European Society of Arachnology
Early Career Newsletter
February 2025, No. 4

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Dear fellow arachnologists

Here comes the next edition of the Early Career Newsletter (EarlCNews) from the European Arachnological Society. The EarlCNews serves as a dedicated platform for the society's younger members, including Bachelor's, Master's, and PhD students, providing them with a unique opportunity to showcase their ongoing projects and recent research findings. This special issue compiles summaries of theses completed within the past year across various academic levels, offering a comprehensive overview of the latest contributions to arachnological research by early-career scientists.
The abstracts featured in this edition are organized into three distinct scientific areas. Such categorization allows readers to easily navigate through the diverse range of research topics and find studies aligned with their specific interests. To foster collaboration and knowledge exchange within the arachnological community, each abstract is accompanied by the corresponding young researcher's email address. This enables direct communication between members, facilitating discussions, potential collaborations, and the exchange of ideas. Such networking opportunities are invaluable for early-career researchers, as they can lead to mentorship relationships, research partnerships, and a broader understanding of the field's current trends and challenges.
The European Arachnological Society's initiative to create this specialized newsletter demonstrates their commitment to nurturing the next generation of arachnologists. By providing a dedicated space for young researchers to disseminate their work, the society encourages scientific growth, promotes diversity in research topics, and helps bridge the gap between established researchers and those just beginning their careers in arachnology.

Gabriele Uhl
President of the European Arachnological Society

#BEHAVIOUR, ECOLOGY & CONSERVATION

Tomáš HAMŘÍK | PhD thesis

Local and landscape factors affecting the biodiversity of spiders in temperate deciduous forest and forest-steppe ecosystems

Open woodlands and forest-steppes are among the biologically richest yet highly endangered ecosystems in the temperate zone. The conservation of open woodlands and forest-steppes requires an understanding of the factors that determine the occurrence of functionally important organisms closely related to specific environmental conditions. Among these organisms are spiders, constituting the most diverse group of invertebrate predators with distinct environmental requirements. The biodiversity of spiders is influenced by both habitat-related factors (local factors) and landscape-related factors (landscape factors). However, there exists a notable gap in knowledge regarding the effect of these factors on spider biodiversity in temperate deciduous forests and forest-steppe ecosystems. The doctoral thesis comprises four studies. Three of these studies aim to compare the effect of forestry treatments on the biodiversity of ground-dwelling spiders in formerly open woodlands of the Czech Republic. The first study examines the different canopy thinning intensities (Děvín NNR), the second study evaluates different successional stages following canopy thinning (Podyjí NP), and the third study compares the retention forestry using dispersed retention against clear-cutting (Lower Morava Biosphere Reserve). The fourth study investigates the effect of habitat type and landscape-scale heterogeneity on ground-dwelling spider biodiversity in the natural forest-steppes of Kiskunság NP in Hungary.
The first study demonstrated a positive effect of canopy thinning on spider biodiversity. The second study indicated the significance of different successional stages for distinct assemblages. Strong thinning and advanced successional stage supported the highest biodiversity of spiders, including species of conservation concern. The third study revealed that both retention forestry and clear-cutting homogenise spider assemblages. However, retention forestry supported higher biodiversity than clear-cutting. The fourth study showed that habitat type plays a more important role than landscape structure in shaping spider assemblages in natural forest-steppes. Each component of the forest-steppes (forest, forest edge, grassland) contributes significantly to the conservation of spider biodiversity.
This doctoral thesis presents results that can be practically applied to protect the biodiversity of lowland woodlands and forest-steppes. An effective approach to forest management in protected lowland woodlands involves a combination of various thinning intensities and the maintenance of diverse successional stages. Retention forestry, utilizing dispersed retention, emerges as a suitable alternative to clear-cutting in lowland commercial woodlands. The conservation management strategies for each forest-steppe habitat should be adapted individually.

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Luca BORIO | Master thesis

Conservation ecology of the Italian endemic dysderid spiders (Araneae, Dysderidae)

The dysderids (Araneae, Dysderidae) constitute an important group of endemic spiders from the Mediterranean region, and in Italy, they represent the family with the highest rate of endemism. This study aims to assess the conservation status of 52 Italian endemic species based on presence data available in the literature, which have been georeferenced and supplemented with information on the species' autoecology, habitats, protection status of the areas, and potential conservation threats. Based on the gathered information, the species were evaluated according to the IUCN Red List criteria, leading to an assessment of extinction risk and the assignment of the corresponding IUCN category for each assessed species. Where possible, distribution models were used to estimate the impact of climate change on current distribution in order to predict potential future contractions. Most species fall into one of the IUCN threatened categories (21% CR, 67% EN, 2% VU), due to phenomena directly or indirectly related to climate change and habitat fragmentation caused by anthropogenic

pressures. The main identified threats, conservation challenges, and management implications for the protection of this important endemic group are discussed.

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Karolína BALÁŠOVÁ | Master thesis

Comparison of spider (Araneae) diversity between commercial and unmanaged stands in the area of the confluence of the Dyje and Morava rivers

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The submitted diploma thesis deals with the comparison of spider (Araneae) diversity between commercial and unmanaged stands in the area of the confluence of the Dyje and Morava rivers. For the research, which took place in two types of management – commercial and unmanaged stands, six suitable locations were selected, i.e., three for each type of stand. Three formalin pitfall traps were then placed on each site of interest, through which the capture of spiders took place from May to September 2021. The material collection took place a total of five times, once a month. As part of the research, 1 412 adult spiders were caught and subsequently determined, belonging to 16 families and 72 species. The only exception in identification were the species Pardosa lugubris (Walckenaer, 1802) and Pardosa alacris (C. L. Koch, 1833), who due to their similarity and difficult distinguishability were collectively classified into the Pardosa lugubris group. The most numerous family of the research was Lycosidae, among others represented by the most abundant species of the study Pardosa lugubris group in the number of 498 spiders. Based on the statistical evaluation of the data, no significant difference was found in the number of species and their abundance and the abundance of rare and endangered species between the studied types of management. However, it was observed that a higher number of rare and endangered species inclined towards undisturbed stands. In addition, it was found that management had a marginally significant effect on the species composition of spiders. The surroundings of each ground trap were also evaluated according to their environmental variables, specifically it was the power of the litter layer, the amount of dead wood on the ground divided into small and large pieces of wood, vegetation cover, and canopy openness. In all the abovementioned factors except for small pieces of dead wood, a demonstrable difference was found. Commercial stands were lighter with denser vegetation cover, while in less lit nonintervention stands there was a larger amount of large pieces of dead wood and a higher power of plant litter. The species representation also corresponded to the management characteristics, when spiders of drier and lighter forests preferred managed locations, whereas in protected stands there were rather shade-loving and moisture-loving species. For both types of management, similar biodiversity values were obtained, the marginal difference is only in the species composition of spiders, which is in correlation with environmental factors. The results show that by choosing a suitable, nature-friendly way of management with the absence of too intensive interventions (large-scale clearcuts, soil milling), a similar level of biological diversity can be achieved as in protected stands, thus achieving the connection of nature conservation and forestry interests.

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Barbora PODESTÁTOVÁ | Master thesis

Spiders of the Nature Reserve Diana

This Master thesis summarizes the results of an arachnological survey on the territory of the nature reserve Diana. This nature reserve is located in the protected landscape area Český les in the district of Tachov in the Pilsen Region. The nature reserve Diana is an area of primeval origin with the presence of beech trees. The research took place in 2022-2023. A total of six habitats were chosen and the collection was carried out using pitfall traps, the litter reducer and sweeping. The results were processed using the Shannon-Wiener index and the Dominance index.
A total of 257 individuals were classified into 14 families and 43 species, of which 158 were males and 72 females. Out of the total number of species, there was only one that is classified as an endangered species on the Red List, namely

Mansuphantes arciger. The highest value of the Shannon-Wiener index is shown by site 2 with a value of 2.30. This means that it is the most diverse in terms of the diversity of spiders found. On the other hand, habitat 4 shows the lowest value with a value of 1.48 and is thus the least species diverse. The Dominance Index results show us that all classes of the Dominance index were represented. The largest number of species belong to subrecedent species, while the fewest are eudominant species. The other classes are represented more or less evenly, which indicates that these are little disturbed biocenoses.

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Marco TAGLIABUE | Master thesis

Effects of Urbanization on Spider Communities in Urban Parks within the Metropolitan Area of Turin

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Urbanization is a process in constant growth on a global scale. It shapes landscape structure and affects environmental parameters, with consequences for biodiversity and related ecosystem services. Thus, studying the structure of communities living in urban environments is a helpful way to better understand the effects of urbanization on different taxas. Spiders have been successfully used as bioindicators in previous studies, for their key role in the trophic chain of ground dwelling arthropods communities. This study evaluates how spider communities, sampled specifically from bushes and low hanging trees using a beating tray, respond to urbanization, by drawing a comparison between communities sampled within Turin's urban parks and those from "La Mandria" regional natural park, a protected area a few kilometers from the city. We tested their responses in taxonomic and functional terms. Species richness and abundance decrease in the city, compared to the control area, as well as functional diversity. Nestedness, meaning the rate of species loss between sampled sites, is higher within Turin's urban area, and turnover, meaning the rate of species substitution between sampled sites, is lower, reflecting the more significant species richness observed in the control area. Furthermore, we identified, based on statistical analysis, several indicator species, from Turin and the control area both, highlighting their ecological preferences. Our results agree with those observed in earlier studies on the effects of urbanization on ground dwelling spider communities within Turin's metropolitan area and suggest that urban environments affect foliage dwelling spider communities by driving them to both taxonomic and functional homogenization.

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Eliška TŘEŠŇÁKOVÁ | Master thesis

Endosymbiotic bacteria associated to stored product mite *Tyrophagus putrescentiae*

Storage mites are important pests of stored food that cause not only financial losses by consuming stored food but also pose a health risk to both consumers and workers in the agricultural and food industry, as they produce allergens and are vectors for a wide range of microorganisms. *Tyrophagus putrescentiae* is a type of store product mite that is found in the grain stores and food industry, mainly of durable foods, such as dried hams, ripening cheeses, spices, cereals, or dried fruit. It hosts a whole range of bacteria, including endosymbiotic ones such as *Cardinium* and *Wolbachia. Cardinium* and *Wolbachia* are bacterial genera known primarily for their ability to manipulate host reproduction in favor of their transmission. In the case of the mite *Tyrophagus putrescentiae*, the occurrence of only one of these bacteria in the population has so far been observed, indicating the existence of competition between these two endosymbiotic bacteria. Therefore, 4 new populations were created, each consisting of 10 adults from a culture infected with either *Cardinium* or *Wolbachia*. These new populations were left for 5 months, at which time they were tested for the presence of both bacteria. At the same time, growth tests were established to demonstrate the effect of possible competition on the fitness of the host. It turned out that only *Cardinium* was present in all populations after 5 months, at a high level of 73–100 %. On the contrary, the occurrence of *Wolbachia* was suppressed after 5 months. Double infections initially occurred at rates of up to 40% but

decreased over time. The ability to grow was indeed reduced after 2 and 4 months from the establishment of the doubly infected cultures and returned to the level of the parental populations only after 6 months, i.e. at the time when *Cardinium* itself had stabilized in the populations. The data in this thesis suggest that there might be some competition between the endosymbiotic bacteria *Cardinium* and *Wolbachia* in *Tyrophagus putrescentiae*. In addition, this competition could have a negative effect on the mite's ability to grow and breed. These findings could be used in the future for possible biological control of this pest.

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Milan TŮMA | Master thesis

Trophic niche of eresid spiders from the Negev desert

The main goal of this master thesis was to describe the trophic niche of eresid spiders, which occur in the Negev desert in Israel. There is very little information known about prey of eresid spiders. These spiders live mainly in burrows in wadis, Frequent prey of desertdwelling spiders are beetles, ants, isopods, spiders or bugs. Webs of eresid spiders together with prey remnants were collected in past by other people and I analysed the content of webs. Each web was dissolved in sodium dichlorite, and remnants of prey were picked up. A total of 239 webs were analysed. The remnants were identified into the lowest taxonomic level possible. I found that the main prey of eresid spiders are members of Coleoptera and Hymenoptera. Beetles from the family Tenebrionidae were the most abundant prey. Of these representatives Erodiini and Tentyriini tribes were the most abundant. Beetles from families Curculionidae and Carabidae were also frequent prey. More than 99 % of prey from Hymenoptera were ants. The trophic niche of all eresid spiders was found to be narrow, that means that they are stenophagous predators. The work also includes a presentation on the predation strategies of spiders, which is as an addition to knowledge about spiders for secondary school students.

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Tereza BARTÁKOVÁ | Bachelor thesis

Eukaryotic parasites of mites

The study is focused on synanthropic mites. Mites are found almost everywhere; dust and storage mites infest human habitats. Dust and storage mites are studied frequently because they produce allergens that cause medical troubles. Well-known representatives of dust mites are *Dermatophagoides pteronyssinus, Dermatophagoides farinae*, and *Euroglyphus maynei*. Dust mites are found in dust. This means that we encounter them every day in our homes. The storage mites *Lepidoglyphus destructor*, *Acarus siro*, and *Tyrophagus putrescentiae* are frequently found in the grain stores. They infest various foods, e.g. grain, cheese, and ham. Predatory mites are bred for the biological control of phytophagous mites and other parasites, and they are used in biological control. There is an effort to control pest mites. The recent trend is to have pesticide-free agricultural crops, which encourages the search for mite predators and bio-pesticides. Mite parasites include eukaryotic parasites of the Coccidia and Microsporidia. Representatives of the Microsporidia and Coccidia have been reported in the mites. Microsporidia are parasites of many vertebrates and invertebrates. Although they are one of the smallest eukaryotic organisms, their spores can infect many hosts. Microsporidia have been demonstrated in the predatory mites *Neoseiulus cucumeris, Amblyseius barkeri*, and *Phytoseiulus persimilis*. Coccidia of genus *Adelina* was found in the mite *T. putrescentiae* based on the analysis of 18S DNA PacBio sequences. For the detection of eukaryotic parasites, a PCR method is used that uses specific primers for each species. In this work, quantification and detection primers were designed for the coccidia of the genus *Adelina* infecting the mite *T. putrescentiae.*

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Kristýna HAVLÍKOVÁ | Bachelor thesis

Ecology and distribution of the wolf spider *Lycosa singoriensis* (Laxmann)

The presented bachelor thesis focuses on the ecology and spread of the wolf spider *Lycosa singoriensis*. The first part of the thesis examines focuses on the family Lycosidae and describes in detail the morphology, anatomy, and ecology of these spiders. It also delves into their lifestyle and preferred prey. It also deals with their reproduction and the characteristic care that females provide to their cocoons and offspring. Furthermore, the thesis addresses the issue of enemies and parasites of wolf spiders, with particular attention given to species belonging to the order Hymenoptera. In conclusion, the term tarantism is defined and its connection with this family.
The second part focuses on the wolf spider *Lycosa singoriensis*. It includes a detailed description of its morphology and anatomy, preferred habitats, reproductive strategies, and care for the cocoon and offspring. Additional chapters explore its life cycle, dietary preferences, hunting methods, and its conservation in nature. This section also contains information about the bite of *the Lycosa singoriensis* and some toxins in its venom.
The third part details the distribution of the *Lycosa singoriensis*. It describes its spread on the territory of the Czech Republic and in selected European countries and method of spread. The development of its spread in the Czech Republic is extensively divided into two phases. The first part focuses on the initial wave of expansion, which began in the early 20th century. However, in the second half of the 20th century, it abruptly disappeared from our territory. The second part examines its second wave of spread in the Czech Republic, which began in the early 21st century.
In conclusion, the bachelor thesis describes related species of the Tatar wolf spider, including information about their distribution, morphology, and ecology, with an emphasis on comparison with the Tatar wolf spider.

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Jan KOPAL | Bachelor thesis

Batesian mimicry in jumping spiders (Araneae: Salticidae)

During their evolution, jumping spiders have developed an immense variety of forms and strategies that have enabled them to survive in different niches. It is therefore not surprising that we encounter herbivorous species, skilled predators, and even nest raiders of other animals. However, due to their diurnal lifestyle, they are attacked by various predators from which they must protect themselves. Consequently, some have developed mimicry to deter predator attacks. A very significant group comprises species that have started to mimic ants, displaying imitations of appearance, behavior, and in some cases, specific chemical compounds. This ant mimicry has independently arisen in distantly related species in different parts of the world. Given the scope of this topic, this paper aims to summarize the findings to date and potentially highlight missing information or suggest possible directions for further research.

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Alexandra KRIŠTOFOVIČOVÁ | Bachelor thesis

Spiders of the Nature Reserve Petrské údolí

Research on the arachnofauna in the Petrské Valley took place in 2023, followed by species determination at the beginning of 2024. The primary method of collection was ground traps, with other entomological collection methods being supplementary.
A total of 334 individuals belonging to 46 species from 16 families were determined at the site. Only adult individuals were included in the research, and juvenile stages without the possibility of closer determination were excluded. Among the rarer findings included in the Red List under the category of critically endangered is *Ozyptila brevipes*. Two species, *Zelotes erebeus* and *Evansia merens*, are classified as endangered, while *Entelecara*

flavipes and *Oxyopes ramosus* fall into the near threatened category.
According to the Red List (Řezáč et al. 2015), most species are categorized as least concern (46 species). The near threatened category includes *Oxyopes ramosus.* Endangered species represented here are three species: *Zelotes erebeus, Evansia merens,* and *Entelecara flavipes*. The only critically endangered species identified was *Ozyptila brevipes.*

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Elena NEGRO | Bachelor thesis

Sex-specific personality across ontogeny in the spider *Pisaura mirabilis*

Recent years have seen a growing interest in the field of animal personality, defined as individual behavioral responses that are constant over time in different contexts. Personality varies among individuals of the same species in relation to both extrinsic and intrinsic factors, such as sex. These differences can be observed in numerous animal taxa: from mammals to birds and fish, and invertebrate groups such as insects and arachnids. What remains poorly understood is if individual variation in behaviour varies during ontogeny. In particular, this thesis aims to test whether two personality traits (exploration and aggressiveness) of the spider *Pisaura mirabilis* vary with ontogeny and sex. Individuals were tested repeatedly during 3 ontogenetic phases: as juveniles, subadults and adults. I measured exploration as the time spent exploring a new environment and aggressiveness as a response to an external stimulus, in this case a poke with a paintbrush. Both tests were repeated at least three times on three different days for each individual within the same ontogenetic stage. The results don't denote a strong correlation between ontogenetic stage and personality, while emphasizing the sex-related effect. In fact, we found that males express greater exploration and females higher aggressiveness and we discuss our results in light of the reproductive biology of the species, where males hunt for prey that is donated in the form of a nuptial gift to cannibalistic females.

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Anna NĚMEČKOVÁ | Bachelor thesis

Arachnofauna of the Nature Reserve Přimda

Results of a faunistic survey of the spiders (Araneae) in the nature reserve Přimda (Western Bohemia, Czech Republic) are summarized in this thesis. Nature reserve Přimda is known as old mixed forests with a predominantly occurrence of beech forests. The spiders were sampled using standards methods such as pitfall traps, a sweeping net or a litter reducer, and additionally using UV light portable traps used for sampling of moths. The spider assemblages were evaluated using Shannon-Wiener index and dominance index.
Altogether, 61 species (316 individuals) from 17 families: Pholcidae, Dysderidae, Araneidae, Tetragnathidae, Linyphiidae, Theridiidae, Hahniidae, Amaurobiidae, Agelenidae, Cheiracanthiidae, Lycosidae, Pisauridae, Gnaphosidae, Clubionidae, Philodromidae, Thomisidae, Salticidae were recorded during 2021. The most important findings are those listed in the red list of threatened spiders namely: *Agyneta subtilis, Bathyphates setiger, Maro lepidus, Micaria fulgens, Mecopisthes silus, Pelecopsis elongata, Thyreosthenius biovatus*.
Based on the results of the Shannon-Wiener index, the most diverse was site 1, open habitat of Přimda castle surroundings (2,93). Index of dominance indicated all categories of dominance, whereas subrecedent species prevailed and higher categories of dominance are almost equally represented. These results indicate native biotopes. This thesis brings important knowledge about spider assemblages in western Bohemia.

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Klára PAPOUŠKOVÁ | Bachelor thesis

Tarantulas as pets in the Czech Republic

Terraristics has become an increasingly popular leisure activity in recent years. The gradual discovery of new species, the development of nomenclature, travel, and trade have significantly influenced the quantity and range of terrarium animal species available on the Czech market.
The aim of this bachelor's thesis was to monitor and analyze the advertisements of offered tarantula species and to document the changes in the range and quantity of offered species in ten-year intervals. Specifically, in the years 1992, 2002, 2012, and 2022.
The data from 2022 were drawn from the advertising internet portal www.ifauna.cz. Data from previous years 1992, 2002, and 2012 were taken from the printed magazines Fauna, which were published in the Czech Republic at fortnightly intervals since 1990. A total of 807 advertisements offering 203 species of tarantulas were analyzed. The number of advertisements, the number of offered genera, species, and individual tarantulas were evaluated. Additionally, the aim was to monitor breeding concerning the international protection of tarantula species (CITES and IUCN).

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Marek SCHILD | Bachelor thesis

Aggressive mimicry of *Zodarion* spiders

Aggressive mimicry is a relatively rare phenomenon across the animal kingdom. In spiders, it has been described in only a few species. Spiders of the genus *Zodarion* appear to use aggressive mimicry to imitate the chemical and tactile signals of their prey, the ants. This bachelor's thesis examines the effectiveness of potential aggressive mimicry of spider *Zodarion rubidum* based on laboratory experiments with various ant species. During its active hunting, this species of spider carries a captured paralyzed ant as a "shield" which it uses to pretend to be an ant, thus deceiving other ants.
The experiments were conducted in Petri dishes. The first ant was released into dish occupied by a spider, to be caught as prey and subsequently serve as a "shield". A second ant was then added which the spider was supposed to deceive, and their interactions were observed. This experiment was repeatedly carried out in four variations, which differed in the combination of the first and a second ant (different species or individual from a different nest). Ants of the species *Lasius niger* and *Formica pratensis* were used. All experiments were recorded on camera and the behavior of both spiders and ants was thoroughly analyzed from the video recordings.
The results suggest that factors such as the ant's chemical odor (colony odor), the size of the "shield," or the size of the second ant have a certain influence on the success of aggressive mimicry. Despite some negative influences, *Zodarion rubidum* is still able to effectively use this form of aggressive mimicry.

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Kateřina SKRBKOVÁ | Bachelor thesis

Ecology and conservation of raft spiders of genus *Dolomedes* (Araneae, Pisauridae) in Europe

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This thesis focuses on the ecology and conservation of raft spiders of genus *Dolomedes* (Araneae, Pisauridae) in Europe. The body of these spiders consists of the cephalothorax (prosoma) and the abdomen (opisthosoma). On the cephalothorax are the eyes, chelicerae and pedipalps. The legs are located on the thoracic part.
Fishing spiders of the genus *Dolomedes* are members of the family Pisauridae, which is characterized by the presence of an anatomical structure on the male's legs called the retrolateral tibial apophysis. This structure plays an important role in mating and serves to anchor the pedipalps in the female's genitalia.
Dolomedes spider is recognised by his brown or grey coloration, longitudinally flattened cephalothorax, oval abdomen and eyes, the arrangement of which forms a trapezoid shape. Fishing spiders mainly inhabit wetlands and marshes with abundant vegetation Courtship occurs on the water surface, where the female allows the male to climb onto her back and then introduces his pedipalps into her copulatory organ. Most of their food consists of terrestrial insects, small fish or smaller reptiles or amphibians.

The raft spider (*Dolomedes fimbriatus* (Clerck, 1757)) and the fen raft spider (*Dolomedes plantarius* (Clerck, 1757)) are associated with preserved, unpolluted wetlands, which have been and are currently threatened by human activities. They are rare species included in the red lists of several European countries and serve as important bioindicators of environmental conditions.

Factors contributing to the decline of fishing spider populations in some areas include the destruction of freshwater wetlands, pollution and eutrophication. However, the main threat remains climate change, which is having a negative impact on the physiology of these spiders and their key habitat. Conservation of the fishing spider (*D. fimbriatus*) and fen raft spider (D. *plantarius*) is essential as a significant reduction in their range is expected in the future.

The most reliable way to differentiate between the fishing spider (*D. fimbriatus*) and the fen raft spider (*D. plantarius*) is through morphological methods, applicable only applicable to adults. The epigyne of the female fen raft spider (*D. plantarius)* is unhairy in the middle, whereas that of the female fishing spider (*D. fimbriatus*) is difficult to see because of the dense hairs. The tibia of the fen raft spider (*D. plantarius*) has a blunt protuberance with serrated termination, whereas the fishing spider (*D. fimbriatus*) has a pointed, non-serrated protuberance. Juveniles of the fishing spider (*D. fimbriatus*) have a greenish coloration, while juveniles of the fen raft spider (*D. plantarius*) are usually brown.

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#SYSTEMATICS, TAXONOMY AND PHYLOGENY

Ivalú Macarena ÁVILA HERRERA | PhD thesis

Evolution of karyotype in selected groups of haplogyne and mygalomorph spiders

Spiders are diverse group of arthropods with a worldwide distribution. They are important predators and colonized successfully most terrestrial ecosystems. Despite importance of this group, the information about the spider karyotypes is still limited, especially in mesotheles, mygalomorphs, and haplogyne araneomorphs. The presented Ph.D. thesis is focused on the karyotype evolution of selected clades of haplogynes and mygalomorphs, specifically on the families Pholcidae and Atypidae. Techniques of standard and molecular cytogenetics were used to determine the karyotypes and the pattern of nucleolus organizer regions (NORs). Obtained results allow to revise the diploid number and sex chromosome system of mygalomorph *Atypus karschi* (Atypidae) and determine probable ancestral karyotype of the genus *Atypus*. *A. karschi* exhibits one NOR, which is adjacent to the large heterochromatin block composed of inactivated rDNA.

Concerning the family Pholcidae, obtained results increase substantially the number of analysed species belonging to this family. Obtained data allowed to study for the first time karyotype evolution of haplogynes on a family level, for the first time also the evolution of NORs. Pholcids show a low diploid number, 2n♂ ranges from 9 to 33. Pholcid karyotypes are predominated by biarmed chromosomes. During evolution, diploid numbers have often been reduced by fusions. The morphology of the chromosomes entering the fusion was first changed by inversions to acrocentric or subtelocentric. The sex chromosome systems and patterns of NORs are very diversified. My studies discovered seven sex chromosome systems, namely X0, XY, X1X20, X1X2X30, X1X2Y, X1X2X3Y, and X1X2X3X4Y. Phylogenetically original is the X1X2Y system, which is probably ancestral to araneomorph spiders. My study revealed the evolutionary plasticity of the X1X2Y system. Its evolution included translocations between X1 and X2 chromosomes, inversions of X chromosomes, and increase of Y chromosome size. The X1X2Y system has been transformed to other systems in some groups. The X1X20 system arose from the loss of the Y chromosome, the XY system from the fusion of X chromosomes. From these systems, the X0 system arose in some evolutionary branches, either by fusion of X chromosomes (from the X1X20 system) or by loss of the Y chromosome (from the X0 system). The X1X2X30 system of *Smeringopus pallidus* arose from the X1X20 system, either by X chromosome fission or nondisjunction. The most complicated systems were found in the subfamily Ninetinae (X1X2X3Y and X1X2X3X4Y). These systems arose from the X1X2Y system like the system found in *S. pallidus*. Number of NOR loci varies from one to nine, they are located on the autosomes and frequently expanded on the

sex chromosomes, possibly by ectopic recombination. Sex-chromosome linked NORs are probably involved in the achiasmatic pairing of sex chromosomes. The number of NORs has increased over the course of evolution. In some groups, the number of NORs, including sex-chromosome linked NORs, has been subsequently reduced. Similar to other haplogynes, male meiosis of pholcids includes a diffuse stage, and these spiders usually have a very low number of chiasmata in male meiosis.

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Christian BARTEL | PhD thesis

Harvestmen (Arachnida: Opiliones) from Palaeogene European and mid-Cretaceous Burmese ambers as a model for evolution, palaeobiogeography and palaeoecology

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Harvestmen (Arachnida: Opiliones) represent the third most diverse order of arachnids following spiders (Araneae) and mites (Acari). Despite their modern species richness and importance for various ecosystems, fossils of this group are largely understudied. This also includes their evolutionary history, palaeobiogeography and palaeoecology. 156 harvestmen fossils were available for this thesis, which are mostly preserved as inclusions in Baltic (Late Eocene, Priabonian) and Burmese amber (mid-Cretaceous, Cenomanian-Albian). Besides the description of new species, the main focus was to answer two palaeobiogeographical hypotheses: Is the Burmese fauna of Laurasian or Gondwanan origin? Does the European amber complex sample a Holarctic fauna? The fossils were mainly examined with classical light microscopy but also with the help of micro-CT scans and then compared with their living relatives available in the literature and the collection of the Museum für Naturkunde, Berlin. 11 new fossil harvestmen species and 12 additional specimens from all four suborders (Laniatores, Eupnoi, Dyspnoi, Cyphophthalmi) are described in this thesis. Of particular interest is the discovery and description of *Sirocellus iunctus* (Cyphophthalmi) from Burmese amber, the first dwarf harvestmen which combines characters from the families Sironidae and Stylocellidae and thus represents a "missing link" between these two families. Based on this fossil, previous hypotheses regarding a Gondwanan origin of the Burmese amber fauna could be reconstructed and confirmed. *Tyrannobunus aculeus* (Eupnoi) is the first fossil of its suborder from Burmese amber and stands out because of its unusual body characters. Large eyes, a small but strongly armed body, spined legs and pedipalps and an undifferentiated penis indicate an early origin in the Eupnoi tree of life. Its very thin cuticle shows additionally an adaptation to humid and warm tropical climates. *Balticolasma wunderlichi* represents the first fossil from the subfamily Ortholasmatinae (Dyspnoi) and was described as a male from the Baltic and as a female from the Ukrainian Rovno amber. These ortholasmatine harvestmen only occur in North-Central America and in parts of Asia these days. This record shows once again that some groups of harvestmen were once widespread throughout the Holarctic during the Eocene and subsequently became extinct due to decreasing temperatures, at least in Europe. The harvestmen fossils could be placed in the appropriate palaeoenvironmental context based on known reconstructions of the palaeoenvironment for the Burmese and European amber forests and on analogues to their extant relatives. The described fossil harvestmen species fit well in the proposed warm-temperate Baltic amber forests with a number of swamp and open habitats, and in the very humid and warm tropical Burmese amber forests. All newly described fossils represent an important foundation for future phylogenetic studies, especially in the form of calibration points, which allows to calculate the origin of the individual groups more precisely. This in combination with the description of new fossils from other unexplored amber sources (e.g. Lebanese amber, African amber, Spanish amber) will further increase our knowledge of the evolution and palaeobiogeography of these animals.

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Daniela T. CANDIA RAMÍREZ | PhD thesis

Systematic revision of the genus *Davus* O. Pickard-Cambridge, 1892 (Araneae: Theraphosidae: Theraphosinae)

The tiger-rump tarantula genus *Davus* O. Pickard-Cambridge, 1892 currently consists of four described species: D. fasciatus O. Pickard-Cambridge, 1892, *D. ruficeps* (Simon, 1892), *D. pentaloris* (Simon, 1888) and *D. santos* Gabriel, 2016. Previously, a high morphological variation and a widespread geographical distribution were reported for these species. However, recent studies focused on the systematics of mygalomorph spiders have found that tarantulas typically exhibit a low dispersal capability and relatively conserved morphology, suggesting that the diversity in this genus was underestimated. This study presents the systematic review of the genus *Davus* using integrative taxonomy and incorporating different sources of evidence to address questions regarding its diversity, its geographical distribution, and its monophyly. The present work is divided into three chapters. The first addresses the species delimitation of the *pentaloris* group, distributed from southern Mexico to Honduras. Morphological variation of adult specimens was examined, and four methods based on mitochondrial DNA were used for species delimitation. Morphological data retrieved 13 morphospecies, while different methods based on molecular data recovered 16 to 18 candidate species. Based on the congruence of the results, 13 confirmed candidate species were recognized, 12 of them new to science. The second chapter addresses the reconstruction of the phylogenetic relationships of *Davus* species to test its monophyly. For this purpose, DNA sequences from five molecular markers were used, one mitochondrial (COI) and four nuclear (MID1IP1, MRPL44, I3568, EF1g) from 85 terminal taxa. Bayesian Inference (BI) and Maximum Likelihood (ML) analyses were conducted. The analyses revealed that the genus *Davus* is polyphyletic and that the *pentaloris* and *ruficeps* groups represent two monophyletic groups, distantly related to *Davus fasciatus*, the type species of the genus *Davus*. Additionally, these analyses, together with morphological data, indicated that the diversity of the *fasciatus* and *ruficeps* groups was underestimated. Finally, the third chapter addresses the taxonomic revision of Gen. nov. 02, and based on the results of the first and second chapter, seven new species from Mexico are described. On the other hand, the species *Davus mozinno* Estrada-Álvarez, 2014, is redescribed, transferred to Gen. nov. 02, and declared as a nomen dubium. Based on the new taxonomic information found, an identification key for males and females of each species of the genus is proposed. It is concluded that the genus *Davus* is only distributed in Costa Rica and Panama, and that two of the four species previously considered within *Davus,* represent two new genera of tiger-rump tarantulas, one currently distributed in Costa Rica and Nicaragua, and the second distributed in Mexico, Guatemala, and El Salvador.

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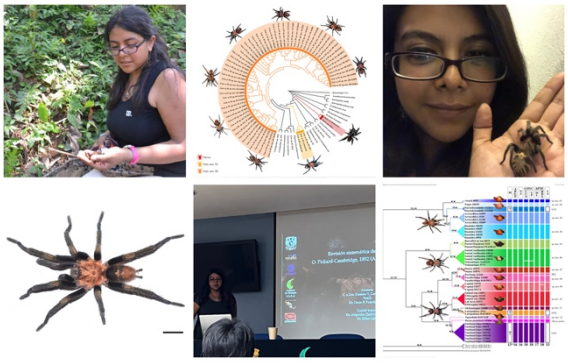

Sahibzada Muhammad JAWAD | PhD thesis

Systematics and biodiversity of scorpion fauna occurring in Khyber Pakhtunkhwa, Pakistan

Arthropod, the largest and the most diverse phylum represented by 1242040 species or about 80% of the total identified animal species. The class Arachnida, one of the major class of phylum Arthropoda, represented 112201 species. The order Scorpiones of class Arachnida includes all scorpions of the world. Present study entiteled “Systematics and biodiversity of scorpion fauna occurring in Khyber Pakhtunkhwa Pakistan” was carried out to explore the diversity of scorpion fauna in various habitats of the province. Scorpions were collected through hand picking, pitfall traps, and leaves and turning stones methods and through UV light lamps. Specimens were preserved in 90% ethanol and identified with the help of available literature. In the Present study, 3 families were identified in 8 genera and 14 species in a total of 4847 collected specimens. The species *Androctonus finitimus,*

Compsobuthus rugosulus, Hottentotta alticola, Hottentotta jalalabadensis, Hottentotta tamulus, Hottentotta buchariensis, Orthochirus fuscipes, Orthochirus jalalabadensis, Vachonus atrostriatus, Isometrus maculates belong to family Buthidae, the most abundant family with 3664(75.6%) specimens out of which 10 species and 6 genera were identified from Khyber Pakhtunkhwa, Pakistan. The most dominant species is *Hottentotta jalalabadensis* with 1295 (26.7%) collected specimens across the province. While the least common species was *Hottentotta buchariensis* with 34(0.70%) specimens. While *Deccanometrus latimanus* is the only species collected from the family Scorpionidae and is the least common family recorded in number of species as well as in number of specimens 407 (8.4%). *Scorpiops yagmuri, Scorpiops pseudomontanus* and *Scorpiops zubairi* belonging to family Scorpiopidae. The 2nd most abundant family in terms of collected specimen's i.e 776 that is 16% of the total collected specimens. *Hottentotta jalalabadensis, Orthochirus jalalabadensis* and *Isometrus maculates* were added as new records to the country. Great number of specimens were collected at warm and humid months from March to October. New species to science were recorded from family Scorpiopidae. Molecular characterization of all the species were done at American Museum of Natural History. Phylogenetic tree was established by Codon code aligner version 8.02. For geographical mapping Garmin TM GPS V Plus device was used. Arc GIS 10.2 Software was used for map formation. Aims of the present study were to explore scorpion fauna of Khyber Pakhtunkhwa and to add new records to the unexplored fauna of Pakistan. Further work on taxonomy, ecology and molecular work on the Scorpions fauna of Pakistan is recommended.

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Pavel JUST | PhD thesis

Assessing diversity of arachnids: synthesis of taxonomical methods

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Arachnids (Arachnida) represent an ancient and specious group, diversified both ecologically and morphologically. Their taxonomy is primarily based on morphological characters; however, commonly present morphological stasis combined with our limited understanding of intraspecific variability, often complicates the species identification as well as delimitation of species boundaries. Implementation of other than traditional morphological approaches suggests that the described diversity is significantly underestimated compared to the real one. The present dissertation thesis evaluates variability of selected characteristics among different arachnid groups (Araneae, Opiliones, Scorpiones, Pseudoscorpiones) by implementing ethologic, cytogenetic and molecular phylogenetic approaches. Evolutionary framework was used to i) compare courtship behavior variability within the wolf spider genus *Alopecosa,* ii) infer the karyotype differentiation in scorpions of the family Buthidae, and iii) evaluate the effect of dispersal capability on speciation in Cheliferidae pseudoscorpions. Likewise, interspecific variability of cytogenetic characteristics was described for entelegyne spiders and harvestmen from the family Phalangiidae. The results brought new insights into our understanding of the evolution and species diversity of each group and corroborate the necessity of integration of additional methods complementing the morphological approach in classification and species delimitation.

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Jan LUKOVSKÝ | Bachelor thesis

Diversity research of arachnids in African biodiversity hotspots

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Although African biodiversity hotspots are often areas of intensive research, arachnids tend to be overlooked in this research. My paper summarizes information on arachnid diversity in eight African biodiversity hotspots. It also summarizes possible explanations for the high diversity of arachnids, or invertebrates in general, in these sites. Explanations for diversity are often related to Africa's complex geological and climatic history. Among the most important geological events that influenced arachnid diversity are the breakup of the Gondwana

supercontinent during the Jurassic and Cretaceous, and the uplift of the Atlas Mountains in North Africa and the East African Highlands during the Miocene. The alternation of wet and dry climate cycles during the Cenozoic was also important for diversification, causing range fragmentation and subsequent allopatric speciation in many arachnid groups. Quaternary glaciation also influenced diversification in North Africa by creating glacial refugia. The best studied part of Africa in terms of arachnid diversity is the Mediterranean Basin hotspot and the hotspots of South Africa.

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Ádám Sándor MAYER | Bachelor thesis

Integrative taxonomy of New Guinean jumping spiders (Araneae: Salticidae)

Island of New Guinea is one of Earth last untouched wilderness and on it's indonesian part lays Batanta from we have no data of any salticid species. In my thesis with the method of integrative taxonomy I examined 10 specimens collected from the island in 2019 and 2023 by Tibor Kovács. The species were identified by morphological characters and compared to molecular data, classification with barcoding (COI) and 2 loci (28S, 16S) phylogenetic tree reconstruction. The collected specimens belong to 5 species, 4 of which are new. These are Euryattus triok sp. n. (male and female), Omoedus tiber sp. n. (male and female), Canama tamasi sp. n. (male), Bathippus mystace sp. n. (male) and Zenodorus cf. lepidus (male and female). The combined phylogenetic tree based on 16S and 28S genes showed results consistent with those of morphological studies. The barcoding phylogenetic tree based on the COI gene showed a different result and, with several polymorphisms. This was used for sex matching.

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#ECOTOXICOLOGY, MORPHOLOGY AND PHYSIOLOGY

Nancy LO MAN HUNG | PhD thesis

Evolution and development of spiders' spinnerets (Arachnida: Araneae)

This thesis investigates into the development and evolution of spinnerets, a crucial structure for spiders. Beginning with an extensive literature review, we explore the morphology, classification, development, and prevailing hypotheses on spinneret origins. A significant milestone was achieved through the sequencing of the transcriptome of a novel Hahniidae spider species from São Paulo, Brazil, contributing to our understanding of spider diversity. Integrating this transcriptome data with 215 others from various species, we constructed a robust phylogenetic framework, offering deeper insights into the evolutionary relationships within the marronoid clade. Contrary to recent portrayals of monophyly, our study reveals a paraphyletic marronoid clade, highlighting the complexity of its evolutionary history and challenging previous assumptions. Further investigation analyze into the molecular rate of evolution of candidate genes, demonstrating site-specific positive selection in the Araneae lineage, and discussing their possible involvement on spinneret ontogeny. Additionally, through maternal RNA interference, we induced the development of spiders with ten legs, shedding light on the functionality of ectopic legs and the implications of gene function for the evolution of appendix morphology. Practical comparisons of RNA extraction methods highlighted critical factors influencing downstream analyzes. Lastly, an unprecedented investigation into spinneret regeneration unveiled complex cellular pathways and connections to gene expression of toxin genes, with potential implications for therapeutic and regenerative medicine. This thesis contributes significant advancements in understanding spinneret development, spider evolution, and spinneret regeneration, contributing to both fundamental knowledge and potential practical applications.

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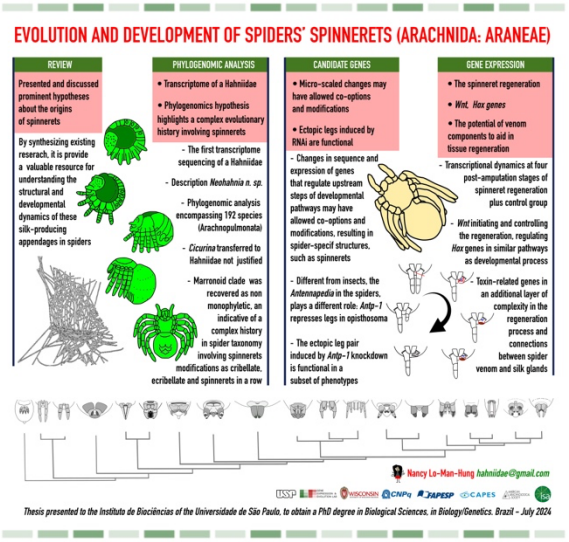

Marco MEYER | PhD thesis

Antiadhesive Structures of Cribellate Spiders

Nanofibres hold tremendous potential for far-reaching innovations, owing to their remarkable surface-to-volume ratio. However, their inherent adhesive properties arising from van der Waals forces pose significant challenges in their processing as the ultrathin fibres stick to even the smoothest surface. Addressing this limitation, cribellate spiders (Cribellatae) provide invaluable insights into the non-adhesive handling of such fibres. These basal spiders intricately produce and integrate fibres as thin as 30 nm into their adhesive threads without experiencing adhesion-related challenges. Therefore, they have a specialised leg comb on the metatarsi of the fourth leg pair, the calamistrum, which bears the necessary antiadhesive properties to process these nanofibres. This comb emerges as a compelling biomimetic model for novel functional surfaces in this doctoral thesis. Its aim is therefore to undertake a comprehensive investigation of the calamistrum and its antiadhesive topography across different cribellate species, focusing on both morphological and functional aspects. Via biomimetic transfer based on laser-induced periodic surface structures (LIPSS) onto various artificial surfaces, the technical viability and associated limitations of these novel structures are explored. To this end, the characteristics of these nanostructures are thoroughly examined using scanning electron microscopy (SEM) and focused ion beam (FIB) analysis. Additionally, adhesion measurements assess their antiadhesive properties, encompassing both the biological model and its biomimetic replicas. Several distinct structures could be characterised. Remarkably, despite their variations in morphology and topography, strikingly similar antiadhesive properties among the species-specific calamistra were revealed. The structures thus reduce adhesion forces by over 75% and similarly counteract the deflection of the threads. Notably, the antiadhesion proved robust across a wide range of ambient conditions, remaining resilient against alterations in spatial frequency, aspect ratio, and orientation. An effect was particularly strong on hydrophilic surfaces and could be reproduced on different artificial materials. This interdisciplinary thesis unlocks the remarkable potential of the calamistrum as a source of inspiration for the development of nanostructured surfaces with antiadhesive capabilities. The findings provide valuable insights into the intricate mechanisms employed by these arachnids to manipulate nanofibres without encountering adhesion-related challenges. Moreover, the biomimetic replication of these nanostructures is promising for addressing the processing difficulties associated with nanofibres, thus paving the way for innovative applications in diverse technological domains.

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Hana BAKEŠOVÁ | Master thesis

Morphological study of the body structure of spiders of the family Paratropididae (Mygalomorphae, Araneae)

This thesis focuses on the morphological study of spiders from the family Paratropididae, which belongs to the infraorder Mygalomorphae. The primary objective of this research was to examine specific cuticle structure, setal diversity, and functional adaptations that enable these spiders to achieve effective crypsis and

camouflage. The results revealed that the surface of their cuticle is adapted for adhesion to soil particles. Consequently, this ability provides the spiders protection from predators and emphasizes their specialized adaptation to the environment. Moreover, detailed analysis using electron microscopy identified a variety of setal types, some with functions that remain unknown. The study also contributed to better understanding the phylogenetic position of the Paratropididae family and emphasized the importance of defensive strategies such as crypsis and camouflage. These findings expand current knowledge of spider morphology and offer a valuable foundation for future taxonomic and ecological studies. This thesis enhances the understanding of evolutionary adaptations and the ecological role of the infraorder Mygalomorphae.

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Karolína KADLECOVÁ | Master thesis

Growth optimization of the spider *Nhandu chromatus* Schmidt

Tarantulas are very popular with invertebrate and spider breeders, but their upkeeping can be very economically challenging. For this reason, breeders choose species imported from abroad from indigenous sites that are often already fully grown and do not need to provide an ideal environment for rapid and efficient growth.
On the individuals of the first instar of us selected model species *Nhandu chromatus* (Schmitd 2004), we observed the effect of feeding frequency, temperature, and size of the breeding arena on their growth. The experiment was conducted in the laboratories of the Faculty of Agrobiology, Natural and Food Resources of the Czech University of life sciences, where 270 individuals of the species mentioned above were bred in three tests groups of 90 individuals in thermoboxes at 20°C, 25°C and 30°C. Another factor was the frequency of feeding when individuals were given *Coptotermes formosanus* termites (Shiraki 1909) as food. The first group was fed one termite every other week, the second group was fed one termite every week, and the last group was fed two termites every week. The last factor was the size of the living arena, when we had a small photo film box with a contents of 7 cm^2, a medium box with a contents of and 19, 6 cm^2 a large with a content of 50, 3 cm^2.
According to the median sternal platelets measured by us, the largest increments were in the environment with the highest feeding frequency, the highest and the largest breeding area. However, the curves of the projected future growth show only one match with our hypothesis, namely feeding frequency. The largest predicted growth is in individuals reared at 25 °C and in the smallest living area.

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Eliška LÁCHOVÁ | Master thesis

Contribution to knowledge of silk production and its role in spiders of the genus *Clubiona* Latreille, 1804 (Araneae, Araneomorphae: Clubionidae)

The presented thesis focuses on the study of the spinning apparatus and silk production in spiders of the genus *Clubiona* (Araneae, Araneomorphae: Clubionidae). The external morphology of the spinning apparatus was investigated using scanning electron microscopy (SEM) and permanent preparations studied using light microscopy. Permanent preparations were used as a basis for line drawings of the spinnerets and spigots - outlets of the silk glands. The presence of four types of spigots belonging to four categories of silk glands was confirmed by a detailed study of the external morphology of the spinnerets. The results of the study of the internal anatomy of the silk glands and a detailed description of the procedure of preparation of the silk glands supported by photodocumentation are also included in the thesis. As part of the breeding of spiders in laboratory conditions, attention was also paid to their ethology. Sibling cannibalism has been proven in the postembryonic stage leaving the cocoon ('spiderlings'). The method of manipulation with the silk for net making is also described. The thesis is both a summary of previously known data on the spinning apparatus of spiders of the family Clubionidae and a presentation of my own and completely original research results, carried out in the framework of my thesis.

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Anděla ŠIMEČKOVÁ | Master thesis

Effect of neonicotinoid treatment on the functional response of arboreal spiders of the genus *Philodromus* (Araneae, Philodromidae)

Neonicotinoids are nicotine-based synthetic insecticides used in agriculture to control plant pests. They are neurotoxic substances that attack the nervous system of insects and can cause paralysis or death. These selective insecticides should have a negligible effect on non-target organisms, including spiders. Spiders are one of the most abundant and diverse natural predators that contribute to the control of pests. However, some pest control practices, such as pesticide application, can reduce their biocontrol potential. Current studies show that even selective insecticides have negative effects on non-target invertebrate species. They can affect them both sublethally - affecting breeding, movement, hunting, ability to defend against predators - and lethally - death.
In the experimental part of this thesis the effect of neonicotinoid treatment with the active substance thiacloprid on the functional response of spiders of the genus *Philodromus* (Araneae, Philodromidae) was investigated. The effect of the insecticide on predatory activity (prey consumption and overkilling) and long-term survival of treated individuals compared to an control group was investigated. The effect of insecticide residues on predation activity 14 days after application was also observed. The spiders were divided into 5 groups according to the number of fruit flies offered (N=1-12). In each group, the number of offered prey was kept constant according to the number of that group. Feeding was done in 7 rounds every 30 minutes. Each round, the amount of consumed and killed flies was recorded.
The results of the study showed that tarsal contact of *Philodromus* spiders with the active ingredient thiacloprid reduced predation activity. The insecticide treatment had no lethal effects on this spider genus. The mortality rate was not significantly different from the control group, however, the treatment caused paralysis. Residues of the insecticide had a marginally significant effect on predation activity.

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Filip SOLAR | Master thesis

Effect of neonicotinoid treatment on the functional response of the spider *Anyphaena accentuata* (Walckenaer, 1802)

Neonicotinoids is a group of pesticides chemically similar to nicotine that affect the nervous system of insects and act as systemic insecticides, hence their use in biological pest control. For many of these products, sub-lethal effects that are not directly observable can be expected and need to be detected in order to assess the hazard of the active ingredient. Current studies suggest that neonicotinoid pesticides may affect various life parameters of non-target invertebrate organisms such as mating, locomotion, hunting or the ability to defend against predators. Non-target organisms also include spiders, which play an indispensable role as a pest predator in the ecosystem. In this study, we aimed to study the effect of a neonicotinoid with the active ingredient thiacloprid on the predatory activity of the spider *Anyphaena accentuata* (Walckenaer) under laboratory conditions. The aim of the study was to determine the relationship between neonicotinoid exposure and predatory activity parameters including functional response to prey. The results showed a significant effect of active ingredient treatment on spider predatory activity, prey consumption and overkilling. Furthermore, we found that the treatment with the active ingredient thiacloprid also had significant lethal effect.

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Jitka KUBEČKOVÁ | Bachelor thesis

Breeding of mygalomorphs (Mygalomorphae) in zoos

The aim of the thesis was to summarize the current knowledge on the biology of the mygalomorphs (Mygalomorphae) together with an assessment of the results of its breeding in zoos in the Czech Republic and to place it in the kontext of European zoos. As background data for the evaluation of breeding in the Czech Republic, the yearbooks of the Union of Czech and Slovak Zoological Gardens (USCZOO) from 2013-2022 were used. As a source of data for the evaluation of the breeding of the gliders in Europe, the international database ZIMS (Zoological Information Management System) was used, from which a report up-to-date as of March 2024 was used.

In the Czech Republic, 29 species of mygalomorphs were bred in 2022, with a total population of 66. This population was distributed across 11 zoos. The three most bred species (in terms of number of animals) are *Cyrtopholis femoralis*, *Brachypelma smithi* and *Brachypelma albopilosum.*

More than 120 zoos in Europe breed spiders of the suborder Mygalomorphae. As of March 2024, a total of 30 genera of glasshopper were recorded in Europe according to the ZIMS database, with a total population of 758 animals. The most successful in terms of breeding appears to be the Moscow Zoo, which had a total of 28 species with a population of 98 animals. In comparison, the Zoological and Botanical Garden of the City of Pilsen had 23 species with a total population of 40 species in 2022.

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Ebbe Christian NÜRNBERG | Bachelor thesis

When winters get warmer – effects on body condition in overwintering *A. bruennichi* spiderlings (Arachnida, Araneae)

Climate change and global warming affect the distribution, phenology, and survival of species. The orb-weaver *Argiope bruennichi* has undergone rapid latitudinal range expansion from southern Europe to Scandinavia in the last century. Previous studies have investigated adaptation and plasticity to colder climatic conditions in the northern regions. However, it remains unclear how spiders of the core populations in the Mediterranean will react to warmer temperatures. We therefore explored whether warmer winters affect the body condition of *A. bruennichi* spiderlings overwintering in the egg sac. Adult females were collected after mating and before oviposition at three locations in southern France. They produced egg sacs under a simulated local temperature regime in the laboratory. Three winter temperature treatments were simulated: warmer (+3.7°C), and even warmer (+4.8°C), as predicted by the IPCC, and a control treatment. Spiderlings hatch from the eggs within a few weeks after oviposition and stay in the egg sac over winter. Egg sacs were randomly assigned the treatments. In spring, we investigated the body condition of the living spiderlings using light microscopy and µ-CT. Spiders that underwent one of the warmer winter treatments had a lower body condition index compared to those in the control group. We therefore surmise that spiderlings which experience warmer winter conditions emerge in spring with a lower amount of resources. Indeed, reduced survival in warmer winters was found in a companion study. We anticipate a shift in the range of this abundant species.

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Lilly STEGLICH | Bachelor thesis

Scenarios of climate change: effects of increasing winter temperature on physiological condition in the spider *Argiope bruennichi* (Araneidae, Araneae)

Climate change has ecological effects ranging from the individual level to the entire ecosystem. Little is known about the specific effects of climate change on overwintering arthropods, although high temperatures can influence the metabolism and energy balance of individuals. I investigated the effect of increased winter temperatures on the warm adapted populations of the spider species *Argiope bruennichi* in Southern France. In *A. bruennichi*, spiderlings hatch from eggs and overwinter in the egg sacs with a limited amount of yolk. I hypothesized that increased overwintering temperatures influence the spiderlings´ metabolic rate, which in turn affects fatty acid consumption and survival probability. To this aim, I exposed egg sacs with spiderlings to two warmer winter regimes (+3.7

and +4.8°C above the "usual" ambient temperatures) as projected by the IPCC and compared them to a control treatment simulating the ambient temperature regime. I demonstrated that spiderlings' mortality and their metabolic rate increases at higher ambient temperatures and with progressing winter. This is correlated with a significant reduction in energy-storing fatty acids, such as saturated, monounsaturated and ω-6 polyunsaturated fatty acids. I suggest that the expenditure in energy stores lead to the higher mortality rate, and that the surviving spiderlings are at a severe disadvantage in the long-term. Consequently, even smaller increases in winter temperatures, as chosen here, are likely to affect *A. bruennichi* at both the individual and population levels, possibly leading to a shift in the range of this abundant species.

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Em STEIGER | Bachelor thesis

Mating strategies and development of the female genital organs in *Parasteatoda tepidariorum*

Mating between two individuals of a species usually takes place after both males and females have reached their adult stage of development. In spiders, as in many other arthropods that grow incrementally through moulting, this adult state is characterised by a final maturation moult. However, in some species of the genus *Latrodectus* (Theridiidae) mating of males with subadult females has been described as an alternative mating strategy. This "immature mating" is assumed to represent an evolutionary counter-adaptation to the pronounced sexual cannibalism of adult females. Indeed, the males seem to benefit, as cannibalism occurs much less frequently in mating with subadult females. Whether immature mating also occurs in other, Latrodectus-related representatives of the theridiids is not yet known. For this study *Parasteatoda tepidariorum* (Theridiidae) was selected. It was used to investigate the possible occurrence of sexual cannibalism and immature mating in another theridiid species and to explore whether the dynamics of genital development in females is comparable to that in *Latrodectus*. The hypothesis was that if the genitalia in *P. tepidariorum* are less developed before the final moult, then immature mating in Latrodectus represents aspects of coevolution between males and females and is not only a male alternative strategy.
We performed morphological examinations of the female genital structures of early, late subadult and adult females using light microscopy, histology and micro-computed tomography (micro-CT). Furthermore, mating experiments with adult and late subadult females were then carried out to test whether mating with subadult females also occurs in *P. tepidariorum* or not.
The results showed that the genital structures (atrium, mating and fertilisation ducts and spermathecae) of late subadult *P. tepidariorum* females are already fully developed a few days before the adult moult, very similar to the situation in *Latrodectus*. We did not record immature mating in the mating experiments, although males showed courtship behaviour towards late subadult females. We conclude that immature mating does not occur in *P. tepidariorum*, despite a developmental predisposition (preparedness of the female genitalia).
These results may contribute to the understanding of the evolution of immature mating as a particular alternative mating strategy of spiders that seems to have evolved as a response to cannibalism with no changes in the development of female genitalia involved.

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