32nd ECA virtual

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32nd European Congress of Arachnology

23-26 August 2021 | virtual event

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Time	Monday **23rd August**	Tuesday **24th August**	Wednesday **25th August**	Thursday **26th August**
13:00-13:15	Welcome address	Welcome and announcements	Welcome and announcements	Welcome and announcements
13:15-14:00	**Session 1**	**Session 5**	**Session 8**	**Session 12**
14:00-14:15	Break	Break	Break	Break
14:15-15:00	**Session 2**	**Session 6**	**Session 9**	**Session 13**
15:00-15:30	Break	Break	Break	Break
15:30-16:30	**Session 3**	**Session 7**	**Session 10**	**Session 14** (until 16:15)
16:30-16:45	Break	Break	Break	Break
16:45-17:15	**Keynote speaker:** Anna-Christin Joel	**Keynote speaker:** Massimo De Agrò	**Keynote speaker:** Elena Piano	**Keynote speaker:** Darko Cotoras
17:15-17:30	Break	Break	Break	Group photo
17:30-18:30	**Session 4**	**Poster session in Gather (until 19:30)**	**Session 11**	**Society Assembly**
18:30-18:45	Break		Break	
18:45	**topical meetings and socializing in Gather**		**topical meetings and socializing in Gather**	Break
19:00				**Awards**
19:30				**Farewell**

Monday, 23rd August

13:00 Welcome address: Gabriele Uhl (Greifswald)

13:15 - 14:00 | Session 1 | Chair: Monika Eberhard (Greifswald)

13:15 **Beydizada et al. ***
Use of conditional prey attack strategy in generalist ground spiders

13:30 **Mowery et al.**
Parasitoid host preference in native and invasive widow spider egg sacs

13:45 **Arabesky et al. ***
Parasitism of local and invasive widow spiders in Israel by the wasp Philolema latrodecti

14:00 break

14:15 - 15:00 | Session 2 | Chair: Andreas Fischer (Vancouver)

14:15 **Michálek et al.**
The composition and specific toxicity of venom of araneophagous white-tailed spiders

14:30 **Jäger et al. ***
CHC composition of insect prey cuticle influences predator success

14:45 **Mangliers et al. ***
Silk-borne chemicals of spider nuptial gifts elicit female gift acceptance

15:00 break

15:30 - 16:30 | Session 3 | Chair: Andreas Fischer (Vancouver)

15:30 **Melcher et al. ***
Trust your gut (content) - DNA analyses of spider diet in permanent grasslands

15:45 **Weber et al. ***
eDNA-based monitoring of canopy associated arthropod communities

16:00 **Willmott et al. ***
Poisoning the web: spiders in a polluted world

16:15 **Vanthournout et al.**
SPIN-CITY: urbanisation effects on colour, size and web building in Araneus diadematus

16:30 break

16:45 ***Keynote speaker:*** **Anna-Christin Joel |** Chair: Jonas Wolff (Greifswald)

Cribellate spider silk – a biomimetic inspiration for production and handling of nanofibres

17:15 break

17:30 - 18:30 | Session 4 | Chair: Martina Pavlek (Zagreb)

17:30 **Satkunanathan et al. ***
Multilocus genetic and morphological phylogenetic analysis of the jumping spider tribe Nannenini with the description of one new genus and four new species (Araneae: Salticidae)

17:45 **Korba et al. ***
Phylogeography and species delimitation in Western Mediterranean Tarantulas

18:00 **Fet et al.**
On the trace of old Russian collectors: genus Othochirus *(Scorpiones: Buthidae) from Central Asia and Iran*

18:15 break

18:30 **topical meeting with Stano Pekár** (The World Spider Trait database) **and socializing in Gather**

Tuesday, 24th August

13:00 Welcome and announcements

13:15 - 14:00 | Session 5 | Chair: Monica Mowery (Beer-Sheva)

13:15 **Fischer et al. ***
Sexual conflict in false black widow spiders - aging females manipulate mate choice by males

13:30 **Sentenská et al.**
Risky business: males choose more receptive adults over safer subadults in a cannibalistic spider

13:45 **Matzke et al. ***
Multiple effects of sperm competition intensity on paternity in a polyandrous gift-giving spider

14:00 break

14:15 - 15:00 | Session 6 | Chair: Susan Kennedy (Trier, Okinawa)

14:15 **Philip et al. ***
Non-consumptive effects of spider and bird on herbivory rate

14:30 **Mendez-Castro et al.**
Landscape configuration and leaf phenology of host trees shape spider diversity in an alpine landscape

14:45 **Michalko et al.**
Differential predation among hunting strategies and cannibalism can explain coexistance in hyperdiverse spider communities

15:00 break

15:30 - 16:30 | Session 7 | Chair: Jonas Wolff (Greifswald)

15:30 **Kirchmair et al. ***
Ram´s horn organs unfolded: their functional morphology in cheliferid pseudoscorpions

15:45 **Lin et al. ***
Diversification through gustatory courtship: an X-ray microcomputed tomography study on dwarf spiders

16:00 **Meyer et al. ***
Influence of temperature and humidity on the functionality of the calamistrum

16:15 **Cotoras et al.**
Implications of a cheliceral axial duplication in Tetragnatha versicolor *(Araneae: Tetragnathidae) for arachnid deuterocerebral appendage development*

16:30 break

16:45 *Keynote speaker:* Massimo De Agrò | Chair: Philip Steinhoff (Greifswald)

The amazing jumping spider: How a modular visual system can simplify perceptual computation

17:15 break

17:30 **Poster session and socializing in Gather** (until 19:30)

Wednesday, 25th August

13:00 Welcome and announcements

13:15 - 14:00 | Session 8 | Chair: Monika Eberhard (Greifswald)

13:15 **Giacomazzi et al. ***
Attentional shift in jumping spiders: a central cue Posner´s paradigm study

13:30 **Ferrante et al. ***
Experimental investigation of attentive priming in jumping spiders using peripheral cues in a spatial cueing task

13:45 **Steinhoff et al. ***
Comparative anatomy of the visual system for motion processing in the brains of cursorial and stationary hunting spiders

14:00 break

14:15 - 15:00 | Session 9 | Chair: Susan Kennedy (Trier, Okinawa)

14:15 **Gajski et al. ***
Assessment of the biocontrol potential of natural enemies against psyllid populations in a pear tree orchard during spring

14:30 **Gravesen et al.**
Arthropod food webs in the foreland of a retreating glacier

14:45 **Khum et al. ***
High trait diversity of spiders is associated with low herbivory in young forest plantations

15:00 break

15:30 - 16:30 | Session 10 | Chair: Monica Mowery (Beer Sheva)

15:30 **Nicolosi et al. ***
Future shifts of cave-dwelling Meta *spiders under the influence of global warming on Etna volcano, Sicily*

15:45 **Sheffer et al. ***
Phenotypic plasticity and genetic adaptation in the wasp spider: response to variation in winter conditions

16:00 **Aagaard et al. ***
Nucleotide, DNA methylation and microbiome variation and their association to climatic gradients in the highly inbred social spider Stegodyphus dumicola

16:15 **Ballarin et al.**
Phylogeography and niche expansion of a troglophilic invasive spider

16:30 break

16:45 ***Keynote speaker:*** **Elena Piano |** Chair: Bram Vanthournout (Ghent)

Suviving city life: spiders as model organisms to study ecological dynamics in urban ecosystems

17:15 break

17:30 - 18:30 | Session 11 | Chair: Martina Pavlek (Zagreb)

17:30 **Aharon et al. ***
Exceptional subterranean speciation of cryptic troglobitic Tegenaria *Latreille, 1804 (Araneae: Agelenidae) in Israel*

17:45 **Armiach Steinpress et al. ***
Lycosa *Latreille, 1804 (Lycosidae) - "the out of Africa theory"*

18:00 **Propistsova et al. ***
Phylogeny and systematics of the Pardosa lugubris *species group (Araneae: Lycosidae)*

18:15 **Privet et al. ***
Phylogeny of wolf spiders from the Hawaiian archipelago inferred from multilocus genetic data: small- and large-scale relationships between spiders living on different islands, volcanoes and lava caves

18:30 break

18:45 **topical meeting with Bram Vanthournout and Elena Piano** (What we know and what we don't know about spiders in the city)**, and socializing in Gather**

Thursday, 26th August

13:00 Welcome and announcements

13:15 - 14:00 | Session 12 | Chair: Ondřej Michálek (Brno)

13:15 **Opris et al. ***
Spider community in relation to vegetation structure and urbanization pressures in a protected raised bog in Scotland

13:30 **Zvik et al.**
Distribution and habitat characteristics of the myrmecophile scorpion Birulatus israelensis *Lourenço 2002*

13:45 **Hacala et al. ***
Driver of spider diversities on maritime heathland

14:00 break

14:15 - 15:00 | Session 13 | Chair: Ondřej Michálek (Brno)

14:15 **Eberhard et al.**
Male vibratory courtship in Pisaura mirabilis*: effect of the developmental and mating stage of the female*

14:30 **Beyer et al. ***
Do female spiders embed directionality information in their silk to aid male mate search?

14:45 **Weissbach et al. ***
Underestimated complexity of cribellate capture threads: stainability indicates variations in protein composition of silk fibres within a thread and between species

15:00 break

15:30 - 16:15 | Session 14 | Chair: Theo Blick (Hummeltal)

15:30 **Milano et al. ***
Spider conservation in Europe

15:45 **Arvidsson et al. ***
Fallows conserve the taxonomic and functional diversity of ground-active linyphiid spiders in agricultural landscapes

16:00 **Faiz et al.**
Diversity of spiders in Pir Chinasi National Park, Azad Kashmir, Pakistan

16:15 break

16:45 ***Keynote speaker:*** **Darko Cotoras |** Chair: Monica Sheffer (Greifswald)

Intraspecific niche partition without speciation: individual level web polymorphism within a single island spider population

17:15 Group photo

17:30 Society Assembly

18:45 break

19:00 Awards

19:30 Farewell

List of Posters

Bartel et al. *
Laniatorean harvestmen (Arachnida: Opiliones) from mid-Cretaceous Burmese amber

Ben Othmen, A.
Cryptic genetic diversity of the North African scorpion, Buthus occitanus *(Scorpiones: Buthidae)*

Brown et al. *
Genomic determination of reproductive mode in facultatively parthenogenetic Opiliones

Castellucci et al. *
The enigmatic genus Mastigusa *Menge, 1854 (Araneae, Hahniidae): phylogenetic placement and provisional taxonomical revision*

Cera, I.
Arctosa cinerea - *distribution and status in Latvia*

Ganem et al. *
Loxosceles*: a true troglophile, opportunist, or both?*

Geci et al. *
A contribution to spider fauna (Arachnida: Araneae) from Bjeshkët e Nemuna mountains (Kosovo)

Hannappel et al. *
Mud dauber nests as sources of spiders in mercury monitoring studies

Hopfe et al. *
Diversity of orb weaving spiders' silk tensile properties on a climatic gradient

Magar et al.
New records of jumping spiders (Araneae: Salticidae) from Nepal

Müller et al.
How do spiders taste and smell? Insights from ultrastructure of tip-pore leg sensilla in the wasp spider Argiope bruennichi

Nyffenegger et al. *
Adhesion of Larinioides sclopetarius *(Araneae, Araneidae) capture thread in relation to pull-off velocity of glass plates and elytra of* Tenebrio molitor *(Coleoptera, Tenebrionidae)*

Rose et al. *
Araneus diadematus *microbiome composition and its possible changes due to urbanization*

Shafaie et al.
New data on the genus Pardosa *from Iran (Araneae, Lycosidae)*

Keynote Speaker

Intraspecific niche partition without speciation: individual level web polymorphism within a single island spider population

Cotoras, Darko D.; Suenaga, Miyuki; Mikheyev, Alexander S.

Presenter's address: *Arachnology. Senckenberg Naturmuseum, Senckenberganlage 25, Frankfurt 60325, Germany; Entomology Department, California Academy of Sciences, 55 Music Concourse Drive, Golden Gate Park, San Francisco, CA 94118, USA; Ecology and Evolution Unit, Okinawa Institute of Science and Technology, Tancha 1919-1, Onna-son, Okinawa 904-0495 Japan*
E-mail: darkocotoras@gmail.com

Early in the process of adaptive radiation, allopatric disruption of gene flow followed by ecological specialization is key for speciation; but, do adaptive radiations occur on small islands without internal geographical barriers? Island populations sometimes harbour polymorphism in ecological specializations, but its significance remains unclear. On one hand, morphs may correspond to 'cryptic' species. Alternatively, they could result from population, developmental or behavioural plasticity. The spider *Wendilgarda galapagensis* (Araneae, Theridiosomatidae) is endemic to the small Isla del Coco and unique in spinning three different web types, each corresponding to a different microhabitat. We tested whether this variation is associated with 'cryptic' species or intraspecific behavioural plasticity. Despite analysing 36,803 loci across 142 individuals, we found no relationship between web type and population structure, which was only weakly geographically differentiated. The same pattern holds when looking within a sampling site or considering only Fst outliers. In line with genetic data, translocation experiments showed that web architecture is plastic within an individual. However, not all transitions between web types are equally probable, indicating the existence of individual preferences. Our data supports the idea that diversification on small islands might occur mainly at the behavioural level producing an intraspecific niche partition without speciation.

Keynote Speaker

The amazing jumping spider: How a modular visual system can simplify perceptual computation

De Agrò, Massimo

University of Regensburg, Germany
E-mail: massimo.deagro@gmail.com

Like many invertebrates, jumping spiders need to perform complex decision-making while being constrained by a limited number of neurons. Decryption of the visual scene is particularly challenging, requiring nested algorithms in order to find, recognize, categorize, and act upon objects. This computation can however be simplified: by initially subdividing the problem, or by resorting to decision-making shortcuts. We know from previous research that jumping spiders have mastered the first: they possess different pairs of eyes, each specialized in a specific visual component, namely figure and motion. The second strategy instead relies on easily available information to produce quick, good-enough responses without the need for complex processes or perfect information. One example of such low-level information is “biological motion”: a peculiar pattern that the joints of the body of many animal species follow during locomotion. This pattern can be picked-up visually, and used to rapidly discriminate between living agents and randomly moving objects. We tested the ability of jumping spiders to detect biological motion using a spherical treadmill setup. We observed whether the animals would produce a body saccade towards either a biologically- or randomly-moving stimulus. We found that jumping spiders are clearly able to discriminate between biological and non-biological motion. Crucially, the discrimination task is performed by the secondary eyes alone, suggesting that these eyes are not just motion detectors, but are also capable of motion discrimination. This results pose crucial questions about the evolutionary history of this discrimination ability, as well as new perspectives on salticids’ visual system.

Keynote Speaker

Cribellate spider silk – a biomimetic inspiration for production and handling of nanofibres

Joel, Anna-Christin

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E-mail: joel@bio2.rwth-aachen.de

Spiders offer many inspirations for humans, e.g. with their tough biomaterial silk. Cribellate spiders produce silk nanofibres about 20 nm thick. These fibres are so small that the typical spider silk protein configuration (i.e. β-sheets combined with α-helices) cannot be found. The fibres' very low elastic modulus reflects this and fits well to their function in capturing prey. As very elastic fibres, however, they are arranged with larger fibres that dissipate most of the energy of struggling prey. This arrangement into one functional unit requires highly orchestrated spinneret movements for sewing up to eight different silks (and many more fibres) into one thread. As cribellate spiders do not produce glue to capture prey, the prey adheres to the nanofibres by entanglement and van der Waals forces. Additionally, the adhesion force is strengthened by using the low viscous substances of the cuticular waxes of the prey as glue. However, though the spiders are brushing over the fibres with a comb (calamistrum), the spiders themselves do not adhere to their capture thread. The calamistrum is covered with a ripple pattern, which reduces van der Waals forces between nanofibres and comb. This can be mimicked with technical surfaces, leading to novel tools easing the production of artificial nanofibres. The talk will cover the complete story of cribellate spider silk nanofibres, from their protein chemistry to biological use and biomimetic inspirations.

Keynote Speaker

Surviving city life: spiders as model organisms to study ecological dynamics in urban ecosystems

Piano, Elena

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The conversion of natural and rural land into urban areas, i.e. urbanization, affects all ecosystem components, with multifaceted repercussions on biodiversity. The investigation of the ecological dynamics occurring in urban ecosystems represents a lively and debated topic in urban ecology. In this presentation, based on experimental data, I will first provide evidence that the process of urbanization correlates with a strong decline of spider diversity and abundance, with remarkable cascade effects due to their strategic position in the trophic web. Second, with a specific study designed to investigate the urban-driven selective processes acting at community level, I will show that spiders are suitable models thanks to their high diversification in terms of species and functional traits. More in detail, taxonomic and functional patterns of spider communities along urbanization gradients allowed us to understand that different selective mechanisms, namely habitat filtering and stochastic processes, are simultaneously acting on biotic communities in urban habitats. Third, I will report the results of an ongoing study planned to investigate the effects of environmental changes caused by urbanization on intraspecific body size variation of wolf spiders. In particular, we observed a positive effect of urbanization on body size mediated by a decline in intraguild predation. Overall, by combining the results of the studies carried out during my research, I outline the role of spiders as ideal model organisms to address ecological questions on factors shaping urban biodiversity.

Evolutionary Biology
Oral presentation

Nucleotide, DNA methylation and microbiome variation and their association to climatic gradients in the highly inbred social spider *Stegodyphus dumicola*

Aagaard, Anne; Liu, Shenglin; Lund, Marie Braad; Schramm, Andreas; Verhoeven, Koen; Bechsgaard, Jesper; Bilde, Trine

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The social spider, *Stegodyphus dumicola*, live across large climatic gradients in the southern part of Africa despite being highly inbred and having very low genetic diversity. These facts point to plastic responses as likely important for optimizing the local spider phenotype. Using environmental association studies that can reveal correlations among climatic factors and molecular variants, we study the sources of molecular and microbiome variation that has the potential to raise differential host phenotypes in response to the local climate. Thus, we have analyzed population divergences in nucleotide, DNA methylation and microbiome variation among six populations across environmental gradients in relation to the divergence in local climate factors. We find that, despite low nucleotide diversity, its distribution across populations suggests local adaptation to climate. Nucleotide variation seems to be especially important in relation to mean and maximum temperature. Similarly, DNA methylation patterns are consistent with playing a role in responses to local climates, and suggest locally adapted or plastically induced variation in DNA methylation profiles. As opposed to nucleotide variation, correlation patterns suggest that DNA methylation variation may be more important in relation to minimum temperature and precipitation. Microbiome variation does not yield strong signals when correlating with local climate, but some relation with precipitation may be present. These results may give rise to hypotheses about the underlying mechanisms for adaptive responses to the given climate, which may subsequently be tested in e.g. a common garden study.

Systematics, Biogeography & Diversity
Oral presentation

Exceptional subterranean speciation of cryptic troglobitic *Tegenaria* Latreille, 1804 (Araneae: Agelenidae) in Israel

Aharon, Shlomi; Ballesteros, Jesus A.; Gainett, Guilherme; Hawlena, Dror; Sharma, Prashant P.; Gavish-Regev, Efrat

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Caves had long been recognized as a window to the process of diversification and convergent evolution due to the unique conditions of isolation and life in the dark. These lead to adaptations and reduce dispersal and gene flow, resulting in high levels of speciation and endemism. The Israeli cave arachnofauna is still poorly known. In a recent survey, we found troglophile funnel-web spiders of the genus *Tegenaria* in 25 caves, present mostly at the cave entrance ecological zone. In addition, we identified at least 14 caves that are inhabited by troglobite *Tegenaria*, present mostly in the twilight and dark ecological zones. Ten of the caves, located in the north and center of Israel, are inhabited by both troglophile and troglobite *Tegenaria*. These spiders are phenotypically very similar, except for the levels of eye reduction and pigmentation. Their close interaction suggests the possibility of repeated local adaptations to the cave environment by a widespread epigean species. In this study we investigate this hypothesis by conducting a broad geographic sampling of cave dwelling *Tegenaria* using morphological and molecular evidence. Our results show that troglobite *Tegenaria* form a clade distantly related to the troglophile species found at each cave entrance. Moreover, seven new species can be identified within the troglobite clade based on genetic differences and features of the female genitalia. While the sister taxon to the Israeli troglobite *Tegenaria* is to be determined, the COI data suggest these species are more closely related to the circum-Mediteranean *T. ariadne* species group, than to their sympatric *Tegenaria*. Future studies with broader sampling of specimens and loci will clarify the pattern and tempo of evolution of the cave dwelling *Tegenaria* in Israel.

Behavioral Biology
Oral presentation

Parasitism of local and invasive widow spiders in Israel by the wasp *Philolema latrodecti*

Arabesky, Valeria; Mowery, Monica; Segoli, Michal; Lubin, Yael

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Invasive species are species that expand beyond their natural range into new locations, usually as a result of human actions, and become a threat to local ecosystems. Traits and ecological factors may influence an invasive species' competitive ability and establishment success compared to native species. We compared the effects of parasitism on native and invasive widow spider species and examined how population density affects parasitism rates. The brown widow spider, *Latrodectus geometricus*, is a synanthropic species, which has now established around the world. The high success of the brown widow spider in invading new environments may be due to traits such as high fecundity, dispersal, and potentially also due to spiky silk structures on the egg sac surface that may defend against parasitism. *Philolema latrodecti* is a generalist parasitoid wasp that parasitizes egg sacs of widow spider species around the world. We hypothesize that the brown widow may have an advantage over native widow species within its invasive range due to its defenses against egg sac parasitoids. To address this hypothesis, we investigated the natural parasitism rate by *P. latrodecti* on egg sacs of the brown widow spider, compared to those of a native widow spider in Israel, the white widow, *Latrodectus pallidus*. We expected to find a higher parasitism rate on the egg sacs of the native white widow because of the lack of egg sac defenses. We collected egg sacs of brown and white widows in six pairs of natural and settled sites around the northern Negev Desert, Israel. Across sites, we found significantly higher parasitism rate in white widow egg sacs. Parasitism varied significantly among sites, which suggests that habitat characteristics such as density may affect parasitism. To assess density-dependent parasitism, we collected white widow egg sacs from ten sites across the Negev Desert, measured population density, and parasitism rates. For comparison, we measured population density in four brown widow spider populations in disturbed, settled habitats. In white widow spiders, denser sites had a higher parasitism rate, although at the individual level, parasitized egg sacs located in dense patches had fewer parasitoids emerge compared to more isolated egg sacs. In contrast, in the brown widow populations, which were extremely dense, we did not find any parasitism. These results indicate that there is a high parasitoid burden and a strong connection between parasitism by *P. latrodecti* wasps and spider population density in white widow populations, but that even dense, invasive brown widow populations are not heavily parasitized, which may contribute to their invasion success.

Systematics, Biogeography & Diversity
Oral presentation

Lycosa Latreille, 1804 (Lycosidae) - the "out of Africa theory"

Armiach Steinpress, Igor; Cohen, Mira; Chipman, Ariel; Gavish-Regev, Efrat

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Lycosa Latreille, 1804 *sensu stricto* is a clade of large burrowing wolf spiders, found in the old world. Currently, the highest diversity of *Lycosa* is reported from the Mediterranean basin. A phylogeny published by Planas et al. in 2013 placed the west Mediterranean *Lycosa* species into four lineages, demonstrating that each of the five species found in western Europe is nested within a north African lineage. Our study aimed at testing how many *Lycosa* species are found in the southern Levant (Israel, Jordan, Palestine and Sinai peninsula), and to explore their phylogenetic relation to the western Mediterranean species. For this purpose we reconstructed a molecular phylogeny based on COI sequences of 18 species from Planas, with the addition of three Levantine morphospecies. We hypothesized that the Levantine morphospecies are closer to one another, than to any of the African lineages, and belong to a separate Levantine clade. Conversely, they could belong to one or more of the north African clades. Our results uncover the existence of three species in the study area: *Lycosa gesserit* sp. nov., *Lycosa hyraculus* sp. nov. and *Lycosa olivieri* (Simon, 1876), and reject the hypothesis of a Levantine clade. The Levantine species were found to be nested in two north African lineages: the two new species are sister taxa within the "oculata" clade, while *Lycosa olivieri* is nested within the "baulnyi"clade. Our findings suggest that in addition to the species from the western Mediterranean, the three *Lycosa* species from the Levant also originated in north Africa. Expanding this updated phylogeny with sequences from species found east to the Levant may help further clarify the origins of *Lycosa*.

Ecology
Oral presentation

Fallows conserve the taxonomic and functional diversity of ground-active linyphiid spiders in agricultural landscapes

Arvidsson, Fredrik; Feng, Lanya; Smith, Henrik G.; Birkhofer, Klaus

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The EU reformed the Common Agricultural Policy (CAP 2013) to include greening measures aimed to decrease the negative impacts of farming on the environment and biodiversity. Whether two of these greening measures, the establishment of fallows and preservation of permanent grasslands, enhance biodiversity is still debated. This study investigated the effect of cereal fields, adjacent fallows, and surrounding permanent grasslands on the taxonomic and functional diversity of ground-active linyphiid spiders (Family Linyphiidae, Order Araneae) caught using pitfall traps in southern Sweden. Linyphiids are widespread and abundant as natural enemies of pests in agricultural ecosystems. In the current study, the species richness, activity density and true diversity of linyphiids did not differ significantly between fallows and cereal fields and was not significantly affected by the proportion of permanent grassland in the surrounding landscape. However, the functional distinctness of linyphiids was significantly higher in fallows than cereal fields, and species composition differed significantly. Our results document considerable species turnover in linyphiid communities of adjacent cereal fields and fallows and therefore suggest that maintaining a combination of agricultural and fallow fields is of high value, not primarily to promote species richness in local habitats, but to conserve taxonomic and functional diversity at larger spatial scales.

Systematics, Biogeography & Diversity
Oral presentation

Phylogeography and niche expansion of a troglophilic invasive spider

Ballarin, Francesco; Mammola, Stefano; Zhang, Zhixin

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Invasive species pose several threats to the native biodiversity in areas that they can colonize. Isolated ecosystems may be particularly prone to be affected by invasive species, due to their vulnerability to external interference. The troglophilic scaffold-web spider *Nesticella mogera* (Nesticidae) represents a good example of a poorly studied yet widely distributed invasive species, potentially able to threaten remote biodiversity hotspots including oceanic islands and caves. This spider is rapidly expanding its geographical range outside Asia to Europe and tropical islands, where it colonized both leaf litter habitats and caves. Nevertheless, we still lack information on niche preference, center of origin, pattern of colonization. Most of all, we have not developed reliable predictions about areas that can be potentially invaded by this species in the future. We characterized the population genetics of several populations of *N. mogera* from both its potentially native range and non-native areas of distribution. We reconstructed the phylogeography of this species using a multi-locus, time-calibrated phylogeny and a niche-modelling approach. Our results assess the center of origin of *N. mogera* in Southern China from where it naturally distributed in Eastern Asia during the Pleistocene Epoch. Its expansion in non-native areas occurred only recently as a consequence of human passive transportation and in concomitance with the widening of its habitat preference and consequent niche expansion. Future putative expansion of the distribution of *N. mogera* is expected to occur in Central Africa, South America and Europe, including in karst-rich areas. This makes *N. mogera* a potential treat for tropical rainforest and subterranean fauna

Behavioral Biology
Oral presentation

Use of conditional prey attack strategy in generalist ground spiders

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Generalist predators have evolved a variety of behavioral adaptations for prey capture to effectively subdue different prey types. Such predators use a conditional hunting strategy. Among spiders, representatives of Gnaphosidae are known to use either bite (subdue prey with venom) or silk (subdue prey with silk) attack. In this paper we aimed to test a hypothesis of conditional use of prey capture strategy (bite versus silk attack)in two species, *Drassodes* sp. and *Zelotes* sp. We also measured the size of their venom and silk glands in order to reveal whether behavioural adaptations are paralleled with metabolic ones. As prey we used other spiders as these are considered dangerous prey. We found that *Drassodes* used mainly silk attack, while majority of *Zelotes* used bite attack. The probability to use silk attack increased with predator/prey body size ratio in *Drassodes* but not in *Zelotes*. Then we disabled individuals of both species to use silk. All disabled *Drassodes* used bite attack but about half of individuals aimed to use silk attack first. All *Zelotes* used bite attack but none aimed to use silk attack first. At last we measured venom and silk glands. We found significantly larger relative size of venom glands in *Drassodes* than in *Zelotes*, while the number of piriform silk glands was almost similar. The behavioural adaptations are thus not paralleled with metabolic ones. Our results suggest that both *Drassodes* and *Zelotes* can use both attack strategies with a similar efficacy.

Behavioral Biology
Oral presentation

Do female spiders embed directionality information in their silk to aid male mate search?

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Locating potential mating partners is essential for animal reproduction, especially for species leading a solitary lifestyle with individuals being widely dispersed in their habitats. While it is possible to rely on random search for finding mates, a particularly potent and target-oriented means for mate localization lies in following chemical or mechanical trails that are left in the environment by conspecifics, usually the females. However, upon encountering a female's trail, a trail-following male is forced to choose a direction in which to proceed, potentially halving its chances to finding the female. One way to increase these chances is the embedding of directionality information in a trail, a rarely observed trail feature whose encryption in trails remains poorly understood. Spider silk represents a well-known medium for trail-following, being commonly used exclusively by females to attract males, often by additionally adding chemicals to their silk. To date, trail directionality has rarely been investigated or found in spiders, and its encryption in the trail remains unknown. In the web-less hunting spider *Pisaura mirabilis*, female silk lines are known to contain tactile chemical cues that induce male sexual excitement and exploration behavior, and preliminary results suggest directionality information in females' silk. We observed males when exposed to female silk lines that were either washed with solvents to remove chemically active components underlying directionality, or unwashed, by conducting assays in a walking corridor, and measured the direction moved (same/different as female), and the time taken to reach the end of the corridor. Results will increase our understanding of trail directionality in spider silk and its role in mate searching.

Systematics, Biogeography & Diversity
Oral presentation

Molecular and morphological species delimitation suggest a single species of the beetle-spider genus *Ballus* in Sri Lanka (Araneae: Salticidae)

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Ballus Koch, 1850 is a beetle-like jumping spider genus encountered in the central highland sub-mountain and mountain evergreen rain forests of Sri Lanka. Taxonomic literature documents three species of the genus for the island. However, neither the taxonomic validity nor the systematics of any of them have been previously tested. We used nuclear and mitochondrial DNA sequences (28S, H3, COI) as well as morphological characters to investigate the diversity of *Ballus* populations in Sri Lanka, including specimens from historical type localities of all three species. No *Ballus* specimens were found outside of the central highland. Results of molecular species delimitation suggested the presence of only a single species of *Ballus* in Sri Lanka, which was further supported by the lack of morphological diagnostic characters. We thus propose *Ballus sellatus* Simon, 1900 as a synonym of *Ballus segmentatus* Simon, 1900, while *Ballus clathratus* Simon, 1901 remains a *nomen nudum*. Further, we discuss the implication of our results for conservation planning.

Developmental Biology
Oral presentation

Implications of a cheliceral axial duplication in *Tetragnatha versicolor* (Araneae: Tetragnathidae) for arachnid deuterocerebral appendage development

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The homology of the arachnid chelicera with respect to other head appendages in Panarthropoda has long been debated. Gene expression data and the re-interpretation of early transitional fossils have supported the homology of the deutocerebrum and its associated appendages, implying a homology between primary antennae (mandibulates), chelicerae (euchelicerates), and chelifores (sea spiders). Nevertheless, comparatively little is known about the mechanistic basis of proximo-distal (PD) axis induction in chelicerates, much less the basis for cheliceral fate specification. Here, we describe a new cheliceral teratology in the spider *Tetragnatha versicolor* Walckenaer, 1841, which consists on a duplication of the PD axis of the left chelicera associated with a terminal secondary schistomely on the fang of the lower axis. This duplication offers clues as to potential shared mechanisms of PD axis formation in the chelicera. We review the state of knowledge on PD axis induction mechanisms in arthropods and identify elements of gene regulatory networks that are key for future functional experiments of appendage development in non-insect model systems. Such investigations would allow a better understanding of PD axis induction of modified and poorly studied arthropod limbs (e.g., chelicerae, chelifores, and ovigers).

Behavioral Biology
Oral presentation

Male vibratory courtship in *Pisaura mirabilis*: effect of the developmental and mating stage of the female

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Vibratory courtship signals are very common in spiders and serve e.g. for species recognition, suppressing the female's aggression towards the male, or signal individual male quality. Males of the nursery web spider, *Pisaura mirabilis*, who usually offer a prey item wrapped in silk as a nuptial gift to the female, vibrate their opisthosoma when in contact with female silk, presumably reacting to pheromones contained in her draglines. Courtship energy expenditure and resource transfer should select for male mate choice in this species. We hypothesized that male *P. mirabilis* are able to differentiate life-stages of females by contacting their silk, and subsequently adjust their vibratory courtship behaviour. To test this, we recorded reactions of 30 male spiders towards draglines of sub-adult, adult unmated, and mated females with a Laser-Doppler-Vibrometer. Our results show that males were less likely to perform vibratory courtship when contacting sub-adult female silk in comparison to adult female silk. In those males that vibrated in response to sub-adult female silk, courtship was initiated later compared to the other two treatments, resulting in a decreased total number of pulses, however pulse intervals and dominant frequencies did not differ between treatments. Our investigation shows that males are able to discriminate the developmental stages of females by contacting their draglines and adjust their vibratory mating behaviour accordingly. Reduced courtship in response to sub-adult female silk seems beneficial as it reduces energy expenditure in the face of a not yet reproductive female. The temporal pattern of male vibratory signals was surprisingly stable and may be used for species recognition and might reduce female aggression.

Ecology
Oral presentation

Diversity of spider in Pir Chinasi National Park, Azad Kashmir, Pakistan

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The present study was designed to document checklist of spiders at Pir chinasi National Park (34°20'12.02" and 34°23'54.78 NL; and between 73°32'26.57" and 73°38'56.94" E) in Azad Kashmir Pakistan. The study was started 20 march 2019 to 20 20 and documented 73 spider species by using line transect method. A total of 50 transects were taken in area of 27.454 km2. The sampling of spiders was carried out by using sweep net and pitfall traps in different habitat type.The diversity of spiders varies significantly along the elevational gradient (1820 m to 3123 m asl) (above sea level).The dendrogram of the recorded species were also formed by using software (XIstat Ecol 4.0). The map of study area with global positioning of spiders was also made by using GPS (Global Positioning System).

Behavioral Biology
Oral presentation

Experimental investigation of attentive priming in jumping spiders using peripheral cues in a spatial cueing task

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The ability to use visual cues to effectively orient attention in space plays a crucial role in many ecological contexts, such as foraging or mating. Jumping spiders (Salticidae) are excellent hunters with a highly developed visual system. In these animals, characteristics such as high spatial resolution and motion detection are divided into structurally and anatomically different groups of eyes. Due to this functional distinction, jumping spiders have to physically turn towards an object in the visual field in order to further inspect it with their principal eyes. Although the visual system of this animal has been thoroughly investigated, not much is known about the ability in the jumping spider to use spatial cues to direct visual attention. Here we tested jumping spiders in a spatial cueing task. We presented to the spiders a peripheral cue, a brief flash of light, to the right or left side on a screen, followed by a target stimulus in the same or opposite position. We tested the spiders by affixing them to a trackball system, registering their intended orientations during stimuli presentation. We found that jumping spiders respond faster to a target stimulus if its position is suggested by a peripheral cue. This facilitatory effect was not found when cue and target appeared respectively in different positions on the screen. Moreover, we observed that the spiders turned towards the target with a higher probability as the interval between cue and target increased. This study suggest the presence of an attentive priming caused by a peripheral cue on the detection of a target stimulus by the secondary eyes in the jumping spider, providing useful data for a better understanding of visuo-spatial perception in this animal.

Systematics, Biogeography & Diversity
Oral presentation

On the trace of old Russian collectors: genus *Orthochirus* (Scorpiones: Buthidae) from Central Asia and Iran

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Species of an Asian scorpion genus *Orthochirus* Karsch, 1892 (fam. Buthidae) are common and widespread in all deserts from North Africa to India. Numerous new *Orthochirus* species have been described by our research group in the recent years. The diversity of this genus in Central Asia and Iran has been a subject of controversy for over 100 years, and identity of most old species from this area was unclear. In 2018-19, we had a chance to examine the collection of the great scorpiologist Alexei A. Birula (1864-1938) kept in the Zoological Institute, St. Petersburg, Russia. We reexamined the identity and confirmed validity of *Orthochirus melanurus* (Kessler, 1874) (Kazakhstan, Uzbekistan), *O. persa* (Birula, 1900) (Iran), and *O. scrobiculosus* (Grube, 1873) (Turkmenistan), based on detailed study of type specimens. Historical sources and travelogues allow to identify localities and clarify previously confused toponyms for rare specimens collected by Gustav Radde, Oscar Schneider, Modest Bogdanov, Nikolai Zarudny, and other prominent zoologists in the 1870s-1900s. when Russian Empire was actively involved in the "Great Game" and colonization of Central Asia. We demonstrate for the first time that the name *O. scrobiculosus*, previously used as an 'umbrella' for various *Orthochirus* from Central Asia and the Middle East, is currently applicable only to a few confirmed populations from the southwestern Turkmenistan, near the Caspian Sea.

Behavioral Biology
Oral presentation

Sexual conflict in false black widow spiders – Aging females manipulate mate choice by males

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Across spider taxa, older females are generally more 'appealing' to males than younger females, but the underlying mechanisms are not known. Here, we investigated how aging of female false black widow spiders, *Steatoda grossa* (Theridiidae), affects their sexual signalling and reproductive output. Age-dependently, the reproductive output of females declined dramatically. Older females also produced lower dense webs and deposited less courtship- inducing contact pheromone on their webs than younger females, as determined by high performance liquid chromatography – mass spectrometry. However, in y-tube olfactometers the webs of old females remained as attractive to mate-seeking males as the webs of young females. It follows that old females manipulate the mate choice of males that would attain higher reproductive fitness by mating with younger females.

Ecology
Oral presentation

Assessment of the biocontrol potential of natural enemies against psyllid populations in a pear tree orchard during spring

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Modern pest control management systems are based on the support of naturally occurring arthropod predators, as it has been shown that such predators offer an important ecosystem service. However, most naturally occurring arthropod predators are generalists (euryphagous). Their role in the biological control of specific pests has been recognized but remains poorly studied. Here, we focused on the naturally occurring arthropod predators of psyllids – the main insect pest of pear trees. We investigated the abundance of psyllids and all of their potential enemies in an abandoned pear orchard on a weekly basis from early spring to early summer. In addition, employing polymerase chain reaction diagnostics and specific primers, we investigated the predation rate on psyllids in all predators collected. We found four predatory groups: spiders were the most abundant (60%, N = 756), followed by coccinellid beetles, anthocorid bugs and cantharid beetles. Anthocorids and spiders had the highest predation rates among the predatory groups. Among spiders, >50% of foliage-dwelling spiders (belonging to the genera *Philodromus* and *Clubiona*; N = 206) were positive for psyllids and showed a numerical response to the abundance of psyllids. We conclude that foliage-dwelling spiders are, of the four groups, the most important natural enemies of psyllids on pear trees during spring in Central Europe, as they outnumber specialized Anthocoris bugs.

Behavioral Biology
Oral presentation

Attentional shift in jumping Spiders: a central cue Posner's paradigm study

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The ability to recognize and identify objects in the outside world is vital for survival. To compute visual stimuli, animals need to focus their resources and direct their gaze towards elements in their visual space, or in other words, direct their attention. In the study of this process, Posner's paradigm is one of the most effective. In such procedures, the focus of the attention is manipulated using a cue suggesting a specific portion of the visual field. Then, a target stimulus appears in the congruent or incongruent side of the cue's suggestion. The cue can be presented peripherally in the position where it wants to elicit attention. Alternatively, it can be presented centrally, but pointing where the attention should be moved to. Different species seems to be subjected to a "Posner effect" showing faster detections in the area indicated by the initial cue. The study we conducted aims to analyse the spider's responsiveness to Posner's paradigm, in which a central cue is presented to the spider's frontal eyes, followed by a target that appears to the left or to the right in the secondary eyes visual field, defining a "congruent" or "incongruent" condition. We found that spiders turn more frequently when targets appear in the same position indicated by the cue in respect to when it appears in the opposite side. However, this effect reverses if the time passing between the disappearance of the cue and the appearance of the target increases. These results suggest that directional cues presented to spiders had an effect in the modulation of the attentional focus in the short term, while this effect tends to slack off over time. These findings are particularly interesting for understanding cognitive aspects and may lead to further attentional studies in this species.

Ecology - *Oral presentation*

Arthropod food webs in the foreland of a retreating glacier

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Arthropod food webs comprising the below- and above-ground communities were explored at a glacier foreland area in low-arctic South-West Greenland aiming for a better understanding of the mechanisms behind the arthropod succession driven by glacier retreat in a context of an arctic climate change scenario Pitfall sampling was performed in 2015 and 2016 along a down slope transect from 300 m to 200 m above sea level to quantify the local arthropod abundance-activity in relation to an environmental data set was subject to analysis by Structural Equation Modelling (SEM) and generalized linear mixed model (GLMM) to detect bottom-up and top-down food web control mechanisms. The SEM analyses were supported by DNA metabarcoding as well as by the existing literature. Only a few predator species were found: one carabid beetle (*Nebria rufescens*), one harvestman (*Mitopus morio*), 20 spider species and eleven parasitoid species (Hymenoptera). Among potential prey of the generalist predators, there were 19 Diptera families, six Acari families (mites), three Collembola families, and one Aphididae species. We observed a shift from bottom-up to top-down cascades between arthropod predators and their potential prey animal populations mainly driven by increasing temperatures away from the glacier. In the early stage of the vegetation succession, bottom-up mechanisms were found while in the later stage of succession, top-down mechanisms prevail. The arthropod population activity-density increased and showed optimum density 30-100 meter away from the glacier where after the density decreased - probably due to the top-down effect. The transect includes late succession stages that have been ice-free for at least two thousand years, which is the longest known glacier foreland chronosequence in relation to arthropod succession intensively studied. SEM revealed mechanisms regulating arthropod prey and predator populations in relation to environmental variables. Thus, bottom-up mechanisms were important for the linyphiid spider and harvestman populations while top-down mechanisms were important for the ground beetle populations. These mechanisms may be closely related to hunting strategies of the predators as a bottom-up mechanism may be connected to sit-and-wait behavior while top-down mechanisms may be related to active-search behavior. The generalist arthropod predators seem to share the same prey species as almost all available prey species were detected in the guts of the studied predator species. Instances of intraguild predation (IGP) were common among all arthropod predators. Particularly in the guts of the linyphiid spider, *Collinsia holmgreni*, many trophic linkages to other linyphiid and lycosid spiders were detected. The IGP-ratio was negatively correlated with the activity-densities of ground living prey animals but positively correlated to the spider activity-density. Global warming may accelerate the top-down effects and lead to lower population densities of arthropods in the later stages of glacier foreland areas which could potentially include huge areas in Greenland as well as in other Arctic areas. This decline in population densities is particularly pronounced for the potential prey animal populations which may have consequences for the decomposition rate of organic material as collembolans and mites are important for the decomposition process. The decomposition rate may decrease with the consequence that the organic content at the soil surface will increase. Increased top-down effects may also be a threat to cold-adapted linyphiid spider species like *C. holmgreni* while lycosid spider species may benefit from global warming.

Ecology
Oral presentation

Driver of spider diversities on maritime heathland

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In order to increase our knowledge and understanding of assembly rules in spider communities, we studied spider assemblages on maritime clifftops heathland with different restoration ages (ranging from 5 to 15 years). Sampling took place in Western France using pitfall trapping over the spring 2017. Several diversity metrics were computed: taxonomic (both alpha and beta), phylogenetic and functional diversities, and related to environmental drivers. A high variability of responses to changes in habitat conditions was observed depending on the metrics considered. A significant decrease in taxonomic diversity was highlighted when salinity increased. Contrarily, a significant increase in species richness was observed with higher humidity. Human related disturbance was not linked to any significant variation in spider's alpha diversity, but changes in beta diversity patterns were observed. Those patterns were due to turnover between degradation intensity states and decreasing heterogeneity within assemblages with decreasing degradation. A strong link was observed between phylogenetic, functional and taxonomic diversities (Structural Equation Modeling). This relationship was characterized by a cascading pattern of influences, with taxonomic diversity influencing phylogenetic diversity which influenced/s functional diversity. This pattern concurs with the trait conservatism theory. Phylogenetic and functional diversities are therefore sensitive to the same driver(s) than taxonomic diversity. This result highlights spider's responses to local environmental factors, and how their resilience (or dispersal) is such that the filters in this study are not strong enough to make spiders deviate from what the trait conservatism theory predicts.

Evolutionary Biology
Oral presentation

CHC composition of insect prey cuticle influences predator success

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Insects represent the main prey of spiders, and spiders and insects co-diversified in evolutionary history. One of the main features characterizing spiders is their web as trap to capture prey. One of the phylogenetically oldest thread specialized to capture prey is the cribellate thread. It consists of nanofibers, which do not only adhere to insects via van-der-Waals forces, but also interact with the insects' cuticular hydrocarbon (CHC) layer, thus enhancing adhesion. CHC layers consist of multiple hydrocabron types and are highly diverse between species. In this study, we show that CHC adhesion to cribellate capture threads is affected by CHC composition of the prey. We studied the interaction in detail for four different insect species with different CHC profiles and observed a differential migration of CHCs into the thread. The migration speed depends on the molecular structure of the hydrocarbon types as well as their viscosity, influenced by altering the ambient temperature during interaction. Consequently, adhesion forces to CHC layers differ depending on their chemical composition. Our results match predictions based on biophysical properties of hydrocarbons, and show that cribellate spiders can exert selection pressure on the CHC composition of their prey.

Ecology
Oral presentation

High trait diversity of spiders is associated with low herbivory in young forest plantations

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The biocontrol potential of spiders is context-dependent and spiders can enhance, reduce, or have no larger effect on pest densities and herbivory. The biocontrol potential of spiders may depend on the interaction between ecosystem type and trait composition of spider community as predation pressure on pests increases with increasing complementarity among predators. Currently, it is unknown how the trait composition of a spider community affects pest suppression and herbivory in forest plantations. We addressed this gap in knowledge in young (10-15 years) oak (*Quercus* spp.) and ash (*Fraxinus* spp.) forest plantations. During the season, we sampled (N = 96 samples) foliage-dwelling arthropods and leaves in four oak and four ash stands. We then measured the traits of spiders (body size, hunting strategy) and examined herbivory. We found that the system in both forest types was driven by bottom-up as well as top-down processes as spider diversity and densities initially increased with pest densities, but spiders reduced pests and herbivory when their trait diversity was high. This finding provides indirect evidence that a highly diverse community of foliage-dwelling spiders can be useful for the biological control of forest pests and forest management should aim to conserve highly-diverse spider communities.

Morphology
Oral presentation

Ram's horn organs unfolded: Their functional morphology in cheliferid pseudoscorpions

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Mating strategies in pseudoscorpions are stunningly diverse. In the family Cheliferidae, complex mating dances are present and sexual dimorphism is well pronounced. Conspicuously, male cheliferids possess so-called "ram's horn organs" (RHOs), that constitute paired tube-like structures of the posterior ventral diverticulum. At rest hidden under the posterior genital operculum, they are extruded towards the partner during courtship. We demonstrate the usage of these organs via video analysis of mating events in *Dactylochelifer latreillii latreillii* (Leach, 1817). In addition, the external and internal anatomy of RHOs, as well as adjacent structures, were reconstructed from synchrotron radiation micro computed tomography (SRµCT). Based on this data, RHOs in *D. l. latreillii* were shown to consist of an accordion-like folded outer cuticular layer and a single-layered inner epithelium. In the retracted state, the inner epithelium is arranged in two large folds extending into the RHO and the adjacent body cavity. In case of extrusion, inner and outer layers unfold, probably driven by an increase of hemolymph pressure, this mechanism is discussed.

Systematics, Biogeography & Diversity
Oral presentation

Phylogeography and Species Delimitation in Western Mediterranean *Ischnocolus* (Araneae: Theraphosidae)

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The family Theraphosidae (known as tarantulas) is most diversified in the tropics, however two genera inhabit the Mediterranean - *Chaetopelma* mostly eastern and *Ischnocolus* mostly western part of the basin. Their phylogenetic placement within the family has been long debated as well as the status of some *Ischnocolus* species. In our work, we implement for the first time a multi locus phylogenetic approach to resolve their position within Theraphosidae. Genetic data are further integrated with morphology and ecological data to explore species boundaries in *Ischnocolus*. Our findings indicate that two Mediterranean genera are not closely related - *Chaetopelma* was inferred as sister to African Eumenophorinae while *Ischnocolus* was repeatedly inferred as sister to Neotropical taxa. Within Western Mediterranean *Ischnocolus*, we found two clearly distinct morphotypes differing in lifestyle as well as morphology, which diverged in early Miocene. Within first morphotype, we found evidence in genetic, morphological and ecological data to redescribe south Moroccan endemic species and restore *I. mogadorensis* **sp. reval.** differing from *I. valentinus*. Although distinct allopatric lineages were also found within the second morphotype, lack of reliable morphological characters as well as poor node supports impeded proper species delimitation.

Evolutionary Biology
Oral presentation

Diversification through gustatory-courtship: An X-ray micro-computed tomography study on dwarf spiders

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Sexual selection has been considered to promote speciation. Sexually dimorphic species have been used to explore the supposed effect, however, with mixed results. In dwarf spiders (Erigoninae), many species are sexually dimorphic - males possess marked prosomal modifications varying from moderate elevation to bizarre shapes. These structures have been shown to produce substances that are taken up by the female. Since the transfer of substances increases male mating probability and female oviposition rate, the dimorphic traits evolved in the context of sexual selection. Here, we explore the evolutionary lability of these traits by investigating 1) if modified prosomata are inherently linked to nuptial-gift-producing glands, 2) if gland evolution preceded that of the modified prosomal shapes and by assessing 3) the probability of convergent evolution and cryptic differentiation, aiming at assessing the role of this trait complex in species divergence. We reconstructed the dimension of the glandular tissue and the muscular anatomy in the anterior part of the prosoma of 76 dwarf spiders and three outgroup species using X-ray micro-computed tomography. We incorporated the location of glands and muscles into an existing matrix of morphological traits of these taxa and reanalyzed their phylogenetic relationship. Our result supports that possession of glandular equipment is the ancestral state. The manifold modifications of the prosomal shape have evolved convergently. We found differences in glandular position between congeneric species with both modified and unmodified prosoma, indicating that glandular position is highly susceptible to changes. We reported on seven cases of gland loss, which suggest considerable maintenance costs of glandular tissue and nuptial feeding. Our results demonstrate divergent evolutionary patterns of gustatory-courtship-related traits, and a likely facilitating effect of this type of sexual selection on speciation.

Behavioral Biology
Oral presentation

Silk-borne chemicals of spider nuptial gifts elicit female gift acceptance

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Chemical communication is important in a reproductive context by conveying information used for mate recognition, assessment, and/or manipulation during courtship and mating. Spider silk often functions as vehicle for chemical communication between the sexes. However, despite its function being well described in females, male silk-borne chemical communication remains unexplored. Males of the spider *Pisaura mirabilis* silk-wrap prey (nuptial gifts) that is offered to females during courtship and eaten by the female during copulation. Interestingly, males that are rejected during courtship add silk to their gifts and are accepted after re-offering it, suggesting the presence of silk-borne chemicals that facilitate gift acceptance. To test this hypothesis, we offered females standardized gifts covered with male silk that was either washed in solvents or unwashed, and scored female gift acceptance. Females accepted gifts covered with unwashed silk more often than those with washed silk, suggesting that silk-borne chemicals of nuptial gifts stimulate female responses to mating. Silk-borne chemicals may potentially signal male underlying quality or manipulate females into mating beyond their reproductive interests given the occurrence of male cheating behaviour via nutritionally worthless gifts in this system.

Ecology
Oral presentation

Multiple effects of sperm competition intensity on paternity in a polyandrous gift-giving spider

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Sperm competition drives traits that enhance fertilization success, where particularly the amount of sperm transferred relative to competitors is key for attaining paternity. In addition, female reproductive morphology and male mating order may influence sperm precedence. In the polyandrous nuptial gift-giving spider *Pisaura mirabilis* copulation duration correlates positively with sperm transfer. Although female anatomy suggests first male precedence, a model proposed that under intense sperm competition, the last male achieves a relatively constant share of paternity, potentially shifting sperm precedence patterns. This could explain the maintenance of the nuptial gift, which prolongs copulation to secure a high paternity of the last male to mate. We determined the degree of polyandry in three wild populations by assessing the number of sires in broods with microsatellite markers. A conservative analysis identified up to 4 sires, with a mean of 2 sires per brood, which is consistent with an optimal mating rate for females. We varied sexual selection intensity experimentally and determined competitive fertilization outcome by genotyping broods. We found a mating order effect of deceasing paternity when females were mated to 4 males, however this effect disappeared when mated to 6 males due to increased sperm mixing. As the number of mating partners increased the proportion of males that successfully sired offspring drastically decreased. Males that copulated longer gained the highest paternity share independently of mating order, reinforcing the advantage of traits that prolong copulation duration under intense competition. We conclude that sperm competition intensity strengthens the impact of competitive sexual traits on fertilization outcome.

Systematics, Biogeography & Diversity
Oral presentation

Trust your gut (content) – DNA analyses of spider diet in permanent grasslands

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Spiders are top predators in temperate grassland biomes. Their diet is potentially susceptible to any factors that change the abundance and biodiversity of their arthropod prey, as well as competition and araneophagic predators. Using molecular gut content analysis, we investigate spider diet in grassland ecosystems, and compare the taxonomic compositions of both spider diet and arthropod community of the respective ecosystem. Preliminary results show great success in enriching prey DNA using specialized primers, as well as a high variance in spider diet composition.

Systematics, Biogeography & Diversity
Oral presentation

Landscape configuration and leaf phenology of host trees shape spider diversity in an alpine landscape

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Forest patches and single trees forming treelines display size and isolation gradients resembling vegetation islands. This specific spatial arrangement constitutes a suitable scenario to study biogeographic and environmental forces driving species diversity and distribution. In this study, our objective is to find out if biogeographic forces such as habitat size and isolation shape the species richness and composition of spider communities in the canopy of the treeline ecotone. We conducted three field surveys matching the active seasons of spiders (autumn, spring, and summer) between 2017-2018. We collected spiders living in the lower canopy (up to 2.5m) of *Pinus cembra* and *Larix decidua* – the dominant trees in the study area– by beating their branches. We found that the habitat size-isolation gradient is an important driver of the spider communities in the lower canopy of alpine trees. In line with the theory of island biogeography, the effect of island size (i.e. tree height) on spider species richness was positive, and the effect of isolation (represented by elevation and habitat distribution in the landscape) was negative. These biogeographic processes were however restricted to trees occurring at the treeline ecotone (the habitat most resembling islands and archipelagos in the alpine landscape), and to the active hunters guild. We also found evidence of a strong effect of seasonality and tree phenology on spider species richness produced by larch deciduousness - i.e. the loss of leaves promotes cycles of local extinction (during winter-spring) and recolonization (summer-autumn) for spiders. Finally, we observed different patterns for contrasting functional groups of spiders. On one hand, web weavers were especially sensitive towards processes occurring in continuous forest patches while on the other hand, active hunters respond stronger to processes occurring at the tree line.

Morphology
Oral presentation

Influence of temperature and humidity on the functionality of the calamistrum

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Nanofibers attract attention due to their advantageous surface-to-volume ratio and the variety of possible applications. However, their production remains challenging, as such fibers adhere to almost all surfaces due to van der Waals forces. Here, engineers could learn from nature's specialists in fibre processing: cribellate spiders. These spiders weave thousands of nanometer-thick fibers into their capture threads to catch and hold their prey. To this end, they use a comb-like structure on their hindmost metatarsi, called calamistrum. We were able to demonstrate that the calamistrum is essential for the spiders to handle nanofibers without sticking to them. Its anti-adhesive property is due to a fingerprint-like nanostructuring on the setae of the calamistrum, which effectively reduces van der Waals forces by preventing fibres from smoothly adapting to its surface, thus minimizing the contact area. The successful biomimetic transfer to artificial surfaces highlights the functionality of the structure and presents a first technical application of this innovative and so far, unique structure. In this work, the influence of relative humidity and temperature on the anti-adhesive properties of the biomimetically developed surfaces are investigated to study the relevance for cribellate spiders.

Evolutionary Biology
Oral presentation

The composition and specific toxicity of venom of araneophagous white-tailed spiders

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The venoms of predators are under strong selection pressure because the venom is a costly substance and prey may become resistant. Therefore, the efficiency and the composition of the venom should be tailored to affect the focal prey. Prey specialists represent a small proportion of spiders with narrow diets and intriguing hunting adaptations, including potent venom. The venoms of prey specialists are often taxon-specific and less complex than the venoms of generalists, but they have not been studied in detail. In our study, we investigated the venom composition and efficacy of the araneophagous white-tailed spider (Lamponidae: *Lampona* sp.) using proteo-transcriptomics and venom injection bioassays. The proteo-transcriptomic analysis revealed 208 toxin sequences, comprising 103 peptides and 105 proteins. Peptides were more abundant, bigger compared to typical araneomorph or mygalomorph toxins, and showed Cysteine-rich scaffolds likely representing variations on the inhibitor-cystine-knot (ICK) motif. Proteins included various toxins similar to galectins, leucine-rich repeat proteins, trypsins and neprilysins. *Lampona* venom was prey-specific, as it was more potent on their focal prey (spiders) than alternative prey (crickets). On the other hand, the venom of the related generalist (Gnaphosidae: *Gnaphosa* sp.) was similarly potent against both prey types. We also tested the efficacy of two venom fractions in *Lampona* (smaller and larger than 10 kDa). Only the high mass fraction was effective on both spider and cricket prey. Prey-specialised spiders represent a promising model system for the investigation of novel toxic compounds with an expected specific mode of action.

Ecology
Oral presentation

Differential predation among hunting strategies and cannibalism can explain coexistence in hyperdiverse spider communities

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Intraguild predation (IGP) is a common interaction in generalist spiders when they competitively exploit similar resources and prey on each other. Theoretical models predict limitations for intraguild predator coexistence unless some mechanisms, such as utilization of alternative prey (i.e., trophic niche partitioning) and cannibalism, increase the relative intraspecific clustering and interspecific segregation. As hunting strategies determine trophic niches of spiders and their own vulnerability to predation, the hunting strategies may also determine the relative importance of cannibalism, predation, and exploitative competition and consequently the intensity of IGP. The importance of hunting strategies on the potential outcome of IGP remains poorly understood. Using published data on spider prey of spider predators, we investigated how predation of a top-predator on a mesopredator is determined by the functional distance between both spiders to understand how predation and exploitation are distributed in spider communities. The hunting strategies of top-predators and mesopredators interacted to determine the relative capture proportions of conspecifics and hetero-specifics. Two mechanisms can reinforce coexistence in highly diverse spider communities. First, top-predators preyed most frequently on functionally distinct mesopredators, which indicates the overall intensity of IGP may be relaxed by a balanced distribution between exploitative competition and predation. Second, cannibalism was common for top-predators with a hunting strategy of frequently preying on functionally similar mesopredators. Cannibalism may lead to self-limitation of top-predator populations and may thereby facilitate coexistence between two predator species.

Ecology
Oral presentation

Spider Conservation in Europe

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Despite their ecological importance and diversity, spiders are underrepresented in conservation policies, especially in comparison to other groups of arthropods. We provide an updated frame of all the extant international and regional conservation tools focusing on spiders in Europe, with the goal of highlighting general patterns, limitations, gaps, and future directions in the field of spider conservation. Existing international legislation has limited coverage in Europe. Only one species, *Macrothele calpeiana*, is included in the Bern Convention and in the Habitats Directive. At the national and subnational levels, 178 species are formally mentioned in the legislation of 19 European countries. Moreover, the International Union for Conservation of Nature (IUCN) includes assessments for only eight spiders native to Europe. Spider conservation is also promoted by regional Red Lists and Red Books in 28 European countries, with 1,552 species assessed out of >4,000 occurring in Europe. Northern and Central European countries have the highest percentage of species assessed at the regional level in Red Lists and Red Books, mainly due to a broader understanding of the spider fauna occurring in these countries as a consequence of the greater number of arachnologists and local experts. Conversely, the Mediterranean basin has the highest spider diversities in Europe but conservation efforts are lacking, both in terms of assessments and national or subnational legislation, mainly due to taxonomic and geographical uncertainties. Among European species, *Dolomedes plantarius*, *Argyroneta aquatica* and *Eresus kollari* are the most frequently mentioned in European conservation measures, possibly due to their ecological traits and their strict association with declining habitats. Considering the current threats to spiders in Europe, mainly related to habitat loss and environmental changes, the protection of large areas of suitable habitat should be considered as the most effective approach to spider conservation.

Behavioural Biology
Oral presentation

Parasitoid host preference in native and invasive widow spider egg sacs

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During colonization, invasive species establish and spread into new habitats, where they may have an advantage over native species. Such advantages can be direct, through competition, or indirect, through effects via avoidance of predators or parasites. We investigated the differential impact of an egg sac parasitoid wasp, *Philolema latrodecti* (Eurytomidae) on two widow spider species, one native to Israel, the white widow, *Latrodectus pallidus*, and one invasive, the brown widow, *Latrodectus geometricus*. Female *L. geometricus* construct silk spike-like structures on the surface of their egg sacs, which may function as defenses against parasitoids. In no-choice tests, we found that wasps were more likely to parasitize and oviposited longer on white widow egg sacs. In choice tests with one brown widow egg sac and one white widow egg sac in close proximity, wasps showed no preference for egg sacs of either species. In contrast, in choice tests between white widow and brown widow spider webs and egg sacs, wasps first made contact with white widow spider webs significantly more, indicating that spider silk may be a cue for parasitoids to select hosts. After oviposition, wasps took the same amount of time to develop inside egg sacs of the two species. Parasitoids had higher reproductive fitness when parasitizing white widow egg sacs: more wasps emerged from white widow sacs, and wasps were larger than those emerging from brown widow egg sacs. Better defense of the brown widow egg sacs and fitness advantages of parasitizing white widow egg sacs are two possible mechanisms explaining the higher parasitism rate on white widow egg sacs. Our results suggest that invasive brown widow spiders are less preferred and less suitable hosts for parasitoids, which may contribute to brown widow invasion success.

Ecology
Oral presentation

Future shifts of cave-dwelling *Meta* spiders under the influence of global warming on Etna volcano, Sicily

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The genus *Meta* (Araneae: Tetragnathidae) in Europe includes two of the most renown inhabitants of the twilight zone of most hypogean sites across the continent: the European cave spiders *Meta menardi* (Latreille 1804) and *M. bourneti* Simon 1922. Compared to specialized cave spiders, both species show broad ranges of distribution, which can be explained in light of their life cycle encompassing an epigean and an hypogean phase and their wide tolerance to microclimatic fluctuations. Recent observations in Sicily in the Etna volcanic caves pointed out the presence on the island of both species, with *M. menardi* (so far unknown for the island) in a limited number of caves. On the basis of the field investigations conducted in 2020-2021, we analyzed the distribution and the ecology of *M. menardi* and *M. bourneti* on the Mount Etna. Although they share similar ecological requirements, our results demonstrate a significant effect of climate and altitude on the separation of the two species, with no sites of co-occurrence and *M. menardi* becoming dominant in caves above 1200 meters altitude. Accordingly, *M. menardi* was observed in sites with lower temperature (mean ± sd = 10.1±0.7°C) and higher precipitation (683 ± 22 mm) compared to *M. bourneti* preferring sites with higher temperature (14.3±1.8°C) and lower precipitations (614 ± 34 mm). In light of the recent global warming dynamics, a possible increase in temperature could favor the upshift of *M. bourneti* on Mount Etna, determining on one hand a possible interaction - of unknown outcome - of the two species and, on the other, a possible upshift of *M. menardi* towards upper areas subjected to very high volcanic risk. In this regard, investigations on the response of *Meta* spiders to increases in temperature on the Etna volcano represent an intriguing asset to its conservation.

Ecology
Oral presentation

Spider community in relation to vegetation structure and urbanization pressures in a protected raised bog (Red Moss Nature Reserve, Scotland)

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Spiders provide many ecosystem services and have been used to indicate habitat health and productivity. Spider communities are positively influenced by habitat complexity and structural heterogeneity in vegetation. They may also be heavily influenced by ecological change due to anthropogenic effects. However, spider research in many countries, including the UK, has largely focused on agro-ecosystems, highlighting the need for investigating non-agricultural habitats. This is the first study aiming to evaluate vegetation structure and anthropogenic disturbance effects on spider taxonomic and functional assemblages (guilds) in a protected raised bog (Red Moss Nature Reserve, Balerno, Scotland). Over a period of 27 weeks from Autumn 2020 to Spring 2021, 784 individuals comprised of 71 species and 14 families were collected using pitfall-traps and vegetation sweeping. Overall, this study found higher vegetation complexity, particularly vegetation height and richness, to significantly improve spider abundance and richness, while spider diversity was positively impacted only by vegetation richness. Although the distance from the nearby road had no significant effect on spider parameters, a functional classification approach revealed a distinctive spider assemblage in proximity to the road. This was characteristic of the natural wetland-woodland transition, possibly counter-balancing any negative disturbance effect. Furthermore, this highlighted the role of the ecotone in maintaining habitat heterogeneity, particularly relevant for taxa of high conservation value. Lastly, results emphasize the need to integrate invertebrate conservation in wetland management plans, as essential to fully understand the community-wide effects of climate change and ecological succession.

Ecology
Oral presentation

Non-consumptive effects of spider and bird on herbivory rate

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Non-consumptive effects have a complex interaction, as it can be either negative or positive effects on the prey, the prey host plant or from the prey to the predator. Previous studies showed that the presence of spider as predator reduced the herbivory damaged significantly. In this study, we tested whether there are any differences in herbivory rate in two local species of plants (*Rubus ideaus* and *Urtica dioica*) after being expose with predators-bird and spider via enclosure experiment. We found that the herbivory damage was significantly higher in *Rubus ideaus*, though no significant difference in the percentage of herbivory damage with the presence of predators' cues on both plant species. Feeding guilds analysis showed that leaf chewer and leaf sucker were more abundant in *Rubus ideaus*. We conclude that the specificity of predator-herbivore-plants plays an important role in determining the effects of herbivory damage.

Systematics, Biogeography & Diversity
Oral presentation

Phylogeny of wolf spiders from the Hawaiian archipelago inferred from multilocus genetic data: small- and large-scale relationships between spiders living on different islands, volcanoes and lava caves

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The Hawaiian archipelago is one of the world's finest natural laboratories for the study of evolution and patterns of speciation. We investigated wolf spiders (Lycosidae) which present on Hawaii a really diversified ecological range: some are found at the top of volcanoes, some others on lava flows, some in lava caves and even some in wet forests. Here we investigated the evolutionary relationships of 200 specimens of wolf spiders from the Hawaiian archipelago. We studied the relationships (1) amongst wolfs spiders from the different islands of the Hawaiian archipelago, and (2) among the islands between the spiders found on different volcanoes and (3) on a volcano between the spiders that live at the surface and in the lava caves. Phylogenies were reconstructed by maximum likelihood and Bayesian methods using eight molecular markers; the mitochondrial genes 12S rRNA, 16S rRNA, COI and the nuclear genes 18S, 28S, ITS2, Actin5C and Histone 3. These markers were assessed by multiplex PCR and next generation Illumina amplicon sequencing. The resulting phylogenies allowed us to determine the relationship between Hawaiian wolf spiders living on the different islands, volcanoes and caves. In particular, lava caves wolf spider species are all related to each other and thus seem to have colonized the archipelago from cave to cave. Conversely, our phylogenies did not clearly identify the relationship between web-weaving Hawaiian spiders and other Hawaiian spiders because the orb-weaving specimens were too few and too old. The results of this study are a first step in reconstructing the phylogenetic relationships among wolf spiders from all Pacific islands, and represent an important insight in the understanding of the still deficient evolutionary history of the Lycosidae.

Systematics, Biogeography & Diversity
Oral presentation

Phylogeny and systematics of the *Pardosa lugubris* species group (Arachnida, Araneae, Lycosidae)

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The spider genus *Pardosa* C.L. Koch, 1847 is the largest and most widespread genus in the family Lycosidae (Araneae), including 549 species. Species of the genus are distributed in the Palaearctic, Nearctic, and enter the Indo-Malaysian and Ethiopian regions. Species of the genus are divided into groups of species based mainly on morphological characters: structure of copulatory organs, coloration, measurements of leg length, and carapax. At the same time, species within groups practically do not differ in morphology, especially females. *Pardosa alacris* is considered a typical species of the genus, this species belongs to the *Pardosa lugubris* species group, the morphology of females of which seems to be one of the most complex. According to some authors, the genus deserves to be divided into several genera. At present *P. lugubris* group includes 7 species. As defining characters of spiders of the Lycosidae family, the measurements of body length, relative eye size, ratio of carapax length to foreleg femur length, as well as the structure of copulatory organs of males and females are used. In the group of the studied species, females are traditionally determined by the males caught in the same area. The aim of the study was to investigate the relationships of species within the group, using the methods of molecular phylogenetics, linear and geometrical morphometry. The first stage of the work was the selection of genus-specific primers for PCR and development of a technique for DNA isolation from organisms by boiling. Cytochrome oxidase genes, 28S, and 12S ribosome subunits were selected as markers. We also synthesized a new primer that amplified, in combination with already known primers for the cytochrome oxidase gene, a site measuring 1,200 bp. Preliminary data show that the molecular method allows us to distinguish only part of the species. *Pardosa koponeni* forms a separate clade, a sister clade containing *P. lugubris*, *P. saltans*, and *P. alacris*, while morphologically *P. koponeni* is the least different from the *P. lugubris*. The species *P. caucasica* is well separated. The second part of the study consisted of checking the morphological characteristics used to separate species of the group. The coloration of the palpus of males proved to be a trait effective for distinguishing species, and the partial effectiveness of measurements of body length ratios was shown. The method of geometric morphometry was proposed for the first time to study the epygine of females. The partial efficiency of this method was shown; when analyzing the principal components by 7 landmarks on the graph, *P. caucasica* forms a separate cluster. The difference is caused by the structure of anterior pockets of epygine. Based on the data of geometrical morphometry, we compiled the first identification key for females of the *Pardosa lugubris* species group. Linear morphometry of ratios of body lengths of spiders showed small efficiency.

Systematics, Biogeography & Diversity
Oral presentation

Multilocus genetic and morphological phylogenetic analysis of the jumping spider tribe Nannenini with the description of one new genus and four new species (Araneae: Salticidae)

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Sri Lankan endemic genus *Epidelaxia* Simon, 1902 has remained taxonomically unrevised and has never been subjected to phylogenetic evaluation since its initial description. This study is designed to investigate the phylogenetic placement of *Epidelaxia* within the Tribe Nannenini Maddison, 2015. Using a multilocus molecular data set (18S, 28S, CO1 and H3) and 61 morphological characters (coded for 17 taxa), we provide the first hypothesis on the internal phylogenetic structure of the *Epidelaxia* and its placement within tribe Nannenini. We used TNT 1.1 for the parsimony analysis of the morphological data matrix and RAxML for the maximum-likelihood (ML) analysis of the molecular data set. The resulting ML analysis includes 30 taxa (09 ingroups, 21 outgroups). All analysis strongly supports the monophyly of *Epidelaxia* and validates its placement within the tribe Nannenini. Additionally, this study provides new diagnoses, description of a new genus and four species and a key to all *Epidelaxia* of Sri Lanka.

Behavioral Biology
Oral presentation

Risky business: Males choose more receptive adults over safer subadults in a cannibalistic spider

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Male brown widow spiders (*Latrodectus geometricus*) can mate with adult as well as immature (subadult) females. Mating with adults starts with lengthy courtship and ends with female cannibalistic attack, but mating with subadults involves only brief courtship and no cannibalism. Therefore, male preference of subadult over adult females is predicted. We investigated male mate choice, and despite our expectations, males chose contact pheromones of adults. This suggests either that males do prefer adult females or that subadult females produce weaker or no chemical signal. We swapped adult and subadult females between webs, and show that some courtship components are triggered solely by contact with the silk (web alteration) or body (silk binding) of adult females, but vibratory courtship occurs regardless of the web origin or developmental stage. In our experiments, subadults females were more reluctant to mate than adults. We conclude that males can detect subadult females, but are more likely to invest in mating attempts with adults. Low courtship investment may explain the reduced receptivity of subadults, or could be an evolutionary response of males to lower subadult receptivity.

Ecology
Oral presentation

Phenotypic plasticity and genetic adaptation in the wasp spider: Response to variation in winter conditions

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Range expanding species offer the unique opportunity to study organismal adaptation to novel climates in real time. The European wasp spider, *Argiope bruennichi*, has expanded its range from warm, oceanic and Mediterranean climate zones into the continental climate zone of the Baltic States and Scandinavia within the last century. Continental climates are characterized by greater seasonality and colder winters compared to the Mediterranean. This range expansion is coupled with genetic differentiation of the edge populations relative to core populations, leading to the central question of this project: to what extent are local adaptation and/or phenotypic plasticity responsible for successful colonization of northern latitudes in the wasp spider? To answer this question, we followed a reciprocal transplant common garden design to compare overwintering survival and cold tolerance traits (supercooling point, lower lethal temperature, chill coma recovery time) of edge and core populations, at mid-winter and after winter. Our findings indicate a strong role of local adaptation in determining cold tolerance, with seasonal differences in the degree of plasticity. Genetic adaptation seems to be coupled with a loss of plasticity in some traits.

Neurobiology
Oral presentation

Comparative anatomy of the visual system for motion processing in the brains of cursorial and stationary hunting spiders

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Some animal species have evolved different types of eyes that are specialized for specific tasks. A prime example for this are spiders, which possess eight pairs of eyes, of which one pair (the principal eyes) are used for object discrimination, while the three other pairs (the secondary eyes) are used for movement detection. We investigated the brain neuropils that process information from the secondary eyes in four spider species: Two cursorial hunters *Marpissa muscosa* (Salticidae) and *Pardosa amentata* (Lycosidae) that strongly rely on visual cues, and two stationary, web building hunters *Argiope bruennichi* (Araneidae) and *Parasteatoda tepidariorum* (Theridiidae) that detect prey by vibrational cues. We predicted that the differences in primary sensory input between the different species would be mirrored by differences in those brain areas that process the incoming information. Using Bodian silver impregnations, immunohistochemistry, microCT and dye backfills, we investigated the structure and volume of the visual neuropils and higher-order neuropils, as well as their connectivity, including projections to the ventral nerve cord. We show that the neural substrate for movement detection differs in neuropil number, arrangement, relative volume and connectivity between the investigated spider taxa. While the cursorial hunters possess prominent mushroom bodies that send projections toward the leg neuropils, these are much reduced or absent in the stationary hunting spiders. Our results indicate that the spider mushroom bodies may play a major role in visual motion processing, and show that depending on lifestyle, strong differences exist in the visual systems of spider species.

Ecology
Oral presentation

SPIN-CITY: urbanisation effects on colour, size and web building in *Araneus diadematus*

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Cities can be viewed as "living labs" that provide unique opportunities to investigate evolution in real-time as they differ markedly in (a)biotic factors compared to surrounding rural areas. Urban areas can heat up considerably due to the heat island effect. It is expected that this increased temperature prompts an evolutionary colour response with lighter individuals in urban areas that can stay cooler compared to their darker counterparts. Because of smaller prey in cities, it is also expected that spiders build webs with smaller meshes to increase capture efficiency. We investigated urbanisation effects on *Araneus diadematus* in Ghent (Belgium) using a picture based approach, supplemented with spectrophotometry and thermography. We also present "SPIN-CITY for scientists": we are currently looking for collaborators to investigate these urbanisation effects through replicated sampling of cities across Europe and North America (www.spiderspotter.com).

Systematics, Biogeography & Diversity
Oral presentation

eDNA-based monitoring of canopy associated arthropod communities

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Anthropogenic stress significantly influences biodiversity. Scientists are researching the insect decline to finally identify the main drivers of this observation. However, there are almost no time series available that could give insights for the true factors of the most recent events. The German Environmental Specimen Bank (GESB) has been collecting a variety of samples for over 35. Our special interest lies in the GESB`s leaf samples consisting of four abundant tree species in Germany. We developed a method based on the leaf samples´ environmental DNA to analyze the changes in arthropod communities. In total, we analyzed almost 400 samples and tested our discoveries against pesticides, landscape changes and weather variables. As a result of our community analyses we present novel and interesting insights of the canopy biocoenoses and changes for the last three decades. Surprisingly, we recognize a German-wide expansion of an unidentifiable Acari species coming from southern Europe, reaching the most northern sample sites just recently. The developed methods and the results of this study have the potential to be used in future monitoring projects around the world to help us to understand arthropod communities better.

Morphology
Oral presentation

Underestimated complexity of cribellate capture threads: stainability indicates variations in protein composition of silk fibres within a thread and between species

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Besides the well-known dragline silk, spiders produce many other types of silk with different chemical and mechanical properties. By interweaving a combination of these silks, even complex structures such as webs, attachment discs or capture threads can be built. The capture threads of cribellate spiders, e.g., consist of a complex multi-fibre system with thousands of individual fibres and up to seven different silk types - including nanofibres. The silk types involved thus form a fibre composite, in which each fibre is most likely assigned a specific mechanical task. For analysing the properties of the individual silk types, they would ideally have to be separated from their interconnected system. However, this is either not possible at all, or only by introducing mechanical stress, which would significantly influence their material properties. We present here a structural analysis of the threads of three different cribellate spiders (*Badumna longinqua*, *Deinopis subrufa*, *Uloborus plumipes*) by using different preparation and imaging techniques. In previous studies, the assignment of different fibre types was primarily based on varying diameters only. However, differences in light refraction effects, fluorescence and stainability revealed that fibres from different species - previously assigned to the same silk type - must actually feature different material components. Considering the individual function of the fibres within a cribellate capture thread, this could also have an impact on the mechanical properties and imply that there are more functional types of fibre than previously recognised.

Ecology
Oral presentation

Poisoning the web: Spiders in a polluted world

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The presence of artificial light at night (ALAN) and the overuse of pesticides are independently implicated in the observed global declines of invertebrates. However, while these pollutants co-occur in disturbed environments, their interacting effects have not been well studied. There is evidence of circadian rhythms in pesticide susceptibility in some insects, but the effects on spiders have not been tested experimentally. Both pollutants have been shown individually to affect development, morphology, and behaviour in spiders, so there is potential for interesting effects. In a laboratory study, I reared spiders under either a natural day:night cycle or chronic ALAN, and performed repeated acute exposures to different concentrations of the neonicotinoid insecticide imidacloprid. I explored the impacts of these two pollutants on the growth and climbing performance of the native Australian garden orb-weaving spider (*Eriophora biapicata*). This nocturnal orb-weaver is widespread and abundant in a range of anthropogenically disturbed urban and agricultural habitats. I found that the effects of imidacloprid increased with increasing concentration, but the impacts interacted with exposure to ALAN. Pollutants rarely act alone in disturbed habitats, so these results highlight the importance of considering multiple stressors when assessing the biological consequences of pollutants. I discuss these results in the context of the natural history of *Eriophora biapicata* in urban habitats, with reference to several interesting aspects of their biology.

Ecology
Oral presentation

Distribution and habitat characteristics of the myrmecophile scorpion *Birulatus israelensis* Lourenço 2002

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The Levantine scorpion, *Birulatus* Vachon, 1974, is known from four species, each described from a single specimen or locality. Since their description, very few additional *Birulatus* scorpions, if any, were found. In 2016 several individuals of *B. israelensis* were observed during a field survey in association with the harvest ant *Messor ebeninus* Santschi, 1927, suggesting that *B. israelensis* is a myrmecophile. We investigated this relationship and the drivers of the species' distribution. We surveyed 10 *Messor* ant nests at 20 new sites in the region surrounding the 2016 locality. Each nest was searched with UV light on moonless nights for live *Birulatus* or remains of their exuvia, along the ant's foraging trails and at the nest and its vicinity, including litter piles and underground upper chambers. We modelled *B. israelensis* distribution within Israel using presence-absence ecological niche model ensembles and seven environmental variables signifying soil type, topographical parameters, precipitation, and temperature. Our study indicates an extensive and exclusive association between *B. israelensis* and *Messor* ant nests. We found up to 12 individuals in a single ant`s nest, either among the ants on the foraging trail or inside the nest upper chambers. Remains of *B. israelensis* exuvia were also found in the nest`s outer litter piles. No individuals of *B. israelensis* were found in a distance of more than 50 m from a nearby *Messor* nest. Our model suggests that topographic wetness, soil type, slope, and winter temperatures, best predict the presence of *B. israelensis*. Further surveys are needed to verify whether *B. israelensis* is found in the sites predicted by the model.

Systematics, Biogeography & Diversity
Poster

Laniatorean harvestmen (Arachnida: Opiliones) from mid-Cretaceous Burmese amber

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One new family, nine new genera and nine new species of laniatorean harvestmen (Arachnida: Opiliones: Laniatores) from the mid-Cretaceous (Cenomanian, ca. 99 Ma) Burmese amber of Northern Myanmar have been described. The families Beloniscidae, Petrobunidae, Podoctidae, Pyramidopidae, Tithaeidae are recorded for the first time as fossils and an extinct family, Mesokanidae, has been recognised. Three new species are added to the family Epedanidae, which was previously known from Burmese amber. Two additional juveniles with Insidiatores affinities are also described, which is of interest as this Infraorder is not known from Southeast Asia today. These records offer new mid-Cretaceous constraints for the origins of six modern families and suggest that the Burmese amber forests hosted a fairly diverse fauna of laniatorean harvestmen which mostly belonged to lineages still present in Southeast Asia today. A further inference from these finds is that the modern Laniatores fauna of Southeast Asia may have had a Gondwanan origin.

Systematics, Biogeography & Diversity
Poster

Cryptic genetic diversity of the North African scorpion, *Buthus occitanus* (Scorpiones: Buthidae)

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The variability of the cytoplasmic genome was assessed by directly sequencing a 304 bp fragment of the DNA encoding mitochondrial 16s rRNA in 11 scorpions belonging to the species *Buthus occitanus*: 11 sequences and 7 haplotypes were recognized. The "uncorrected p-distances" genetic distances vary between 0.3% and 4.3% between the different haplotypes of *Buthus occitanus*. The lowest value is recorded between the two haplotypes Buth06occitanus and Buth07occitanus and grouping the two scorpions of Telept. However, the highest divergence was recorded between the two haplotypes Buth04occitanus and Buth05occitanus, respectively defining the haplotypes of Kerkena and Djerba scorpions. We note that except for the two Telept specimens which each show a separate haplotype, the other specimens belonging to the different localities combine into a single haplotype. From 11 individualized sequences, 7 haplotypes were identified. These sequences were analyzed both by the parsimony method ("Branch and Bound" method; the number of haplotypes, in this case, is low, which allows the application of this method) and by the method. "Neighbor Joining" and always taking as an outgroup the 16S rRNA mitochondrial sequence of *Buthus occitanus* from Morocco for tree rooting. The two trees drawn from these sequences were identical. The majority consensus tree obtained by bootstrap analysis over 1000 iterations highlights two main branches: The first is defined by the haplotype of the Tunis specimen, the second, brings out two sub-branches: one, defined by the haplotype from Tozeur while the other sub-branch groups the remaining haplotypes belonging to the different localities of Tunisia. It is important to note that apart from the two Telept specimens, which define two combined mitochondrial haplotypes (89% bootstrap value), all other scorpions belonging to the same locality, define the same haplotype. However, the grouping of the two haplotypes Buth02occitanus and Buth05occitanus from Kef and Kerkena Island respectively is supported by a high value of Bootstrap, the latter grouping argues in favor of a possibility of passive transport of scorpions between geographically distant localities.

Ecology
Poster

Genomic determination of reproductive mode in facultatively parthenogenetic Opiliones

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Despite sexual reproduction posing myriad short-term costs to individuals, sex is near ubiquitous in animals. To understand the factors maintaining sex, study of alternative reproductive modes is necessary. Facultative parthenogenogenesis is theorized to mitigate many costs of sex; individuals can participate in occasional sex and obtain genomic benefits. *Leiobunum manubriatum* and *L. globosum* are facultatively parthenogenetic harvestmen well-suited for mating system studies as males vary in frequency and coercive sexual traits across populations. We asked: if populations of facultative parthenogens contain high frequencies of coercive males, will females mate? Will offspring production differ from conspecific, low male frequency populations? We addressed these questions by first collecting females and egg clutches from populations varying in male frequency. In *L. manubriatum*, female fecundity did not significantly vary between populations with high or low male relative frequency, despite the potential release of the latter from sexual conflict. Using three genotyping methods, we revealed *L. manubriatum* offspring from high-male populations were primarily produced asexually, despite sex ratios in these populations approaching equality. Rapid and accurate SNP genotyping will continue to provide inference on sire assignment, allowing us to address broader evolutionary questions regarding the maintenance of sex.

Systematics, Biogeography & Diversity
Poster

The enigmatic genus *Mastigusa* Menge, 1854 (Araneae, Hahniidae): phylogenetic placement and provisional taxonomical revision

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A first attempt of phylogenetically placing the spider genus *Mastigusa* (Menge, 1854) using molecular data is presented, together with a provisional revision of the three species currently ascribed to the genus. These spiders, found in Europe, North Africa and the Near East, are fascinating for several reasons. They show extreme modifications in the morphology of both male and female genitalia and peculiar ecological features, being often observed in close association with different ant species. The genus *Mastigusa* had a troubled taxonomic history with uncertainty about its phylogenetic relationships and the number of species that it should include. The genus was placed in different families but it was never included in any published molecular phylogeny. Three species are currently recognized: *M. arietina* (Thorell, 1871), *M. lucifuga* (Simon, 1898) and *M. macrophthalma* (Kulczyński, 1897). The circumscription of the three species has been problematic due to the inconsistency of the diagnostic characters used, leading to confusion about their actual status and distribution. Our multi-locus phylogenetic analysis shows *Mastigusa*, currently placed in the family Hahniidae, clustering within Cybaeidae. The morphological examination of the types and specimens collected all over the known distribution range of the genus reveals that only specimens from Slovenia and Croatia bare morphological features that differentiates them from all the other populations. We propose the movement of the genus *Mastigusa* to Cybaeidae and we provisionally revise the status of the three species by suggesting *M. lucifuga* as a junior synonym of *M. arietina* and by redescribing both *M. arietina* and *M. macrophthalma*.

Ecology
Poster

Arctosa cinerea - distribution and status in Latvia

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Arctosa cinerea is the only spider species protected by the law in Latvia up to date. In this study, we analyze all reported observations of the species in the territory of Latvia during the period of 2003-2021 in order to estimate the species' current status. This is done according to IUCN Red List criteria for updating all Red List species, as well as potential Red List species of Latvia. Such updates have been carried out already in neighboring countries: Lithuania, Estonia, and Finland. Information was gathered by both - scientists reporting on an official site by Latvian Nature conservation agency www.ozols.gov.lv and citizen science platform for reporting of observations www.dabasdati.lv. *Arctosa cinerea* is recorded at 15 sites, during the study period a total of 32 adult specimens were observed. In most cases, the species was discovered in the foredunes of the Baltic Sea, where it was hiding under the stones or under the pieces of deadwood. On one occasion the species was observed at the river bank where the wolf spider was crawling on the sand (June 3, 2008), ca. 4 km from the sea. *Arctosa cinerea* preferred habitat to live on bare sand, also at river banks. There is no data on the species presence in inner dunes or other similar structures as sandy places in Latvia up to date. Given the available information, *Arctosa cinerea* may be considered endangered in Latvia, but more data are needed to confirm this status.

Systematics, Biogeography & Diversity
Poster

Loxosceles: a true troglophile, opportunist, or both?

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Loxosceles rufescens Dufour, 1820, is native to countries surrounding the Mediterranean basin. Outside of its original distribution range, *L. rufescens* was suggested to be a synanthropic species due to its proximity to man, occurrence in artificial habitats, and its ability to invade new habitats. In its original distribution range, it is found in shaded natural habitats, in addition to artificial habitats. Recently we conducted a thorough arachnid survey in 35 Levantine caves. Surprisingly, *L. rufescens*, which was identified morphologically, was the third most common spider species in our survey. We hypothesized that *L. rufescens* is an accidental cave visitor species, as it has no troglomorphic characters. As a potential opportunistic species, it might be able to utilize the cave habitat as a temporary shady refuge. Therefore, we predicted that it would be found only in the cave entrance, not in the twilight or dark zones. Moreover, as an accidental visitor, we predicted that it would not establish viable populations within caves. We compared the number of individuals found in all ecological zones in the sampled caves to test the first hypothesis. We found 116 individuals in 19 of the 35 caves sampled. Of the 116 individuals, 76 were found in the cave entrance, 63 in the twilight, and 13 in the dark zone. We also recorded dense, viable populations of males, females, egg-sacs, and juveniles in some of the caves. These results do not agree with our hypothesis that *L. rufescens* is an accidental visitor in caves. On the contrary, our results suggest that *L. rufescens* is a true cave troglophile in Levantine caves. Further study is needed to understand its opportunistic nature in caves. In addition, we are conducting a molecular study to verify cryptic-species existence.

Systematics, Biogeography & Diversity
Poster

A contribution to spider fauna (Arachnida: Araneae) from Bjeshkët e Nemuna mountains (Kosovo)

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Kosovo is the least studied country in the Balkan Peninsula in terms of spider fauna and uninvestigated areas still remain. From Bjeshkët e Nemuna Mountains until now were reported only 13 species. We collected spider specimens from 20 sites in Bjeshkët e Nemuna National Park. In total, we collected and identified 321 specimens, 87♂♂, 234♀♀, excluding juveniles. These specimens belong to 91 species, 69 genera, and 23 families. Of those, 47 species, 17 genera, and 3 families are new records for the spider fauna of Kosovo, 78 species are new for the mountain. Spiders from subterranean habitats are not included in this investigation.

Ecotoxicology
Poster

Mud Dauber Nests as Sources of Spiders in Mercury Monitoring Studies

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Identifying ecosystems where biota may be contaminated with hazardous levels of methylmercury (MeHg) is a challenge. One approach for determining site-specific MeHg contamination is to monitor MeHg contamination in sentinel species. Terrestrial spiders that consume emergent aquatic insects (e.g., midges and mayflies) have been proposed as sentinels of MeHg contamination of aquatic ecosystems. The purpose of the present study was to determine whether a novel sampling technique, collection of spiders from nests of mud dauber wasps (Sphecidae), would be an efficient method for capturing MeHg-contaminated spiders for use as sentinels in ecological risk assessments. Mud dauber nests were collected near the Clear Fork of the Trinity River in Fort Worth, Texas (USA). Nests contained 627 unconsumed spiders from 5 families: Araneidae, Salticidae, Thomisidae, Oxyopidae, and Theridiidae. MeHg concentrations ranged from 12.2 to 56.3 ng/g wet weight in Thomisidae and Araenidae, respectively. MeHg concentrations of the spiders were generally low relative to risk thresholds for adult birds, but a few families of spiders could pose a risk to nestlings. Although mud dauber nests have been recognized as a source of spiders for biodiversity studies, the present study is the first to demonstrate the potential use of spiders collected from mud dauber nests for ecotoxicology studies.

Ecology
Poster

Diversity of orb weaving spiders' silk tensile properties on a climatic gradient

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For more than 350 million years, silk has played a central role in the survival of spiders, thus evolving into a variable and outstanding biological material. Investigating spider silk variations and how they come to pass can further our understanding of spider evolution and ecology, as well as inform choices when designing biomaterials. Understanding the influence of the environment on living organisms is a major ecological tenet, and climatic factors act as comparably stable evolutionary drivers that explain many global trait patterns. Likewise, the evolution of different spider silk tensile properties might directly or indirectly have been influenced by these climatic factors. Here, we compare the tensile properties of dragline silk from orb weaving spiders between different climatic zones in Colombia, one of the most biodiverse countries worldwide, to uncover patterns in silk tensile property distribution driven by climatic variation. To that end, 52 spider species and their silks have been collected in 8 sites, from semi-arid to super humid climates over an altitudinal range of 3500 meters. Preliminary results on the variation of tensile strength, elasticity and toughness of the silks are reported.

Systematics, Biogeography & Diversity
Poster

New records of jumping spiders (Araneae: Salticidae) from Nepal

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This paper presents new records for nine species of jumping spiders (A*semonea tenuipes*, *Chrysilla volupe*, *Epocilla aurantiaca*, *Hyllus semicupreus*, *Icius alboterminus*, *Phintella vittata*, *Siler cupreus*, *Telamonia dimidiata* and *Telamonia festiva*) from Nepal. Habitats and distribution of species within the country are briefly discussed.

Morphology
Poster

How do spiders taste and smell? Insights from ultrastructure of tip-pore leg sensilla in the wasp spider *Argiope bruennichi*

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Sensory biology of arthropods relies mainly on cuticular sensilla. Some sensilla receive mechanical or chemical (olfactory or gustatory) information; others detect changes in temperature, humidity, or CO2. Most of our knowledge of the structural and functional diversity of sensilla is based on studies on insects and only little is known of the structural and functional diversity of sensilla in spiders. One major gap of knowledge concerns the identity of olfactory sensilla in spiders. This is surprising since behavioral observations clearly show that spiders use airborne chemicals to detect prey, predators and mating partners. In insects, wall-pored sensilla are known to receive volatile odors but have only been reported as singleton sensilla from one spider species. Sensilla with a single, terminal pore, however, seem common in spiders. Although they are assumed to function as contact-chemoreceptors by analogy with insects, they appear to be the only candidates for olfaction in spiders. To assess the possibly cryptic diversity of chemosensilla in spiders, we scrutinized the walking legs of *Argiope bruennichi* utilizing SEM and found only tip-pore sensilla. By means of TEM, we investigated the internal anatomy of the tarsal tip-pore sensilla for structures that might reveal differential receptor modalities. We expected that in gustatory sensilla dendrites of all chemoreceptor neurons should reach the tip-pore, just like in tip-pore sensilla of insects, whereas olfactory sensilla should contain dendrites of various lengths and structure (ramifications), accessible to volatile odors via cryptic wall pores. However, tarsal tip-pore sensilla of *A. bruennichi* lack cryptic pores, but possess up to 22 chemoreceptor neurons (only 4 present in insects). Our TEM data suggest that some of the chemoreceptive dendrites terminate little distant from the tip pore. Future research will assess whether there is disparity in sensilla ultrastructure and function on different podomeres or no such disparity exists, if tip pore sensilla in spiders can receive both gustatory and olfactory compounds.

Ecology
Poster

Adhesion of *Larinioides sclopetarius* (Araneae, Araneidae) capture thread in relation to pull-off velocity of glass plates and elytra of *Tenebrio molitor* (Coleoptera, Tenebrionidae)

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Ecribellate capture threads are characterized by viscoelastic glue droplets; the elasticity of both, the axial fiber and the glue has a significant influence on the stickiness of the thread. In 2010, Sahni et al. measured the required force to separate a single glue droplet from a glass probe and showed that it increases with pull-off velocity, i.e. that it is rate dependent. We tested whether the pull-off velocity has an influence, not only on the stickiness of a single glue droplet, but instead on a piece of capture thread of defined length. Glass plates and elytra of the beetle *Tenebrio molitor* (Linnaeus, 1758) were used as objects and an Index of Adhesion (IOA) gave an indirect measure for the force required to pull off the glass plate or the elytron from the capture thread. We used capture threads of the Bridge Spider, *Larinioides sclopetarius* (Clerck, 1757) for measurements with velocities of 10, 40 and 70 mm/s and an acceleration of 4 mm/s2. Our results show that the adhesion of the capture thread of *L. sclopetarius* is rate dependent for both, glass plates and elytra, and the IOA accordingly increases with rising velocity.

Evolutionary Biology
Poster

Araneus diadematus microbiome composition and its possible changes due to urbanization

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Organisms harbour microorganisms that can sustain essential function to the host. Host-symbionts association are shaped by the host but also influenced by the host's environment. Microbiome of various taxa has been shown to be affected by anthropogenic perturbation such as exposure to pesticide and heavy metals, climate change and habitat fragmentation. As urbanization integrates several of these environmental perturbations it can be predicted to affect host-symbionts interactions. Microbiome variation induced by urbanization may increase host phenotypic variation and thus contribute to host urban adaptation. A few studies have investigated urbanised population compared to rural population in birds and the impact of urbanization on microbiome vary according species, season and spatial scale. The garden spider *Araneus diadematus* (Araneae) is one of the most common species in both urban and non-urban orb web spider communities in western Europe making it a valuable model to study the effect of urbanization on spider's microbiome. The goal of this study is to describe the unknown microbiome of the garden spider and to investigate whether it varies according to its occurrence in urban and rural habitats. 20 adult females were sampled in 7 cities and in the associated rural area across Denmark, Sweden, Germany and Belgium for a total of 14 sites. DNA was extracted from whole animals and the microbiome analysed by 16sRNA gene amplicon sequencing.

Systematics, Biogeography & Diversity
Poster

New data on the genus *Pardosa* from Iran (Araneae, Lycosidae)

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The Lycosidae, commonly known as wolf spiders, is the sixth-largest family distributed worldwide. *Pardosa* C. L. Koch, 1847 is the most species-rich lycosid that currently contains 536 species. The genus is including small to medium size slender wolf spider species. The members can be distinguished from other genera by the vertical sides of the head and the ratio of AME diameter/clypeus height. Although Iran is amongst the most biodiverse countries geographically, the spider composition of the country is poorly understood. The wolf spiders of Iran are no exception and up to now, only 26 *Pardosa* species have been recorded for the country. During the period of study Iranian lycosids, we found a new species, *Pardosa karadagh* sp. n., belonging to the northwest of Iran. Also, *Pardosa caucasica* Ovtsharenko, 1979 and *Pardosa incerta* Nosek, 1905 are reported from the country for the first time. Accordingly, the total number of lycosid species recorded from Iran is raised to 73 species.

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