intraspecific split (5.8% COI-distance between two clades) in the GBOL (German Barcode of Life Project) dataset encouraged us to reconsider the taxonomic status of *Micaria pulicaria*. We found clear differences in somatic and genitalic morphology between the two genetic clusters that occur in Europe. Consequently, we propose the re-elevation of *M. nitens* to species level, though the name allocation remains challenging because of limited access to the type material. The situation is more complex in North America, where BOLD sequences revealed two additional genetic lineages that at present we cannot distinguish morphologically.

Keywords: genetic clusters, genitalic morphology, somatic morphology, species boundary, synonymy, variation.

New records of Geogarypidae (Arachnida: Pseudoscorpiones) from the Indo-Malayan region and New Guinea, with two new species

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Pseudoscorpions are small predatory arachnids with more than 3500 species worldwide and can be found in a great variety of natural and anthropogenic habitats. The pseudoscorpion family Geogarypidae Chamberlin, 1930 includes 61 named species, with the majority occurring in tropical areas. The family contains three genera, *Geogarypus* Chamberlin, 1930, *Afrogarypus* Beier, 1931 and *Indogarypus* Beier, 1957. The genus *Geogarypus* has 46 species and differs from the other two genera in having accessory teeth on the chelal fingers and lacking a sulcus in the dorsal or interno-lateral face of the chelal hand. Twelve species have been reported from the Indo-Malayan region and New Guinea. During the 19th and 20th centuries, researchers from the Hungarian Natural History Museum took part in several zoological expeditions to these areas, and the specimens of *Geogarypus* collected by them were the subject of the present study. As a result, two new *Geogarypus* species are described from Papua New Guinea and from India with detailed figures. A new specimen of *G. sagittatus* Beier, 1965 was found in Papua New Guinea, and a supplementary description is given based on its characters – according to our present knowledge, this species seems to be endemic to New Guinea. Furthermore, new occurrences of *G. longidigitatus* (Rainbow, 1897) are provided from the Indonesian region; this species is widely distributed in the Indonesian and Pacific regions. A *Geogarypus* tritonymph from Papua New Guinea could not be attributed to any described species – a short description of the unidentified specimen is also given.

Keywords: endemic species, false scorpions, museum collections, new faunistic records.

Is araneophagy a reason for the spread of the Daddy Long-legs spider *Pholcus phalangoides*?

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The aim of this study was to discover more about predation and araneophagy in the synanthropic spider *Pholcus phalangoides* (Pholcidae), which is rapidly expanding its range in Central Europe. Invasive and expansive species, including *P. phalangoides*, pose a serious threat to natural habitats not only in the Czech Republic but around the world. Together with the increasing use of natural resources, climate change and environmental pollution, it is one of the main factors that threaten the existing biodiversity of original ecosystems. The potential hazard posed by this species stems particularly from its interactions with other synanthropic species of spiders. *Pholcus phalangoides*'s versatile predatory behaviour means it has all the prerequisites to prefer other synanthropic species of spiders as prey – the study therefore focused on these interactions. The experiments took place under laboratory conditions using a total of 248 spiders. Five other species were tested against *P. phalangoides*, namely *Hasarius adansoni*, *Psilochorus simoni*, *Parasteatoda tepidariorum*, *Tegenaria atrica* and *Tegenaria domestica*. All experiments were carried out in individually labelled experimental containers under the same laboratory conditions. Preliminary results indicate that *Pholcus* can negatively affect the populations of our native species, especially because adults have no problems killing and consuming juveniles of the other species. This may have a detrimental effect on future populations of our original synanthropic species, within its expanding range.

The project was supported by the grant IGA FA MENDELU Brno No. IP_29/2016.

Keywords: Araneae, colonization, Pholcidae, potential hazard, synantropic species.

Preliminary studies on the spider fauna in Nigeria (Arachnida; Araneae)

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Nigeria is a West African country whose climate is seasonally damp and very humid. A number of climate/vegetation zones are distinguishable, from forests in the south to Sahel savannah vegetation in the far north, with Guinea and Sudan savannah in between. The dry season is more prolonged in the north while the rainy season is more protracted in the south, resulting in greater vegetation cover. The present study was an attempt to assess and evaluate the distribution, diversity and occurrence of spider communities across six zones and to initiate the process of documenting the spiders of Nigeria. In total 270 species in 38 families were recorded from five out of the six zones. The Araneidae, Miturgidae, Salticidae and Sparassidae were the most widely distributed and found in four of the zones. The Salticidae, with 35 genera and 79 species, was the most dominant family. Sixteen families were restricted to a specific zones – 10 of these families were limited to the south-west zone, three to the south-east, and two and one to the north-central and south-south zones, respectively. For every family distributed across more than one zone, the south-west was one of them. The only exception was the Hersiliidae, which was found across the south-south, north-central and north-east zones. The south-west region had the highest species richness and diversity, followed by the south-east. However, this could be because more studies have been conducted in these two zones than in the rest. No study has been made of the north-west, hence the absence of spider records from that zone. Nigerian spiders are under studied and poorly documented because of a lack of interest in the country. This work sought not only to begin the documentation of Nigeria's arachnofauna but also to raise awareness of its spiders.

Keywords: distribution, diversity, endemics, West Africa, spider communities.

Occurrence of a primitively segmented spider (Mesothelae, Liphistiidae) on Lampi Island of the Myeik Archipelago, Tanintharyi Region, southern Myanmar

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An interesting spider of the genus *Liphistius* Schiödte, 1849, presumably a new species, was found on Lampi Island of the Myeik Archipelago located at the base of the Malay Peninsula. Details of the material are as follows: one female and three juveniles (male unknown), along a rivulet near the beach between Thin Aw and Michaung Aw, western side of Lampi Island, Bokepying Township, Tanintharyi Region, Myanmar, 21-V-2017, collected by H. Ono. The Myeik archipelago comprises several hundred islands distributed along the coastline for 600 km in the Andaman Sea. These islands are geologically characterized mainly by limestone and granite, and their shoreline consists of sandy beaches, rocky headlands and mangrove swamps. This sea area has been isolated from modern civilization by the traditional lifestyle of the fishing tribe Moken, and the islands are covered with thick tropical growth, which preserves habitat of some endangered animals. Although 32 species of *Liphistius* are hitherto known from neighboring Thailand, only two recent species are recorded from Myanmar: *L. birmanicus* Thorell, 1897 from Carin Hill, Kayah State and *L. lordae* Platnick & Sedwick, 1984 from Taunggyi, Shan State. However, these mountainous species have little relation to the present species. In the structure of female genitalia, the Lampi species seems closer to those of the *trang* group (*sensu* Schwendinger, 1998) recorded from the area between Chumpon and Yala Province, southern Thailand, especially to *L. bicoloripes* Ono, 1988 and *L. castaneus* Schwendinger, 1995, both from Ranong Province about 180 km Southeast of Lampi Island. This discovery may suggest the existence of species diversity in the Myeik Islands as is known in the genus *Ryuthela* Haupt, 1983 in the Okinawa Islands of Japan.

Keywords: Araneae, *Liphistius*, new species, *Ryuthela*, species diversity.

Distribution of spiders (Arthropods, Arachnida) according to vegetation in Algiers ecosystems

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Within arthropods and arachnids, Araneae have the greater diversity and ecological importance in the balance of ecosystems. They are sensitive to vegetation changes and play an important role in the functioning of the agro-ecosystem. These semi-natural environments harbour a well-adapted terrestrial fauna, which generally maintains a trophic order. A monthly survey of spiders was carried out over the course of a year at the Technical Institute of Great Crops (T.I.G.C.) Oued Smar (Algiers). Six 1.5 hectare plots were selected according to the height of the vegetation cultivated: durum wheat, oilseed rape, soft wheat, two plots with clover and one uncultivated. In each plot, six pitfalls traps were used to harvest the spiders. They were plastic bottles, dug in a straight line with an interval between them of at least 1 m. A total of 600 individuals were collected: 303 males, 116 females and 181 juveniles. They belong to 18 families, 36 genera and 46 species. *Diplocephalus graecus* was the dominant species (145 individuals). Species diversity differed between plots. The diversity gradually increased with vegetation height, and there was a significant correlation between the abundance of spiders and the height of the vegetation cultured in this agro-ecosystem. The vegetation cover provides favorable habitats for Araneid species living in such environments.

Keywords: agro-ecosystem, diversity, species richness, spiders, vegetation height.

A comprehensive database of ground spiders (Gnaphosidae) from Asia and Australia

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Ground spiders (Gnaphosidae) comprise one of the largest groups of spiders (2195 species and 125 genera) widely distributed around the globe. The main goal of this project is to create a database of ground spiders of Asia and Australia by combining comprehensive data, both newly generated and re-evaluated, such as genomics, morphological and anatomical information obtained using state-of-the-art technologies. The new online database will feature an interactive mapping tool and allow data entry and retrieval. The image core of the database will include all presently available and recently obtained digital images of known species of gnaphosids. The images are generated by digital cameras and SEM, and 3D images are obtained with X-ray micro-computed tomography (micro-CT). Each specimen will be accompanied with a thorough description. Genomic DNA will be isolated from representative specimens and several molecular markers that represent both nuclear and mitochondrial ribosomal and protein-coding genes will be used in DNA barcoding. DNA sequences will be uploaded to the new database as well as Genbank.

Keywords: 3D images, anatomy, genomics, micro-computed tomography, morphology.

Molecules vs. morphology - is *Eratigena* (*Tegenaria*) *atrica* (Agelenidae) one species or three?

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The *Tegenaria atrica* group of Large House spiders traditionally comprised three closely-related and macroscopically indistinguishable species, *T. saeva*, *T. gigantea* (= *duellica*) and *T. atrica*. Bolzern *et al.* (2013) proposed that these, and several other *Tegenaria* species should be transferred to the genus *Eratigena*, a suggestion with strong morphological and molecular support. More controversially they argued from relatively limited material, mostly from continental Europe, that the three *Tegenaria* species in the *atrica* group should be regarded as a single, albeit variable, species *Eratigena atrica*. The evidence for this was that the three could not clearly be distinguished on the basis of mtDNA sequences and that they are difficult to tell apart morphologically. This proposal was at odds with a long-term study of the species in Britain, which showed clear geographical patterns in species distributions. One hypothesis to explain this discrepancy is that there may have been sufficiently widespread hybridisation in continental Europe for the species effectively to fuse into one, whereas in southern Britain their specific status is maintained. To test this possibility we obtained further molecular and morphological data from Britain, and examined additional specimens from continental Europe, North America and the Republic of Ireland. Our new data fully support the complexity at the molecular level and confirm the small genetic distance between taxa, comparable to intraspecific variation in many other spiders. The morphological evidence, however, clearly reveals the same three, distinct entities in southern Britain, continental Europe and elsewhere, refuting the possible fusion of species in Europe. Although the proposition that there is just one species *Eratigena atrica* has been widely accepted, our results suggest that the original three species *E. atrica*, *E. saeva* and *E. gigantea* (= *duellica*) should be resurrected. This case provides a salutary example of where morphology (= nuclear DNA) provides the right answer, and mtDNA sequences mislead. The molecular complications may be vestiges of both ancient and modern hybridisation events.

Keywords: *Eratigena atrica* group, hybridisation, Large House spiders, molecular phylogeny, morphometrics.

Characterisation of the role of HES (hairy/enhancer-of-split) gene family members during embryogenesis of the spider *Parasteatoda tepidariorum*

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Arthropods, annelids and vertebrates undergo a time- and space-controlled patterning developmental mechanism that differentiates body segments. Much that is known about segmentation in arthropods has come from the insect *Drosophila melanogaster*. However, this model shows a derived mode of segmentation, whereas many other arthropods display short-term sequential addition of segments from an undifferentiated region on the posterior of the embryo. The HES (hairy/enhancer-of-split) gene family in *Drosophila* has a role in both segmentation and neurogenesis, but the role of these genes in the development of other arthropods is less well understood. A suitable model to study the evolution of this developmental mechanism is the spider, *Parasteatoda tepidariorum*, which exhibits a dynamic interplay between the Delta-Notch and Wnt signalling pathway as major upstream controllers for segmentation, which in turn direct the expression of downstream target genes. The gene *hairy* (HES-1 orthologue) exhibits dynamic expression in this process, and expression analysis by *in situ* hybridisation has revealed that this gene is expressed in spatial-temporal patterns that are indicative of a role in segmentation. Another three HES genes were identified: HES-2, an orthologue of the *Drosophila deadpan* (*dpn*) gene, and HES-4 and HES-7 orthologues of the respective vertebrate genes. The expression of these orthologues reveal a conserved role in neurogenesis and segmentation, with HES-2 showing expression in the presumptive neurectoderm and HES-7 showing the same pattern of expression as HES-1. Further experimentation and functional studies will be carried out, specifically analysing the expression pattern of these genes in RNAi knockdowns embryos for Wnt and Delta-Notch, which will provide new insights into how this gene family is involved in the gene-regulatory network underlying segmentation in this spider. Funding: Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq – Brazil)

Keywords: Araneae, development, gene expression, neurogenesis, segmentation.

Open Air Laboratories: How to engage one million participants in citizen science?

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Open Air Laboratories (OPAL) is a UK-wide citizen science project that has been running for 10 years. It aims to answer ecological questions, while enabling communities to engage more with nature and better understand their local environment. Through a unique combination of well-defined environmental surveys and our network of community scientists, the OPAL network has engaged with nearly 1 million members of the British public, many of whom are from our most deprived regions. Our work has resulted in more than 20 peer reviewed papers in addition to community reports and policy documents. OPAL is an outstanding example of how researchers can work with the public to produce excellent science and have a lasting impact. We have recently launched 'Spider School', which is a year-long project working with local school children, using spiders to explore the useful properties of natural materials such as spider silk.

Keywords: ecology education, community, environmental surveys, 'Spider School'.

The golden mimicry complex uses a spectrum of defenses to deter a community of predators

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Mimicry complexes typically consist of multiple species that deter predators using similar anti-predatory signals. Mimics in these complexes are assumed to vary in their level of defense from highly defended through to moderately defended, or not defended at all. Here, we report a new multi-order mimicry complex that includes at least 140 different putative mimics from four arthropod orders including ants, wasps, bugs, tree hoppers and spiders. All members of this mimicry complex are characterised by a conspicuous golden body and an ant Gestalt, but vary substantially in their defensive traits. However, they were similarly effective at deterring predators – even mildly defended mimics were rarely eaten by a community of invertebrate and vertebrate predators, both in the wild and during staged trials. We propose that, despite the predominance of less defended mimics, the three predatory guilds avoid the mimics because of the additive influence of the various defensive traits.

Keywords: anti-predatory signals, mimics, multiple species, predatory guild.

Variation in ground spider communities along a micro-scale climatic gradient in NE Greece

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Climate change affects the spatio-temporal presence of organisms. The Mediterranean region is more affected by climate change than the rest of Europe. However, arthropod community responses to climate change have not been adequately addressed, despite their importance in ecosystem functioning. In the district of Evros, NE Greece, a climatic gradient is created where three distinct bioclimatic zones meet, offering the opportunity to assess changes in arthropod community structure at a small geographical scale. The results presented here are part of a study in which we test the diversity and structure of ground-spider communities in response to climate, habitat and seasonal variation at a micro-geographical scale. In a well-designed experimental scheme, which divides the study area in eight zones and explores the three typical habitats of the region, we put pitfall traps in 24 sites and developed an appropriate analytical framework. We show that elevation and average temperature do not have a significant effect on community composition of spiders at the family level. In contrast, habitat type and average humidity significantly affect community composition, with some families clearly preferring one of the three habitats and most of them avoiding high humidity. In terms of conservation management, our results suggest that a spatially heterogeneous mosaic of habitats should be maintained to ensure that the ecological needs of all spider groups are met.

Keywords: Araneae, bioclimatic zone, conservation, ecosystem functioning, habitat.

Utilization of molecular cytogenetic markers in the study of karyotype dynamics in the family Buthidae (Arachnida, Scorpiones)

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In the evolution of species, the karyotype can be the subject of genomic alterations that affect the number, structure and composition of chromosomes. Comparative molecular cytogenetics currently represents an effective tool with which to study karyotype dynamics and genome organization. Linking such knowledge with the phylogeny of taxa helps to clarify what structural mechanisms drive the differentiation of karyotypes. In our research, we aimed to expand our knowledge of the karyotype dynamics in the family Buthidae, the most deeply diverged and diverse lineage within the order Scorpiones. Compared to other scorpion families, buthids are unique in possessing holokinetic chromosomes and exhibiting karyotypes of lower diploid number ($2n = 5-56$), which are highly conserved in some genera but hypervariable in others. In addition, a wide variety of species exhibit chromosomal multivalent associations in meiosis that indicate an accumulation of multiple fusion/fission or translocation events. Such chromosomal complexity demands the application of modern FISH techniques using specific gene probes to shed light on hidden structural changes underlying karyotype differentiation. In this presentation, we will demonstrate the utilization of molecular cytogenetic markers in the study of karyotype dynamics of buthid scorpions and provide an example of comparative chromosomal mapping of the gene for 18S rRNA.

This research was supported by the Grant Agency of the Charles University (GA UK 1324217).

Keywords: buthid scorpions, chromosomes, evolution, genome alterations, karyotype dynamics.

Cryptic diversity, endemism and biogeographical history in Alpine scorpions (Euscorpiidae: *Euscorpius*)

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The European Alps historically played a crucial role in shaping the phylogeography of many species. This topographically diverse area has a complex geoclimatic history. In this context, local biota repeatedly faced dramatic environmental changes, which in many cases may have induced diversification. The present-day Alpine biotic diversity has been traditionally interpreted in the light of recent Quaternary climatic oscillations. However, we still know very little about the biogeographical history of the Alpine fauna. In the present study, we cytogenetically and genetically investigated the endemic scorpion species *Euscorpius (Alpiscorpius) alpha*, *E. (A.) germanus* and *E. (A.) gamma* to explore the population structure of extant lineages and to provide an insight into the species diversification in the context of mountain-area history. All three species show a conspicuous intraspecific variability, which is congruent at both chromosomal and genetic levels. In total, we detected ten genetically delimited karyotypic races, which exhibited the attributes of locally endemic cryptic species. Specifically, we found three in *E. (A.) alpha* and *E. (A.) germanus*, and four in *E. (A.) gamma*. A time-calibrated, multilocus phylogeny revealed that all karyotypic races emerged during the Pliocene-Pleistocene period when geomorphological processes and significant climatic changes took place in the Alps. As the cytogenetic results indicated, the diversification process was accompanied by dynamic structural rearrangements in the genomes of Alpine scorpions. Such genomic changes may serve as strong post-zygotic barriers to gene flow, and so augmented the process of speciation. The present study was supported by the Grant Agency of the Charles University (GA UK 1350214).

Keywords: Alps, biogeography, cytogenetics, karyotypic races, multilocus phylogeny, Scorpiones.

Decrypting female choice: investigation of possible post-copulatory cryptic female choice mechanisms in *Argiope bruennichi* (Scopoli, 1772)

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Cryptic female choice (CFC), whereby polyandrous females discriminate and choose between sperm of different males post copulation, has been intensively studied for the last two decades. As consequence of its internal, and therefore mostly hidden, processes observations of the mechanisms involved are rather difficult. From the duration for which the male is allowed to transfer sperm, sperm dumping, neutralisation, or even digestion through to controlled activation or selected transport, there are several different means and locations within the female reproductive tract where choice is possible. Entelegyne spiders are particular fitting for investigations into these mechanisms because females have paired spermathecae, with complementary insemination organs in males. In particular, the copulatory and insemination processes in spiders like *Argiope bruennichi*, where effective post-copulatory plugging naturally limits the number of possible copulations, provide an easy-to-manipulate and selectively observable platform with which to conduct experiments. Previous studies have revealed CFC in three *Argiope* species in which females favoured sperm from smaller males, non-siblings over siblings and courting males over non-courting males. We will present initial results on the spatial and conditional differences of sperm cells inside the spermathecae of *A. bruennichi* females inseminated by males of different genetic relatedness (siblings and non-siblings). The insemination pattern is fixed and ipsilateral and we pre-determined the storage site for each male's sperm by removing one of the pedipalps. Spermathecae of females, each with the sperm of one of the different males, were removed at three different times post copulation to be fixed and embedded for subsequent transmission electron microscopy examination.

Keywords: Araneae, entelegyne spiders, orb weavers, polyandrous females, siblings, spermathecae.

Molecular phylogeny of the spider family Oonopidae (Araneae, goblin spiders)

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Goblin spider diversity on the island of Sri Lanka is very high, with at least 44 species of which 39 are endemic. We present phylogenetic evidence from two nuclear ribosomal loci showing the relationship of 43 taxa from Sri Lanka (41 endemics) to the remaining global goblin spider fauna. The Oonopidae is shown to be monophyletic, confirming previous studies. *Brignolia* and *Opopaea* are both paraphyletic and should be redefined in morphological terms. This result is in contrast with the current morphological hypothesis that both genera are monophyletic. The same goes for *Aprusia* and *Ischnothyreus*. Further, our results confirm that a low degree of body sclerotisation within the Oonopidae is plesiomorphic, as found in previous studies. Sri Lanka has a diverse goblin spider fauna with numerous undescribed species. Most of this diversity is generated by within-island speciation, as demonstrated in species of *Aprusia*, *Brignolia* and *Xestaspis*, all of which consist of closely related assemblages of more than two species. These species are narrow endemics with very restricted distributions. However, to document this biodiversity and its evolutionary origins more research is needed.

Funding provided by the National Institute of Fundamental Studies (Sri Lanka) is acknowledged.

Keywords: diversity, endemics, island speciation, spider fauna, Sri Lanka.

Do ladybird spiders (Araneae: Eresidae) really mimic ladybirds?

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Red-and-black males of several ladybird spider species (*Eresus* spp., Araneae: Eresidae) are, as their name suggests, considered to mimic aposematic ladybird beetles (Coleoptera: Coccinellidae). They are expected to be Batesian (unprotected) mimics, as they do not seem to possess any effective defence against birds, the most important potential predators. However, the hypothesis of a mimetic relationship between ladybird spiders and their potential models lacks any solid support. We focused on mimetic relationships of two ladybird spider species, *Eresus moravicus* and *E. kollari*. Males of these species share similar coloration pattern, which implies that they imitate the same model. The model should be more abundant than its Batesian mimics, and should temporally co-occur with them. However, *E. moravicus* and *E. kollari* have different phenologies: adult males of *E. moravicus* occur in spring, whereas those of *E. kollari* occur in late summer and early autumn. It is therefore possible that predators associate each of these species with different models. To identify potential model species, we assessed relative abundances of all red-and-black coloured arthropods with a similar body size as ladybird spiders during the whole season at nine localities where the spiders occur. We then analysed visual similarity (colour, shape, pattern, and reflectance) between the collected species and *Eresus* spp. Our results suggest that ladybirds (especially *Coccinella septempunctata*) could indeed be the models for both ladybird spider species, as they occurred at sufficient abundances at all studied localities during the entire season and are relatively similar to ladybird spiders. Some other aposematic species may also serve as models for ladybird spiders, but their role would be temporally and/or spatially constrained.

Keywords: Batesian mimicry, mimics, models, phenology, predators, visual similarity.

Taxonomic revision and insights into the speciation mode of the spider *Dysdera erythrina* species-complex (Araneae: Dysderidae): sibling species with sympatric distributions

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The genus *Dysdera* Latreille, 1804, a species-rich group of spiders that includes specialised predators of woodlice, contains several complexes of morphologically similar sibling species. Here we investigate species limits in the *D. erythrina* (Walckenaer, 1802) complex by integrating phenotypic, cytogenetic and molecular data, and use this information to gain further knowledge on its origin and evolution. We describe 16 new species and redescribe four poorly known species belonging to this clade. The distribution of most of the species in the complex is limited to southern France and the north-eastern Iberian Peninsula. The species studied do not show any obvious differences in habitat preference, and some of them even occur sympatrically at certain sites. They probably feed on the same type of prey as they readily capture woodlice. On the other hand they differ in body size, mouthparts shape, sculpturing of carapace, morphology of the copulatory organs, karyotype and DNA sequences. Experimental interspecific mating showed a partial precopulatory behavioural barrier between *D. erythrina* and an undescribed species. Our data suggest that karyotype evolution of the complex included chromosome fusions and fissions as well as translocations (among autosomes as well as between autosomes and sex chromosomes). We hypothesize that chromosome rearrangements generating reproductive incompatibility played a primary role in speciation within *Dysdera* complexes. *Dysdera* spiders are poor dispersers, and their

original distribution areas (forested regions in the Mediterranean) were repeatedly fragmented during Quaternary climatic oscillations, facilitating integration of chromosome rearrangements into karyotypes as a result of genetic drift. Sympatric occurrence of closely related species may have been promoted by prey segregation, as suggested by differentiation in body size in co-occurring species. Fifteen new *Dysdera* species will be described.

Keywords: cytogenetics, molecular data, new species, phenotype, sympatry, taxonomy.

Morphological and functional diversity of minor ampullate glands in spiders from the superfamily Amaurobioidea (Entelegynae: RTA clade)

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Minor ampullate glands produce fibres that are involved in construction of the complex adhesive band for capturing prey, which is produced by particular cribellate spiders. Despite such a specific role, however, the glands persist even in species where production of cribellate capturing bands no longer occurs. In these species, minor ampullate fibres are instead used to reinforce major ampullate fibres in draglines and capturing webs. The fibers are also used in combination with the aciniform fibrils to make silk for bridging lines – airborne lines used by spiders to allow them to move to points on the substrate where these threads adhere. In this study, we compare the morphology of minor and major ampullate glands in related cribellate and ecribellate groups within spider families of the group traditionally termed the Amaurobioidea, which lies at the base of the RTA clade. We found that the minor ampullate glands are bifurcated in the cribellate members of this group, in particular in the representatives of the families Amaurobiidae, Titanoecidae, Desidae, Amphinectidae and Phyxelididae. In ecribellate representatives, the major ampullate glands are never bifurcated. We found irregularly branched minor ampullate glands in some representatives of the family Agelenidae. In other ecribellates, the glands are either unbranched or they are absent. Thus, bifurcation of the minor ampullate gland seems to be important in determining some aspect of cribellate capturing band formation that is as yet undetermined.

Keywords: ampullate fibre, Araneae, cribellate spiders, ecribellate spiders.

Running for cover: increasingly risk-prone behaviour of male wolf spiders

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Male animals of many taxa spend a significant portion of their daily time budget seeking potential mates. While we know a great deal about relatively few, larger animals, very little information exists concerning estimates of, and factors influencing, movement of small, hard to track animals, especially arthropods. Male wolf spiders (Lycosidae), popular models for exploring complex communication, spend a significant portion of time moving in search of mates. Males who are more active and travel greater distances are arguably more likely to encounter potential mates and/or cues left behind by potential mates, but are also exposing themselves to predators. As part of a multi-year field survey of behaviour, activity patterns, and population dynamics of brush-legged wolf spiders *Schizocosa ocreata*, we measured the displacement distance (linear distance between start and end points) of individual males during ten-minute observation periods. Male spiders traveled significantly greater distances as the breeding season progressed. The Adult Sex Ratio (ASR) and Operational Sex Ratio (OSR) remain essentially unchanged over the course of much of the field season, most likely due to subadults molting to maturity as the season progresses. The Risk Ratio (ratio of potentially cannibalistic, mated females to adult males) steadily increases. Males that move greater distances as the season progresses are more likely to encounter mated females, increasing risk of predation.

Keywords: adult sex ratio, Araneae, Lycosidae, operational sex ratio, risk ratio.

New insights in explaining spider diversity in pomegranate orchards

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Spiders are considered effective biological control agents in some agro-ecosystems. Their ability to control pest insects can depend on their species composition, richness and abundance, but the factors that influence these characteristics are poorly studied. In this research, the effects of climatic gradient and landscape properties on spider diversity in pomegranate orchards were investigated by testing predictions based on general ecological hypotheses. A novel hypothesis, the agricultural landscape evenness hypothesis (ALE), was tested. It predicts that spider diversity will increase with increasing evenness of the areas occupied by different habitats near the orchard. Spiders were sampled twice during the pomegranate growing season in 2015 in 12 orchards along the rainfall gradient in Israel. We used two methods: shaking canopy branches combined with visual searches of the trees, and trunk traps placed on the trees and collected after one month. Both methods combined yielded 1804 individuals representing 18 spider families and 36 genera. Spider diversity showed no pattern with regard to measures of productivity or habitat-heterogeneity, but was positively associated with agricultural landscape evenness. The spider community composition at the genus level was related to elevation of the orchard, annual rainfall at each site, and the proportion of the surrounding landscape occupied by perennial crops and non-crop habitats.

Keywords: agricultural landscape, Araneae, biological control, composition, habitat, productivity.

The effects of four forestry treatments on the community structure of spiders

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There is a paradigm shift in Central Europe from the traditional forestry systems towards continuous-cover forestry, resulting in a diversification of management practices. The effects of four forestry treatments on the community structure of ground-living spiders were studied in a mature, temperate sessile oak-hornbeam forest in Northern Hungary. Management types belonged either to a rotation system (preparation cutting, clear-cutting or retention tree group) or to selection forestry (gap creation) and were compared with control blocks, resulting in five treatment levels. The experimental setup followed a complete block design with six replicates for each treatment. Spiders were collected by four pitfalls in each 30 x 30 m block. The experiment was established in 2014. Here we summarize the short-term responses of the spider community that were observed between the pre-treatment state (2014) and two years after-treatment (2016). All treatments resulted in a significantly increased cover of plants, especially in the gap and clear-cut management systems. Spiders largely followed this trend, as both species number and species richness increased in the managed blocks compared with the control blocks. Species composition based on NMDS ordination were the same between control and management blocks in 2014, whereas by 2016 the control blocks were separated, but the various management types remained mixed together in ordination space. Ongoing experiments are likely to uncover the longer-term dynamics of changes in forthcoming years.

The study was supported by Hungarian Research Found (OTKA 111887) and by the National Research Development and Innovation Office (GINOP-2.3.2-15-2016-00019).

Keywords: Araneae, Central Europe, forestry system, ground living spiders, species composition.

The significance of non-consumptive effects of spiders in biological control

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One secret relationship between wolf spiders and wolfs is that they are both classic subjects of studies on the non-consumptive effect (NCEs) of predators. The indirect predatory effect of spiders has been studied not only in natural ecosystems but in agriculture, as well. Here we present a brief review of the topic and provide a summary of two projects that concern the manifestation of spider NCE under specific circumstances. In organic cucumber crops both global warming and the use of artificial covers increase the temperature in the crop, which in turn increases herbivory by cucumber beetles. We studied how two spider species, with characteristically different heat tolerances, affect herbivory by cucumber beetles in normal and raised temperature environments. Neither spider species reduced herbivory at ambient temperature. However, at the warmer temperature, both species reduced herbivory with evidence of a dominant, non-consumptive effect, which almost compensated for the heat-induced increase in herbivore damage. Another example is a 'plant – plant virus – leafhopper – spider' model system where spiders, through their NCE, may affect the transmission and spread of plant diseases. In a specific setup we used an electrophysiological method – electric-penetrography (EPG) – to examine how specific phases of sap feeding events (so called penetration phases) change in the presence of a spider predator. We showed that the general feeding activity of the leafhoppers was reduced and that they spent less time feeding. When feeding, penetration phases responsible for water uptake were less affected, but those phases that were responsible for the ingestion of phloem sap, as well as the transmission of the virus, were the most reduced. This leads to the prediction that NCE can specifically inhibit the acquisition and inoculation of plant diseases in sap-feeding insect vectors.

Keywords: Araneae, cucumber crops, herbivores, Lycosidae, predation, wolf spiders.

Histology and structural analysis of venom glands of *Mesobuthus gibbosus* (Brullé, 1832) (Scorpiones, Buthidae)

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Mesobuthus gibbosus (Brullé, 1832), known as the Balkan yellow scorpion, is a large buthid scorpion that is widely distributed across southern parts of the Balkan Peninsula and Turkey. The aim of this preliminary study was to examine the histological structure of the venom glands using standard histological staining and light microscopy. These structures have previously been studied in other buthid and non-buthid scorpions, but not of *M. gibbosus*. The venom apparatus of *M. gibbosus* comprises two large venom glands located inside the telson, and wrapped with thick layers of muscle and connective tissue. The venom glands follow the general shape of the telson and are connected to lateral openings near the very tip of the aculeus by two venom ducts, one from each gland. Anatomically, *M. gibbosus* venom glands are composed of three types of cells: muscle cells, venom producing cells and supporting cells. Muscle cells form two layers of striated muscle, *stratum circulare* and *stratum longitudinale* (external and internal, respectively). Between the muscle layers and the secretory epithelium is a *lamina basalis*. The glandular secretory epithelium is made up of two types of cell, venom producing cells and non-secretory supporting cells. The *lamina basalis* protrudes towards the lumen in several places. Those protrusions create folds that increase the surface area of the lumen and the secretory epithelium. Venom-producing cells are of the apocrine type, with a high columnar shape and a nucleus in the basal portion. These cells are electron dense and darker in color although it is possible to see fine granules of medium coloration, which are components of venom. Supporting cells are cuboidal in shape and occur between venom-producing cells. They are less dense and brightly colored and some of them are hollow in appearance. The venom gland of *M. gibbosus* is classified as Type II, because of the folds in the secretory epithelium.

Keywords: anatomy, Balkan region, muscle cells, secretory epithelium, telson.

Intraguild predation in an extreme arid desert: antlions and scorpions in the 'Arava

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Seventeen months after an oil spill at 'Avrona Nature Reserve, a long-term monitoring of arachnids was launched in May 2016 as part of a larger monitoring project of the Israel Nature Protection Authorities (INPA) and Israel's National Nature Assessment Program (HaMaarag). As part of the Arachnid monitoring, scorpions are assessed twice a year (May and August) during three consecutive "moonless" or "new moon" nights using ultra-violet light. Here we report on interesting observations of antlion larvae predation by two different scorpion species, each scorpion using a different foraging behaviour. While the scorpion *Orthochirus scrobiculosus negebensis* (Shulov & Amitai, 1960) actively forages for antlion larvae by walking from one antlion pit-trap to another, the scorpion *Buthacus leptochelys* (Ehrenberg, 1829) uses a sit-and-wait ambush technique inside the antlion's pit-traps. Here we describe the different foraging behaviours in detail and discuss the observed phenomena.

Keywords: foraging behaviour, monitoring project, Scorpiones, ultra-violet light.

Different approaches to whip spider taxonomy (Arachnida: Amblypygi)

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Whip spiders (Amblypygi) are a neglected arachnid order and have hardly changed morphologically in 300 million years. What is known about their life history and behaviour reveals complex courtship and mating rituals. Despite the deep evolutionary timescale, global distribution, fascinating life history and behaviour, little progress on their systematics has been made in the last century, hindering their higher classification and taxonomy. A basic phylogenetic study was conducted 20 years ago. However, it is in urgent need of re-evaluation and new sets of characters identified that may help in future studies. Most of the known whip spider species are only recorded through their original descriptions, and type material is often fragmented if not lost. Thus many characters used nowadays are not sufficiently described or illustrated and are not available for comparison with other (new) taxa. Hence, we have chosen two major approaches to deal with this necessity: (i) describing and re-describing taxa and (ii) introducing new sets of characters for species discrimination. In a series of publications we have described two new species of the Charinidae and one new species of the Charontidae, documented the super-hydrophobic cerotegument structure (which represents a valuable character for taxonomic determination and systematic classification) and drawn attention to the structure and functional morphology of the pretarsus (including the presence/absence of arolia on the tips of the walking legs). Furthermore, whip spiders show a ritualized courtship behavior and indirect insemination *via* a stalked spermatophore. We argue that it is the complex structure of the spermatophore, and not the soft and often simple genital structures, that offer valuable characters for taxonomic purposes. Hence, we emphasize the importance of including species-specific spermatophore descriptions into taxonomic works, and provide several examples.

Keywords: arolium, cerotegument structure, morphology, phylogeny, spermatophore, systematics.

Sensory organ found in the male pedipalp of an entelegyne spider

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Male spiders transfer their sperm *via* a secondary reproductive organ, the so-called palpal bulb. Based on several histological studies, the spider bulb is considered unique among animal genitalia for the lack of muscles, innervation and sensory organs. A recent study, however, reported the first evidence of neurons in the male bulb of *Hickmania troglodytes*, from a relict group of spiders, and suggests that the male bulb is capable of receiving sensory input. We performed a morphological study on the male copulatory organ of an entelegyne spider *Philodromus cespitum* by means of microcomputed tomography, light and transmission electron microscopy. We have discovered a nerve in the bulb and, moreover, an internalized multi-sensillar sensory organ at the base of the embolus, the intromitting structure. The sensory organ likely provides mechanical or chemical feedback to the male during copulation. We also investigated bulbs of other entelegyne spiders and also found nerves, but whether they likewise possess a sensory organ needs to be investigated. Our results open up new views on genitalic sensory feedback and mate assessment in spiders.

Keywords: Araneae, multi-sensillar sensory organs, secondary reproductive organs.

Epigeic spider assemblage in burned forests across European Russia

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Epigeic spider assemblages were assessed in burned and control forests in European Russia across a 3,000 km longitudinal transect from the Black Sea to the White Sea. The sampling was carried out in twenty, five-year-old burned areas of five eco-regions in 2015. For the macrofaunal investigation, five soil samples 20 cm in diameter and 15 cm deep were collected with a soil corer in each plot. Additional samples were taken for assessing other parameters. In total, 90 spider species in 18 families were recorded during the study. Linyphiidae were the most abundant and rich in species (more than a half of species and individuals). Another other numerous families were Hahniidae (17%) and Lycosidae (5%). The geographical location of forest was found to be the most important driver explaining variation in the assemblage parameters. Thus, linyphiids gradually increased in their proportional representation from 35% to 95% towards the north. Hahniids occurred mainly in the central zones, whereas Gnaphosidae and Thomisidae were more typical in the south. The total density of epigeic spiders also differed significantly along the latitudinal gradient: they were more numerous in the north than in south (170 against 70 ind/sq m) and the most abundant in temperate latitudes (360 ind/sq m). On the species level, few or no dominants were common in the neighboring regions (the faunal similarity was quite low in general). Among them are *Tapinocyba pallens* and *Hahnina pusilla*, which dominated in two central regions. The spider abundance and diversity were generally lower in the burned areas relative to controls. The smallest differences between fire- and control plots were observed in the Baltic region, especially for hahniids. The following taxa tended to prefer the burned plots (in descending order): *Lathys nielsenii*, *Zora* spp., *Neon reticulatus*, *Porrhomma pallidum*, as well as some lycosids and gnaphosids. The sampling was performed under project 14-14-00894 of the Russian Science Foundation.

Keywords: Araneae, ecology, fire-site, latitudinal gradient, soil sample.

A discovery of hidden species related to *Pardosa pontica* (Thorell, 1875) in northern Iran

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Pardosa C.L. Koch, 1847 is the third largest genus among spiders and most species-rich genus within the Lycosidae, with over 550 species. Currently 30 species groups are recognized in the genus. One of the largest is the *Pardosa monticola* species groups with over 30 species distributed in the Holarctic. Although it is easy to delimit this species group from others, it is very hard to distinguish species within it. Of 21 *Pardosa* species recorded from Iran, seven species (or one third) belong to the *monticola*-group. In Iran, the most widespread species of this group is *P. pontica* (Thorell, 1875), which is known from West Azerbaijan Province through to eastern Mazandaran. A detailed morphological comparison of eastern and western populations of this species from Iran has revealed clear differences between the two populations. The western population has the same colour pattern and spination as found in specimens from the type locality (the Crimea) and seems to be true *P. pontica*. The eastern population belongs to a new species. Although the two species differ in colour, size and leg spination, no molecular differences in COI, 28 SrRNA and 16SrRNA have been found between these species. We are planning to apply ddRAD sequencing, a novel method that allows us to separate sibling species in the Pardosinae.

Keywords: molecular analysis, *monticola*-group, morphological analysis, Pardosinae.

Niche partitioning in Hawaiian spiders

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Niche partitioning limits competition, allowing ecologically similar taxa to coexist and thereby also contributing to the origin and maintenance of biodiversity. On the islands of Hawaii, three spider genera, *Orsonwelles* (Araneae: Linyphiidae), *Argyrodes* (Araneae: Theridiidae), and *Ariamnes* (Araneae: Theridiidae), all live and feed on the webs of *Orsonwelles*. This study aims to understand how the three genera, living in such close quarters with seemingly similar lifestyles, partition resources in order to persist together on the webs. This study describes two modes of partitioning: spatial partitioning and dietary partitioning. Spatial partitioning: when all three genera are present on a web, *Ariamnes* is located at the borders of the webs, on support structures above and below the main sheet structure, while *Argyrodes* and *Orsonwelles* share the area closest to the sheet. When *Ariamnes* is not present on the webs, *Argyrodes* is found primarily in the support structures. Dietary partitioning: using next generation sequencing of spider gut contents, this study compares the diets of the three genera to see how they divide up food resources caught in the webs. The diet of *Argyrodes* and *Ariamnes* is very similar, with them sharing about 75% of prey OTUs (Operational Taxonomic Units), but very different from that of *Orsonwelles*, with which they share about 13% and 11%, respectively. In conclusion, *Argyrodes* and *Ariamnes* partition their niches through spatial partitioning as a result of prey resource overlap, and both differentiate their niches from *Orsonwelles* by taking advantage of different prey.

Keywords: Araneae, biodiversity, cleptoparasitism, dietary partitioning, ecology, spatial partitioning.

How to trap a master trapper: the various methods of catching Idiopidae

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Trapdoor spiders (family Idiopidae) spend most of their lives hidden in underground burrows. Their burrowing behaviour, which inspires intrigue, wonder, and trepidation in the minds of the general public, serves only to frustrate arachnologists who wish to collect them. In cultures where burrowing spiders are eaten, they are tempted with vibrations from grass, or smoked or flooded from their burrows; for research, they are often dug out of the ground. Collecting trapdoor spiders using these methods is frequently destructive to the habitat, damaging to the specimen, or ineffective. I will discuss the four different methods I have used to collect New Zealand Idiopidae for my PhD research on idiopid ecology and biogeography. I will present results from trialing a new and effective method using tethered beetles to collect idiopids, with minimal damage to both habitat and specimen.

Keywords: Araneae, collecting methods, trapdoor spiders.

Spiders and wetlands: biodiversity and specificity of Souk Ahras (north-east of Algeria)

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An araneological inventory of the wetlands of Souk Ahras has allowed us to present the first overview, albeit incomplete, of the spider species occurring there. No previous araneological knowledge existed, except for scarce single records. The complex of wetlands in the region of Souk Ahras, which are poorly known nationally, contains a very important faunal and floristic diversity. During one year, more than 9822 spider specimens from 25 families and 62 genera were collected. Among them, more than 80 species were ground-dwelling, collected from under the stones and vegetation. Lycosidae, Gnaphosidae, Salticidae, and Linyphiidae showed the highest species numbers. Other families (Philodromidae, Pisauridae, Araneidae, Dysderidae, Filistatidae, Liocranidae, Cybaeidae, Dytinidae, Thomisidae, Tetragnathidae, Clubionidae, Ctenizidae, Sparassidae, Oxyopidae, Anyphaenidae, Zodariidae, Clubionidae, Eutichuridae, Oecobidae and Palpimanidae) accounted for many species with low abundance or occurring as singletons. We conclude that some abiotic (soil humidity, soil acidity, organic matter content) and biotic (vegetation height and biomass, weed abundance) factors affect spider distributions. Anthropogenic pressure was not an obstacle to the occurrence and dynamics of spiders. The information can be used as an indicator of the quality of wetland habitats. Our concern should be directed towards the conservation, restoration and sustainable management of these habitats.

Keywords: aggregation, Araneae, spatial distribution, wetland quality indicators.

Body size and personality affect reproduction in raft spiders (*Dolomedes fimbriatus*)

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Individual reproductive success depends on behavioural and physical characteristics, but because these attributes are usually studied in isolation, their relative importance remains poorly understood. We studied how physical and behavioural traits affect reproduction in raft spiders, *Dolomedes fimbriatus*. To investigate if personalities (consistent between-individual differences in behaviour) affect sexual behaviour and mating success, we staged three types of personality tests. In males, two situations assessed locomotory activity and one tested for shyness, the latter was also assessed in females. To investigate if male body size affects sexual behaviour and mating success, we staged mating trials exposing a female to two differently sized males. We found consistent behavioural differences among individuals of both sexes in all tested situations. Male activity correlated across all test situations, as well as during mating trials. Our data show that raft spider male mating success relates to individual size and shyness. Male shyness was negatively correlated with aggressiveness towards a rival and copulation success. Male behaviours during mating trials varied according to female characteristics. Males encountering bolder and larger females were less active and less aggressive towards rivals. Compared with smaller rivals, larger males were less active, but had higher mating success. In conclusion, raft spider reproduction depends on the interplay of both male and female personality types, and sizes.

Keywords: Araneae, locomotory activity, male size, male shyness, mating success, Pisauridae.

Living in caves: a comparative morphological analysis of the central nervous system in *Pinelema* spiders

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Sensory deprivation can cause changes in receiving and processing structures deprived of sensory input. Classic examples of natural selection leading to the reduction or loss of sensory structures are provided by blind, cave-living organisms. The spider genus *Pinelema* (Telemidae) comprises five species (eyed or eyeless) that all live in completely dark caves in southern China. As a starting point for a comparative analysis, we explored the anatomy of the brains of the six-eyed *Pinelema bailongensis* Wang & Li 2012, and the eyeless *Pinelema huobaensis* Wang & Li 2016, by means of paraffin-histology, microCT analysis and whole-mount immunolabelling. We compared the brain structures of the *Pinelema* species to that of salticid and ctenid spiders. As is typical for spiders, the synganglion of *P. bailongensis* and *P. huobaensis* is a highly fused, clearly demarcated mass within the prosoma. The ventral nerve cord, the pedipalpal neuromere (tritocerebrum) and the cheliceral neuromere (deutocerebrum) are of similar structure to those found in salticid and ctenid spiders. The protocerebrum is located dorsally to the deutocerebrum and comprises the arcuate body and the rather non-structured protocerebral neuropil. Visual neuropils and a mushroom body were not detected, but are clearly present in the syncerebrum of the salticid *Marpissa muscosa* and the wandering spider *Cupiennius salei*. Our data strongly suggest that ecological diversity has led to structural disparity in spider brains.

Keywords: Araneae, Ctenidae, neuromeres, protocerebrum, Salticidae, sensory deprivation, Telemidae.

Overwintering of spiders in terrestrial molluscs shells in eastern Slovakia

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Overwintering in land-snails shells is an interesting phenomenon which is not well-studied. Indeed, there are no records of this behaviour from Slovakia. We focused on the occurrence of spiders which hibernated in terrestrial molluscs shells in eastern Slovakia. We collected three species of gastropods: *Cepaea vindobonensis* (Férussac, 1821), *Xerolenta obvia* (Menke, 1828) and *Helix pomatia* (Linnaeus, 1758). Shells were collected in wintertime at the turn of 2012/2013 and 2013/2014. We searched various xerothermic locations – post-industrial sites, road and railway embankments, quarries and steppe lawns. There were 24 sites from which we collected 1085 shells, of which 10.69% contained spiders. Altogether 116 spiders from ten families were acquired. Salticidae was the most common spider family and *Pellenes tripunctatus* (Walckenaer, 1802) the most abundant species, comprising 50% of the total number of determined specimens. The most interesting records were of *Cheiracanthium montanum* (L. Koch, 1877) which is considered ‘vulnerable’ and *Sitticus penicillatus* (Simon, 1875), with a lower risk threat according to the Red List of Slovakian spiders. We did not confirm the presence of *Pellenes nigrociliatus* (Simon, 1875) which is frequently recorded from shells. Other species included *Euryopsis flavomaculata* (C. L. Koch, 1836), *Myrmarachne formicaria* (De Geer, 1778) and *Micaria formicaria* (Sundevall, 1831), and common genera *Heliophanus* sp., *Talavera* sp. or *Zelotes* sp. Land-snail shells provide important refuges as well as places to hibernate and may be inhabited by rare or endangered species.

The research was financially supported by the grant IGA FA MENDELU Brno No. IP_8/2017.

Keywords: Araneae, hibernation, refuge habitat, xerothermic sites.

Diversity of silks and spinning apparatus of the water spider *Argyroneta aquatica* (Araneae, Cybaeidae)

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Spider silk is a remarkable material: highly elastic, stronger than steel and applied to wounds as a healing aid by the Ancient Greeks. Of approximately 46,000 species of spider, only *Argyroneta aquatica* has adapted to spin silk whilst submersed. The diving bell, a sheet of silk spun to hold a bubble of air underwater, acts as a physical gill, providing an adult spider with a constantly replenishing underwater air supply. In this project, we investigate the diving bell and the spinning apparatus of the spider, using transcriptomics and environmental Scanning Electron Microscopy (eSEM). Here, we present the first eSEM images of hydrated *Argyroneta* silk, showing the range of fibres present including microthreads and ribbons of silk coated in a proteinaceous hydrogel. SEM images of the spinnerets show a typical spigot structure and arrangement, with an unusual coating of suspected hydrogel. Additionally, we identified a number of silk types which, until now, have not been identified outside of a group of highly specialised orb-weaver spiders. Finally, we show how structural features are conserved genetically and phylogenetic relationships are maintained, suggesting that the silk of the diving bell spider is not so far removed from that of “normal” spiders. These results mean that spider silk may be even more versatile than previously imagined – and exploitable. Coupled with new technologies and advances in synthetic silk research, this biomaterial has a diverse range of potential applications.

Keywords: diving bell, hydrogel, orb-web spiders, silk properties, synthetic silk transcriptomics.

Non-consumptive effect of spiders on the foraging behaviour of herbivorous insects

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Spiders are natural predators that help to keep insect pest populations below economic injury levels. As well as direct predation, they also indirectly affect the pest populations by leaving chemical cues such as pheromones and spider silk on plants. These produce an adverse reaction in herbivorous insects. Herbivores avoid plants which bear predators or cues of predators and hide themselves for protection. This may cause their demise as a result of starvation. Furthermore, the presence of predators may alter the foraging behaviour of pests. In this study we conducted laboratory and field experiments to examine the indirect impact of predators or their cues on the herbivory by insects. Spiders were used as a model predator and grasshopper as a model pest. The herbivory by the grasshopper was greatly reduced in the presence of spiders or spider cues, even when there was no direct predation. It is concluded that herbivory can be reduced and plant productivity enhanced by promoting spiders and other natural predators in agro-ecosystems.

Keywords: agro-ecosystem, herbivory, insect pests, plant productivity.

The venom of the trap-door spider *Cyrtocarenum* Ausserer, 1871: isolation and *in vitro* anti-proliferative effect on a breast cancer cell line

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The trap-door spider genus *Cyrtocarenum* Ausserer, 1871 (Araenae, Ctenizidae) is endemic to Greece and the area surrounding the Aegean Sea, including the Turkish coast. Despite the intense focus on the phylogeography and molecular systematics of trap-door spiders of the Mediterranean region in recent years, the venom of these spiders has never been examined by means of toxinology. In the present study we isolated the crude venom of 112 spiders collected from the island of Skopelos and studied its anti-cancer effects on the breast cancer cell line MCF-7. The poison glands were extracted from living animals and homogenized in PBS to be stored at -20°C. Protein quantification of the pooled crude venom was performed by the BCA method and was found to be 28.6 mg/ml. Effects of crude venom on MCF-7 were assessed by a colorimetric cell viability assay using MTT [3-(4,5-Dimethylthiazol-2-yl)-2,5-Diphenyltetrazolium Bromide]. Serial venom concentrations ranging from 0.1 µg/ml to 400 µg/ml were tested after 48 h exposure in serum-free proliferation conditions. In parallel, untreated negative control cells receiving just the vehicle solution. The results showed that administration of crude venom caused a substantial dose-dependent reduction in the viability of MCF-7 cells. To our knowledge, these preliminary data are the first toxinological approach towards characterizing the potency and potential anti-cancer properties of the venom of *Cyrtocarenum*.

Keywords: Araneae, Ctenizidae, endemic species, toxinology.

Histology and structural analysis of the venom glands of the tarantula *Brachypelma albopilosum* (Valerio, 1980) (Araneae, Theraphosidae)

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Brachypelma albopilosum is also known as the 'Honduras curly hair tarantula'. This species is native to Costa Rica and less widely found in Honduras. The objective of the present preliminary study was to describe the anatomy and histological structure of the venom gland of *B. albopilosum*, using glands from adult spiders examined by histological staining and light microscopy. There have been previous histological analyses of the venom glands of spiders, for example *Phoneutria nigriventer* and *Loxosceles intermedia*. The venom of *Brachypelma* spiders is secreted by a pair of venom glands located inside the chelicerae and connected to the fangs by two independent ducts. The venom is not of medical concern because of its low toxicity. Anatomically, *B. albopilosum* venom glands have two layers of striated muscle fibers, *stratum circulare* and *stratum longitudinale* (external and internal, respectively), which are in touch with a thin *lamina basalis* that separates the muscle cells from the secretory epithelium of the gland. The secretory epithelium is of a simple glandular type and represents the largest gland area, surrounding the lumen. Using light microscopy we observed that the secretory epithelium is composed of three types of cells: one with a nucleus and two types with granules varying in electron densities, shape and compactness. All three types of cell have thin membranes. The cells with a nucleus are arranged in a single layer below the *lamina basalis* and around the gland. They are oval to irregular in shape, electron dense, dark in colour, and contain granules and one large nucleus. The first type of cell with granules is predominantly oval in shape, electron dense and darker in color. These cells are solitary and scattered among the second type of cell with granules. This second type of cell with granules is oval to slightly irregular in shape, compacted and electron lucent with lighter granules. We consider that these cells have functions in the production, secretion and/or the storage of venom. Our study also identified empty, white cells surrounded by membranes. These are irregular in shape, unevenly distributed among the cells with granules and closer to the lumen. We assume that these cells could be the result of cellular debris and cellular structures being eliminated with the venom secretion, which may indicate a holocrine secretory mechanism.

Keywords: anatomy, histology, *lamina basalis*, muscle fibers, secretory epithelium.

Phylogenetic analysis of the Australasian genus *Cytaea* (Araneae: Salticidae) based on morphology and molecular markers: preliminary results

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The genus *Cytaea* Keyserling, 1882 comprises 40 described species, although the real number may be over 100. The genus is distributed in Australasia. According to morphological and molecular data, it belongs to the Euophryini. The taxonomy of *Cytaea* is still poorly understood, both in terms of inter- and intra-generic relationships. The goal of the project is a complete revision of the genus in order to reconstruct its distributional history and phylogenetic relationships. The study is based on type and new materials and includes about 1000 specimens and field records. Analyses are based on morphological (LM, SEM, X-ray microtomography), molecular (COI, 28S rDNA, 16S-ND1) and geospatial data. So far, study of the type material has allowed us to distinguish 28 nominal species, five of them being synonymised, and a few others proved non congeneric. As many as 60 putative new species have been found in Australia alone. Species in this genus can be distinguished by the shapes of the embolus, course of sperm duct, cymbium and tibial apophysis, the different positions of the copulatory opening and the shape and length of spermathecae, copulatory ducts and accessory glands. Within some species distinctive variation has been found. The study revealed some new morphological characters for the genus such as embolic teeth and embolic accessory glands, the latter being not only of diagnostic value but also producing mating plug, i.e. the structure confirmed in many females. Phylogenetic analyses performed for gene fragments revealed small differences between species and supported morphologically distinguished species groups; however it showed (contrary to morphology) different relationships between them. Also the monophyly of the genus *Cytaea* s.l. has not been supported – some nominal species needs to be transferred to other genera. Distribution analysis confirms the role of Australia and New Guinea as primary diversity and radiation centres for the genus.

Keywords: distribution, diversity, Euophryini, Micro-CT, molecular phylogenetics.

A journey inside the nuptial gift of a spider

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In the Animal Kingdom males often offer edible donations to females during courtship or mating. These so-called nuptial gifts are intriguing male reproductive traits, taxonomically widespread and extremely diverse in form and function. Gifts have evolved as a male mating effort to attract females and secure matings, as a form of parental investment because of the nutritious resources provided, and as a protective practice against cannibalistic mating partners. Despite being uncommon in spiders, *Pisaura mirabilis* has become one of the best-known model organisms for the study of nuptial feeding behaviour. Males of this species hunt for a prey item, cover it in dense silk layers and offer it to females during courtship. Mating occurs only once the female accepts the donation and starts feeding from the gift. In this talk I will explore the evolutionary significance of gift giving, addressing both male and female reproductive interests. I will review findings from recent experimental laboratory studies and field surveys that have shed light on the evolution and maintenance of this male trait. Finally, I will illustrate how sexual selection and sexually antagonistic co-evolution have shaped this spiders' fascinating mating system.

Keywords: Araneae, courtship behaviour, mating, parental investment, reproductive interest.

Cross-sex genetic correlation does not extend to sexual size dimorphism in spiders

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Males and females are often subjected to different selection pressures for homologous traits, resulting in sex-specific optima. Because organismal attributes usually share their genetic architectures, sex-specific selection may lead to intra-locus sexual conflict. Evolution of sexual dimorphism may resolve this conflict, depending on the degree of cross-sex genetic correlation (r_{MF}) and the strength of sex-specific selection. In theory, high r_{MF} implies a tight genetic base for a given trait and consequently sexual monomorphism, while low r_{MF} indicates a loose genetic base and sexual dimorphism. Here, we broadly test this hypothesis on three spider species with varying degrees of female-biased sexual size dimorphism, *Larinioides sclopetarius* (sexual dimorphism index, SDI = 0.86), *Nuctenea umbratica* (SDI = 0.60), and *Zygiella x-notata* (SDI = 0.48). We find moderate body mass heritability, but no obvious patterns in sex-specific heritability. Against the prediction, the degree of sexual size dimorphism is unrelated to the relative strength of same-sex versus opposite-sex heredity. Our results do not support the hypothesis that sexual size dimorphism is negatively associated with r_{MF} . We conclude that the theory behind this prediction is too simplistic, and that a sex-specific genetic architecture may not be necessary for the evolution of a sexually dimorphic trait.

Keywords: Araneae, Araneidae, cross-sex genetic correlation, genetic architecture.

Barcoding failure in the *Pardosa lugubris* group: hybrid introgression caused by *Wolbachia*?

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Recently it was shown that CO1 barcoding does not recognise three closely related species of European wolf spiders, i.e. *Pardosa lugubris*, *P. saltans*, and *P. alacris*. Such a failure of the barcoding approach may have different reasons; one of them concerns infections with endosymbiotic bacteria of the genus *Wolbachia* that occur in numerous terrestrial arthropods. These bacteria may use or mediate rare hybridisation events in their host species in order to spread across species boundaries. They are mediated *via* the egg cell and may homogenize the mitochondrial genome of two (or more) species. This has been shown in a few cases in Lepidoptera, Diptera and Hymenoptera. We tested 93 individuals of the three *Pardosa* species for *Wolbachia* infection. In only a single female of *P. lugubris* was the test positive. We conclude that infection with *Wolbachia* is probably not the reason for failure of the barcoding approach in the *Pardosa lugubris* group.

Keywords: Araneae, endosymbiotic bacteria, hybridisation, Lycosidae, wolf spiders.

Wolf spiders of Northwest Anatolia (Araneae: Lycosidae), with an updated checklist of lycosids in Turkey

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This investigation was carried out in Northwest Anatolia between 2006 and 2011. From 27 localities, 14 species in five genera were recorded. *Pardosa pertinax* von Helversen, 2000 is recorded from Turkey for the first time. In addition, an updated checklist of the Turkish lycosids is presented.

This work was financially supported by the Ministry of Culture of the Czech Republic (DKRVO 2017/15, National Museum, 00023272).

Keywords: Asia Minor, fauna, inventory.

SPISCAN: revealing spider evolution through 3D-scanning

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Spiders demonstrate an astonishing diversity, with currently more than 45,000 recognised species. They have conquered all terrestrial and even some aquatic habitats in which they are considered top arthropod predators. The successful diversification of spiders is generally attributed to the key innovation of producing silk to form capture webs. In particular, the evolution of the wheel-shaped orb web, with its vertical orientation and prey-snaring capture threads, is believed to have been a strong driver of spider diversification. Recently, spider phylogenies have revealed, surprisingly, a more ancient origin of orb-webs and a higher diversification rate in wandering spiders that hunt on vegetation or on the ground. This begs the question whether factors other than web building have driven spider diversification and, if so, to what extent. Morphological change is considered one of the key drivers in the most successful adaptive radiations (African cichlids, Darwin finches, etc.). While the number of spider species matches an almost equally diverse variation in morphology, a broad, comparative approach to spider morphology and its role in diversification of both web-building and ground-dwelling spiders is currently lacking. Using micro-ct scanning, which results in accurate 3D reconstructions, we will quantify the variation in key morphological components (such as, cephalothorax, chelicerae, etc.) and relate this to ecological components such as habitat, diet and web type, thus identifying which body parts play a role in the radiation of spiders. In this poster, I want to present the general method and approach and would welcome any feedback on the project.

Keywords: 3D-reconstructions, micro-ct scanning, morphology, spider diversification.

The spider tree of life. What does it mean for the New Zealand fauna?

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After a gestation period of over ten years, a massive phylogenetic analysis of spiders has recently been published by Wheeler *et al.* 2016. The phylogenetic analysis was performed on a dataset of 932 spider species, representing 115 families, 700 known genera and additional representatives of 26 unidentified or undescribed genera. The dataset includes DNA sequences from three mitochondrial genes (12S, 16S, COI) and three nuclear genes (histone H3, 18S, 28S). These were analysed by multiple methods, including constrained analyses using a highly supported backbone tree from transcriptomic data. Most of the higher-level structure of the spider tree was well supported. New Zealand spiders make up 9% of the species in the phylogeny, which is pretty good considering its fauna is 1–2% of the world fauna. This indicates the importance of the New Zealand spider fauna when trying to understand spider systematics. Of particular relevance to the New Zealand fauna is the support for a large group termed the marronoid clade, which includes the families Amaurobiidae, Desidae, Dictynidae, Hahniidae, Stiphidiidae, Agelenidae and Toxopidae. These families have been redefined and New Zealand genera have been moved around between them. Numerous New Zealand species in the marronoid clade can be a source of misery when trying to identify them to family but now many can be cast into Desidae, which has been redefined to include five subfamilies, four of which are found in New Zealand: Amphinectinae, Ischaleinae, Porteriinae and Desinae. Why should European arachnologists care about the New Zealand spider fauna? Not only is it a phylogenetically significant fauna, but you'll also have the opportunity to come and see New Zealand spiders, harvestmen and pseudoscorpions in February 2019 at the 21st International Congress of Arachnology in Canterbury.

Keywords: Araneae, DNA sequences, international congress, marronoid clade, phylogenetic analysis.

Biosystematics of the spiders in some oases of the north of the Algerian Sahara

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A study of the spider fauna was undertaken in four oases within two Algerian regions, Biskra and Touggourt, which belong to the Saharian bioclimatic zone. It represents the first taxonomic inventory of the spiders of these two regions. The environment studied comprised an agro-ecosystem composed of different varieties of date palms. Spiders were trapped in pitfalls and caught by hand. During one year, 1621 individuals were collected – 656 males, 513 females and 452 juveniles, representing 123 species from 22 families. The results revealed the predominance of the family Gnaphosidae with 29 species followed by the Lynphiidae and the Salticidae, with 11 species each. The dominant genus was *Zodariion* (Zodariidae). A study of various abiotic indexes suggests that climatic conditions, such as temperature, are the main factors influencing the distribution of spiders in the different palm plantations. The phenology of species studied showed that each species is different in this respect. The abundance of males was higher than that of females, but females were present more consistently throughout the year than males.

Keywords: Biskra, North Africa, oases, phenology, Touggourt.

Characterisation of protein families in spider digestive fluids and their role in extra-oral digestion

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Spiders are capable of subduing and consuming relatively large prey items compared to their own body size. For this purpose, they have evolved potent venoms to immobilise prey and digestive fluids that break down nutrients inside the prey's body by means of extra-oral digestion (EOD). Both secretions contain an array of active proteins, and an overlap of some components has been anecdotally reported, but not quantified. We systematically investigated the extent of such protein overlap. As venom injection precedes EOD, we further infer functional explanations and, by comparing two spider species belonging to different clades, assess its adaptive significance for spider EOD in general. We describe the protein composition of the digestive fluids of the mygalomorph *Acanthoscurria geniculata* and the araneomorph *Stegodyphus mimosarum*, in comparison with previously published data on a third spider species. We found a number of similar hydrolases which are highly abundant in all three species. Among them, members of the family of astacin-like metalloproteases were particularly abundant. While the importance of these proteases in spider venom and digestive fluid was previously noted, we now highlight their widespread use across different spider taxa. Finally, we found species-specific differences in the protein overlap between venom and digestive fluid, with the difference being significantly greater in *S. mimosarum* compared to *A. geniculata*. The injection of venom precedes injection with digestive fluid and the overlap of proteins between venom and digestive fluid suggests an early involvement in EOD. The species-specific differences in the overlap may reflect differences in ecology between our two study species. Yet, the protein composition of the digestive fluid of all the three species we compared is very similar, suggesting that the cocktail of enzymes is highly conserved and adapted to spider EOD.

Keywords: active proteins, Araneae, enzymes, injection, secretion, venoms.

Kin-mediated differences in group feeding performance in sub-social *Stegodyphus africanus* spiders (Araneae, Eresidae)

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While 99% of spiders are solitary predators, a few species cooperate in social groups. This cooperation is characterised by communal web construction, hunting and feeding. The evolution of sociality in spiders is suggested to follow a route from an extended maternal care over sub-social living to permanently social bonding. In sub-social spiders, juveniles cooperate for several instars after hatching until they disperse to mate and to found new nests. In contrast, social species build permanent nests with lifelong cooperation and sibling matings. Previous studies revealed that kin recognition may mark a key feature for the evolution of spider sociality and is present in various sub-social species, but seems to be absent in social species. Although being able to recognise related individuals, sub-social spiders do not discriminate against non-kin individuals, but readily cooperate with them. This raises the question, why kin recognition is maintained in those species. Studies on sub-social *Stegodyphus lineatus* revealed that spiders in pure kin-groups grow at a higher rate than those of mixed groups, indicating a benefit of associating exclusively with kin. To understand the nature of this benefit, we investigated the group feeding performance of another sub-social species, *Stegodyphus africanus*. We hypothesised that competition between kin and non-kin individuals is expressed by subtle behavioural differences and by a differential investment in extra oral digestion during communal feeding. We studied the performance of kin and non-kin (mixed) groups in 200 behavioural trials. Our results show that groups of *S. africanus* feeding on houseflies reduce the body mass of prey significantly faster when feeding exclusively with kin. This indicates that these spiders, based on inclusive fitness benefits, invest more in communal digestion when feeding with kin than with non-kin. Apart from that, we further noticed that the time until spiders attacked the presented prey items was significantly shorter in kin groups. Our findings unveil mechanisms of how the maintenance of kin recognition benefits the spiders, even though intraspecific competition remains rather inconspicuous.

Keywords: behavioural traits, communal webs, cooperation, intraspecific competition.

The phylogeny and biogeography of the genus *Gasteracantha* Sundevall, 1833 (Aranea: Araneidae)

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The spider sub-family Gasteracanthinae, commonly known as thorn spiders due to their large abdominal spines, is Pan-Tropical in its distribution. Currently there is considerable taxonomic confusion about the status of the members in this sub-family. Little has been published about the relationship and classification of the genera and species; and some of what has is conflicting. This project is examining the evolution and distribution of the sub-family with the aim of providing a robust phylogeny using taxonomic and biogeographic tools to resolve the relationships between the members of the sub-family. For the taxonomic work the focus is on using (global) museum specimens to undertake quantitative character analysis involving multiple characters and morphometric analyses, with the possibility of validating this approach with molecular markers. The project will also create a world distribution map for the genera of the sub-family Gasteracanthinae using data extracted from publications and museum collections worldwide to build an accurate distribution resource. This biogeographic resource will then be used in conjunction with the phylogenetic analysis to propose a phylogeographic history of the sub-family.

Keywords: distribution, evolution, molecular markers, phylogeny, phylogeography, thorn spiders.

Investigating the influence of biogenic amines on the circadian rhythmicity of anti-predator behaviour in orb-weaving spiders

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While it is widely assumed that circadian rhythms benefit organisms by allowing them to anticipate changing conditions, only a few studies have directly tested this. Being both predator and prey, orb-weaving spiders offer a novel, tractable model system to test whether circadian rhythms are adaptive due to their variety of temporal foraging strategies across species. Previous work suggests that spiders modulate their aggression/wariness over the 24-cycle and that aggression and wariness are modulated by biogenic amines (neurohormones). In this study, we analyzed temporal changes in biogenic amine levels and transcriptional regulation in the orb-weaving spider *Larinioides cornutus* (Clerck, 1757). *L. cornutus* individuals were collected from sites in northeast TN. After a seven-day entrainment period, spider cephalothoraxes were dissected and haemolymph collected at four different time points over a 24-hour cycle. We measured gene transcription levels and neurohormone levels in haemolymph and cephalothoraxes using RNA-sequencing and HPLC-ED, respectively. Levels of individual catecholamine neurohormones did not change over the 24-hour period. However, there appears to be a pattern with the ratio of octopamine to serotonin levels fluctuating over the course of the day. In addition, patterns in gene expression, specifically octopamine receptor expression, also appear to fluctuate throughout the day. Our findings demonstrate a role of not only catecholamine levels but also underlying changes in gene expression in producing the circadian rhythmicity of aggression in the spider *L. cornutus*.

Keywords: Araneae, Araneidae, gene transcription, neurohormones, octopamine, serotonin.

Prescribed burning as a method of protecting heathlands in Poland – a spider perspective (Arachnida: Araneae)

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Heathlands contribute considerably to biodiversity in Central Europe as they host many rare invertebrate species. There is however a need to rejuvenate the heather. For this purpose prescribed burning was applied to a heather plot in western Poland in 2015. A subsequent survey was made of the flora and fauna of this plot and some other open habitats in the area – a mature heather patch and *Molinia caerulea* grasslands. This paper presents data on spider assemblages two years after burning and discusses them in the context of heathland protection. Ground dwelling invertebrates were sampled with pitfall traps; other methods were used to collect animals from vegetation. We sampled the whole year round, visiting the area every three weeks. All of the spider assemblages were rich in species, with the number exceeding 70 per plot. The overall activity of spiders was higher in unburned plots, however when specific spider families or ecological groups were considered the results were not so clear. For instance the rather thermophilous gnaphosids were more abundant in the burned plot. Although a large number of species were common across the different habitats, the dominance structure of the assemblages was very different. We also compared the number and activity of the taxa that are 'typical' for heathlands or recognized as endangered. They were more abundant in the area where burning was applied than in old heather vegetation. We recorded some spiders whose significance has already been recognised with respect to heathland protection (*Eresus kollari*, *Oxyopes heterophthalmus*, *Philaeus chrysops*, *Uloborus walckenaerius*), and many other rare species were also common in the area. Our results show that prescribed burning promotes very valuable spider assemblages. We suggest that the best solution for protecting the local diversity might be to create a mosaic of heather patches of different ages. Other methods of rejuvenating heathland, and their impact on animal communities, also need to be analysed.

Keywords: endangered, heather, spider assemblages, succession, thermophilic species.

Consequences for the use of the comparative method and presumed sexually-selected traits in spiders

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The comparative method in biology aims to resolve the issue of non-independence of data points, resulting from shared ancestry. However, many sexually-selected traits in spiders are considered to be relatively rapidly evolving. What is more, in the case of the application of mating plugs, clear examples exist of convergence of function fulfilled through different mechanisms. They might appear to the observer to be homoplastic, but in fact may be continuously varying with innovations of mechanism. These factors combined mean that, effectively, a far larger data set is potentially available to students of sexual selection in spiders than the discrete character approach of the biological method would dictate. The role of anthropomorphic linguistic artefacts is briefly considered, in recognition of the fact that traits should be considered not only in terms of how they function but also how they are formed. In this conceptual framework, an attempt is made to consider the extended phenotype (*sensu* Dawkins, 1982) trait of mating plugs in spiders as a continuum in morphospace, with innovations. It is also considered whether the trajectories of a vector-field can be deduced from a few dimensions, to add to our understanding of the evolution of mating systems in spiders. Finally, expectations for 'Rube Goldberg' design and 'cryptic plugging' behaviours, as well as implications for the evolution of the entelegyne condition, are briefly discussed.

Keywords: Araneae, extended phenotype, mating system, morphospace, sexual selection.

Why do some Entelegyne females seem to multiply mate with one male? Quantitative analysis and fitness consequences of mating behaviour in *Zygiella x-notata*

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It has been observed that many mating behaviours are costly, just as are other traits subject to sexual selection. For spiders the costs of mating for females can be potentially as high as those for males (e.g. energetic and time costs). Therefore, it might not be expected that females would multiply mate with the same male. Contrary to the prediction of this 'female costs' hypothesis, most male Entelegyne spiders alternate the application of the pedipalps to the epigyne of the female a variable number of times during copulation. In *Zygiella x-notata*, this appears to occur in a supernumerary fashion (observed number of insertions, 1 - 28; \bar{x} = 15) and in a stereotypical manner. Applications occur in bouts with some 'conventional' courtship in-between and followed by investment in mate-guarding and extended courtship. Effectively, females are multiply mating with the same male, during which they have a extendedprolonged opportunity to assess quality. The poster investigates different theoretical reasons for this behaviour in spiders and explores the issues through quantitative observations of male mating behaviours including: duration of courtship, number of bouts, symmetry of alternations, and durations of insertion and total mating. The hypotheses generated from these considerations create an expectation that the mating characteristics of second-mating males should be modulated according to the first male's performance under female influence. To see if this is so, *Zygiella x-notata* females (n = 40) were mated in captivity to two males (scored for size). A number of singly-mated controls were also set up (n = 10). All females were permitted to lay eggs under standard conditions to confirm that sperm transfer had occurred and also as a proxy measure of fitness (*viz.* number of eggs, number of second instar, time to egg lay, etc.). The findings indicate male mating characteristics were matched to some extent between males in pairwise analyses, but that females may modulate the acceptance of second males according to the behaviour of first males. Quantitative analysis of mating behaviour *via* the pedipalp alternation phenomena, combined with paternity testing in *Z. x-notata*, is suggested as a model system for the study of copulatory courtship and the assessment of qualitative aspects of mating performance that may determine paternity.

Keywords: Araneidae, fitness, mating behaviour, pedipalp alternation, sperm transfer.

Comparative morphology of venom glands in ground spiders (Araneae, Gnaphosidae)

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All spiders, except for Uloboridae, have paired venom glands. Each gland has a cylindrical chamber and a tubular duct that opens at the top of the fangs. According to their size and location, venom glands are classified into two groups: endocheliceral and endocephalous. In most Mygalomorphs and some Araneomorphs (e.g., Hypochilidae) venom glands are comparatively small and located only within the chelicerae. This type of venom glands are called endocheliceral. In most Araneomorph spiders venom gland are endocephalous. These are relatively large glands that extend out of chelicerae. Morphological and histological studies revealed that the walls of the venom glands are made of two layers, an internal glandular epithelium and an external layer of cross-striated muscles. Both layers are innervated by motor neurons. Arachnologists have noted that a muscular layer spirals around the body of the venom gland and suggest that this allows for the rapid release of venom. Until now, the venom glands of gnaphosid spiders have not been studied. The goal of this study is to examine the anatomy of venom glands of Gnaphosidae in order to determine if there are morphological differences within the family, especially with regards to the spiral arrangement of their muscle fibres. X-ray micro-computed tomography was used to visualize minute details of the morphology of venom glands of the ground spiders *Haplodrassus kulczynskii*, *Drassodes lapidosus*, *Gnaphosa muscorum* and *Zelanda* sp. Venom glands of ground spiders are typical endocephalous and extend to half of the prosoma's length. The ratio between gland and prosoma length vary from 0.41 in *Zelanda* to 0.60 in *Gnaphosa*. Glands have a single chamber without visible constrictions or subdivisions. Striated muscles in the venom gland walls have an oblique spiral orientation. Morphometric characteristics of venom gland are presented and their generic morphological differences described. Venom glands of all the species studied were found to be asymmetric, with the left gland longer and larger than the right one. This asymmetry was found in males as well as females.

Keywords: endocephalous glands, endocheliceral glands, morphometry, tubular duct.

Amazing characters found in the Afrotropical Chediminae (Araneae: Palpimanidae)

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Currently, three subfamilies are recognized in the Palpimanidae: Chediminae, Otiiohopinae and Palpimaninae. The Otiiohopinae is the most species-diverse subfamily and the Chediminae is most genera diverse. In the presentation we will discuss morphological features recently found in several genera of the Afrotropical Chediminae, including the unique eye pattern in two recently described genera, the mechanism locking the epigastric furrow in *Chedima*, the weakly sclerotized embolus in all genera and a new mechanism for sperm transfer in *Diaphorocellus*.

Keywords: eye pattern, locking mechanism, morphology, sperm transfer.

List of Participants

All those who have officially registered by 18/07/2017 are included in the printed copy. A full list, including alterations and updates, is provided on the congress web-page.

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