

# AAS Virtual Summer Symposium

## Poster Presentation Abstracts

### June 24 - July 1, 2021

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Arranged by first author's last name

Asterisk (\*) indicates contestant in student competition

Presenter underlined

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#### **Are elevation and climate main factors on *Leprolochus* aff. *birabeni* (Araneae: Zodariidae) abundance in a Brazilian seasonal dry tropical forest?**

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Elevation and climate are key factors for many arachnid distributions along altitudinal gradients, such as spiders. Despite this, the way spider populations are influenced by these factors is unknown for many species. This is particularly true for Neotropical spiders that occur in a Brazilian Seasonal Dry Tropical Forest (hereafter, Caatinga). Therefore, the aim of this study was to assess the influence of elevation and climate variables on *Leprolochus* aff. *birabeni* spider abundance in Caatinga. From August 2020 to January 2021, 150 pitfalls traps were installed monthly along three different elevation points (370, 600 and 700 m.a.s.l.) in Maciço do Baturité, Ceará state, Brazil. The interactions between spider abundance and the explanatory variables (elevation, rainfall and temperature) were assessed by a Multiple Regression followed by AIC criteria in R software. A total of 171 adult individuals were collected with the highest spider abundance collected (81.87%) at 600 m.a.s.l. Our results indicated that elevation and climatic variables had high influence (84%) on *L. aff. birabeni* abundance variance. Therefore, our findings suggest that abiotic factors such as elevation, rainfall and temperature exerts a great influence on *L. aff. birabeni* abundance in Caatinga.

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**The effects of seasonal changes on the density of different size classes of the striped bark scorpion, *Centruroides vittatus* (Buthidae: Scorpiones)**

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Densities of the striped bark scorpion, *Centruroides vittatus*, in south Texas, vary with temporal changes. Densities were obtained from La Union Ranch, a site east of San Ygnacio, Texas. La Union Ranch can be described as a semi-arid region, with seasonal changes, such as temperature change and precipitation, affecting the activity and density of different size classes of scorpions. Scorpion densities were measured in plots with a four-meter radius, or approximately fifty square meters. The plots were selected at random throughout the ranch. Ultraviolet lights were used to locate scorpions within the plots. Scorpions were then classified into four class sizes. Class sizes were visual estimates obtained by the observer. Densities of the different size classes varied throughout the course of the year. Seasonal changes influence the activity and densities of scorpions. We suspected that in the presence of the largest size class, the smaller size classes would show less activity. Our data shows that even though the largest class size may have an effect on the activity of the smaller size classes, each of the smaller size classes is affected differently.

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**Advances on systematics of the jumping spider genus *Titanattus* Peckham & Peckham, 1885 (Araneae: Salticidae: Salticinae)**

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Among spiders, Salticidae is the most diverse family, with more than 6000 valid species described worldwide. Within the subfamily Salticinae and tribe Thiodinini, *Titanattus* is a genus composed of 12 species distributed from Guatemala to Argentina, distinguished from other thiodinine genera by the higher carapace and the heart-shaped sternum. In this work, we present preliminary results of the systematic revision of the genus *Titanattus*. *Titanattus* is a monophyletic genus not closely related to thiodinines. With these results, we call attention to the incongruences of previous studies based on molecular data and our results obtained with morphology. Additionally, the female of *T. euryphaessa* is described for the first time, and an update to the delimitation of species groups based on apomorphic characters is proposed.

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**Systematics of *Cobanus* F.O. Pickard-Cambridge, 1900 (Araneae: Salticidae: Salticinae: Euophryini) with description of two new species**

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The current review of groups of neotropical jumping spiders continues to reveal their morphological complexity, phylogenetic relationships, and high taxonomic richness. Some of these groups had not been reviewed in years. Here, we provided morphological synapomorphies that support the genus *Cobanus* F.O. Pickard-Cambridge, 1900, and the transference of some species placed in *Sidusa* to *Cobanus*. To address these issues, we carry out a morphological phylogeny using parsimony, likelihood, and Bayesian methods. *Cobanus* is monophyletic with strong support in all analyses. Based on the morphological synapomorphies, we transfer *S. bifurcata* (Chickering, 1946), *S. cambridgei*, (Chickering, 1946), *S. electa* (Chickering, 1946), *S. mandibularis* (Peckham & Peckham, 1896), *S. unicolor* (F.O. Pickard-Cambridge, 1900) to *Cobanus*. Additionally, two new species of *Cobanus* are described.

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### **New genus and species revealed by phylogenetic analyses of *Antillattus* (Salticidae: Euophryini)**

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An extensive ongoing survey of Caribbean arachnids continues to uncover, across multiple genera and families, greater species richness than hitherto appreciated. Here, we focus on a clade of jumping spiders endemic to the Caribbean, currently all placed in the genus *Antillattus*. Phylogenetic analyses were conducted on *Antillattus* s. l., and the group was revised based on the analyses. These analyses are based on molecular and morphological data, and include Cuban species, which were absent from previous analyses. A total of 125 morphological characters were scored for the group. Additionally, these data were used for species delimitation and identification. Our results indicate that several species formerly placed in *Antillattus* are misplaced in this genus and a new placement is proposed. One morphological synapomorphies and molecular data support the monophyly of the *Antillattus* clade and indicate that the genus as currently circumscribed actually comprises three divergent clades (*Antillattus*, *Pensacolatus* group and *Bryanattus* group). The monophyly of *Antillattus* (new circumscription) is supported by twelve morphological synapomorphies and is revised to include *A. gracilis*, *A. placidus*, *A. cambridgei*, *A. cubensis*, and *A. sp.* [Cuba] is genetically distinct from the other species but is morphologically cryptic. The *Pensacolatus* group, is revised to include *A. darlingtonia*, *A. electus*, *A. maxillosus*, *A. montanus*, *A. peckhami*, *A. scutiformis*, *Pensacolatus* sp. [Dominican Republic], and *P. sp.* [Cuba]. Finally, *Bryanattus* group is proposed to include the type species

*A. keyserlingi*, *A. mandibulatus*, *Petemathis unispina*, *Bryanattus* [Cuba1], *B.* [Cuba2], and *B.* [Cuba3].

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### **Diversity and distribution of Scorpions from Brazil: a well-known fauna?**

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The Brazilian scorpion fauna has been the subject of hundreds of publications, which described one of the most species-rich scorpion fauna of the World. The previous list of the Brazilian scorpion species showed records for 131 species, ten years ago. Herein, we provide the first results of a comprehensive revision of literature regarding the Brazilian scorpion fauna, and update the list of the Brazilian scorpion species. With the present project, we aim to provide an on-line and species catalog and use the database on diversity and biogeographic studies on this fauna. The information is being mined through direct examination of 600 out about 2500 scorpion studies in our library, by filtering those that present records from Brazil. The database presents 3477 records of 182 species, belonging to 28 genera and four families. Buthidae is the most diversified family with 100 species and ten genera, followed by Chactidae (50 spp., 11 genera), Bothriuridae (28 spp., 5 genera) and Hormuridae (1 genus and 4 species). Exploratory analysis revealed large poorly sampled areas in Brazil, thus indicating a large Wallacean shortfall and suggesting a high Linnean shortfall, supported by a large number of hitherto undescribed species available in Brazilian museums.

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### **Parasitoid life strategy fine-tuned to its dangerous spider host**

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We studied the highly specialised koinobiont spider parasitoid *Sinarachna nigricornis* (Ichneumonidae, Ephialtini, Polysphincta group of genera) in both field and in laboratory. Parasitoid host specificity and the interaction with spider host was studied in detail. We found that the studied *S. nigricornis* was associated only with one spider species, respectively with orb web building spider *Araneus sturmi*. The phenology of parasitoid was synchronised with the phenology of its host when the parasitoid larva evidently inhibits its development for the purpose of hatching in a period when a high number of preferred hosts are available. *A. sturmi* under manipulation by *S. nigricornis* built a modified cocoon web serving to parasitoid for the pupation. *S. nigricornis* exhibited high variability in the architecture of the cocoon web induced by its

penultimate instar larva. The most common cocoon web was of 3D architecture with a small central silk platform, from which the wasp cocoon was suspended by its apical end, another cocoon webs consisted only of a few threads, presumably resembling a molting or resting web.

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### **Effects of trophic herbicide exposure in the wolf spider *Pardosa milvina* (Araneae: Lycosidae)**

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We measured the lethal and sublethal effects of consuming herbicide-contaminated prey on the common agrobiont wolf spider, *Pardosa milvina*. Using a 5x2 experimental design, we exposed crickets to one of four different herbicide treatments: atrazine, s-metolachlor, dicamba, 2,4-D or a distilled water control. Spiders were presented weekly with either freshly sprayed crickets or crickets coated with dried herbicide residue while lunge response and prey capture latency was measured during a 20-minute feeding trial. Each spider was maintained on a diet of one of the ten cricket herbicide treatments for six-weeks during which time weight change was measured weekly and mortality was checked daily (n=30, N=300). Herbicide-sprayed crickets did not significantly increase spider mortality or reduce prey capture latency across treatments compared to the water control. We also found no difference in feeding behavior among dry or wet-applied herbicides, but we did find significant differences in prey lunge latency and weight change over time. Only spiders in the control and dicamba treatments gained weight while s-metolachlor, atrazine, and 2-4,D resulted in weight loss for spiders despite spiders feeding on prey. Prey contaminated with these herbicides have significant sublethal effects on these beneficial agricultural predators.

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### **Chemical sensitivity of spiders: effects of morphology, phylogeny and habitat**

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Although the use and registration of pesticides in agriculture is highly regulated, undesirable effects on non-target arthropods have been reported over the last decades. Additionally, pesticides are present in ecosystems other than agroecosystems, where they may threaten the ecological function of spiders as keystone predators. Insecticides from the pyrethroid group can have strong effects on the survival, foraging and reproduction of spiders. Despite these undesired effects, arachnids have received little attention in terms of the Environmental Risk

Assessment (ERA) of pesticides, and studies mainly focused on typical agricultural species. Thus, the aim of this study was to provide ecotoxicological data for spider species from multiple habitats, and to estimate the possible implications on ecosystem function. To do this, the mortality (i.e. 24 hours contact acute test) of lambda-cyhalothrin was tested on spiderlings hatched from field-captured spiders, which were caught in open spaces (*Pardosa agrestis*, *Diplocephalus graecus*), forests (*Pardosa saltans*, *Pirata hygrophilus*, *Enoplognatha ovata*) and wetlands (*Pirata latitans*, *Pardosa amentata*). Our preliminary results show that the response to lambda-cyhalothrin appears to be genus-dependent rather than habitat-dependent, though for robust conclusions testing with further species is required.

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### **Electrical Venom Extraction in the Scorpion *Vaejovis carolinianus*: Evaluating Power and its Effect on Venom Yield, Health, and Survival**

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Electrical venom extraction is a common method for obtaining venom for research and antivenom production, especially in invertebrates. Although widely used, studies seldom report both voltage and current (power) values in their methods. Some of these studies also report injury, death, and reduced venom yield associated with this procedure. This lack of basic electrical information coupled with the negative outcomes for the study organism, suggests proper method development is not occurring. In this study we stratified the scorpion species *Vaejovis carolinianus* into high (1.5 Watt), intermediate (1.0 Watt), and low (0.5 Watts) power groups (N = 4 males and 5 females per group) and recorded extracted venom volume, change in feeding, mass, presence of injury, and death. We milked each scorpion three times, with two-week between each milking. The high-power group experienced significantly more injury and death but did not release significantly more venom compared to the other power groups. We also found that venom yield decreased overtime across all power levels. Our results suggest that more power does not increase extracted venom volume and that how the pulse is applied may be more important. In addition, the decrease in extracted venom volume across all powers merits further investigation.

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### **Prey type and size acceptance in the ricinuleid *Cryptocellus narino***

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Feeding behavior and prey choice are very relevant ecological parameters, since both aspects are often used to determine the role of animals in trophic webs. Ricinuleids are one of the less known arachnid orders and although they are part of the edaphic fauna in tropical regions, their feeding ecology remains unknown. We analyzed the prey type and size consumption in the Neotropical ricinuleid *Cryptocellus narino*. We randomly offered to males (n=8), females (n=11) and juveniles (n=9), termites (Isoptera: Termitidae), millipedes (Arthropoda: Diplopoda), ants (Hymenoptera: Formicidae) and earthworms (Annelida: Enchytraeidae) as prey, and recorded the acceptance rate. We did not find a significant effect of prey type or ricinuleid's sex and instar on acceptance, but a slight preference for earthworms was observed. In a second experiment, we offered earthworms of different sizes to males (n=15), females (n=20) and juveniles (n=20) of *C. narino*. We did not find a significant effect of size, or instar and sex on acceptance, and ricinuleids captured earthworms up to four times their own size. These results suggest that ricinuleids are euryphagous predators able to overcome prey with different morphologies. In addition earthworms, might be a relevant prey to *C. narino* given the large size captured.

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### **Morphometric variation in a widely distributed species of *Idiops* (Mygalomorphae, Idiopidae) across different Brazilian biomes**

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The trapdoor spiders of the Idiopidae family are associated with a sedentary lifestyle and limited dispersion. The most diverse genus is *Idiops* Perty 1833, with more than 100 species, of which 24 are in South America. After a recent review of the Neotropical species, the species *I. pirassununguensis* had its distribution expanded, occurring along the Amazon, Caatinga, and Cerrado biomes. Considering this unusual wide distribution, we investigated whether there is morphological structuration in *I. pirassununguensis* in the different biomes. Geometric morphometric analyzes were performed for the copulatory bulb, sternum, and eyes arrangement of 65 specimens from 21 locations. In addition, linear measurements yielded a data set of 90 variables, including linear and proportional values. To analyze how these structures are distributed in the morpho-space and structured in relation to the biomes, we performed Discriminant Analysis for geometric structures and Cluster Analysis for linear measurements. We found no significant differences in shape of copulatory bulbs along the geographic distribution, which indicates that the specimens belong to the same species. The analyses revealed that individuals from Caatinga can be set apart from the others by the shape of sternum and eyes arrangement, as well as the linear variables.

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### **Phylogeographic investigation into the New Zealand harvestman genus *Algidia* (Arachnida: Opiliones: Triaenonychidae)**

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Opiliones are valuable organisms in biogeography because their limited dispersal ability and ancient lineages enable the use of phylogeographic methods to investigate how distributions have shifted with geographic change. Here, the first robustly sampled phylogeny of the understudied New Zealand triaenonychid genus *Algidia* is presented in order to establish a solid taxonomic foundation for future work. UCE libraries were prepared with DNA from 87 *Algidia* specimens from the Museum of Comparative Zoology. We performed UCE locus assembly on the sequenced libraries using the software PHYLUCE, constructed matrices, and reconstructed the phylogenetic history of *Algidia*. Several divergence dating analyses and species delimitation were performed. Collectively the data suggest monophyly of the genus with 8 putative species. The group began diversifying well before the Oligocene Marine Transgression of New Zealand and their evolutionary history was impacted by major geologic events, including the Southern Alps orogeny and the Last Glacial Maximum. Alongside this work, distribution data from the Global Biodiversity Information Facility were used to perform ecological niche modeling to assess the most important ecological variables determining habitat suitability for *Algidia*, providing information about which environmental conditions have been most conducive to their survival through evolutionary time.

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### **Diversidad y Estacionalidad de La Familia Thomisidae (Arachnidae: Araneae) en Tres Localidades del Estado de Morelos**

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En este trabajo se analizó la abundancia, riqueza, diversidad y composición de la comunidad de arañas de la familia Thomisidae en tres comunidades de Sierra de Huautla en el estado de Morelos, México, y se compararon sus variaciones estacionales. Los muestreos se realizaron mediante paraguas entomológico y búsqueda directa, ambos aplicados en lapsos de 7 h por localidad, una vez al mes, durante el periodo abril 2013-marzo 2014. Se recolectaron un total de 240 individuos de los cuales 81 fueron juveniles y 76 fueron adultos (42 hembras y 34 machos), éstos pertenecieron a diez géneros y doce especies, de las cuales ocho especies son nuevos registros para el estado. La diversidad anual de orden  $q_1$  fue de 6.5 mientras que  $q_2$  fue de 4.8. La temporada de lluvias presentó mayor riqueza, abundancia y diversidad en comparación con la temporada de secas. El género con mayor número de especies fue



*Misumenoidea*. La especie con mayor abundancia fue *Parasynema cirripes*. De acuerdo con los estimadores de riqueza no paramétricos todavía falta por registrar entre el 25% y el 50% de las especies. Por último, la localidad que presentó mayor riqueza y abundancia fue La Carretera Huautla-Ajuchitlán.

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### **Experimental assessment of trophic ecology in a generalist spider predator: Implications for biocontrol in Uruguayan crops**

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Spiders are a very important group of native predators in several crops, nevertheless their trophic ecology remains largely unknown, especially for Neotropical species. We evaluated the predatory behaviour of the wolf spider *Lycosa thorelli* against pest and non-pest arthropods varying in size, all found in South American soybean and rice crops. As prey we used the bug *Piezodorus guildinii* as well as larvae and adults of the moth *Spodoptera frugiperda*, both being considered important pests in Uruguayan crops. We also used non-pest arthropods as prey, sarcophagid flies, carabid beetles and wolf spiders. All prey were attacked in similar proportions. Nevertheless, carabids were not consumed, and bugs were consumed in significantly lower proportions than flies. A negative correlation was found between prey size and acceptance rate. Immobilization times were longer against larvae when compared to moths and flies, while predatory sequences were longer for bugs when compared to flies, moths and spiders. In addition, we found a positive effect of prey size on predatory sequence length and complexity. Our results confirm the ability of spiders to attack and feed upon prey with different morphologies, included well-defended arthropods, and their potential use as natural enemies of several pests in South American crops.

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### **The dark side of the Levant: cave-dwelling spider assemblages of Israel and Palestine**

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Caves around the world share unique conditions that have led to convergent adaptations in cave-dwelling spiders and other animals, such as eye reduction. Some spider families are frequently found in caves; however, the composition of cave-dwelling spider assemblages is also affected by geographic locations and local conditions. We conducted a survey of 35 Levantine caves, distributed along a climate gradient from the mesic in the north of Israel to

hyper-arid areas in the south. Latitude, precipitation, minimum temperature, elevation, and guano levels significantly affected cave-dwelling spider assemblage composition. Caves situated in mesic Mediterranean climate had higher species richness and abundance than caves in arid climates. We found 62 spider species in the survey; we classified four species as troglobites, 28 as trogloniles, and 30 as accidental cave visitors. The troglonile and troglobite species belong to 12 families (Agelenidae, Dysderidae, Filistatidae, Leptonetidae, Linyphiidae, Nesticidae, Pholcidae, Phyxelididae, Sicariidae, Sparassidae, Theraphosidae and Theridiidae). Agelenidae bore the highest number of cave-dwelling species, followed by Pholcidae, Linyphiidae and Dysderidae. Our discoveries contributed to the knowledge of the local arachnofauna and identified gaps in taxonomic knowledge. These faunistic surveys are crucial stages for understanding the evolutionary and ecological mechanisms of arachnid speciation in Levantine caves.

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### **First endemic arachnid from Isla Sala y Gómez (Motu Motiro Hiva), Chile: a new species of tube-dwelling spider (Araneae: Segestriidae)**

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The Isla Sala y Gómez or Motu Motiro Hiva is located 415 km northeast of Rapa Nui (Easter Island) and 3420 km from the coast of northern Chile. It is a small oceanic island (2.5 km<sup>2</sup>) dominated by volcanic rock with very little vegetal cover. Here, we describe the first endemic arachnid for the island, *Ariadna motumotirohiva* sp. nov. Females are similar to those of *Ariadna perkinsi* Simon, 1900 from Hawai'i and *Ariadna lebronneci* Berland, 1933 from the Marquesas in the dorsal dark abdominal pattern, but they differentiate from the latter in the anterior receptaculum, promarginal cheliceral teeth and leg IV macrosetae. A recent survey of the arachnid fauna of Rapa Nui, which included Motu Nui and the rocky shores, did not record the presence of the family Segestriidae, neither has it been found during previous surveys. However, it is not possible to discard the possibility of a local extinction on Rapa Nui and survival on Sala y Gómez. This study suggests other endemic terrestrial arthropods could be present on this very small and remote island.

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### **Bacterial growth inhibition potential in cocoon and hunting spider silk**

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Despite numerous attempts made in the literature, the questions regarding the antimicrobial properties of spider webs still seem unresolved. Possible differences of various silk types produced by their specific glands make this issue even more complicated. Thus, this project is focused on spider silk, concerning its potential antibacterial properties. Our previous, published research showed that eggs within cocoons of *Parasteatoda tepidariorum* species are free from external, cultivable bacteria. It also appeared to be true for the newly hatched nymphs. Thus, this project aimed to: (i) extend the comparative analyses to the representatives of other spider families, initially Salticidae (e.g., *Saitis barbipes*, *Marpissa muscosa*), (ii) find possible differences in the inhibition of bacterial growth between cocoon and hunting silks initially using *Parasteatoda tepidariorum* species. Unopened cocoons and sterile-acquired eggs were incubated on Petri dishes using lysogeny broth (LB) agar medium for 3 days at 37°C to detect potential bacteria present on their surfaces. For growth inhibition tests, the OD measurements of the bacterial suspensions (both Gram+ and Gram-) were applied. These measurements included various concentrations and were carried out for 1 hour at 37°C.

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### **Romance everywhere: testing sexual behavior according to substrate in *Paratrochosina amica* (Mello-Leitão, 1941)**

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Knowledge about South American spiders from Allocosinae subfamily is scarce. However, several studies have been performed in *Allocosa senex* and *Allocosa marindia*. These two species show reversal in sex roles expected in spiders, what could be related with the fluctuating coastal environment where they inhabit. *Paratrochosina amica* is an Allocosinae species that inhabits grasslands and more rarely meadows close to coasts of streams. The aim was to describe sexual behaviour in *P. amica* and compare the results under different substrates. We exposed pairs of females and males with soil and sand as substrate (N=13 and N=18, respectively), and recorded their behaviors. Thirteen females mated on soil and thirteen on sand (Fisher test; mating frequencies soil versus sand,  $p=0,06$ ). In all the cases males initiated courtship and approached females. Courtship duration averaged  $283,39\pm 285,44$  sec on soil and  $194,00\pm 193,24$  sec on sand (U=69;  $p=0,44$ ), while copulation duration was  $291,54\pm 701,59$  sec and  $6,23\pm 7,45$  sec (U=53;  $p=0,11$ ), respectively. According to our results, *P. amica* would not show reversal in sex roles and males would be the mobile and courting sex. Sexual behavior in this species seems to be stereotyped what could indicate this spider is adapted to both types of habitat.

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### **Lethal effects of herbicides and herbicide residues on the wolf spider *Pardosa milvina***

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We measured lethal effects of chronic exposure to herbicide treated soil on juveniles of the wolf spider, *Pardosa milvina*. We tested six herbicides: atrazine, S-metolachlor, mesotrione, glyphosate, 2,4-D, and dicamba. We also tested a mixture of all six herbicides and a distilled water control. Spiders were housed with topsoil previously sprayed with a recommended herbicide dose or water control. To test for herbicide residue effects, we reared spiders under herbicides exposed to three aging treatments: freshly applied herbicides, herbicides aged for 69 days under laboratory conditions (indoor aged) or aged for 69 days in a greenhouse (outdoor aged) (N=960; n= 40 spiders across 24 treatments). Spiders were maintained on the treated substrates for 48 days, fed crickets and checked for mortality daily. Mesotrione and combined herbicide treated spiders showed very high mortality within two weeks of exposure among both freshly applied and indoor aged soil treatments while mortality did not differ across outdoor aged herbicide treatments. Mesotrione had significantly higher mortality than the combined herbicide treatment suggesting antagonistic toxicity effects between herbicides. Our results indicate that mesotrione is a powerful araneocide that may have its toxic effects partially mediated by adjuvant herbicides and natural breakdown under field conditions.

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### **Landmark-guided T-maze learning in the wolf spider *Tigrosa helluo***

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Cursorial spiders may use landmarks to navigate the environment. One type of landmark is a reference frame which is an environmental shape or boundary that aids spatial localization. Using a modified water T-maze, we recorded the ability of adult female *Tigrosa helluo* wolf spiders to navigate toward a target reward. We measured variation in spatial learning of the target location with and without a reference frame. We tested females over ten consecutive trials whereby each subject had a maximum of thirty minutes to successfully achieve the goal. We repeated training the following day for each subject for a total of 20 trials over two days (28 spiders, N=560 trials). For each trial we recorded latency to achieve the goal and path retracing behavior. Results indicate significantly shorter time to goal over subsequent trials with shorter mean latency to achieve goal on the second day compared to the first and these effects were more pronounced when landmarks were present. *Tigrosa helluo* can learn simple T-maze navigation under our testing conditions and show significantly fewer errors when landmarks are present. These wolf spiders are also better able to retain this spatial learning over a 24-hour period when landmark cues are present.

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## **Evolutionary Conservation of Protein Domain Structure in Putative Spider Circadian Rhythm Genes**

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Internal biological clocks allow organisms to adjust their behavior and physiology to the external environment. While circadian rhythms are affected by environmental stimuli, they tend to be driven by a conserved set of endogenous molecular mechanisms. While most animals use these innate controls to follow a daily period close to 24 hours without environmental time cues, spiders have species specific daily periods that deviate significantly from this norm ranging from 18-29 hours. Differences in the molecular clockwork could be a contributor to the variation observed in spider periods. While the identity and function of circadian regulators in insects have been well characterized, these regulators have not yet been studied in spiders. The goal of this study was to identify putative circadian regulators in spiders and to analyze and compare domain structures of these proteins to their orthologs in other invertebrates. Using bioinformatic approaches, we identified spider orthologs for six central circadian rhythm regulatory proteins. Domain structures were comparable between spiders, insects, and crustacean orthologs, however some differences were observed in location and number of nuclear localization and export sequences. These results support the existence of an ancestral circadian clock pathway that may function similarly in spiders as in other invertebrates.

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## **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.

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## **How spiders actively modulate web-vibration sensing for prey localization**

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Organisms flexibly adjust postures and movements to acquire information from environments based on real-time sensory feedback. Studies have provided insight on sensorimotor integration in vision and vibrissal sensing. Nonetheless, despite the ubiquity of vibrational sensation in animals from worms to elephants, less is known about how behavioral dynamics modulate vibratory sensory information they perceive. This study aims to understand how spiders actively perform a series of sensorimotor actions to modify the vibrational sensory field during prey capture. We hypothesize that orb-weaving spiders actively adjust leg postures and produce web vibrations to increase sensory gain. In Aim 1, we will identify how leg posture is altered as a function of web perturbation. In Aim 2, the vibration sensitivity as a function of leg postures will be characterized. We will identify the mechanical properties as well as the functional organization of the vibration sensor, the slit sensilla. By combining these measurements, we will be able to infer how the spider modulates leg vibration sensitivity to detect prey. To study active sensory modulation, we will define the dynamics of leg posture and web-vibration during active sensing in Aim 3. Importantly, this study will improve our understanding of sensorimotor integration of substrate-vibration sensation.

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## **Characterizing the Morphology and Function of Elongate Sensory Hairs in the Arachnid Order Solifugae (Camel Spiders)**

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Arachnids in the Order Solifugae are predominantly desert-dwelling, fast-moving, strong-jawed animals, good at escaping predators and catching prey, yet little is known about their sensory ecology. Solifuges have unique sense organs like malleoli for chemoreception and most species

are covered in hairs of lesser-known structure/function. The ubiquitous hairs covering the pedipalps appear to function in chemoreception and mechanoreception. However, the long sensory hairs on their hindlegs remains understudied. Initially confused with trichobothria, these long sensory hairs might similarly detect near-field sound. My research at Cedar Point Biological Station in the sandhills of Nebraska this summer will be conducted with solifuges found there. To test the hypothesis that solifuges can perceive near field sound using the long sensory hairs on their hindlegs, I have three research objectives. First, I will observe that natural foraging behavior of solifuges in the field using light and camera traps. Second, I will determine the (a) mechanical and (b) physiological properties of the elongate sensory hairs by exposing them to different frequencies of near-field sound and quantifying (a) their physical deflection and (b) their neural response. Third, I will conduct behavioral trials in controlled laboratory setting to evaluate the behavioral responses of solifuges to near-field sound.

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### **Negative consequences of some insecticides on the mobility of a South American wolf spider**

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Insecticides application is a widely used strategy for pest control in South America, however, the negative effects of these products on native local fauna are unknown. The wolf spider *Lycosa cf. bivittata* is a common predator found in soybean fields from Uruguay, being a suitable model to analyze the effect of insecticides on local predators. We evaluated the effect of selective (Methoxifenocide) and broad-spectrum insecticides (Thiamethoxam + Lambda Cyhalothrin) on the mobility of *Lycosa cf. bivittata*. We topically exposed adult females of *Lycosa cf. bivittata* to both selective and broad-spectrum insecticides, in control group we exposed spiders to acetone. We recorded the mobility and speed of spiders on each group during 72hs. We observed a mobility reduction in spiders exposed to broad spectrum insecticides when compared to the other treatments, the opposite trend was observed in the selective insecticide. Spider's speed increased on insecticide treatments when compared to control group. Reduction on spider's mobility caused by broad spectrum insecticide might affect its predatory activity, while the increased speed caused by insecticides, suggesting an irritating effect. These results suggest that broad-spectrum insecticides might have a strong negative effect on spiders. Further studies will evaluate the compatibility of spiders and selective insecticides.

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### **Tasty aphids react to chemotactile cues from the wolf spider, *Pardosa milvina* (Araneae, Lycosidae).**

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Predators can influence prey both by reducing densities and by shifting their activity and distribution. The behavioral shifts in potential prey can be costly if they reduce access to resources critical to growth or reproduction and, as such, selection should only favor strong reactions when the risk of predation is high. Since aphid species differ a great deal in their quality of prey for spiders, we predicted that the reactions to cues from a spider would be related to the propensity of that spider to kill members of their species. We documented the activity of the aphids, *Aphis fabae* and *Aphis nerii*, in laboratory containers with or without chemotactile cues from *Pardosa milvina*. The presence of spider cues caused *Aphis fabae* to move more slowly and cover less distance, however similar cues had no effect on activity of *A. nerii*. In laboratory feeding trials, *P. milvina* females attacked *A. fabae* more quickly than they attacked *A. nerii* and killed more than twice as many *A. fabae* individuals in 30 minute trials. Thus, the anti-predator behavior of the prey was related to their appeal to the predator with implications for their importance in the food web and for biological control.

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### **Cytogenetic characterization of different populations of *Bothriurus rochai* (Bothriuridae) shows intraspecific variety of the diploid number**

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Only five species of *Bothriurus* have their cytogenetics features described. Thus, the objective of this work was to expand cytogenetic information for the genus, characterizing diploid number and chromosomal behavior during meiosis in different populations of *Bothriurus rochai*, a widely distributed species in the Brazilian semiarid region. This study was carried out with males from different populations in the states of Piauí (Brasileira, São Raimundo Nonato, and Pirarucura), Ceará (Icó and Quixadá), Paraíba (Cajazeiras and Maturéia) and Rio Grande do Norte (Apodi and João Câmara). Cells in mitotic metaphase allowed to determine the diploid number  $2n = 18$  for individuals from Piauí populations. On the other hand, for the other populations, the analysis showed a diploid number  $2n = 16$ , the lowest diploid number ever recorded for the Bothriuridae. All populations showed differences in chromosomal behavior during meiosis. Hemispermatozoa of these individuals did not have clearly distinct morphology. Thus, cytogenetics data can indicate the existence of cryptic species. In addition, the study of these chromosomal changes can help understanding the evolution of different populations, since such differences may also be related to the population structure and the dispersion pattern.

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### **Comparative morphology of male genitalia in Neotropical samooid harvestmen (Laniatores: Samooidea) with a homology hypothesis**



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In Opiliones, male genital morphology has great utility for taxonomy and systematics. It is particularly important for small, litter-dwelling harvestmen which exhibit highly convergent external morphologies such as the superfamily Samooidea (Samoidae, Biantidae, and Stygnommatidae). Stygnommatidae is endemic to the Neotropics. Samoidae is mainly Neotropical but has colonized some South Pacific islands. Within Biantidae, the subfamily Stenostygninae is restricted to the Neotropical Realm while other subfamilies are widely distributed across the Afrotropical and Indomalayan Realms. As part of our systematic revision we found that the Neotropical Samooidea represent a monophyletic group and that the limits of compound families need to be redrawn. To achieve this goal, we characterized the bauplan of the male genitalia using a new concept of family-level organization within Neotropical Samooidea. Additionally, we present a homology hypothesis for the constitutive parts of male genitalia. To fully understand the genitalia morphology and establish homologies of genitalic structures, it is necessary to carefully study them using compound light microscopy and SEM, as well as to examine the genitalia in their expanded form. Only with penial expansion can we obtain detailed information about the capsula interna morphology and make inferences about functional morphology.

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**One place, two communities: The effect of seasonality and environment on orb weaver spiders (Araneidae: Araneae) in a tropical dry forest in Mexico**

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Orb weaver spiders of the family Araneidae are a conspicuous component of spider's assemblage in the tropical dry forest in Mexico. Also, their abundance, richness, and diversity seem to be extremely affected by seasonality and environmental factors, leading to a well-marked phenology. The aim of this contribution is to evaluate the effect of those variables on the orb weaver spider community. Material was collected monthly during April 2013-March 2014 in three localities inside and outside the Sierra de Huautla Biosphere Reserve, Morelos, by five collectors using two techniques (vegetation beat and direct searching) during seven daylight hours. We found 674 individuals (302 adults) in 14 genera and 17 species, from which eight species are new records for the state. Richness, abundance, and diversity changed between

seasons with their highest values on rainy season and lowest values in dry season. The species turnover was higher than 70% within and among the three sites. Generalized linear regression models shows a positive effect of precipitation on richness, in the other hand, evaporation has a negative effect on the diversity. The main conclusion is that orb weavers' spiders behave as two different communities, a pattern that is shared with other arthropods and arachnids groups.

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### **Genetic Diversity in a Non-Native Ant-Mimicking Spider in Its Invaded Range**

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The ant-mimicking spider *Myrmarachne formicaria* (Salticidae) is a species native to Eurasia and was first identified in North America in 2001. It has since been found in many locations in the Northeast including western New York, western Pennsylvania, northeastern Ohio, and southern Ontario. Little is known about its introduction to North America and how it has dispersed since. By characterizing the mitochondrial genetic diversity of this species, we can learn about its introduction history and dispersal patterns in North America. Sequencing of a 600-bp mitochondrial DNA gene region spanning the 16s rRNA, leucine tRNA, and part of the ND1 gene from 27 specimens collected from 14 localities in New York, Pennsylvania and Ohio yielded very little genetic polymorphism. Comparisons with sequence data available in GenBank for several other salticid species have shown that within-species variation in this mitochondrial DNA region is found in other spiders, so *M. formicaria*'s lack of variation is likely unusual. Our current data are consistent with a single invasion of *Myrmarachne formicaria* from one source locality, but data from additional loci and samples would help to confirm this conclusion.

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### **Sub-lethal effects of herbicides on the wolf spider *Pardosa milvina***

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Herbicides can have negative effects on non-target ground spiders. We compared exposure effects from herbicides that were freshly applied to soil, aged for 69 days indoors at room temperature, or aged for 69 days in a greenhouse. Field-collected juvenile *Pardosa milvina* were exposed to one of eight herbicide treatments (atrazine, glyphosate, mesotrione, S-metolachlor, 2,4-D, dicamba, a combination of all six herbicides, or a distilled water control; N = 960, n = 40, across 24 treatments) and maintained for 49 days on the treated soil substrate. We recorded prey capture behavior, weight change, and growth rate across treatments. Mesotrione had particularly significant negative effects on feeding and weight gain. Mesotrione impaired prey

capture latency and led to weight loss. We found significantly decreased molting frequency of spiders in the 2,4-D, S-metolachlor, glyphosate, and dicamba treatments relative to the control but this effect was not present in the greenhouse-aged soil treatments. Fresh and indoor-aged soil had similar effects while greenhouse-aged soil dampened most herbicide effects indicating photodegradation and/or temperature degradation of herbicides over the 69-day period. Our results show that some herbicides significantly impair feeding and growth rates in this agriculturally abundant predator with some effects detectable even with greenhouse-aged herbicide residues.

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### **Jumping Spiders (Araneae: Salticidae) associated with native vegetation at the Emas National Park in central Brazil**

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Jumping spiders are excellent predators from the Salticidae family, distributed worldwide, the family is the biggest in the Araneae order, they exhibit a wide range of morphological diversity and behavioral patterns, making them an extremely interesting spider group to study. Despite having the highest number of Salticid records in the world, Brazil still has many undersampled biomes and the Cerrado Biome is one of them. We sampled spiders in the Cerrado's native vegetation, at Emas National Park, in central Brazil's State of Goiás from 2016 through 2018. While the 2018's samples have already been examined, identified by the group's specialist Dr. Gustavo R. S. Ruiz and are now awaiting to be deposited at the Goeldi Museum in Belém, Pará, there's still the 2016 and 2017 samples to be examined. The 2016's samples are being examined now and despite having some drawbacks due to the quarantine, there is a promising number of mature individuals and morphotypes already. This work is expected to provide a species checklist after examining all of the samples acquired through the years, the results so far have been great and the data gathered will be used for my undergraduate thesis and publication.

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### **Success of Batesian Mimicry in the Ant-mimicking Spider *Myrmarachne formicaria***

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*Myrmarachne formicaria* (Salticidae) is an ant-mimicking spider from Eurasia which was first noted in North America in 2001. It is important to understand how *M. formicaria* will impact other

species as it spreads throughout North America. *M. formicaria* mimic ants by moving their forelegs to resemble ant antennae, as well as bobbing their abdomen. The goal of this study was to assess the success of Batesian mimicry used by the ant-mimicking spider in avoiding predation when in a staged encounter with another salticid spider. The predator spiders were placed in a petri dish with either *M. formicaria* or a different non-mimic salticid spider species. *M. formicaria* was attacked less frequently by the predator compared to the non-mimic ( $p = 0.045$ ). We scored the frequency of behaviors in the ant-mimics including abdominal bobbing and movement of their enlarged chelicerae. Video analysis showed that ant-mimics benefit from some of these movements as individuals that were not attacked exhibited a longer duration of chelicerae movement. We found no significant difference in abdomen movement between ant-mimics that were attacked or not. Determining whether their lower incidence of attack is a result of the ant mimic's appearance, behavior, or both will require further investigation.

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### **Exploring the social brain hypothesis in spiders**

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It is known that social spiders have altered morphologies and life histories but the role of brain size and increased cognitive capacity in the evolution of sociality in spiders has not yet been investigated. This project expands the field of neuroethology by testing the hypothesis that spiders with social behaviours have a higher investment in brain regions that correspond to the cognitive challenges of living in social groups (such as the mushroom bodies and the arcuate bodies) which control higher order functioning compared to closely related solitary spiders. To test this, we compared the relative size of different brain regions in spider solitary and social species of Sparassidae (huntspiders). For each individual collected we measured morphology (size and condition) of functionally distinct brain regions (including the mushroom bodies and the arcuate bodies) using Micro CT scanning. Previous results have shown the methodology proposed for Steinhoff (2020) has been working and so far we can distinguish the mushroom body in the images. However, we are still analysing the images in order to compare the two groups.

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### **Harvestmen in the first twenty years: a scientometric analysis of Zootaxa's contribution to opilology (Arthropoda, Arachnida, Opiliones)**

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During 2003-2020, 141 papers on Opiliones, mainly authored by Brazilian opilionologist, were published in Zootaxa (no papers in 2001 and 2002). The journal has greatly facilitated the dissemination of knowledge on Opiliones, especially with respect to the taxonomy and systematics of harvestmen from the Neotropical Realm. Those papers include almost a quarter of the new species described worldwide and introduced 112 new synonymies. Additionally, 27 of those papers proposed 182 new/restored combinations. A total of 108 authors working in 25 countries have contributed with papers. There is a predominance for collaborative contributions with more than twice as many papers authored by two or more authors compared to single-author publications. The majority of papers deal within the local biogeographic realm (where the lead author resides). Studies from seven of the eight biogeographic realms were published and the largest portion were focused on the Neotropical opiliofauna, but Australasian, Nearctic, Indomalayan, Palearctic, Afrotropical and Antarctic are covered as well. No papers on Opiliones have been published by authors representing countries in Africa. We recognize a strong gender bias in authorship and the composition of Opiliones subject editors. We will strive to create an inclusive environment and aim to promote diversity of opilionologist.

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### **Systematic review of the genus *Eucynortula* Roewer, 1912 (Opiliones: Cosmetidae)**

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Cosmetidae is the second largest family among Opiliones, with around 700 species occurring from south of the United States to north of Argentina. Species of Cosmetidae show a conservative general morphology that has been misinterpreted and led early taxonomists to the creation of ambiguous identification systems based on the combination of some strongly variable non-informative characters. The revision of some genera recently started, and new informative characters have been proposed. This work assessed the monophyly of the genus *Eucynortula*, composed of 13 species, under a cladistic analysis using morphological data. *Eucynortula* was recovered as paraphyletic, it was re-diagnosed by the following characters: Tibia IV armed in males, Tibia of pedipalp exceeding the length of femur, ventral plate sub-squared, penial wattle short and dorsal process of glans rounded. The genus was restructured including the species *Eucynortula albipunctata*, *Eucynortula punctatolineata* comb. nov. and *Eucynortula albornata* comb. nov., the last one was included into the genus by recognizing the genus *Cynortoperna* as a junior synonym of *Eucynortula*. Excluded species are transferred to other genera (i.e. *Metacynorta metatarsalis* comb.nov. and *Eucynorta multilineata* comb.nov.) and remaining are considered as Species inquirendae, since further evaluation is necessary to provide a reliable identity.

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## **The assessment of wide spectrum of frequency electromagnetic radiation effects on *Parasteatoda tepidariorum* spiders using a combination of physiological and molecular markers**

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Exposure to radio-frequency electromagnetic fields has increased significantly in recent decades. There is no research which shows the influence of a wide spectrum of electromagnetic field's parameters on cells or whole living organisms and therefore the mechanisms of EMF's acting are unknown. The direct targets of EMF in producing non-thermal effects have not been clearly established. The main purposes of the project is to investigate the influence of frequency of electromagnetic field on the oxidative stress level in spiders' cells, the level of heat shock proteins (HSP), DNA damages and the process of apoptosis. *Parasteatoda tepidariorum* will be used as a research model. Spiders will be divided into groups depending on: stage of development, frequency and time of exposure on EMF. The level of oxidative stress in cells will be shown by the level of reduced glutathione, HSP, antioxidative enzymes and concentration of MDA, using ELISA test, Western Blotting and flow cytometer kits. The assessment of gene expression will be examined by RT-qPCR. The level of DNA fragmentation after EMF exposure will be investigated by using comet assay. The studies can explain some of the molecular mechanisms of EMF's acting and can develop knowledge about the influence of EMF on living organisms.

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## **A new species of *Neominniza* (Pseudoscorpiones: Garypinidae) from the Argentinean Puna**

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The genus *Neominniza* (Garypinidae), endemic from Chile, was defined by M. Beier in 1930 by having two pairs of eyes, tergites and sternites divided, first leg femur longer than patella and by the trichobotrial distribution pattern: ist, it und isb forming a cluster relatively (for the family) distal from the finger basis where ib is located. Harvey and Štáhlavský added, in 2009, the presence of glandular setae in the median sternites; paired and enlarged dorsal anterior glands in the male genitalia; not divided arolia and not paraxially offset chelal pedicel. Actually, the genus comprises two species: *Neominniza divisa* Beier, 1930 from Central Chile and *Neominniza halophila* Beier, 1964 from Coquimbo. Here, we describe a new species collected in a xeric environment of Argentinean Puna which differs from the Chilean species by the number

of galeal rami, shape of the palpal segments (plumper than in *N. divisa*) and the absence of “Tastborsten” in the palpal femur as well of tooth in the proximal half of the moveable finger. Particular attention deserves the presence of microsetae between and on the tip of the finger and the biogeographic implications of this new record for the relations between Argentinean Puna and Chilean arthropod faunas.

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### **Madagascar, the real Treasure Island! Malagasy uncharted diversity of a rare ancient lineage of armored harvestmen (Opiliones: Laniatores: Buemarinoidea)**

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The Opiliones superfamily Triaenonychoidea currently includes four families: ((Synthetonychiidae + Lomanellidae) (Triaenonychidae + Buemarinoidea)). Triaenonychidae is the more diverse with ~110 genera and ~500 species, distributed throughout the Gondwana, whereas his sister group Buemarinoidea comprises four genera widely distributed: *Fumontana* found in the Appalachians, *Turonychus* from Spain, *Buemarinoa* from Sardinia and *Flavonuncia* endemic to Madagascar. The four genera of Buemarinoidea are currently monotypic and each species has a restricted distribution, representing survival relicts of an ancient distribution. Our study focused on members of Madagascar's *Flavonuncia* because we found in the CAS collection several representatives of this genus, widely distributed throughout Madagascar. The study of 375 samples allow us to redescribe *Flavonuncia pupilla*, the type species, and identify four new species. We used stereomicroscope and SEM to detailed study of the external and genital morphology. We found that besides slight external morphological differences, the morphology of the penis exhibits characteristics for species identification therefore the study of the male genitalia is extremely important to the taxonomy of this group. *Flavonuncia* now comprises five species and became the unique non monotypic genus of Buemarinoidea. Madagascar is indeed a real Treasure Island containing the unique example of radiation in the early diverging lineage of Buemarinoidea.

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### **Do eavesdropping male spiders assess the relative size of their rivals?**

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In the wolf spider *Schizocosa ocreata* (Hentz), males use visual signals in courtship, which indicates their mate quality to females. However, males also learn to associate competitor male

signaling with female presence by eavesdropping and initiating courtship, which may distract females and increase chances of mating. Theory predicts that males should be able to assess the quality of rivals relative to their own mating potential. We investigated whether eavesdropping male *S. ocreata* assess potential competitors and behave in a manner that might improve mating success. We exposed focal males (trained eavesdroppers or naïve control males) to manipulated video playback of courting males with larger or smaller leg tufts and recorded courtship rates. The focal males were also measured for body size and tuft area relative to their digital rivals. Results show that males with equal or smaller tufts relative to their competitors courted significantly more vigorously, regardless of training status. While there was no correlation between body size and courtship rates of focal males, different courtship rates based on relative tuft size can be attributed to assessment of rival male size.

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### **Effect of web builder sex on an invasive cellar spider (*Pholcus manueli*)**

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Previous research has shown that *Pholcus manueli* are able to glean important information from a web regarding the web builder via chemical cues on the silk. However, little is still known regarding the basic biology of *P. manueli* and how they interact with conspecific webs. Identifying a web as belonging to a conspecific of the different sex is an important first step in the reproductive process. In this study, spiders were introduced into freshly spun webs. Four experimental groups were used: male into male webs, male into female, female into male, female into female. No spiders were reused. Their behaviour was recorded for 30 minutes. Key differences were observed in two behaviors: tasting silk was observed when the spider applied its mouth/chelicerae to the silk or brought its claws to its mouth/chelicerae and laying silk was observed when the spider added to the structure in which it was placed. Preliminary results show that males spend more time tasting silk and laying silk than females, regardless of web builder sex. Females spend more time tasting silk and laying silk in male webs compared to female laid webs. These differences will contribute to our understanding of courtship and mating in *Pholcus manueli*.

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### **New data on the genus *Karakumosa* Logunov & Ponomarev, 2020 (Araneae: Lycosidae) from Iran**

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Wolf spiders are tiny to very large predators with more than 2400 species distributed worldwide. The fossorial lycosid *Karakumosa* Logunov & Ponomarev, 2020 is almost a diverse genus currently comprises 10 named species- *K. alticeps* (Kroneberg, 1875), *K. badkhyzica* (Logunov & Ponomarev, 2020), *K. gromovi* (Logunov & Ponomarev, 2020), *K. medica* (Pocock, 1889), *K. repetek* (Logunov & Ponomarev, 2020), *K. reshetnikov* (Logunov & Fomichev, 2021), *K. shmatkoi* (Logunov & Ponomarev, 2020), *K. tashkumyr* (Logunov & Ponomarev, 2020), *K. turanica* (Logunov & Ponomarev, 2020) and *K. zyuzini* (Logunov & Ponomarev, 2020)- all of which occur in Central Asia. Iran as one of the most important countries in the Middle East is home to outstanding biodiversity. Despite the recent numerous studies by researchers the faunistic composition and taxonomic relationships for most taxonomic groups of Iran, including spiders, remain poorly understood. Here, we present two new *Karakumosa* species from Iran with detailed figures. Moreover, the occurrence of *K. shmatkoi* is provided from the country for the first time.

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### **The effects of early environmental enrichment on the learning abilities of the wolf spider *Tigrosa helluo* (Araneae: Lycosidae)**

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The ability to learn about the surrounding environment is advantageous for many arachnids and they have been shown capable of learning in numerous contexts. The early environment can also impact behavior and learning abilities in some spiders. Here I present data on learning by the wolf spider *Tigrosa helluo* (Araneae, Lycosidae) reared in varying levels of environmental complexity. Spiderlings were randomly assigned after their third instar to either a simple, intermediate, or complex housing treatment, scaling with both size and habitat complexity, for three months. Spiderlings then underwent learning trials using a modified T-maze design and a novel sucrose reward. Preliminary analyses across all trials revealed no significant effects of treatment on overall latency to select a maze side, latency to locate the reward, or selection of the rewarded side of the maze. A more focused analysis of spider behavior in the trial following their initial contact with the stimulus however yielded a marginally non-significant selection success rate of the rewarded side of the maze, as well as a marginally non-significant effect of treatment on successful contact with the reward. Overall, there was not strong evidence of early environmental enrichment affecting the learning abilities of juvenile *T. helluo*.

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### **Geographic inventory of New Zealand mite harvestmen (Arachnida, Opiliones, Cyphophthalmi)**

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Mite harvestmen (Cyphophthalmi) are excellent models for studying historical biogeography due to their ancient age and limited dispersal. These tiny arachnids occur throughout New Zealand's North and South Islands as narrow range endemics. Occurrence data have been collected on New Zealand's mite harvestmen for a century now. These records are held by many museums, but have never been combined in one place. Having a comprehensive database facilitates the sharing of knowledge through easier access to collection records. Records from fourteen museums were merged into a single dataset, with the format derived from Global Biodiversity Information Facility (GBIF) standards. In total, we compiled data for 1115 collections, comprising over 5000 specimens. Going forward, this database will be used to illuminate biogeographic patterns, such as regional comparisons of species richness across New Zealand.