ABSTRACT BOOK

Keynote Lectures

BIRD-DROPPING MASQUERADE IN *PHRYNARACHNE* CRAB SPIDERS: A BIRD'S EYE VIEW

Li, Daiqin[1,2]

[1] Department of Biological Sciences, National University of Singapore, Singapore 117543; [2] Centre for Behavioural Ecology & Evolution, School of Life Sciences, Hubei University, Wuhan 430062, Hubei, China

Visually-oriented predators are the major force driving the evolution of diverse anti-predator defense strategies such as crypsis, masquerade, mimicry, and aposematism. A masquerade animal evolves to avoid predation by being misidentified as inedible objects by its predators and/or gain access to prey by being misidentified as innocuous objects by its prey. Members of the genus *Phrynarachne* belonging to crab spiders (Family: Thomisidae) are ambushing predators. *Phrynarachne* spiders, often cited as a textbook example of masquerade, are assumed to visually resemble bird-droppings and also to be smelled like bird droppings. Yet this notion remains largely unexplored. In this talk, I present the evidence of a masquerade that resembles bird-droppings both visually and chemically, and acts as both prey and predators in these spiders. Specifically, we used an integrative use an integrative, comparative, and multidisciplinary approach to investigate whether and how *Phrynarachne* spiders resemble bird-droppings using visual modelling, field and laboratory behavioral experiments, and 3D printed models. Our results demonstrate that *Phrynarachne* spiders form a visual and chemical masquerade that resembles bird-droppings. Our study thus highlights the forms and functions of bird-dropping masquerade and sheds light on the underlying mechanisms of bird-dropping masquerade in *Phrynarachne* in specific and in animals in general.

RAINFOREST TO RESEARCH LAB: STUDIES OF THE SOCIAL LIFE (AND SEX LIFE) OF SPIDERS

Uetz, George

Department of Biological Sciences, University of Cincinnati, Cincinnati, OH 45221-0006

In this retrospective, I will share insights gained from a long-term research career studying sociality and sexuality in two very different spiders – ecological costs and benefits of colonial web-building in *Metepeira* from Mexico, as well as multimodal communication and sexual selection in *Schizocosa* from Ohio. With respect to *Metepeira*, I will review work on trade-offs between fitness gains of colonial web-building and costs accrued from competition and predation, and how these are balanced in colonies of varying size. With regard to *Schizocosa*, I will discuss research on seismic/vibratory and visual communication in male courtship and female mate choice, highlight experimental approaches using video/vibration playback, and discuss current work. I also plan to dig up some embarrassing old photos, tell some stories about previous research, and cover some current and unpublished material. As a life member of AAS, I also plan to comment on the history and state of the field and give some advice to others just starting their career (i.e., pontificate a bit on what I think is important).

PALPIMANOID SPIDERS: BIZARRE MORPHOLOGIES, UNUSUAL BEHAVIORS, AND EXTREME SPEEDS

Wood, Hannah

Department of Entomology, National Museum of Natural History, Smithsonian Institution

There is a large amount of morphological diversity across spiders and my research examines both extrinsic and intrinsic factors to understand how this diversity is produced. For example, ancient geologic events, distribution patterns, and competition with close relatives are external factors that may directly relate to divergence of traits. On the other hand, principles of engineering and functional trade-offs may also explain some components of morphological diversity. For this talk I'll focus on the cheliceral-carapace system of Palpimanoidea spiders, and starting with Archaeidae, I'll show how external forces may have produced a diversity of ecomorphs in Madagascar. Then, I'll switch to Mecysmaucheniidae to show how the form and function of their chelicerae may explain the morphological diversity within this family.

Oral presentations

The names of students in the student competition are underlined.

SPIDER CAPTURE SILK SHOW ROBUST ADHESION ON VARIED NATURAL SURFACES

Alicea-Serrano, Angela M.[1,2]; Htut, K. Zin[3]; Coonfield, Alix J.[4]; Karkosiak, Katherine [4]; Onyak, Ariel[4]; Dhinojwala, Ali[1]; Blackledge, Todd A.[4]

[1]School of Polymer Science and Polymer Engineering, The University of Akron, Akron, Ohio, USA; [2]Department of Biological Sciences, University of Massachusetts Lowell, Massachusetts, USA; [3]Division of Biology, Chemistry, and Material Science, Office of Science and Engineering Laboratories, Center for Devices and Radiological Health, Food and Drug Administration, Maryland, USA; [4]Department of Biology and Integrated Bioscience, The University of Akron, Akron, Ohio, USA

Most orb-weaving spiders have a diverse diet. Therefore, webs must be able to capture prey that have cuticles of different surface topologies and surface wettability and to retain stickiness in habitats that can vary greatly in humidity over short periods of time. The aggregate silk in capture threads of orb webs maximizes adhesion through a beads-on-a-string morphology that allows multiple glue droplets to simultaneously resist pull-off. These droplets are suspended in a cocktail of low molecular mass compounds (LMMC), which modulates glue viscosity to optimize the contributions of spreading and bulk cohesion for better adhesion. However, most capture silk adhesion studies and theory use glass as the model substrate, which is smooth and wettable. In this study we investigate the adhesion of capture silk on substrates that are more relevant to spider ecology than glass to understand pull-off mechanics and behavior on substrates of different surface energy and roughness under varied humidity conditions. We found evidence that aggregate silk functions as a remarkably robust adhesive through small changes in spreading and pull-off behavior. This robust performance is important for the generalist predatory strategy of orb spiders and may reduce the probability of insects evolving cuticular defenses against sticking to spider orb webs.

RELATING SPIDROIN MOTIF PREVALENCE AND PERIODICITY TO MAJOR AMPULLATE SILK MECHANICAL PROPERTIES

Arguelles, Joseph[1]; Baker, Richard H.[1]; Perez-Riguiero, Jose[2,3,4]; Guinea, Gustavo V.[2,3,4,5]; Elices, M.[3]; Hayashi, Cheryl Y.[1]

[1]Division of Invertebrate Zoology and Institute for Comparative Genomics, American Museum of Natural History, New York, NY, 10024, USA; [2]Center for Biomedical Engineering (CTB), Universidad Politécnica de Madrid, Pozuelo de Alarcón, 28223, Madrid, Spain; [3]Centro de Investigatión Biomédica en Red de Bioingeniería, Biomateriales y Nanomedicina (CIBER-BBN), Instituto de Salud Carlos III, Madrid, Spain; [4]Departamento de Ciencia de Materiales, Universidad Politécnica de Madrid, ETSI Caminos, Canales y Peurtos, 28040, Madrid, Spain; [5]Biomaterials and Regenerative Medicine Group, Instituto de Investigación Sanitaria del Hospital Clínico San Carlos (IdISSC), Calle Prof. Martín Lagos s/n, 28040, Madrid, Spain

Many spider dragline fibers exhibit incredible mechanical properties, outperforming many synthetic polymers in toughness assays, and possess desirable properties for medical and other human applications. The enormous diversity of spiders presents both an opportunity for the development of new bioinspired materials and a challenge for the identification of fundamental design principles, as the mechanical properties of dragline fibers show both intraspecific and interspecific variations. In this regard, the stress–strain curves of draglines from different species have been shown to be effectively compared by the α^* parameter, a value derived from maximum-supercontracted silk fibers. To identify potential molecular mechanisms impacting α^* values, we analyzed spider fibroin (spidroin) sequences of the Western black widow (*Latrodectus hesperus*) and the black and yellow garden spider (*Argiope aurantia*). Initial findings are that while overall motif composition was similar between species, certain motifs and higher-level periodicities of glycine-rich region lengths showed variation, notably greater distances between poly-Alanine motifs in *A. aurantia* sequences. Additionally, *A. aurantia* spidroins tended to have an increased prevalence of charged and hydrophobic residues, potentially impacting the number and strength of hydrogen bond networks within fibers, which have been implicated in formation and conformational changes of nanocrystals associated with fiber extensibility.

A THREE-DIMENSIONAL BRAIN ATLAS OF THE HACKLED ORB-WEAVER, *ULOBORUS DIVERSUS*

Artiushin, Gregory; Corver, Abel; Polack, Lucas; Gordus, Andrew

Johns Hopkins University, 3400 N. Charles St., Bio East 206, Baltimore, MD 21218

Atlases of brain morphology, accompanied by neuronal sub-type and genetic expression pattern maps, are essential tools for grounding an understanding of behavior to the circuit, cellular and molecular levels in model species. Classic staining work in slices has revealed neurotransmitter expression patterns and general morphology in the wandering spider, *C. salei*, serving as the reference for spider brain anatomy at large. Nevertheless, the brain structure of web-building spider species has not been well-described, and a complete three-dimensional standard brain including expression patterns for the major neurotransmitter and neuromodulator expressing neuronal sub-types does not exist for any spider species. We present progress on a three-dimensional immunostained volume of whole-mounted *Uloborus diversus* synganglia. Using synapsin staining as a common neuropil reference channel, we have aligned image volumes of neurotransmitter/neuromodulator (serotonin, acetylcholine, octopamine/tyramine, etc.) and neuropeptide (CCAP, FMRFamide, proctolin, etc.) expressing populations to a common standard brain using the *elastix* image registration toolkit. This assembly enables analysis of co-expression patterns across the complete synganglion, relative differences in major neuropil structures in the brain of an orb-web builder, as well as hitherto undescribed detail in specific structures, such as the arcuate body sub-layers differentially revealed by individual neuromodulator and neuropeptide expression patterns.

PHYLOGENETIC RECONSTRUCTIONS SUGGEST RELAXED SELECTION ON THE CIRCADIAN CLOCK IN ARANEOID SPIDERS

Ayoub, Nadia[1]; Clarke, Thomas[1]; Toporikova, Natalia[1]; Jones, Thomas[2]; Moore, Darrell[2]; Petko, Jessica[3]

[1]204 West Washington Street, Department of Biology, Washington and Lee University, Lexington, VA 24450, U.S.A; [2]1276 Gilbreath Drive, Biology, Eastern Tennessee State University, Johnson City, TN 37614, U.S.A.; [3]1031 Edgcomb Avenue, Biology, Pennsylvania State York, York, PA 16802, U.S.A.

Circadian clocks with near 24-our endogenous periods, are thought to be evolutionarily advantageous. In contrast, we have discovered remarkably broad distributions of endogenous free-running periods (FRPs) within and among spider species, all concentrated in the superfamily Araneoidea. We propose that araneoids are somehow released from the typical selective constraints of an FRP close to the solar day. To test this hypothesis, we reconstructed evolutionary relationships among 14 araneoid and 4 non-araneoid spiders, a scorpion, and the fruit fly using 1000s of homologous genes. We also identified homologs genes known to control circadian clocks in other arthropods. We estimated that the ancestral FRP of all spiders was close to 24 hours but shifted to less than 24 hours in the araneoid common ancestor. We additionally found rates of evolutionary change in FRP were significantly higher for araneoid spiders than non-araneoid spiders. Finally, most of the clock genes were subject to strong purifying selection, except for *CLOCK*, which encodes a transcription factor important in regulating circadian periods. Heightened rates of evolution in FRP combined with patterns of selection on *CLOCK* support our hypothesis that the Araneoidea has experienced relaxed selection, and perhaps even bursts of positive selection, on the circadian clock.

EVOLUTION OF REPRODUCTIVE STRUCTURES WITHIN SCLEROSOMATID HARVESTERS (OPILIONES)

Bacon, Ryan; Burns, Mercedes

University of Maryland, Baltimore County; 1000 Hilltop Circle, Baltimore, MD 21250

The ancestral mating system in Sclerosomatidae is thought to be solicitation-based, scramble-competition polygynandry, however, multiple sclerosomatid groups are notable for having evolved traits indicative of sexual coercion. Current knowledge of the genus *Leiobunum* (Opiliones) indicates a potential role of reproductive seasonality (i.e., grouping of reproductive events during a specific time of the year due to environmental constraints) in the evolution of sexual conflict. Coercive traits and strategies only occur in species from northern latitudes, while species in tropical locations retain traits associated with solicitous breeding, such as nuptial gift sacs. This trend may apply to other genera, but inter- and intraspecific variation in genital morphology and its impact in mating interactions is one area of research where knowledge is comparatively limited. This dearth of information is compounded by a general research bias towards northern-temperate regions, and the fact that many tropical species of sclerosomatid Opilliones lack even basic genital morphological descriptions. This poses a barrier to broader investigations into the evolution of reproductive structures. Initially, we are evaluating variation in reproductive structures within Sclerosomatidae along a continuous transect of increasing breeding season length, with the expectation that populations from highly seasonal locations will display evidence of increased sexual antagonism.

ENIGMATIC MULTIMODAL SIGNALING IN *SCHIZOCOSA SALTATRIX* (HENTZ, 1844)

Bauer-Nilsen, Olivia[1]; Somerville, Amanda[1]; Clark, Jake[1]; Tucker, Jacob[1]; Moskalik, Brian[2]; Pfeiffer, Laura[1]; George W. Uetz[1]

[1]Department of Biological Sciences, University of Cincinnati, Cincinnati, OH 45221-0006;
[2]Department of Natural Sciences, Joliet Junior College, Joliet, IL 60431

Wolf spiders in the genus *Schizocosa* exhibit both vibratory/seismic and (in some species) visual signals in courting a potential mate. Male *Schizocosa saltatrix* (Hentz, 1844) have been shown to perform visual leg-raising in addition to vibratory/seismic signals, suggesting the use of complex multimodal signals in courtship. Analyses of male behaviors confirm that their complex courtship displays consist of vibratory/seismic signals coupled with simultaneous leg-raising visual signals. Female responses show that rates of vibratory/seismic and visual male courtship signals are both strong predictors of mating success. However, experimental cue-isolation studies show females do not respond to visual cues in isolation. Although female receptivity is a strong indicator of mating success, it is not correlated with male visual courtship signaling rate. Moreover, male visual courtship rate is not correlated with body condition, and therefore does not appear to be an indicator trait. Current phylogenetic analyses suggest that in *S. saltatrix*, pigmentation, leg decorations and reliance on visual signals have all been secondarily lost, although visual displays are retained, perhaps because they serve as attention-altering signals. From this we conclude that while communication in *S. saltatrix* is multimodal, male visual leg raise displays primarily serve to attract the attention of the female.

STRUCTURE AND FUNCTION OF *APHONOPELMA HENTZI* BURROWS

Billotte, Jackie[1,2]; McCallister, Lorna[2]; Hufbauer, Ruth[1]; Reading, Richard R.[2]

[1]Colorado State University, 301 University Ave.,Fort Collins CO, USA 80523-1101; [2]The Butterfly Pavilion, 6252 W 104th Ave, Westminster, CO, USA, 80020

Aphonopelma hentzi (“Texas Brown Tarantulas”) occupies a wide and diverse range in North America. Within this range, they experience a variety of climate conditions throughout the year. However, little is known about how any tarantula species, including *A. hentzi,* can survive in temperatures that are often well below zero degrees. Studying the architecture of tarantula burrows provides information about the more elusive life history elements of tarantulas since observation in a burrow is difficult. Like many animals, tarantulas burrow to help regulate their temperature, protect themselves from predators, mate, and reproduce. To better understand the burrow architecture of the “Texas Brown Tarantula,” burrow casts were made using Plaster-of-Paris and excavated. Temperatures in the burrows were recorded every hour over the course of one year and compared to the surface temperatures next to the burrows. By analyzing the temperature and burrow structures, we can begin to understand some of the survival strategies of an understudied, but highly successful species in Colorado’s shortgrass prairie.

WEAPONS FOR DANGEROUS PREY: TRANSCRIPTOMICS UNDERLYING PREY CAPTURE IN ANT-SLAYING *EURYOPIS* SPIDERS

Blumsack, David; Kwapich, Christina; Garb, Jessica

Department of Biological Sciences, University of Massachusetts Lowell, Lowell, MA, USA

Euryopis is a genus of Theridiidae, the members of which are thought to be myrmecophagous, or specialist predators of ants. Unlike other members of its family, *Euryopis* do not rely on webs for passive prey capture, but instead ambush and lasso ants with silk prior to envenomation. This makes *Euryopis* particularly interesting in terms of how its venom and silk molecular composition may compare to more typical web-building theridiids that are generalist predators such as widow spiders (*Latrodectus sp.*) or the common house spider (*Parasteatoda tepidariorum*). Here we present preliminary transcriptomic data collected from a species of *Euryopis* native to the southwestern U.S. with the aim of characterizing its venom and silk protein repertoire. Through differential gene expression analyses, we quantified expression levels of putative silk and venom gene transcripts. We also examine venom and silk protein evolution in the context of other web-building theridiids for which there are extensive published genomic resources. Finally, we present observations of ant-hunting behavior shedding light on this poorly understood, but fascinating genus.

SPIDER LEG JOINT MEMBRANES AS PUTATIVE 'EARS'

Brandt, Erin E.; Little, Mika; Mhatre, Natasha

Department of Biology, Western University, 1151 Richmond Street, London, Ontario, N6A 3K7, Canada

Spiders are known to sense the world through vibrations, which are detected by strain-sensitive lyriform organs embedded in the cuticle and concentrated near leg joints. Oddly, lyriform organs have the lowest neural thresholds at high frequencies (1-5 kHz), whereas the frequencies of courtship signals and prey movements are typically much lower (~20-500 Hz). Recent work suggests that some spiders perceive airborne sound, potentially via web vibrations. However, it is unclear how sound is perceived. Spider legs are hydraulically actuated. Leg joints contain flexible membranes that expand to accommodate fluid pressure changes in the leg. We investigated whether this membrane could move in response to audio frequencies despite being backed by a high impedance fluid-filled cavity. We used laser Doppler vibrometry to measure motion in the femur-patella joint membrane (FPM) in two spider species: *Latrodectus hesperus* and *Araneus diadematus*. In both species, FPMs moved coherently in response to airborne sound within audio frequencies. We also observed FPM motion by bending the leg at similar frequencies. FPM motion may therefore be induced in two ways: by airborne sound displacing the FPM directly, and indirectly through sound-driven web vibrations. If mechanical energy collected by the FPM is indeed transmitted to lyriform organs at levels that cross the low neural thresholds in this frequency range, this would open up the possibility of direct 'air-to-fluid' ears.

ANTAGONISM AND SOLICITATION: A MULTI-INDIVIDUAL TRACKING APPROACH TO INVESTIGATING BEHAVIORAL SEXUAL CONFLICT

Brown, Tyler A.[1]; Marinko, Emily[2]; Burns, Mercedes[1]

[1] Department of Biological Sciences, University of Maryland, Baltimore County, 1000 Hilltop Circle, Baltimore, MD 21250, USA; [2] School of Life Sciences, University of Nevada Las Vegas, 4505 S Maryland Pkwy, Las Vegas, NV 89154, USA

In leiobunine Opiliones there are two mating syndromes: an ancestral, solicitous state in which males have nuptial-gift-delivering sacculate penises and females lack pregenital barriers; and a derived, antagonistic state in which males have nonsacculate penises and females have pregenital barriers. Males of sacculate *Leiobunum* species produce a primary nuptial gift which is consumed by females before copulation, while both sacculate and nonsacculate species produce a secondary gift which is accessible only during copulation, although the quality of this gift is reduced in nonsacculate species. In this study we compare the intensity of sexual conflict between the nonsacculate species *L. vittatum* and *L. euserratipalpe* and the sacculate species *L. aldrichi and L. bracchiolum* using an original, multi-step behavioral tracking protocol. Our protocol combines the automated tracking program TREX with manual scoring to greatly reduce the workhours required by completely manual approaches and avoids the hardware requirements of many machine-learning approaches. Our results reveal significantly higher sexual conflict behavior in nonsacculate species, indicating the loss of a secondary nuptial gift may contribute to increased conflict. Our behavioral scoring protocol will ultimately allow for more robust, large-scale sexual conflict research in this unique arachnid system.

HIDING IN PLAIN SIGHT?: THE PHYLOGENETIC POSITION OF *LEIOBUNUM CRETATUM* (OPILIONES: SCLEROSOMATIDAE)

Burns, Mercedes; Brown, Tyler

University of Maryland, Baltimore County, 1000 Hilltop Circle, Baltimore, MD 21250

Leiobunum cretatum Crosby & Bishop 1924 (Eupnoi: Sclerosomatidae; synonymous with *L. lineatum* Edgar) is an Opiliones species supposedly found throughout the central and eastern United States. However, validated collections of this species are disjunct and extremely few. Given the large range and frequency of deciduous forest habitat with which the species is associated, why should *L. cretatum* be so rare? In 2021, we collected three specimens in Maryland matching the description of *L. cretatum*, defined by the presence of five silver-white dorsal line markings extending anteriorly from the posterior opisthosoma and an alate penis in male specimens. Each specimen was collected amongst clusters of *L. bracchiolum*, another small leiobunine with partially-sacculate penes and variable coloration and patterning as juveniles, which, despite its commonality in the mid-Atlantic, was not described until 1975. The association of the species suggested to us that the putative *L. cretatum* we collected might have been a juvenile *L. bracchiolum* morphotype. We extensively photographed these and many more juvenile specimens and prepared them for mitochondrial and 3RAD sequencing. Results will serve to better elucidate the phylogeny and diversity of the “bulbate” *Leiobunum* group, which to date includes the diverse species *L. politum* and previously mentioned *L. bracchiolum*.

INSIGHTS FROM THE *HYPTIOTES CAVATUS* GENOME: IS A SPRING-LOADED WEB ASSOCIATED WITH EVOLUTIONARILY DIVERGENT SILK PROTEINS?

Casey, Steven[1]; Correa-Garhwal, Sandra[2]; Baker, Richard[2]; Hayashi, Cheryl[2]; Garb, Jessica[1]

[1]Department of Biological Sciences, University of Massachusetts Lowell, Lowell, MA, USA; [2]American Museum of Natural History, Division of Invertebrate Zoology and Institute for Comparative Genomics, American Museum of Natural History, New York, NY, USA.

Among spiders that produce orb webs, the silk of cribellate orb weavers is not well studied compared to that of ecribellate orb weavers. Cribellate orb weavers use webs made with a dry, fluffy capture thread and some have developed amazing prey catching strategies. For example, the triangle web spider *Hyptiotes cavatus* exploits the elasticity of its dragline silk to spring-load its web. The spider holds a support thread at one corner of the triangle web with its front legs while successively coiling an anchor line attached to the spinnerets. *Hyptiotes* holds the web taught until prey hits, then rapidly releases the tension hoping to tangle it in the loose, moving capture threads. Does it then follow that the silk of this spider has unique properties to facilitate this prey capture strategy? To examine the silk genes in *Hyptiotes cavatus*, we have assembled its genome and collected silk gland specific expression data. These data will help answer questions on silk composition in these spiders and the evolution of silk across cribellate orb weavers in general.

WIND DIRECTION PREDICTS HOMING SUCCESS IN THE NOCTURNAL AMBLYPYGID *PHRYNUS MARGINEMACULATUS*

Casto, Patrick[1,2], Bingman, Verner P.[2,3], Hebets, Eileen A.[4], Wiegmann, Daniel D.[1,2]

[1]Department of Biological Sciences, Bowling Green State University, Bowling Green, OH, USA; [2]J.P. Scott Center for Neuroscience, Mind and Behavior, Bowling Green, OH, USA; [3]Department of Psychology, Bowling Green State University, Bowling Green, OH, USA; [4]School of Biological Sciences, University of Nebraska, Lincoln, NE, USA

Field experiments have shown that nocturnal neotropical amblypygids exhibit homing behavior, and manipulations of the antenniform legs suggest that olfactory cues guide homing. Here we used an alternative approach to explore further the hypothesis that odor guides homing behavior. We displaced *Phrynus marginemaculatus* in their natural pine rockland forest habitat in the Florida Keys, where they reside under rocks, in different wind directions. We hypothesized that subjects displaced downwind would home more successfully than individuals displaced upwind. After site fidelity was established, subjects were either displaced from their home rock or manipulated but not displaced. Individuals displaced downwind were significantly more likely to be resighted under the rock from which they were displaced than subjects displaced upwind. The results further support the hypothesis that olfactory cues guide homing behavior in amblypygids. The olfactory cues that facilitate homing behavior in *P. marginemaculatus*, and other amblypygids are unknown, and further studies are needed to elucidate the source of the cues.

FEELING TENSE? EXAMINING HOW GEOMETRY AND TENSION ALTER ORB WEB ACOUSTICS

Coonfield, Alix[1]; Justus, Nathan[2]; Elias, Damian[3]; Hatton, Ross[2]; Blackledge, Todd[1]

[1]The University of Akron, Department of Biology, Auburn Science and Engineering Center, Akron, Ohio 44325, USA; [2]Oregon State University, School of Mechanical Industrial and Manufacturing Engineering, 204 Rogers Hall, Corvallis, Oregon 97331, USA; [3]University of California, Berkeley, Environmental Science, Policy and Management Department, 137 Mulford Hall, Berkeley, California 94720, USA

Spider webs function as both a snare and sensor—a web must be equipped with the mechanical robustness necessary to withstand prey impacts while effectively transmitting relevant vibrational information to the spider. This project explores how spiders may actively or passively alter vibration transmission in webs during prey capture. We use phase-based video analysis to measure variation in vibration transmission within and between webs of banded garden spider *Argiope trifasciata*. We first test the effect of stabilimenta, or web decorations, on vibration attenuation differences within webs, then we examine how tension may alter orb web acoustics. We assess both the effects of active tensioning on vibration transmission during recorded attack behavior, and passive, or natural radial tension on web acoustics by experimentally manipulating web tension and quantifying web vibrational modes. While stabilimenta do not significantly impede vibration transmission, changes in tension alter both vibration attenuation and web acoustics. We plan to couple this with behavioral assays to examine how thread tensioning and the resulting change in acoustics are relevant in prey detection.

MORPHOLOGY OF THE SILK GLANDS OF THE NET-CASTING SPIDERS *ASIANOPIS SUBRUFA, DEINOPIS SPINOSA,* AND *MENNEUS AUSSIE*

Correa-Garhwal, Sandra M[1]; Stafstrom, Jay[2]; Baker, Richard[1], Hayashi, Cheryl Y.[1]; Hoy, Ronald[2]; Reeve, H. Kern[2]; Garb, Jessica[3]

[1]Division of Invertebrate Zoology and Institute for Comparative Genomics, American Museum of Natural History, New York, NY 10024, USA; [2]Department of Neurobiology and Behavior, Cornell University, Ithaca, NY 14853, USA; [3]Department of Biological Sciences, University of Massachusetts Lowell, Lowell, MA 01854, USA

Net-casting spiders (Deinopidae) are cribellate spiders that spin a rectangular, sticky net that is held stretched between the claws of their first two pairs of legs. Deinopids produce eight distinct silk types: aciniform, pyriform, tubuliform, major ampullate, minor ampullate, cribellate, paracribellate, and pseudoflagelliform. Our knowledge of these silks is mostly limited to the spigots associated with the different fibers. As there have been no studies of deinopid silk gland morphology, we dissected all the silk glands from *Asianopis subrufa, Deinopis spinosa,* and *Menneus aussie,* and document their number and morphology. We show that silk gland position and morphology is consistent with the type and number of silk spigots described for Deinopidae. Notably, for the first time, we describe the silk glands mainly associated with cribellate silk: paracribellate, pseudoflagelliform, and cribellar silk glands.

A MACHINE LEARNING APPROACH TO RECONSTRUCTING SENSORIMOTOR RULES UNDERLYING SPIDER WEB-MAKING

Corver, Abel[1,2]; Sarma, Sridevi V.[2,3]; Gordus, Andrew[1,4]

[1]The Solomon H. Snyder Department of Neuroscience, Johns Hopkins University School of Medicine, Baltimore, MD 21205, USA; [2]Kavli Neuroscience Discovery Institute, Johns Hopkins University, Baltimore, MD 21218 USA; [3]Institute for Computational Medicine, Department of Biomedical Engineering, Johns Hopkins University, Baltimore, MD 21218, USA; [4] Department of Biology, Johns Hopkins University, Baltimore, MD 21218, USA

The intricate geometries of spider webs are produced by stereotyped sequences of leg movements organized on both the second and multi-hour timescales. The origins of such motor sequences, however, remain incompletely understood. Motor actions could be initiated based on moment-to-moment tactile feedback that the spider receives from its interactions with the web. Alternatively, action sequences could result from an interplay of short-term memories and sensory input. Identifying such internal and external factors is complicated by a lack of tools for quantitatively tracking spiders' real-time interactions with the changing web structure. Here, we present machine learning tools enabling automatic quantitative analysis of the dynamic two-dimensional orb webs produced by the spider *Uloborus diversus*. Using a dynamic state-space modeling approach, we reconstruct sensory inputs and infer hidden internal states that predict leg probing behaviors. Though web-making displays hallmark features of complex, sequenced behaviors seen in larger animals, it is performed using several orders of magnitude fewer neurons than most vertebrates, making *Uloborus diversus* a promising neuroethological model for studying sequential cognitive behavior.

LIVING WITH THE ENEMY: BEHAVIORAL STUDY OF *MYRMECICULTOR CHIHUAHUENSIS* RAMÍREZ, GRISMADO & UBICK (ARANEAE: MYRMECICULTORIDAE)

Cushing, Paula[1], Wicker, Richard M.[1], Horner, Norman V.[2]

[1]Denver Museum of Nature & Science, Denver, Colorado USA; [2]Emeritus, Department of Biology, Midwestern State University, Wichita Falls, Texas USA

The spider, *Myrmecicultor chihuahuensis* Ramírez, Grismado & Ubick 2019 is a myrmecophage. In an earlier study, we found that the spider's cuticular hydrocarbon (CHC) profile overlapped with that of its prey. In the present study we photographed nests of *Novomessor* ants to determine whether these spiders live inside the ant nest with their prey or in the vicinity of the colony. We set up two 35 mm cameras over two main entrances of one nest of *N. albisetosus* (Mayr 1886) such that images would be captured of the ant colony surface (including the entrances) every 15 – 60 sec. over five consecutive nights. These images included five showing *M. chihuahuensis* directly at one of the nest entrances investigating dead ants. The spider was not seen away from the entrance. This study provides evidence suggesting that this myrmecophage may live inside the colony with the ants it eats.

THERE AND BACK AGAIN - FIELD STUDY OF *TETRAGNATHA* AQUATIC NAVIGATION ON RIVERS

Danielson-Francois, A.; Bowlin, M.; Moore, E.

University of Michigan, Dearborn, Department of Natural Sciences, 4901 Evergreen Road, Dearborn, MI 48128 USA

Four families of spiders have demonstrated the ability to walk or run on water: Pisauridae, Trechaleidae, Ctenidae, and Tetragnathidae. Two of these families have species that evolved a specialized gait for aquatic locomotion: Pisauridae and Tetragnathidae. Here we examined the navigation ability of *Tetragnatha elongata*, a riparian species that traverses the water's surface with a specialized gait. In 2022, between June and August we collected spiders along the lower branch of the Rouge River in Canton, MI and tested their ability to navigate back to the bank when they were dropped into the river. To determine whether vision was required for navigation we tested the spiders before and after blinding them. A subset of spiders were used as controls and sham-blinded. We found that vision was not required for spiders to safely navigate to the nearest bank. Spiders used a variety of strategies beyond their unique aquatic gait including drifting, sailing, and rafting to get to the bank. The fastest speed observed in the field was 0.45 m/s but a more typical speed was 0.25 m/s. We supplemented this field study with more detailed observations of spider behavior in smaller artificial pools.

BIOGEOGRAPHIC HISTORY OF THE CROZET ISLAND ENDEMIC HARVESTER (OPILIONES: LANIATORES: TRIAENONYCHIDAE)

Derkarabetian, Shahan[1]; Renault, David[2]; Gonzalo Giribet[1]

[1]Harvard University, Department of Organismic and Evolutionary Biology, Museum of Comparative Zoology, 26 Oxford St. Cambridge, Massachusetts, USA; [2]Université de Rennes 1, UMR CNRS 6553 Ecobio, 263 Avenue du Gal Leclerc, CS 74205, 35042 Rennes Cedex, France

Biogeographic studies of Gondwanan taxa have been the source of much debate regarding the relative importance of vicariance versus dispersal in explaining current distributions of taxa across these terranes. Opiliones are well-known to be excellent study systems for biogeography from regional to worldwide scales, with the Gondwanan family Triaenonychidae being no exception. In the context of a recently published UCE phylogeny and previous biogeographic analyses of the family Triaenonychidae, I will introduce the species *Promecostethus unifalculatus* Enderlein 1909, the only Opiliones recorded from, and endemic to, the Crozet Islands. This species was not included in published analyses; however, specimens were recently acquired and are now included in phylogenomic and biogeographic analyses. In conjunction with divergence dating, I will explore the geologic and climatic factors that explain the distribution of this species on the relatively young Crozet Islands and answer the question: How did an ancient lineage end up on a young island?

SYSTEMATIC REVISIONS OF COSMETID HARVESTMEN (OPILIONES: LANIATORES: COSMETIDAE) IN THE CARIBBEAN ISLANDS

Disla-Polanco, Cielo; Proud, Daniel N.

Moravian University, Department of Biological Sciences, 1200 Main St., Bethlehem, Pennsylvania, USA

With more than 6,650 species described worldwide, Opiliones (daddy longlegs or harvestmen) represent the third largest order of arachnids. Endemic to the Neotropics, the family Cosmetidae contains more than 700 species of harvestmen. Although it is the second largest family of harvestmen, an antiquated classification system and the lack of a family-wide systematic study have made it difficult for researchers to study these animals. Using morphological and molecular data, we evaluated the relationships of Cosmetidae in several Caribbean islands (e.g., Puerto Rico, Cuba, Jamaica) to better understand their evolutionary relationships. We identify new characteristics that can be used to organize them into genera. In our molecular phylogenetic analysis, we recovered two distinct clades (genera) that occur in Puerto Rico. We describe a new genus that includes three species; of those, we describe one new species and redescribe another that was previously included in *Paecilaema*. Additionally, in Cuba, species belonging to several different genera were recovered as a monophyletic group. This work enables us to propose several systematic revisions of island lineages. We examine the morphological characters that are useful in diagnosing cosmetid genera and discuss the importance of an integrative approach to taxonomic studies within this family.

SCORPION NAVIGATION: USING A COMPUTER MODEL TO ASSESS THE INTERPLAY BETWEEN SENSORY AND ENVIRONMENTAL PARAMETERS

Gaffin, Douglas

Department of Biology; University of Oklahoma; Norman, Oklahoma 73019

The ability to return faithfully to a consistent point – e.g., a food source or shelter – is a fundamental animal behavior. However, biologists debate how animals accomplish this task. Bees and ants may navigate based on scene familiarity. That is, the animals use their pixelated compound eyes to acquire information during goal-directed training flights/walks. Then, in later excursions, they return home by comparing current scenes to stored scenes and navigate toward those that are most familiar. Vision-based navigation, however, is difficult to test experimentally because three-dimensional views entail ever-changing angles and distortions. Testing navigation in scorpions, however, simplifies the problem. These animals may use mid-ventral pectines to detect matrices of chemical and textural information on the two-dimensional ground for comparison to those stored in memory. In this study, we have developed a computer simulation of navigation by chemo-textural familiarity, building in parameters gleaned from behavioral, morphological, and physiological studies. We used the simulation to analyze the interplay of varying sensor gray scales and sensor resolutions against small patches of random landscapes with varying degrees of Gaussian blur. We then assessed how the predicted parameters predicted navigation success of a simulated scorpion across a variety of landscapes.

GENOMIC INNOVATIONS IN SPIDER SILK PRODUCTION: WHAT MORE IS LEFT TO LEARN?

Garb, Jessica[1]; Haney, Robert[2]; Gregorič, Matjaž[3]; Kuntner, Matjaž[3]; Agnarsson, Ingi[4]; Blackledge, Todd[5]

[1]Department of Biological Sciences, University of Massachusetts Lowell, Lowell, MA, USA; [2]Department of Biology, Ball State University, Muncie, IN 47306, USA; [3]Jovan Hadži Institute of Biology, Research Centre of the Slovenian Academy of Sciences and Arts, Ljubljana, Slovenia; [4]Faculty of Life– and Environmental Sciences, University of Iceland, Reykjavik, Iceland; [5]Department of Biology, The University of Akron, Akron, OH, USA

Silk production has undergone extraordinary diversification in spiders, with many species spinning a multitude of functionally divergent silks. Each silk type is synthesized in morphologically distinct glands predominantly expressing select members of the spidroin gene family encoding the main structural proteins composing silks. Sequence differences in the spidroins comprising these silks in part explains their distinct mechanical properties, illustrating how successive rounds of duplication and divergence at the genomic and morphological level has enabled the spectacular complexity of spider silk production. While significant progress has been made in linking the spidroin genes forming each silk in “model” orb-weavers, far less is understood of spidroin variation across species with divergent silk glands and webs, or even among closely related orb-weavers. Yet recent advances in sequencing technologies have vastly improved the ability to characterize spidroin diversity and understanding of spider silk evolution. This presentation will provide an overview of silk molecular evolution uncovered by recent genomes and transcriptomes, highlighting work investigating spidroin diversity in the bark spider genus *Caerostris,* as well as other species.

IN SEARCH OF LOVE (WITH EIGHT LEGS); THE *APHONOPELMA HENTZI* MATING SEASON.

Haselhuhn, Dallas; Shillington, Cara

Eastern Michigan University, Department of Biology, 441 Mark Jefferson Science Complex, Ypsilanti, Michigan 48197, USA

Tarantula “migrations", while not true migrations, are often reported with hundreds of males crossing major roads and highways, signifying the start of the mating season. With decades of public observations across multiple species and regions but with little published, critical information pertaining to the life history of these tarantulas is lacking in the literature. By studying the Colorado Brown Tarantula (Aphonopelma hentzi) during their mating season we have developed a better understanding of the timing, activity, location, and triggers of this natural phenomenon. Male tarantula were counted during their mating season on the Comanche National Grasslands in Southwestern Colorado. Daily presence-absence surveys were conducted to monitor male activity at established plots across three different sites. Vegetation surveys were completed for each daily plot while temperature and humidity were recorded continuously during the season. There was a significant negative correlation between the number of male tarantulas observed and daily temperature. Results suggest that a ‘cold snap’ is a key environmental trigger initiating the start of the mating season, with additional ‘cold snaps’ causing more individuals to begin mate-seeking. Community science will play a key role in the continued monitoring of this natural phenomenon.

CHASING THE WANDERER: PHYLOGENOMICS REVEALS INCOMPLETE CONVERGENT MORPHOLOGICAL EVOLUTION ASSOCIATED TO HABITAT SHIFTS IN TROPICAL WANDERING SPIDERS (ARANEAE, CTENIDAE)

Hazzi, Nicolas A[1]; Wood, Hannah M[2]; Hormiga, Gustavo[1]

[1]Department of Biological Sciences, The George Washington University, 2029 G St. NW, Washington, DC, 20052, USA; [2]Department of Entomology, Smithsonian Institution, National Museum of Natural History, Washington, DC, USA

Wandering spiders (Ctenidae) are a diverse group that is distributed worldwide, with different morphotypes that specialized to different kinds of habitats (ground, low vegetation and arboreal). Herein, we present the first and most extensive phylogenetic sampling of Ctenidae using genome scale data. Furthermore, we infer a dated molecular phylogeny for character mapping and morphospace analyses, to address the effect of habitat shifts on ecomorphological adaptations. Ctenids and its main lineages originated during the Paleocene–Eocene and have diversified in the tropics since then. The ancestral reconstruction of the habitat suggests that ancestrally ctenids were arboreal, and colonized the ground independently at least four times. In addition, there were three independent events of colonization from the ground to low vegetation. Phylomorphospace analyses indicated a clear morphological separation between arboreal and ground species, and low vegetation species occupying an intermediate morphospace between the two other habitat types. Using Ornstein-Uhlenbeck stabilizing selection models we were able to detect that morphological shifts in the phylogeny correlate with habitat transitions, but these analyses also suggest that different morphological types originated from repeated habitat transitions. Thus, the evolutionary shifts to different habitats has promoted the diversification of ctenids, resulting in layers of morphologically convergent forms.

HOW SPIDERS ACTIVELY MODULATE WEB-VIBRATION SENSING DURING PREY CAPTURE

Hung, Hsin-Yi[1]; Corver, Abel[1]; Gordus, Andrew[1,2]

[1]Solomon H. Snyder Department of Neuroscience, Johns Hopkins University School of Medicine, Baltimore, Maryland, USA.; [2]Department of Biology, Johns Hopkins University, Baltimore, Maryland

Organisms flexibly adjust postures and movements to acquire information from environments based on real-time sensory feedback. 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. By quantifying the web vibrational landscape elicited by *Drosophila*, we manually perturb the web with well-defined frequencies and amplitudes to identify how leg posture is altered as a function of web perturbation. We found that *Drosophila* produces low frequencies between 5-30 Hz on the web. In addition, spiders actively generate resonance on the web by crouching and stretching silks during prey localization. We will identify the mechanical properties and vibration sensitivity as a function of leg postures of the vibration sensor. By combining these measurements, we will be able to characterize the dynamics of leg posture and infer how the spider modulates leg vibration sensitivity to detect prey. Importantly, this study will improve our understanding of sensorimotor integration of substrate vibration sensation.

A NEED FOR SPEED: IMPACTS OF MORPHOLOGY, PHYLOGENY, AND ENVIRONMENT ON RUNNING PERFORMANCE IN 28 HUNTSMAN SPIDER SPECIES (SPARASSIDAE)

Hurst, Jacob [1,3]; Giulian, Joseph [1,2]; Rayor, Linda S. [1]; Gorneau, Jacob [1,4]

[1]Cornell University; [2]East Tennessee State University; [3] California State University, Fresno; [4]California Academy of Sciences

Running speed is a measure of whole organism performance that impacts prey capture, predator avoidance, and navigation through habitat with consequences for individual fitness. Our study explored morphological, phylogenetic, and environmental factors that impact running speed in 28 species of huntsman spiders. High-speed recordings (n=163) of spiders running through an acrylic tube were fed into a DeepLabCut ™ neural network trained to extract velocity data from videos. Running velocity was paired with leg and body size measurements to determine allometric slopes via GLM and AIC modeling. Running velocity was mapped to our sparassid phylogeny (Gorneau et al., 2022) to examine phylogenetic patterns in running performance. Effects of retreat size and habitat type on morphology and running velocity were explored using ANOVA and PCA. Huntsman spiders are among the fastest spiders measured, with some individuals reaching speeds of 117cm/sec. Spiders with proportionally longer legs ran faster in cm/sec and body lengths/sec, while higher body mass was associated with overall slower running speed in body lengths/sec. Body size as reflected by carapace width is unrelated to retreat size, while shorter L2 length is associated with smaller retreats. Running performance varies widely across taxa from open environments, suggesting diverse ecophysiologies for the Sparassidae.

EXPLORING VISUAL ATTENTION IN SPIDERS: LESSONS FROM HUMAN PSYCHOLOGY

Jakob, Elizabeth[1]; Winsor, Alex[2]; Pagoti, Guilherme[3], Daye, Daniel; Cave, Kyle[4]; Cheries, Erik[4]

[1]Department of Biology, Morrill III, UMass Amherst, Amherst, Massachusetts 01003 USA; [2]Organismic and Evolutionary Biology, French Hall, UMass Amherst, Amherst, Massachusetts 01003 USA; [3]Instituto de Biociencias, Universidade de São Paulo, Rua do Matão, 321, Travessa 14, Cidade Universitária, São Paulo, Brazil; [4]Department of Psychological and Brain Sciences, UMass Amherst, Amherst, Massachusetts 01003 USA

Jumping spiders face a challenge: equipped with a brain only a little bigger than a sesame seed, they must interpret a sense of a stream of visual information from their eight eyes and make appropriate behavioral decisions rapidly and accurately. Visual attention is the selective processing of this information flow. In this talk, we will give an overview about how the human psychology literature helps our group to generate questions about visual attention in an ecological context, especially using gaze direction as a precise measure.

EXPLORING HERITABILITY OF CHRONOTYPE IN THE COMMON HOUSE SPIDER, *PARASTEATODA TEPIDARIORUM*

Jones, Caitlin[1]; Jones, T.C.[1]; Moore, Darrell[1]; Petko, Jessica[2]

[1]East Tennessee State University, Johnson City, TN; [2]Pennsylvania State York, York, Pennsylvania

Circadian rhythms are often tightly confined around a mean of 24 hours with little variation in traditional model organisms. Some spider species fall well outside this normal range with means of 18 hours and variation around these means of 6 hours or more. This extreme variation in circadian rhythm is not well-understood and is the focus of the current study. Using *Parasteatoda tepidariorum* as a model organism, we investigated the potential sources of variation in eight circadian parameters as genetic variation, environmental variation, or an endogenous feature of the circadian system of *P. tepidariorum*. No significant correlation was found between mother spiders and their offspring, nor was a significant difference found among groups exposed to different environments. We conclude that circadian variation seen in *P. tepidariorum* is likely a result of an innate circadian feature such as relaxed selection for a precise, 24-hour circadian rhythm.

TAXONOMIC IMPLICATIONS OF A PHYLOGENOMIC ANALYSIS OF EREMOBATIDAE (SOLIFUGAE) USING ULTRACONSERVED ELEMENTS

Jones, R. Ryan[1,2]; Garcia, Erika L.[1,2]; Shikak, Goran[1,2]; Brookhart, Jack. O.[1]; Graham, Matthew R.[3]; Cushing, Paula E.[1,2]

[1]Department of Integrative Biology, University of Colorado Denver, 1151 Arapahoe St., Denver, Colorado 80204, U.S.A.; [2]Denver Museum of Nature & Science, 2001 Colorado Blvd., Denver, Colorado 80205, U.S.A.; [3]Department of Biology, Eastern Connecticut State University, 83 Windham Street, Willimantic, CT, 06226, USA

The North American family Eremobatidae (Solifugae) is the only camel spider family for which a family level molecular-based phylogenetic hypothesis exists. This hypothesis, based on traditional Sanger-sequence data generated from approximately 45% of the documented eremobatid diversity, demonstrated extensive poly- and paraphyly of multiple genera and species groups. Additionally, this hypothesis suggested that Eremobatidae likely diversified in conjunction with aridification and development of North American desert ecosystems. Here, ultra-conserved elements captured from field collected and legacy museum material has allowed us to vastly improve the sampling effort of the family, achieving over 300 terminals representing every genus and ~70% all of all described eremobatid diversity. In addition, this analysis also indicates a multitude of putative new species, the majority of which are distributed in Mexico. Here we present the new preliminary phylogenomic hypothesis for Eremobatidae and ongoing morphological, biogeographical, and taxonomic work resulting from this new phylogenomic backbone.

EXTRAORDINARY SPIDER CLOCKS PROVIDE A UNIQUE MODEL FOR CHRONOBIOLOGY RESEARCH

Jones, Thomas C.[1]; Moore, Darrell[1]; Ayoub, Nadia[2]; Toporikova, Natalia[2]; Petko, Jessica[3]

[1]East Tennessee State University; [2]Washington and Lee University; [3]Pennsylvania State University, York

The fact that circadian rhythms are nearly ubiquitous and have evolved at least four times among eukaryotes and prokaryotes suggests they are generally important to life. These daily rhythmic processes are regulated by an internal clock and share common properties including oscillating at close to 24 h and being able to synchronize to the solar day. Some spider species have extremely unusual circadian biology including: a) natural clocks differing from 24 h by as much as 5 h, b) the ability to phase-shift their clocks unusually quickly, c) the ability to synchronize to environmental periods up to 10 h different from their internal clocks, and d) showing no survivorship costs to internal/external clock mismatches. Because they are so unusual, we believe spiders provide a unique opportunity to better understand circadian biology in general by exploiting variation not seen in in other taxa. We are also using spiders to develop a relatively new field of chronoecology connecting circadian rhythms to adaptation. This talk will review our current (albeit limited) understanding of spider circadian rhythms and provide an introduction to our symposium on research into the extreme clock variability within and among spider species.

WISDOM OF WEBS: PROGRESS REPORT ON REASSESSMENT OF SPIDERS IN THE TETONS, WY, & INSIGHTS FROM THE SPIDER WORLD FOR BETTER CARING FOR OUR INTERDEPENDENCE

Karikó, S. J.

Gossamer Labs LLC/Museum of Comparative Zoology, Harvard University, 26 Oxford Street, Cambridge, MA 02138 USA

Despite their ecological importance, worldwide distribution and remarkable diversity, research on spiders in the Greater Yellowstone Ecosystem has advanced little since the 1950s when Levi & Levi and Lowrie & Gertsch conducted preliminary invertebrate surveys in the then Jackson Hole Wildlife Park. I will report on retracing the Levi's steps from their historic collecting trip and provide an update on this ongoing work on the biodiversity of spiders in the Upper Snake River Region of Northwestern Wyoming during wildfires and drought; on the first field observations of the mating behavior for the genus *Castianeira* (Araneae: Corinnidae) in the field; as well as broader impacts of this research including the exhibition *Spiders! Interconnectedness, Innovation & Stewardship* at the National Museum of Wildlife Art and exhibition in Grand Teton National Park and beyond. This research is part of a larger project interweaving insights from studying spiders into finding better ways to care for our interdependence: To address the biodiversity knowledge gap, inspire better ways of caring for ecological and societal systems together and increase the beneficial rippling out of our actions throughout the web of life.

HOW DO SPIDER EGG SACS PREVENT WATER LOSS WITHOUT PREVENTING DIFFUSIVE LOSS?

Karkosiak, Katherine[1]; Schwartz, Ravi[2]; King, Hunter[3]; Blackledge, Todd[1]

[1]University of Akron, Department of Biology, 235 Carroll St., D401, Akron, OH, 44325-3908, USA; [2]University of Akron, Department of Polymer Science, 170 University Ave., Akron, OH 44325, USA; [3]Rutgers University, Department of Physics, 136 Frelinghuysen Rd., Piscataway, NJ, 08854-8019, USA

Spider egg sacs protect their developing young from predators and the environment. Several studies show that silk egg sacs can limit water vapor loss and maintain an environment of higher humidity inside of the egg sac, but other studies show significant variation in the effect of egg sac removal on spiderling survival. Some of these conflicting findings may be due to differences in how silk membranes influence the diffusive versus advective loss of water. We hypothesize that egg sacs are typically too porous to influence diffusion of water vapor loss, but that three-dimensional outer surfaces of egg sacs increase the boundary layer between eggs and wind thereby reducing advective loss of water. We test this hypothesis by measuring the flux of water vapor across egg sac membranes from several species of spiders, with and without wind, and compare our results to a model we developed to predict diffusion across porous materials.

NEGLECTED NO LONGER: PHYLOGENOMIC RESOLUTION OF HIGHER-LEVEL RELATIONSHIPS IN SOLIFUGAE

[1]Kulkarni, Siddharth; [1]Steiner, Hugh; [2]Garcia, Erika; [3]Iuri, Hernán; [2]Jones, Ryan; [4]Ballesteros, Jesús; [1]Gainett, Guilherme; [5]Graham, Matthew; [6]Harms, Danilo; [7]Lyle, Robin; [3]Ojanguren-Affilastro, Andrés; [8]Santibañez-López, Carlos; [9]Silva de Miranda, Gustavo; [2]Cushing, Paula; [10]Gavish-Regev, Efrat; [1]Sharma, Prashant

[1]Department of Integrative Biology, University of Wisconsin–Madison, Madison, WI 53706, USA; [2]Department of Zoology, Denver Museum of Nature & Science, Denver, CO 80205, USA; [3]División de Aracnología, Museo Argentino de Ciencias Naturales "Bernardino Rivadavia", Buenos Aires 1405DJR, Argentina; [4]Department of Biology, Kean University, Union, NJ 07083, USA; [5]Department of Biology, Eastern Connecticut State University, Willimantic, CT 06226, USA; [6]Museum of Nature Hamburg - Zoology, Department of Invertebrates, Leibniz Institute for the Analysis of Biodiversity Change, Hamburg, Germany; [7]Biosystematics: Arachnology, ARC—Plant Health and Protection, Pretoria, South Africa; [8]Department of Biology, Western Connecticut State University, Danbury, CT 06810, USA; [9]Department of Entomology, National Museum of Natural History, Smithsonian Institution, Washington, DC, 20560, USA; [10]The National Natural History Collections, The Hebrew University of Jerusalem, 91904 Jerusalem, Israel

Considerable progress has been achieved in resolving higher-level relationships of Arthropoda in the past two decades, largely precipitated by advances in sequencing technology. Yet, dark branches persist in the arthropod tree of life, principally among groups that are difficult to collect, occur in cryptic habitats, or are characterized by minute body size. Among chelicerates, the mesodiverse order Solifugae (commonly called camel spiders or sun spiders) is one of the last orders of Arachnida that lacks a higher-level phylogeny altogether and has long been characterized as one of the "neglected cousins", a lineage of arachnid orders that are comparatively poorly studied with respect to evolutionary relationships. Though renowned for their aggression, remarkable running speed, and adaptation to arid habitats, inferring solifuge relationships has been hindered by inaccessibility of diagnostic characters in most ontogenetic stages for morphological datasets, whereas molecular investigations to date have been limited to one of the 12 recognized families. In this study we generated a phylogenomic dataset via capture of ultraconserved elements (UCEs) and sampled all extant families. We recovered a well-resolved phylogeny of solifuge families, with two distinct groups of New World taxa nested within a broader Paleotropical radiation. To provide a temporal context to solifuge diversification, we estimated molecular divergence times using fossil calibrations within a Bayesian framework. Solifugae were inferred to have radiated by the Permian, with divergences of most families dating to the post Paleogene-Cretaceous extinction. These results accord with a diversification history largely driven by vicariance as a result of continental breakup.

SPIDER (AREANEAE) DIVERSITY AT RED BANKS ALVAR STATE NATURAL AREA

Kurovski-Legris, Jillian[1]; Draney, Michael[2]; Wefferling, Keir[2]; Wolf, Amy[2]

[1]University of Nebraska Lincoln, 1101 T St, Lincoln, NE 68588, USA; [2]Univeristy of Wisconsin, Green Bay, 2420 Nicolet Dr., Green Bay, WI 54311, USA

Alvar is an understudied landform defined by shallow soils (less than 25cm) and dolomite bedrock supporting sparse, often distinctive vegetation. Red Banks Alvar State Natural Area (SNA) is one of Wisconsin's best examples of alvar. The goal of this study was to investigate how the unique alvar plant community of Red Banks Alvar SNA may be influencing the spider community composition and diversity. We captured 4,094 spiders across five focal sites through pitfall trapping and a Rapid Assessment Protocol that included vegetation sampling and litter sifting. This assemblage included 173 spider species representing 23 families and 101 genera. Of adults identified to species, 21 are Wisconsin state records including 2 species range extensions. An indicator species analysis identified characteristic indicator species including *Pardosa saxatilis* and *Neoantistea magna*. We used non-metric-multidimensional scaling to illustrate sub-habitat types of alvar (alvar grassland, alvar woodland, and degraded alvar) with distinct spider and plant community assemblages. Spider diversity was compared to plant diversity and average plant height diversity to explore how plant community diversity and structure influence spider community diversity and structure. Spider diversity did not show a strong relationship with plant diversity, but our results support the hypothesis that diversity in plant structure influences spider community composition and diversity.

MODELING AND DESIGN OF SPIDER WEBS USING DEEP LEARNING AND ADDITIVE MANUFACTURING

Lu, Wei[1]; Lee, Nic[2]; Buehler, Markus[1]

[1]Department of Civil and Environmental Engineering, Massachusetts Institute of Technology, 77 Massachusetts Ave., Cambridge, MA 02139, USA; [2]MIT Media Lab, Massachusetts Institute of Technology, 77 Massachusetts Ave., Cambridge, MA 02139, USA

Spider webs are hierarchical biological structures with striking mechanical properties. However, the underlying construction principles have not been understood, and the modeling and synthesis of 3D-based web structures remain challenging. We develop three deep neural networks to model and synthesize 3D web structures. The generative models are conditioned on key geometric parameters, and we use inductive representation sampling of experimentally determined web graphs for dataset augmentation. The models are scalable, produce *de novo* web mimics that meet the design objectives. We further propose an algorithm that assembles the generated web samples into larger-scale structures based on geometric design targets. Innovative spider web designs are constructed with diverging architectural complexity. Some are 3D printed and tested to assess mechanical properties and underlying structure-property relationships. The work lays the foundation for spider web generation and explores bio-inspired design, with potential application extending to other hierarchical structures. Ongoing work that will be discussed involves additional spider web data collection during web construction under varied conditions, including the use of our laser-scanned image and digitalized graph data generation method, bio-inspired design assessments, and more generative methods (e.g. for silk protein synthesis that will be integrated into hierarchical web architectures using protein-focused additive manufacturing methods).

THE MYSTERY OF DISAPPEARING WIDOW SPIDERS IN THE NEGEV DESERT

Lubin, Yael

Blaustein Institutes for Desert Research, Ben-Gurion University, Sede Boqer Campus, Midreshet Ben-Gurion 8499000, Israel

Nests of adult female desert widow spiders, *Latrodectus revivensis*, are highly visible in the desert shrubland and preserve a complete record of individual productivity that can be monitored and compared over the years. During 1992-2000, a yearly survey was conducted of *L. revivensis* nests in the Negev highlands, Israel. We counted *L. revivensis* nests at the end of the reproductive season (December or January) and recorded the number of egg-sacs present in each. A subset of *L revivensis* nests was collected to analyze prey remains, and egg-sacs were opened to count the contents (eggshells or young). The abundance of *L. revivensis* declined sharply in 1994 and did not recover during the following years. There was a weak positive relationship between rainfall in the previous wet season and the number of nests and prey/nest in the following reproductive season, and no significant relationship between previous-season rainfall and the number of egg-sacs/nest. Spider abundance and productivity were unrelated to the number of prey consumed. I propose that there was an indirect effect of rainfall on spider abundance via habitat change and subsequent predation risk.

RESOLVING PHYLOGENY AND GENERIC LIMITS OF PLEXIPPINE JUMPING SPIDERS USING UCE DATA

Marathe, Kiran[1]; Maddison, Wayne[2]

[1]Department of Zoology, University of British Columbia, Vancouver, British Columbia, Canada; [2]Departments of Zoology and Botany and Beaty Biodiversity Museum, University of British Columbia, Vancouver, British Columbia, Canada.

The subtribe Plexippina includes primarily Afro-Eurasian salticids with such familiar genera as *Evarcha*, *Plexippus*, and *Hyllus*. Their high species diversity (~500 spp.), conservative body form, and simple genitalia render this group problematic for revisionary work. We investigate their phylogeny and currently-chaotic generic concepts using Ultra-Conserved Element data (104 taxa, ~2565 loci and ~1.3 million nucleotides/taxon). We confirm the monophyly of the tribe Plexippini and its two subtribes, Harmochirina and Plexippina, with one modification: the unusual antlike *Eburneana*, formerly interpreted as harmochirine, is sister to other Plexippini, suggesting its harmochirine-like epigynal pocket is a synapomorphy of the whole tribe. *Evarcha* s. lat. was a special focus because of its recent controversial fragmentation into several genera, rejected by the WSC but accepted in Metzner's compilation. Our data recover it as monophyletic and thus credible as a single genus. *Hyllus* is polyphyletic; *Thyene* and *Pancorius* largely monophyletic. Relationships among genera are also resolved, including *Artabrus*, *Burmattus*, *Epeus*, *Iranattus*, *Ptocasius*, *Telamonia,* and *Vailimia*. Excessive reliance on superficial morphology has led to taxonomic mistakes — several genera with non-distinctive body forms are polyphyletic. As phylogenetic knowledge improves, we will be able to better recognize morphological synapomorphies and clarify generic concepts.

SPIDER COLORATION: FROM PREY ATTRACTION TO POSTURAL CAMOUFLAGE

Messas, Yuri

University of Campinas, Department of Animal Biology, 255 Monteiro Lobato Street, 13083-862, Campinas, São Paulo, Brazil

The biology of color typifies modern research by integrating multiple areas of knowledge using high-technology solutions. For example, we are now capable of simulating some non-humans' visual perceptions to test hypotheses about the adaptive value of animal colouration. Spiders are ideal models for animal coloration research, representing a highly diverse and abundant group with several color patterns and strategies for signalling or concealment. Here I explore digital photography as a methodological tool in Sensory Ecology by combining image analysis, visual modelling, virtual games, field experiments and laboratory trials to study the ecology and behavior of Brazilian and British spiders. Examples of study cases involve recent results from my research exploring (1) the prey attraction in fluorescent spiders, (2) behavioral choice and background matching as strategies for facilitating concealment in orb-web spiders, (3) the importance of color, shape, and posture in the evolution of spider camouflage in branched habitats, (4) a complex insect-mimicry involving a striking colourful jumping spider. Full of natural history and macro photographs, this talk highlights the power of animal coloration research to the understanding of behavioral and evolutionary ecology.

POSTURE CONTROLS MECHANICAL TUNING IN THE BLACK WIDOW SPIDER MECHANOSENSORY SYSTEM

Mhatre, Natasha[1,2]; Gartly, Reese[1]; Sivalinghem, Senthurran[2]; Mason, Andrew[2]

[1]Department of Biology, University of Western Ontario, London, Ontario, Canada; [2]Department of Biological Sciences, University of Toronto at Scarborough, Scarborough, Ontario, Canada.

Spiders rely on vibration sensing for sexual signalling, prey capture and predator evasion. Slit sensillae that are crucial to sensing web- and other substrate-borne vibrations are organised into lyriform organs and are densely distributed around leg joints. Vibrations cause bending at leg joints and activate these lyriform organs. However, the biomechanical interactions between web vibrations and the body of a freely-suspended spider in its natural posture are poorly understood. Female black widow spiders, in particular, have a striking body-form; their long thin legs support a large pendulous abdomen. Here, we show that in their natural posture, the large abdominal mass of black widow females, interacts with the spring-like behaviour of their leg joints and determines the mechanical behaviour of different leg joints. Furthermore, we find that adopting different body postures enables females to alter both the level and tuning of the mechanical input to lyriform organs. Therefore, we suggest that posture may be used to flexibly and reversibly focus attention on different classes or components of web vibration. Postural effects thus emphasize the dynamic loop of interactions between behaviour and perception, i.e. between 'brain' and body.

THE TAXONOMY OF THE RARELY-COLLECTED, WETLAND-DWELLING SPIDERS OF *FLORICOMUS* (ARANEAE: LINYPHIIDAE)

Milne, Marc A.[1]; Tyler, Brett D.[2]

[1]Department of Biology, University of Indianapolis, Indianapolis, IN 46227; [2]Wildlife Resources Division, Georgia Department of Natural Resources, Social Circle, GA 30025

The linyphiid spider genus *Floricomus* Crosby & Bishop, 1925 (Linyphiidae) is widespread throughout North America, especially on the East Coast, though most species are rarely encountered. Commonly called “dwarf spiders,” they are tiny (1.0-2.0 mm body length) and many species live in wetland habitats such as marshes, swamps, bogs, fens, and pond edges. *Floricomus* currently contains 14 species, and no significant work has been done on the genus since 1944. Over the past few years, we have re-discovered multiple lost species in this genus, some of which haven’t been collected since their description over 100 years ago. We are currently updating the taxonomy of this genus by adding three new species (*Floricomus berryae* n. sp., *Floricomus suteri* n. sp., *Floricomus sandlinae* n. sp.). Moreover, we will describe the female of *Floricomus nigriceps* for the first time and transfer *Mythoplastoides exiguus* (Banks, 1892) into this genus as *Floricomus exiguus* n.comb. In the future, we hope to examine more specimens from unsearched collections and to integrate these morphological data with molecular evidence to refine our conclusions.

COMPARING RESTING METABOLIC RATES IN WEB-BUILDING AND CURSORIAL HAWAIIAN SPIDERS (*TETRAGNATHA, TETRAGNATHIDAE*)

Nagel, Kathryn[1]; Williams, Caroline[2]; Gillespie, Rosemary[1]

[1]Department of Environmental Science, Policy, and Management, University of California, Berkeley, 130 Mulford Hall #3114, Berkeley, CA 94720-3114; [2]Department of Integrative Biology, University of California, Berkeley, 3040 Valley Life Sciences Building #3140, Berkeley, CA 94720-3140

Metabolic rates and the factors influencing energy allocation to competing physiological functions are central to understanding the biology of any organism. Compared to other terrestrial arthropods, spider metabolic rates are 40-60% lower than expected for their body size[1–4]. Web-building spiders typically have lower resting metabolic rates (RMR) than cursorial hunters; however, past studies compared distantly related taxa in varied environmental conditions and evolutionary histories, making it difficult to tease out specific causal factors that dictate these differences [1,4,5]. I address this problem by focusing on a radiation of spiders (*Tetragnatha, Tetragnathidae*) in the Hawaiian Islands: one web-building, one cursorial[6]. Most species occur in similar native wet forest environments[6]. I measured the RMR at 20°C of two web-building species, *T. hawaiiensis* (n= 11) and *T. lena* (n= 7), and two cursorial species, *T. kauaiensis* (n= 17) and *T. tantalus* (n= 2). The normalized RMR for the two web building species were 64.3 and 59.0 VCO_2/g*hr, while the RMR for the cursorial species were higher at 110.3 and 137.2 VCO_2/g*hr respectively. This direct comparison supports the hypothesis that cursorial spiders have faster RMRs than web-builders independent of phylogenetic and environmental conditions, providing further insight into the energetic costs of prey capture.

HAVE GLUE DROPLET MATERIAL PROPERTIES CHANGED WITH PREY CAPTURE BIOMECHANICS IN COBWEBS SPUN BY THE SPIDER FAMILY THERIDIIDAE?

Opell, Brent[1]; Kelly, Sean[1]; Morris, Sarah[2]; DuMez, Lucas[1]; Correa-Garhwal, Sandra[3]

[1]Department of Biological Sciences, Virginia Tech, Blacksburg, VA 24061 USA.; [2]Department of Biological Sciences, The George Washington University, Washington, D.C. 20052 USA.; [3]Institute for Comparative Genomics, American Museum of Natural History, New York, NY 10024 USA.

The elastic modulus and toughness of *Latrodectus hesperus* and *Parasteatoda tepidariorum* glue droplet proteins were similar, as were those of *Latrodectus mactans* and *Steatoda grossa*, reflecting similarities in habitat humidity. Orb web capture spiral turns are more closely spaced than are most gumfoot lines, are able to implement a suspension bridge mechanism that sums the adhesive forces of multiple droplets and are arrayed to recapture prey that has struggled free of adjacent capture spirals. In contrast, the weak pyriform anchors of a gumfoot lines detache upon contacting prey, causing their taught support fibers to hoist prey from surfaces and prevent them from easily pulling free of these lines. These biomechanical differences caused us to hypothesize that, to prevent prey from pulling free from a gumfoot line, theridiid glue protein is stiffer than that of orb web glue protein. Instead, we found that the elastic modulus and toughness of theridiid glue fell within the range of values for orb web glue. This suggests that the elastic modulus of theridiid glue has remained low to ensure low viscosity, which allows these adhesives to spread rapidly upon contacting prey to establish a firm initial adhesive bond.

LETHAL EFFECTS OF THE HERBICIDES GLYPHOSATE AND GLUFOSINATE ON SIX SPIDER SPECIES.

Persons, Matthew; Raneri, Gianna; Strevig, Ashley; Ryan, Conor; Williams, Katryna; Keagy, Ryan

Biology Department, Ecology Program, Susquehanna University, Selinsgrove, PA 17870

Glyphosate is one of the most used herbicides in the world. Due to the evolution of glyphosate-resistant weeds, it is often applied with the herbicide glufosinate ammonium. Different agricultural spider species may vary in herbicide susceptibility due to size differences and microhabitat preferences. We measured mortality of six spider species when chronically exposed to field-relevant concentrations of glyphosate, glufosinate, glyphosate and glufosinate or untreated control soils over a 15-day period (N=873). We tested the web-builder *Frontinella pyramitela,* crab spider *Mecaphesa asperata,* nurseryweb spider *Pisaurina mira,* and wolf spiders *Tigrosa helluo*, *Rabidosa rabida*, and *Pardosa milvina*. Glufosinate, but not glyphosate caused significant mortality for all spiders tested ranging from a low of 20% for *Pisaurina* and *Tigrosa* up to 80% and 100% mortality for *Frontinella* and *Pardosa* respectively. We also found a significant antagonistic interaction between glyphosate and glufosinate for *Pardosa*. *Pardosa* sprayed with both herbicides survived longer than those sprayed with glufosinate alone. We found significant sex differences in mortality among *Rabidosa* and *Tigrosa* with males showing higher mortality than females. Glufosinate is a potent araneocide and should be used with caution as part of an integrated pest management system within commercial agriculture.

UNCOVERING WHEN, WHY, AND HOW EXTREME CIRCADIAN RHYTHMS EVOLVED IN ARANEOID SPIDERS.

Petko, Jessica[1]; Jones, Thomas[2]; Moore, Darrell[2]; Ayoub, Nadia[3]; Toporikova, Natalia[3]

[1]Department of Biology, Penn State York, 1031 Edgecomb Ave, York, PA, 17403; [2]Department of Biological Sciences, East Tennessee State University, Box 70703, Johnson City, TN, 37604; [3]Department of Biology, Washington and Lee University, Howe Hall, Lexington, VA, 24450

Circadian rhythms ensure the optimal timing of many biological processes, allowing organisms to adapt their activities to the Earth's 24-hour daylength. While the properties of these rhythms are typically well-conserved across different species, spider species within the superfamily araneoidea exhibit intriguing deviations from the norm. This presents an exceptional opportunity to explore the evolution of circadian rhythms and shed light on their underlying mechanisms. The Spider Clock Consortium (SCC) brings together experts from diverse fields including ecology, molecular biology, evolution, mathematical modeling, and statistics. The SCC is an NSF-funded group of collaborators working toward the shared goal of comprehensively understanding the chronobiology of spiders. This talk will provide an overview of the SCC's future research directions, focusing on three key questions: Why do spiders possess such unique circadian rhythms? When did these rhythms evolve? And how did they evolve through alterations in the molecular clockwork?

REARING TEMPERATURE AFFECTS CYTOPLASMIC INCOMPATIBILITY IN MALE SPIDERS BUT NOT IN FEMALES

Proctor, Jordyn; White, Jen

University of Kentucky, S-225 Agricultural Science Center North, Lexington, KY 40546

Bacterial endosymbionts manipulate their host arthropods' reproduction to increase their own infection rate. One such manipulation is cytoplasmic incompatibility (CI), wherein sperm are modified in infected males to produce inviable zygotes in uninfected females, but bacteria in infected females provide a rescue factor that restores fertility. In the spider *Mermessus fradeorum* (Linyphiidae), a bacterial symbiont in the genus *Rickettsiella* causes variable levels of CI. We hypothesized that temperature affects CI strength. I reared *Rickettsiella*-infected spiders at one of two constant temperatures (20°C vs 26°C), then tested both the ability of infected males to induce CI when paired with uninfected females, as well as the ability of infected females to rescue CI when crossed with infected males. I found that hatch rate was significantly higher when uninfected females mated with warm-reared infected males than with cool-reared infected males, indicating that the warmer rearing temperature compromised CI induction in the males. However, different rearing temperatures had little to no effect on the ability of infected females to rescue CI, as hatch rates were high regardless of temperature. Results suggest that symbiotic manipulation is quite sensitive to environmental conditions in this system.

PREDATORY POTENTIAL OF WOLF SPIDER (*LYCOSA PSEUDOANNULATA*) AGAINST SUCKING-CHEWING INSECT PEST COMPLEX OF MAIZE CROP IN FAISALABAD, PUNJAB, PAKISTAN.

Rafique, Faiza; Shahzad, Muhammad Aneeb; Ikram, Danyal

University of Agriculture, Section of Acarology, Department of Entomology,1Jail Road, Faisalabad, Punjab 38000, Pakistan.

Wolf spider (*Lycosa pseudoannulata*) is an epigeal arthropod predator in cultivable land. The results of this study indicated that *Lycosa pseudoannulata* has positive effect on suppressing the population of sucking and chewing species as to their pre-emergence. This study was conducted in two different areas on two different varieties i.e. Pop-1 and FH-988 in Faisalabad. Mass rearing of *Lycosa pseudoannulata* was done under controlled laboratory conditions and released in maize crop during mid-summer. We introduced wolf spider at density of 50 individuals in 20 different patches of $100m^2$ in an acre. Data was recorded till end of cropping season. Results revealed that successful reduction in population of corn leaf aphid (66.67±3.3; 62.33±4.1), jassid (58.33±2.9; 55.33±2.7), shoot fly (27.67±2.3; 23.21±1.67), cob borer (33.33±3.1; 36.67±2.7), maize stem borer (36.33±2.9; 31.67±4.1) was observed on both varieties, respectively. No impact on fall armyworm population was observed. However, a little evidence was recorded that predation was changed with change of biotic and abiotic condition by correlating the abundance of insect pest population and wolf spider population with climatic conditions. Present study confirmed that wolf spiders (*Lycosa pseudoannulata*) has potential to play an important role as biological agent in controlling herbivore populations in agricultural fields.

DIFFERENCES IN BEHAVIOR AND LIFE-HISTORY PATTERNS BETWEEN PROLONGED-SUBSOCIAL AND SOLITARY HUNTSMAN

Rayor, Linda S.[1]; Gorneau, Jacob A.[1,2]; Giulian, Joseph[1,3]

[1]Department of Entomology, Cornell University, Ithaca, NY 14853, USA; [2]Institute for Biodiversity Science and Sustainability, California Academy of Sciences, San Francisco, CA 94118, USA; [3]Biological Sciences, East Tennessee State University, Johnson City, TN 37614, USA

While most huntsman spiders (Sparassidae) live solitarily beyond a short period of egg sac guarding and maternal care, five prolonged-subsocial species live in large matrilineal groups where a single adult female retains reproductive dominance and multiple sibling cohorts remain together until sexual maturity or into adolescence depending on the species. Observations from >42 species of social and solitary huntsman during >20 years of comparative lab and field study reveal patterns of social evolution. We evaluated duration of association, patterns of prey sharing, clutch size, retreat use, 1st-feeding instar, and other aspects of life-history in the framework of our recent molecular phylogeny (Gorneau et al., 2022) to assess whether there are characteristics found only in social species or whether these traits are derived versions of typical biology of solitary species. To identify biological and group-living traits that are correlated, the D-test, which examines stochastic character maps in a pairwise manner, was implemented. Our results show a distinct suite of biological and behavioral traits in prolonged subsocial huntsman associated with evolution of group-living, including a unique non-feeding instar, smaller clutches, larger permanent retreats, and multiple tolerant sibling cohorts which results in greater prey access via sharing.

EFFECTS OF SYMBIONT COMMUNITIES THAT MANIPULATE SPIDER REPRODUCTION AND PHENOTYPE IN RESPONSE TO SELECTION

Robertson, Becca[1]; Mackevicius, Virginija[2]; Rosenwald, Laura[1]; Durkin, Emily[1]; Gottlieb, Yuval[2]; White, Jen [1]

[1]Department of Entomology, University of Kentucky, Lexington, Kentucky, USA.; [2]The Robert H. Smith Faculty of Agriculture, Food, and Environment, The Hebrew University of Jerusalem, Rehovot, Israel.

Maternally-inherited symbionts are pervasive across arthropods and often facilitate their spread in host populations via reproductive manipulation. The Linyphiid spider, *Mermessus fradeorum*, is naturally co-infected with up to five strains of endosymbiotic bacteria (*Rickettsiella*, *Tisiphia*, and 3 strains of *Wolbachia*). Spiders co-infected with all five symbionts have entirely female, feminized offspring. The roles of each symbiont within the consortium aren't clear, but one symbiont on its own, *Rickettsiella*, induces and rescues a different reproductive manipulation, cytoplasmic incompatibility (CI). These two distinct and potentially conflicting phenotypes led us to investigate the effects of artificial selection on both the phenotype expressed and the titer of symbionts communities. In this multigenerational experiment, I ask whether the stability and functionality of the 5-fold consortium is compromised when the functional role of *Rickettsiella*, to rescue CI, is removed. For 14 generations we have mated feminized spider lineages with uninfected males, removing the selective pressure to maintain CI rescue, and compared them to lineages mated with *Rickettsiella*-infected males. We've found that titer for all bacteria is very low, but spiders generally retain both feminization and their ability to rescue CI. Our results suggest that coinfecting bacterial communities are persistent and resilient.

LIFE HISTORY DIFFERENCES ACROSS THE INVASIVE RANGE OF *PHOLCUS MANUELI* (ARANEAE: PHOLCIDAE)

Salazar, Alex[1]; Rypstra, Ann[2]

[1]Department of Biology, Miami University, Oxford, OH, 45056, USA; [2]Department of Biology, Miami University, Hamilton, OH, 45056, USA

Life history differences have been noted between disparate populations of invasive species, particularly along the continuum of the core of the invasive range and the leading edge. *Pholcus manueli,* while not native in the United States, was formally described in New Jersey, USA in 1937. Since then, it has slowly expanded westwards subjecting it to different selective pressures as it over-invades a congener species, *Pholcus phalangioides*; however, its response to these pressures is not known. We hypothesized that spiders from the leading edge would show life history differences from spiders from the core. Specifically, we predicted the leading edge spiders would produce more spiderlings per egg sac, and take fewer days to hatching and dispersing, take fewer moults and days to reach adulthood and so be smaller upon reaching their final moult. Contrary to our predictions, leading edge spiders produced fewer spiderlings per egg sac, took more days to reach adulthood, and were larger at adulthood. Moults to adulthood were not significantly different. While traits that promote faster life histories tend to be more prevalent along the leading edge, an increase in adult size may be more important in increasing the dispersal in *P. manueli. P. manueli* may be driven to larger sizes along the leading edge where it competes with *P. phalangioides* whereas core *P. manueli* no longer experience the same pressure as *P. phalangioides* have largely been displaced.

SHATTERING IMPASSES IN A TOXIC WORLD: UNRAVELING THE SYSTEMATICS OF SCORPIONS THROUGH DIFFERENT GENOMIC DATASETS

[1]Santibanez-Lopez, Carlos; [2]Ojanguren-Affilastro, Andrés; [3]Graham, Matthew; [4]Sharma, Prashant

[1]Department of Biology, Western Connecticut State University, CT 06810, USA; [2]División Aracnología, Museo Argentino de Ciencias Naturales, C1405DJR, Buenos Aires, Argentina; [3]Department of Biology, Eastern Connecticut State University, CT 06226, USA; [4]Department of Integrative Biology, University of Wisconsin-Madison, WI 53706, USA.

Scorpions are ancient and historically renowned for their unique morphology and potent venom. The systematics of this group of chelicerates was traditionally supported by morphological characters until recent phylogenomic analyses (using RNAseq data) revealed most of the higher-level relationships as non-monophyletic. While these phylogenomic hypotheses are stable for almost all lineages, some nodes have been hard to solve due to minimal taxonomic sampling (e.g. family Chactidae). In the same line, the use of transcriptomes and other genomic sources such as the ultraconserved elements (UCEs) have recovered contrasting hypotheses in some nodes in the Arachnid Tree of Life, but potential incongruences in the scorpion evolutionary tree have not been explored. Here, we compared the phylogenetic signal of transcriptomes versus UCEs by retrieving UCEs from newly published scorpion transcriptomes, and reconstructed phylogenies using both datasets independently using different phylogenetic methods. We reexamined the monophyly and phylogenetic placement of Chactidae, sampling an additional chactid species, and reevaluated the divergence times of the superfamilies. Our results showed that both sets of genome-scale datasets recovered highly similar topologies, with Chactidae rendered paraphyletic due to the placement of Nullibrotheas allenii. Lastly, we identify salient inquiries as high-value targets for scorpion phylogenetic studies that may be facilitated by the establishment of new UCE datasets.

CLASSICAL CONDITIONING IN THE WOLF SPIDER *TIGROSA HELLUO* (ARANEAE: LYCOSIDAE)

Shannon, Hailey[1]; Rypstra, Ann[2]

[1]Department of Biology, Miami University, Oxford, OH, 45056, USA; [2]Department of Biology, Miami University, Hamilton, OH, 45011, USA

Learning associations between resources and their reliably associated predictors can improve an animal's fitness by allowing them to locate and/or utilize these resources more efficiently. Classical conditioning has long been employed to examine associative learning abilities across numerous taxa, including a variety of spider species. In this study we designed a protocol by which to examine classical conditioning in the wolf spider *Tigrosa helluo*. Using a modified T-maze we explored the ability of *T. helluo* spiderlings to successfully locate a covered retreat and avoid an aversive stimuli of heat and light produced from overhead heat lamps. The retreat was paired with either a grey or black-and-white background cue. Spiderlings underwent a total of 20, 5-minute trials in the maze over the course of two consecutive days (10 trials on each day). Overall we found that the probability that spiderlings successfully entered the retreat increased significantly over time. There was no change in the latency to enter the hide across trials 1-10 on the first day of training. However, there was a significant reduction in the latency to ether the hide across trials 11-20 on the second day. Our findings indicate that *T. helluo* spiderlings successfully learned an association between shelter and a novel environmental stimulus under our learning regime in as few as 20 trials. The validation of this procedure provides a basis for its use to further examine the features of learning in this species.

INVESTIGATING CHARACTERS TO REVISE CHIHUAHUAN AND GREAT PLAINS *EREMOBATES PALPISETULOSUS* GROUP SPECIES.

Shikak, Goran[1,2]; Cushing, Paula[1,2]

[1]Denver Museum of Nature and Science, Zoology Department, Denver, CO 80205; [2]University of Colorado Denver, Department of Integrative Biology, Denver, CO 80204

Solifugae is a mesodiverse but understudied group of arachnids. A phylogenetic analysis of one of the 12 solifuge families, Eremobatidae, was published in 2015 testing the monophyletic relationships of taxa found within this family. This phylogeny supported the monophyly of the family but found the three most species-diverse genera were poorly supported. *Eremobates*, *Eremochelis* and *Hemerotrecha* were found to be poly-paraphyletic. The genus Eremobates, consisting of 88 species, is subdivided into seven species groups. My research focuses on one of the most diverse species groups found within *Eremobates*, the *Eremobates palpisetulosus* species group. The group was constructed for 47 species using a single character, presence of a retro dorsal process on the chelicerae of males. The 2015 analysis showed that this group was polyphyletic and separated into three clades. The chelicerae likely possess diagnostic characters that remain underexplored for the species group. I am testing whether these three clades are morphologically divergent using traditional and new characters. I investigated chelicerae metrics, chelicerae and genital operculum shape from the palpisetulosus species group for analysis. The results of the data may provide morphological synapomorphies that can be informative for a taxonomic revision of the species group.

SENSORY ECOLOGY OF NET-CASTING SPIDERS

Stafstrom, Jay[1]; Hebets, Eileen[2]; Hoy, Ronald[1]

[1]Cornell University, Department of Neurobiology and Behavior, 215 Tower Rd, Ithaca, NY 14853; [2]University of Nebraska - Lincoln, School of Biological Sciences, 101 T St, Lincoln, NE 68588

Ogre-faced, net-casting spiders live a circadian Jekyll and Hyde lifestyle, avoiding predators by day through camouflage, and stealthily ambushing prey by night. The sensory systems of these predators are well-adapted for nocturnal foraging - massive, motion-sensing eyes, complemented by multiple sensory organs used to detect airborne acoustic information. These sensory systems allow deinopid spiders to exhibit a unique style of active foraging, termed “net-casting.” While suspending themselves above the ground in a frame web, these spiders hold a specially made net in their front four legs and wait for insects to pass by. The near approach of prey triggers explosive acts of body movement and net manipulation that underlie an uncanny ability to ensnare prey walking beneath (forward prey strike) or flying above (backward prey strike). Through a combination of behavioral and neurophysiological studies, we show sensory modality partitioning in net-casting behavior, dependent on prey type (i.e. cursorial vs. aerial). Here, I will present our insights into the sensory ecology of net-casting, highlighting the capabilities and limitations of vision and hearing as they pertain to foraging in this fascinating group of animals.

DEW OR DIE: UNRAVELING THE WET VS. DRY ADHESIVE PERFORMANCE OF BLACK WIDOW ATTACHMENT DISCS

Steklis, Bernd; Blackledge, Todd

University of Akron, Department of Biology, Auburn Science and Engineering Center, 244 Sumner St, Akron, OH 44325-3908, USA

The adhesive performance of black widow (*Latrodectus hesperus*) attachment discs (ADs) in wet and dry conditions was investigated. Black widow spiders are known for their adhesive capabilities, but their performance in wet environments remains unclear. Experiments were conducted to evaluate the adhesive strength of black widow ADs under controlled wet and dry conditions. Results showed a significant reduction in adhesive strength in wet conditions compared to dry conditions. This suggests that black widow ADs are specialized for dry terrestrial habitats and may not be optimized for adhesion in aquatic or highly humid environments. These findings provide insights into the functional adaptions of black widow ADs. Further research is needed to understand the compositional and structural features that contribute to their superior adhesive performance in dry conditions. Additionally, investigating the adhesive capabilities of ADs from spider species adapted to aquatic environments will provide a broader understanding of wet adhesion in spiders. Such knowledge has implications for bioinspired adhesive technologies and the development of adhesives suitable for various environmental conditions.

SPIDROIN CATALOG OF THE COMMON HOUSE SPIDER, *PARASTEATODA TEPIDARIORUM*

Stellwagen, Sarah

Department of Biological Sciences, Woodward Hall, UNC Charlotte, 9201 University City Blvd, Charlotte, NC 28223

Spiders make up to seven different silk types, each used for a different purpose. The proteins that make up spider silks, called spidroins, are encoded by extremely long and repetitious genes, making them difficult to sequence and study. *Parasteatoda tepidariorum*, or the common house spider, is a well-studied spider with little known about its spidroins and corresponding gene sequences. Using long-read technology, this study reveals the most comprehensive spidroin catalog to date, representing all orb-weaver silk classes. Over 35 spidroin gene variants are documented across all major silk types, most of which are represented on single reads. This is the first study to use raw sequencing reads, rather than amplification or assembly, to explore spidroin diversity.

LETHAL AND SUBLETHAL EFFECTS OF COMMON HERBICIDES ON AN AGROBIONT WOLF SPIDER

Sweger, Alexander[1]; Ward, William[2]; Heinly, Briana[2]; Preston, Jack[2]; Johnson, Catherine[2]; Persons, Matthew[2]

[1]Hartwick College, Department of Biology, P.O. Box 4022, Oneonta, NY, USA 13820; [2]Susquehanna University, Department of Biology, 514 University Ave, Selinsgrove, PA, USA 17870

The quantity and diversity of herbicides used in commercial crop production has steadily increased for decades, which has had unintended and unpredictable consequences on non-target organisms. Spiders in particular are important and often beneficial species found in agricultural systems, and prior studies have shown that commonly applied herbicides can have adverse effects on spider health. We tested lethal and sublethal effects of five commonly used herbicides on the wolf spider *Pardosa milvina* when individually exposed to soil with field relevant dosages. Male and female spiders from two collection sites were exposed to one of seven herbicide treatments (atrazine, glyphosate, mesotrione, S-metolachlor, rimsulfuron, a combination of all herbicides, or a distilled water control) and maintained on soil substrate. We recorded mortality, predatory behavior, weight change, courtship behavior, and egg sac production over a 52-day period. We observed significant increases in mortality among spiders treated with mesotrione and a combination of herbicides. Other herbicides showed negligible effects on mortality, or slight increases to survival. We also observed varied effects on predatory behavior, weight change, and egg sac production (in females) based on sex, site, and treatment. Our results show some herbicides may have modest, short-term survival benefits, while others strongly increase mortality.

EFFECT OF LSD ADMINISTRATION ON *ULOBORUS DIVERSUS* WEB-BUILDING BEHAVIOR

Task, Darya; Corver, Abel; Rabinovich, Anthony; and Gordus, Andrew

Johns Hopkins University Department of Biology, 3400 North Charles Street, 209 Bio East Building, Baltimore, Maryland, USA, 21218

Psychoactive drugs provide a window into neural circuits involved in sensory perception, learning and memory, and motor behavior. Experiments in various orb-weaving spiders have shown that drugs can alter distinct components of a spider's web. Due to the challenges of recording spider leg movements, these prior studies had a limited ability to connect changes in web structure to changes in web-building behavior. Using machine vision tracking and computational modeling methods established by our lab, I am investigating the effects of psychoactive substances on behaviors underlying different stages of web building in *Uloborus diversus*. Surprisingly, preliminary experiments involving oral LSD administration did not show significant alterations in spiders' behavioral motifs. To ensure adequate drug delivery to the central nervous system, we have developed a novel, reversible spider immobilization and coxa injection protocol. We are repeating these initial experiments with LSD injection directly into the spider hemolymph.

ELUCIDATING THE MOLECULAR CLOCKWORK OF SPIDER CIRCADIAN RHYTHMS

Wicker, Hannah; Haggett, Hunter; Ramos, Gia; Petko Jessica

Department of Biology, Penn State York, 1031 Edgecomb Ave, York, PA, 17403

Circadian rhythms are daily patterns in biological processes that exhibit a near 24-hour period in most organisms. In contrast, spiders display a remarkable range of interspecific period lengths and intraspecific variability. The transcription-translation feedback loop responsible for regulating the circadian clock in insects has been extensively studied and shows conservation in other invertebrates. Changes in the structure, function, or expression of the molecular clock components in spiders may underlie their unique chronobiology. In this study, we characterized orthologs of the core circadian clock genes in the common house spider, *Parasteatoda tepidariorum*. In addition to examining their predicted protein domain structures, we employed RT-PCR to identify alternative transcripts and assess their overall expression. Alternative splicing was detected in two clock genes, *period* and *clock*, which could potentially impact transcript stability, translational efficiency, or protein structure and function. *In vitro* GST-pulldowns were used to analyze protein-proteins interactions between these orthologs. Our findings support the presence of a conserved ancestral circadian clock in spiders with unique differences in splicing and expression. This study lays the foundation for comprehensive investigations into how spider molecular clocks evolved and are regulated.

VISUAL OBJECT CATEGORIZATION IN THE JUMPING SPIDER BRAIN

Winsor, Alex[1]; Remage-Healey, Luke[1,2]; Hoy, Ronald[3]; Jakob, Elizabeth[1,4]

[1]Graduate Program in Organismic and Evolutionary Biology, University of Massachusetts Amherst, Amherst, MA 01003, USA; [2]Center for Neuroendocrine Studies and Department of Psychological and Brain Sciences, University of Massachusetts Amherst, Amherst, MA, 01003, USA; [3]Department of Neurobiology and Behavior, Cornell University, Ithaca, NY 14853, USA; [4]Department of Biology, University of Massachusetts Amherst, Amherst, MA, 01003, USA

Many animals use visual information to rapidly classify objects into categories such as prey, predators, or conspecifics. Important questions include whether animals use particular features or combinations of features to identify objects, and where in the brain such features are extracted. We explore these questions in the visual system of jumping spiders (Araneae: Salticidae). Salticids have six motion-detecting secondary eyes and a forward-facing pair of principal eyes capable of high spatial resolution and color vision. The principal-eye retinas have narrow visual fields but can move internally to scan objects. In *Phidippus audax*, we simultaneously monitored gaze direction with our eyetracker while collecting dual extracellular recordings of lower and higher order protocerebral neuropils. We presented spiders with a stimulus set of ecologically relevant holistic objects, including prey, conspecifics, heterospecific salticids, predators, and unpalatable prey. We also presented images with stepwise complexity reductions that distill objects into their elemental components to parse whether spiders respond to local features or global structure. Our results across nine subjects show multi-unit activity within both the lamina and arcuate body is strongly driven by images of palatable prey and suppressed by images of unpalatable prey, compared to the baseline firing rate. We have begun sorting single units and detected a ~68% neuronal activation when the spider viewed palatable prey, and a ~72% neuronal suppression when the spider viewed unpalatable prey. Moreover, our data suggest relatively simple features are extracted for recognition. Ongoing analyses examine neural responses within stimulus categories and to simpler image components, and correlations with retinal exploration (DeepLabCut). Future work aims to use neural activity to predict behavioral outcomes. In summary, our study reveals neural correlates of prey categorization in a behaviorally complex predator.

Posters

UPDATED LIST OF OPILIONES INTRODUCED TO USA AND CANADA: A COMMUNITY SCIENCE PROJECT

Adams, Nicholas[1]; Derkarabetian, Shahan[2]; Bal, Bernard[3]; Dubois, Pascal[4]; Jacques-Fero, Dylan[5]

[1]Boerne, Texas, USA; [2]Harvard University, Department of Organismic and Evolutionary Biology, Museum of Comparative Zoology, 26 Oxford St. Cambridge, Massachusetts, USA; [3]Asters-CEN74, Annecy, Haute-Savoie (74), France; [4]Maclas, Loire (42), France; [5]Natick, Massachusetts, USA

Community science has contributed significantly to biodiversity and conservation related research. iNaturalist is a popular community science application, where community-submitted photo documentation of observed taxa has led to a large natural history database. Here, we present results of an iNaturalist project focusing on documenting introduced Opiliones to the USA and Canada. Including all observations made in this project up through 31 December 2021, there were 849 total observations (486 research grade), which included 16 introduced species (excluding multiple species of uncertain status), 11 of which were newly recorded for the USA and Canada. We provide an updated checklist of introduced species, including updated distributions for previously recorded species. This research was facilitated by the community science platform iNaturalist, which allows easy interactions between scientists of all types.

BEAT THE HEAT: DETERMINANTS OF RETREAT IN COLORADO BROWN TARANTULAS (*APHONOPELMA HENTZI*)

Allendorfer, Bradley; Shillington, Cara

Mark Jefferson Science Complex, Ypsilanti, MI 48197, United States

Burrow-dwelling tarantulas, including the Colorado Brown Tarantula (*Aphonopelma hentzi*) spend the majority of their life in proximity to, or within their burrows. As primarily nocturnal/crepuscular animals, they move toward the entrance around dusk, and retreat further into their burrows after dawn, where they remain for the hottest parts of the day. Few studies have investigated the activity patterns of burrowing tarantulas in the field, and most emphasis has been placed on behaviors that occur at dusk. Instead, we recorded individuals around their burrows prior to daytime retreat (6:30 AM to 8:30 AM), at the Comanche National Grasslands, in La Junta, Colorado. Of the 35 burrows studied, 21 individuals were identified as active throughout the recording period and used for additional comparisons. At each minute, individuals were scored based on the proximity of their carapace to the burrow entrance (i.e. carapace fully out of the burrow, visible within the burrow, not visible). Movement outside the burrow ceased when individuals retreated into their shelters and sealed the entrance with a layer of silk. Correlations of activity with daylight, temperature and body size will be analyzed to better understand the triggers leading to web covering and daytime retreat.

DOES PERSONALITY AFFECT MIMETIC ACCURACY IN THE ANT-MIMICKING SPIDER *LEPTORCHESTES BEROLINENSIS* (SALTICIDAE)?

Apple, Jennifer L.[1]; Pekár, Stano[2]

[1]SUNY Geneseo, Department of Biology, 1 College Circle, Geneseo, New York, 14454, USA; [2]Department of Botany and Zoology, Faculty of Science, Masaryk University, Brno, Czech Republic

Personality traits like boldness, aggressiveness, and exploratory tendencies may affect an individual's foraging behavior, predation strategies, and defensive behavior. The myrmecomorphic spider *Leptorchestes berolinensis* (Salticidae) is a Batesian mimic that benefits from its physical resemblance to ants as well as its ant-like behavior. In this study, we investigated whether *L. berolinensis* exhibits consistent inter-individual behavioral differences that could be characterized as different personality traits such as boldness. We predicted personality differences may relate to mimetic accuracy in behavioral imitation of ants as bolder individuals would have closer or more frequent encounters with predators. We identified the percent of time spent in the center of an arena vs. the edge to be a repeatable measure of boldness for this species. Contrary to our prediction, bolder individuals were not more accurate in their mimetic resemblance of ants. Bolder individuals exhibited a higher leg-wave rate (a movement that mimics the antennal movement of ants). However, we failed to find boldness to be significantly related to interactions with predators, like the total time or number of episodes spent near predators (mantids or nursery spiders). We conclude that boldness may not affect mimetic accuracy.

PHENOLOGY AND MATING BEHAVIOR OF THE NON-NATIVE ANT-MIMICKING SPIDER *MYRMARACHNE FORMICARIA*

Apple, Jennifer; Brzezicki, Julia; Ontiveros-Oberg, Eliana; Ridley, Marlena; Zhou, Jacqueline

SUNY Geneseo, Department of Biology, 1 College Circle, Geneseo, New York, 14454, USA

The ant-mimicking spider *Myrmarachne formicaria* (Araneae: Salticidae) is a recent arrival to North America from Eurasia, first noted in Ohio in 2001. Relatively little is known about its natural history in its native or invaded range. From 2017-2022 in natural settings in fields and woodlands in western New York, the appearance of adult males and females, eggs, spiderlings, and juveniles was monitored to describe the phenology of this species. Comparisons of field data from New York to species occurrence data from the Global Biodiversity Information Facility (GBIF), as well as field work in Europe, suggests differences between the phenology of *M. formicaria* in its native range and that observed in North America. Opportunistic collections of spiders indicate they can overwinter as subadult females, adult unmated females, mated females, and adult males. The species is sexually dimorphic, with males bearing enlarged chelicerae that are often displayed in male-male encounters; larger males almost always prevail in these confrontations. Preliminary mating experiments suggest outcomes of male-male contests may not directly affect female acceptance of males as mates and that female response to male courtship may be context-dependent.

RESPIRATORY EFFECTS OF OXYTOCIN ON BOLD JUMPING SPIDERS

Berry, Alexander; Flaskey, Phoebe; Ecker, Geoffrey

Buena Vista University, 610 W 4th St, Storm Lake, Iowa 50588

Established literature states that spiders are lacking vasotocin pathways (Liutkeviciute et al. 2016, Koev et al. 2018). A previous transcriptome analysis suggested that the ground-dwelling wolf spider *Pardosa milvina* possessed mRNA for vasotocin-like receptions but not for the hormone itself (Berry 2021). This allows for the opportunity that at least some spiders could respond to absent vasotocin (or potentially its mammalian equivalents). In this project, we measured the respiration rate of female bold jumping spiders, Phidippus audax, both before and after administering either a dose of oxytocin or distilled water. This was accomplished using a Li-cor 6400 with an insect respiration chamber. Before trials, the spiders had similar respiratory rates. After exposure, those spiders who received the dose of oxytocin had significantly higher respiratory rates than those exposed to distilled water. Although preliminary, and with a small sample size, this finding would suggest that the jumping spiders are able to physiologically respond to oxytocin.

DIFFERENCES IN ACTIVITY AND BEHAVIOR AMONG LIFE-STAGES OF TARANTULAS (*TLILTOCATL ALBOPILOSUS*)

Brogan, Annalyse; Shillington, Cara

441 Mark Jefferson, Department of Biology, Eastern Michigan University, Ypsilanti, MI 48197

Life-history strategies in male and female tarantulas vary when males reach sexual maturity they leave their burrows and search for females, while sexually mature females remain within close proximity to their retreats. Less is known about juveniles especially after leaving the maternal retreat. In this experiment we examined activity of *Tliltocatl albopilosus* (Curly Hair Tarantula) at different life-stages and between the sexes (mature and subadult males, females and unsexed juveniles). Data were collected using video-tracking equipment and a circular arena to compare distance, velocity and thigmotaxis which was used to indicate “boldness”. Arena sizes were scaled to the different size/age groups. Mature males traveled at higher velocities but did not necessarily travel further than the other groups. Additionally, mature and subadult males showed less thigmotaxis and were more likely to cross the inner portion of the arena indicating bolder individuals. These results support differential reproductive strategies with bolder males searching actively for females. Subadults showed similar activity patterns to mature males while juveniles were more similar to females. Further studies on different development stages in these long-lived animals is essential for understanding behavioral differences with age and sex and would provide valuable insights into their biology and reproductive strategies.

LOOKING FOR RELATIVES: POPULATION STRUCTURE OF *LATHYS MACULINA* GERTSCH IN THE SOUTHEASTERN UNITED STATES. (ARANEAE: DICTYNIDAE)

Canseco, David[1]; Montana, O. Katherine[2]; Cala-Riquelme, Franklyn[2]; Crews, C. Sarah[2]; Esposito, Lauren[2]

[1]Department of Entomology, University of California, Riverside, Riverside, CA 92521, USA; [2]California Academy of Sciences, 55 Music Concourse Dr., San Francisco, CA 94118, USA

The genus *Lathys* comprises 54 species of small spiders that are typically found in leaf litter throughout the Holarctic. *Lathys* was described by Simon in 1884, but since that time the only studies of the genus have been descriptions of new species. Here we provide the first data of the population structure of *L. maculina*, a species occurring primarily in the eastern United States. We used the COI gene from 35 specimens from 8 populations to determine how populations are structured across their range in the southeastern United States. Our results indicate that there are genetic differences among and between populations. Additionally, we compared somatic and genitalic characters among adult specimens within and among populations and found variation; however, the variation is not consistent with the genetic differences, a pattern seen in other spider groups. Our study provides a basis of comparison for studies of other *Lathys* or litter-dwelling animals with similar distributions and represents the first molecular study of the genus.

EYE SIZE AND ITS EVOLUTION IS AFFECTED BY HUNTING ECOLOGY IN SPIDERS.

Chong, Kaylin L.[1,2]; Perl, Craig[3]; Sumner-Rooney, Lauren[2,4]

[1]Department of Organismic and Evolutionary Biology, Harvard University, Cambridge, MA USA; [2]Oxford University Museum of Natural History, Parks Road, University of Oxford, Oxford OX1 3PW, UK; [3]School of Life Sciences, Arizona State University, Tempe, AZ 85281, USA; [4]Museum für Naturkunde, Leibniz Institute for Evolution and Biodiversity Science, Invalidenstrasse, 10115 Berlin, Germany

Eye size affects many aspects of visual function, including contrast sensitivity and achievable spatial resolution, but eyes are also costly to grow and maintain. The allometry of eyes can provide insight to this trade-off in the context of visual ecology, but to date, this has only been explored in detail in species that have uniform eye sizes. By contrast, the eyes of spiders are often different sizes between pairs, but their ontogenetic and evolutionary allometry has not been studied. Our study reveals variable evolutionary and developmental dynamics in eye size across 972 individuals in 39 species and 8 families, driving the evolution of different eye pairs in distinct ways. We observed variation in the relationship between eye and body size not only between taxa but also between eye pairs within species. Supplementing our sampling with the dataset of Wolff et al. (2022), we identified significant shifts in eye size for certain eye pairs across the spider phylogeny. Furthermore, incorporating ecological factors such as visual hunting, web building, and diurnality into our phylogenetic analysis, we found that these factors also impact eye size variation. Notably, we discovered allometric differences between families based on their visual or nonvisual hunting behaviors. This study represents the first interspecific comparison of visual allometry in spiders, revealing striking differences in eye growth not only between families but also within species. Our findings shed light on the intricate relationship between spider visual systems and their diverse hunting ecologies.

MULTIMODAL COURTSHIP IN *MAEVIA INCLEMENS* (WALCKENAER 1837)

Clark, David L.[1], Moskalik, Brian[2] , Uetz, George W.[3]

[1] Department of Biology, Alma College, Alma, MI 48801, U.S.A.; [2] Department of Natural Sciences, Joliet Junior College, Joliet, IL 60431; [3] Department of Biological Sciences, University of Cincinnati, Cincinnati, Ohio, 45221

The dimorphic jumping spider, *Maevia inclemens* (Walckenaer) exhibits two male phenotypes (tufted and gray); each morph has distinct courtship behavior. Visual displays are accompanied by vibratory/seismic signals in a multimodal courtship. We recorded the vibratory component of *M. inclemens* courtship with piezo-electric film and Laser Doppler vibrometry (LDV). Results indicate vibratory signaling is variable during Phase I male courtship; signal production is synchronous with male movement in gray but not tufted morphs. During Phase II, both morphs exhibit similar vibration signals (a “propeller” sound). Responses of female *M. inclemens* to video and vibration playback of conspecific courtship vary depending on the presence of visual cues, but do not differ between morphs. Females approach isolated vibration cues, but only exhibit receptivity (an audible “triplet” percussion signal) to multimodal or visual cues. Cue conflict experiments show female receptivity to combined heterospecific/conspecific video and vibration playback (‘multimodal mixed messages’) was low or absent, except when a male *Maevia* was the visual component. These results illustrate the complex multimodal courtship signaling of this dimorphic species. However, despite the presence of vibratory signals in male *M. inclemens* courtship, visual cues appear to be the dominant mode of communication.

EFFECTS OF BIFENTHRIN RESIDUES ON REPRODUCTIVE BEHAVIORS IN *ARGIOPE TRIFASCIATA*

Foellmer, Matthias; McManus, Keith

Adelphi University, Department of Biology, 1 South Ave, Garden City, New York 11530, USA

Pesticide residues remaining in the environment can affect the behavior and physiology of beneficial arthropods, with the potential to impact population dynamics and community structure. In 2020, the US EPA allowed New York State to use the pyrethroid bifenthrin on fruit crops to control the invasive brown marmorated stink bug. To evaluate side effects of bifenthrin application, we conducted a series of experiments on the effect of residual concentrations on *Argiope trifasciata*, an orb-weaver common in the Hudson Valley farm lands. Here we report the results of exposure to a low concentration of 0.00174 mL/L bifenthrin on courtship and mating behavior. We exposed individuals through contact with dried filter paper, which had been soaked with a dilution of the pesticide Talstar® or DI water. Males were used on the day of exposure and reused if unresponsive. Females were used 12 to 21 days after exposure, depending on web presence. Bifenthrin had no effect on the behavior of males. However, males were less likely to approach and mate with females which had been exposed to the pesticide and time to approach was negatively correlated with time since female exposure. Thus, exposure to very low concentrations of bifenthrin affects reproductive behaviors.

POST-EMBRYONIC DEVELOPMENT OF *STEATODA TRIANGULOSA*

Frias, Elizabeth; Myers, PZ

University of Minnesota Morris, Division of Science & Math

We have developed protocols for raising large numbers of *S. triangulosa* in the lab. This species is common in our region and is of particular interest for studying patterning of the integument. Our current work has focused on optimizing growth and fecundity of the animals, investigating the impact of a controlled diet on the growth rate and development of a breeding colony of *S. triangulosa*, from early stages to adulthood, and we have found that twice-weekly feedings of Drosophila is sufficient to maximize growth and to reach reproductive age after approximately 6 weeks. We are easily obtaining hundreds of embryos every week from a small set of ~20 adult females. The current direction of our work is to characterize embryonic development and to directly compare the stages with the published work in *Parasteatoda tepidariorum (*Mittman & Wolff, 2012). One significant difference between the two is that *S. triangulosa* embryonic development is approximately three times slower.

IMPACTS OF SOCIAL ISOLATION ON THE BEHAVIOR OF GROUP-LIVING TARANTULAS

Galvao, Attarian, Laura; Hoefer, Sadie J.; Lan, Brendan

Cornell University, Department of Entomology, 129 Garden Ave, Ithaca, NY 14853

Some species of mygalomorphs live in social groups, both in prolonged mother-offspring-sibling groups (Eumenophorines: *Mononocentropus balfouri, Hysterocrates* sp.,) or larger social aggregations (*Neoholothele incei).* All are characterized by burrow sharing followed by moving into or creating neighboring burrows. Key elements of burrow sharing with tolerance and nonaggression can be evaluated by assessing the tendency to amicably aggregate and to remain in physical contact. We compared aggregation tendencies in *M. balfouri* from sibling groups before and after a 4-month isolation period. Because it is impossible to follow individuals in burrows, individuals were placed in large open cages with potential artificial burrows for one to two weeks and allowed to interact freely. We measured contact, nearest neighbors, and cannibalism. While pre-isolation *M. balfouri* remained in frequent contact, social isolation significantly reduced their tolerance and aggregation, as well as precipitated cannibalism. A similar ‘free interaction’ test with social *Hysterocrates* demonstrated major differences with *M. balfour*i, as these individuals were tolerant but never aggregated. These results suggest that social isolation decreases aggregation rates and increases conspecific aggression in *M. balfouri* making burrow sharing impossible*. M. balfouri* discontinue contact when reintroduced post-isolation suggests that, once isolated through dispersal, individuals start their own colony, suggesting subsociality.

SPIDERS OF THE SOUTHERN APPALACHIANS: A FIELD COURSE IN IDENTIFICATION AND BIODIVERSITY

Garrett, Jess[1]; Stellwagen, Sarah D.[2;] Burns, Mercedes[3]; Catley, Kefyn M.[4]

[1]Denver Museum of Nature & Science, 2001 Colorado Blvd., Denver, CO. 80205, United States; [2]Department of Biological Sciences, UNC Charlotte, 9201 University City Blvd, Charlotte, NC. 28223, United States; [3]Department of Biological Sciences, University of Maryland, 1000 Hilltop Circle, Baltimore, MD. 21250, United States; [4]558 Jones Landing Way, Blaine, TN. 37709, United States

Spiders of the Southern Appalachians, a field course in spider biology and identification, is offered at the Highlands Biological Station in Highlands, North Carolina in the late summer of even calendar years. Over a two-week period, students learn the basics of spider biology in the classroom and work to build a personal catalogue of the region's unique and highly diverse spider population through collecting excursions to various field sites in the surrounding areas. The course may be taken for college credit by students looking to supplement a general biology degree with arachnology-focused material, or simply for personal interest by community scientists and other parties who would like to expand their knowledge and experience the incomparable biodiversity of the Highlands region. Attendees leave the course with experience identifying specimens to species level, enhanced field identification skills, and a general understanding of spider biology and evolutionary history.

ASSESSING POTENTIAL INVASIVE RANGE OF *TRICHONEPHILA CLAVATA* USING DISTRIBUTION MODELS

Giulian, Joseph; Moore, Darrell; Jones, Thomas C.

Department of Biological Sciences, College of Arts and Sciences, East Tennessee State University, Johnson City, TN 37601, USA

The invasive potential of the east-Asian spider, *Trichonephila clavata*, in North America remains uncertain. MaxEnt species distribution models (SDMs) were used to assess the invasive process and potential range of *T. clavata* based on its climatic niche preferences. Our results reveal that *T. clavata* favors a climatic niche between subtropical and temperate latitudes, with high suitability primarily projected in coastal or montane forest regions spanning latitudes of 30-50 degrees. Model projections also indicate moderate to high risk of continued expansion beyond the current invasive range. Areas with more than 50% suitability are projected to extend northward as far as 45-50º N and into Canada, while the southern extent may approach the Gulf Coast. Highly contrasting drivers of distribution between native and invasive populations suggest the exploitation of distinct niches. Niche flexibility should aid invasive potential, however, additional factors, such as competition dynamics and non-climatic constraints, likely also influence the species' ability to exploit niches during northward expansion. Overall, model predictions indicate a wide climatically suitable region in North America for *T. clavata*, highlighting the need for further research on biotic factors and management strategies to mitigate potential ecological impacts.

TERRITORIAL MALES' MATE-GUARDING AFFECTS SNEAKER MALES' OPPORTUNITIES IN A NEOTROPICAL HARVESTMAN

Grossel, Laís A.[1]; Machado, Glauco[2]

[1]Programa de Pós-graduação em Zoologia, Instituto de Biociências, Universidade de São Paulo, SP, Brasil.; [2]LAGE do Departamento de Ecologia, Instituto de Biociências, Universidade de São Paulo, SP, Brasil.

In many species showing alternative reproductive tactics, majors guard females after copulation. Minors, in turn, sneak copulations with unguarded females. Theory predicts that the longer the mate-guarding period, the higher the paternity share of the majors. Usually, minors can sneak copulations only when majors abandon an ovipositing female. Majors of the harvestman *Serracutisoma proximum* guard females for 8-72 h after copulation. The sneaker tactic of the minors is possible because females do not lay all eggs during the mate-guarding period. However, there is no data on how mate-guarding may affect mating opportunities of sneakers. Field observations show that the oviposition period extends from 1 to 11 days after mating. On average, 75% of the eggs are laid in the first 3 days after mating, which corresponds to the mate-guarding period. Thus, on average, sneakers can sire as much as 25% of eggs. We also found that majors that received more females in their harems invested less time in mate-guarding. Thus, the mating opportunities for the sneakers are higher in larger harems. In conclusion, the long oviposition period in *S. proximum* provides the opportunity for sneak copulations, allowing minors to sire at least part of the eggs laid by the females.

COMPARING THE RATES OF CIRCADIAN RE-ENTRAINMENT BETWEEN ARANEOID AND NON-ARANEOID SPIDERS

Holden, Sara; Jones, Thomas C.; Moore, Darrell

Department of Biological Science, College of Arts and Sciences, East Tennessee State University, 173 Sherrod Dr, Johnson City, TN 37614 USA

Circadian rhythms are roughly 24-hour endogenous processes present in almost all living eukaryotes. In nature, organisms synchronize their internal clocks to the Earth's solar day. Spider species within Araneoidea have been found to exhibit extreme circadian periods up to five hours different than the 24-hour day, with little evidence of such extremes occurring outside of this superfamily. Studies have shown that araneoid spiders can undergo large phase shifts without exhibiting any evidence of fitness costs. Araenoid species can re-synchronize their internal clocks to large phase shifts, up to 10 hours daily. Re-synchronization also appears to be accelerated in araneoid species. This indicates a functional difference between the circadian clocks of araneoid species and non-araneoid species. Rates of re-entrainment to a six-hour phase shift were compared between *Metazygia wittfeldae* and *Pholcus manueli*. We hypothesized that the non-araneoid spiders would require a longer amount of time to re-entrain. Results to date are ambiguous. *Metazygia wittfeldae* can re-entrain to a six-hour shift within two days. We were unable to draw strong conclusions in *P. manueli*. However, the data suggest that this species may have two circadian oscillators, one which re-entrains to a phase shift rapidly, and one which is highly resistant to re-entrainment.

A NEED FOR SPEED: IMPACTS OF MORPHOLOGY, PHYLOGENY, AND ENVIRONMENT ON RUNNING PERFORMANCE IN 28 HUNTSMAN SPIDER SPECIES (SPARASSIDAE)

Hurst, Jacob[1,3]; Giulian, Joseph [1,2]; Rayor, Linda S. [1]; Gorneau, Jacob [1,4]

[1]Cornell University; [2]East Tennessee State University; [3] California State University, Fresno; [4]California Academy of Sciences

Running speed is a measure of whole organism performance that impacts prey capture, predator avoidance, and navigation through habitat with consequences for individual fitness. Our study explored morphological, phylogenetic, and environmental factors that impact running speed in 28 species of huntsman spiders. High-speed recordings (n=163) of spiders running through an acrylic tube were fed into a DeepLabCut ™ neural network trained to extract velocity data from videos. Running velocity was paired with leg and body size measurements to determine allometric slopes via GLM and AIC modeling. Running velocity was mapped to our sparassid phylogeny (Gorneau et al., 2022) to examine phylogenetic patterns in running performance. Effects of retreat size and habitat type on morphology and running velocity were explored using ANOVA and PCA. Huntsman spiders are among the fastest spiders measured, with some individuals reaching speeds of 117cm/sec. Spiders with proportionally longer legs ran faster in cm/sec and body lengths/sec, while higher body mass was associated with overall slower running speed in body lengths/sec. Body size as reflected by carapace width is unrelated to retreat size, while shorter L2 length is associated with smaller retreats. Running performance varies widely across taxa from open environments, suggesting diverse ecophysiologies for the Sparassidae.

SIZE DOESN'T MATTER: FEMALE MATE CHOICE IN *PHIDIPPUS REGIUS* C. L. KOCH, 1846 (ARANEAE, SALTICIDAE)

Jahnig, Carter J.; Patrick, Brian L.

Department of Biological Sciences, Dakota Wesleyan University, 1200 W. University Ave., Mitchell, SD, USA, 57301

Phidippus regius C. L. Koch, 1846 is a large jumping spider found in the southeastern United States and the Caribbean. Little has been documented of female mate choice in this species, and here we document female mate choice based on the size of the male. We measured the total length, carapace width, abdomen length, and abdomen width and we recorded the time for a female to notice the male, display duration, copulation duration (if occurred), and time to male retreat. Only virgin males and females were used. There was no connection between larger males and female preference. Three of the five successful matings had males above the 50th percentile in both total width and length. The experiments with clearly larger males did not show a change in behavior. There were 18 tests run with 5 mating successes. There was an average of 6.05 minutes total interaction time for the 18 tests run. There were no links between size and time in any of the distinct time measurements. Distinct time measurements refer to time to notice, display duration, copulation time, and time until male retreat. Mating success was any event in which the female allowed the male to mount.

LOW CONCENTRATIONS OF THE SYNTHETIC PYRETHROID BIFENTHRIN REDUCE THE SURVIVORSHIP AND WEB-BUILDING BEHAVIOR OF THE BANDED GARDEN SPIDER *ARGIOPE TRIFASCIATA*

Jordan, Breanna[1,2]; Kross, Sara[1,3]; Sterling, Eleanor[4,5]; Foellmer, Matthias[6]

[1]Ecology, Evolution, and Environmental Biology, Columbia University, New York, NY, 10027, USA; [2]Organismic and Evolutionary Biology, Harvard University, Cambridge, MA, 02138, USA; [3]School of Biological Sciences, University of Canterbury, Christchurch, New Zealand; [4]American Museum of Natural History, New York, NY, 10024, USA; [5]Hawai'i Institute of Marine Biology, Kaneohe, HI, 96744, USA; [6]Biology, College of Arts and Sciences, Adelphi University, Garden City, NY, 11530, USA

Insecticides are commonly used to mitigate damages caused to commodity crops by a multitude of organisms, referred to as pests. These chemicals can have reverberating impacts on nontarget species, including beneficial species, such as orb-weaving spiders (Araneae: Araneidae). Orb-weavers provide natural pest control services, but sublethal effects of insecticides could alter the provisioning of such services, including changes in web building and predatory behaviors. We examined the effects of a low concentration of the synthetic pyrethroid insecticide bifenthrin, on survival, web-building frequency, and web architecture of the banded garden spider (*Argiope trifasciata*). *Argiope trifasciata* exposed to bifenthrin had a 56% chance of surviving 5 days post exposure compared to a 92% chance of survival in the control group. Surviving spiders in the treatment group built very few webs immediately after exposure, and even after four days only 42% of spiders in the treatment group built webs, compared to 61% of spiders in the control group. Hence, bifenthrin had a negative effect on web building behavior and survival, even at supposedly sublethal doses. These results indicate that even very low residual concentrations of bifenthrin exposure can have immediate negative effects on a provider of natural pest control services in agroecosystems.

GENETIC AND MECHANICAL ANALYSIS OF SPIDER SILKS

Kellner, Ella; Warren, Abby; Stellwagen, Sarah

UNC Charlotte, Department of Biological Sciences, 9201 University City Blvd Charlotte, North Carolina, 28223, USA

Silk genes, specifically in spiders, are incredibly long and repetitive, and are some of the largest genes ever researched. Long read sequencing technology is being used in order to understand and analyze how these genes are expressed and how expression may vary. Furthermore, these organisms use their glues in different environments, of which differing humidity and temperatures affect the strength and elasticity. Droplets produced by our research organisms will be probed using force transducers under a microscope. In order to preserve the integrity of the experiment and the glues, they are tested within an environmental chamber that mimics the humidity and temperature of the organisms' natural habitats. We aim to study the properties of silk genes and glue droplets on both a molecular and biomechanical level so that we may draw conclusions about these organisms' evolutionary patterns and ecological behaviors.

YOU ARE WHAT YOU EAT: RESPONSES IN PERFORMANCE AND GROWTH IN TARANTULA TO PREY NUTRIENT CONTENT

Landor, Peter; Shillington Cara

Eastern Michigan University, Ypsilanti, MI 48197

Nutritional composition of prey plays a pivotal role in building tissues and growth. In turn body size can be indicative of fitness. We provided tarantulas with nutritionally-biased diets to assess effects of macronutrient content on growth, metabolic rate and activity. Spiders are obligate predators; thus, supplementing was done using a single prey species fed different diets. Crickets were reared on one of three diet treatments to simulate prey with differing macronutrient compositions: high protein, high carbohydrate, or high protein with B vitamins. Measurements of growth were determined from duration of instar period and metatarsus length. Activity was tracked in novel arenas where distance moved and velocity were measured over a 30-minute period. Metabolic rates were compared pre-treatment (2nd instar) and post-treatment during the 5th instar. Spiders supplemented with carbohydrates had larger growth rates, and tended to move faster and longer distances. There was a positive correlation between metatarsal length and activity variables. Furthermore, instar periods were shorter in the high carbohydrate group than in either of the high protein groups. This supports our findings that the carbohydrate group displays faster growth in comparison to the protein diets. Samples sizes were small, but the carbohydrate group also had the highest mortality.

INTERSPECIFIC INTERACTIONS AMONG THE NEARCTIC TREETRUNK SHEETWEAVER (LINYPHIIDAE: *DRAPETISCA ALTERANDA*)

Lara, Bryan; Draney, Michael; Tank, Whitney; Maule, Ethan; Jena, Berceau; Jarrod, Ehnert; Forsythe, Patrick

University of Wisconsin, Green Bay, Department of Natural and Applied Sciences, 2420 Nicolet Dr, Green Bay, WI 54311, USA.

Studies regarding intraspecific behavior have been heavily focused on the Salticidae and Lycosidae family within Araneae, however there has been hardly any investigation focused on Linyphiidae, despite being the second most diverse spider family and being numerically abundant. Because of this, the goal of this study was to document any behavioral observations that would occur between multiple treatments within our model organism, the Nearctic Treetrunk Sheetweaver (*Drapetisca alteranda*). Spiders were assigned to one of four treatments: MM (paired males), MF (male and female), FF (paired females), or CM (single male) and CF (single female) as controls and were left alone over a number of days in a mesocosm containing a small cut tree trunk section of their preferred habitat. On average, spiders maintained a neighbor distance of 106.8mm amongst all paired treatments. FF treatments resided on a higher position on the tree trunk (119.10mm average) compared to MF treatments (113.83mm average) and MM treatments (108.59mm average). Amongst all treatments, many spiders had a downward-faced orientation on an average of 81% throughout the duration of the experiment. Understanding interspecific behavior of this unique tree dwelling species will allow us to ask more sophisticated questions about its ecological role in forest ecosystems.

PROTEOMICS SUGGEST PYRIFORM SILK ANCHORS ORB WEB CAPTURE SPIRAL JUNCTIONS

Cooper Lazo[1], Maria Luzaran[1], Jamal Magoti[1], Kyle Friend[2], Brent D. Opell[3], Nadia A. Ayoub[1]

[1]Department of Biology, Washington and Lee University, Lexington, VA, USA; [2]Department of Chemistry and Biochemistry, Washington and Lee University, Lexington, VA, USA; [3]Department of Biology, Department of Biological Sciences, Virginia Tech, Blacksburg, VA, USA

Spiders make multiple task-specific silks, each possessing unique material properties. Orb web weaving spiders, like *Argiope trifasciata*, rely on sticky aggregate glue droplets lining the capture spiral of their web to retain prey. Past research indicates that glue droplets placed later in web construction at the innermost region of the capture spiral are smaller, more diluted, and less extensible than glue droplets placed early in web construction at the bottom region of the capture spiral. We hypothesized that these differences may be due to the spider running out of sticky aggregate material later in web construction. Here, we compared the protein composition of the glue droplets placed at the bottom of the web to those placed later in web construction at the inside of the web. Our results showed a lower abundance of the putatively sticky proteins in the inner web, supporting our original hypothesis. Interestingly, we also found that pyriform spidroin, which anchors bridging lines of the web to the substrate, was more abundant in the inner region of the web, which has a higher density of capture spiral-radial line junctions. We propose that pyriform spidroin has a previously unidentified role in orb webs: anchoring the capture spiral to radial lines.

INVASIVE BROWN WIDOW SPIDERS (*LATRODECTUS GEOMETRICUS*) THWART THEIR PARASITOIDS

Lubin, Yael

Blaustein Institutes for Desert Research, Ben-Gurion University, Sede Boqer Campus, Midreshet Ben-Gurion 8499000, Israel

Invasive species may possess traits that promote their invasiveness, such as high productivity, short development, and high dispersal ability. In addition, they may be less susceptible to natural enemies such as predators and parasites. The brown widow spider *L. geometricus* (Koch), is a highly invasive species globally. One of the main natural enemies of *L. geometricus*, as well as of other widow spider species, is the parasitoid wasp *Philolema latrodecti* (Fullaway), which lays its eggs inside the egg sac of the spider. The wasp larvae consume the spider eggs, pupate inside the egg sac and emerge as adults. In Israel, we found that *L. geometricus* is less susceptible to parasitism by this wasp than a native species, the white widow spider, *L. pallidus*, under both field and lab conditions. We proposed that egg sacs of *L. geometricus* are better defended against parasitism in comparison with those of *L. pallidus*. We demonstrated that surface structures on *L. geometricus* egg sacs repel the wasps, that female *L. geometricus* more actively defend their egg sacs against the parasitoid, and that wasp reproductive success was higher on *L. pallidus* egg sacs than on those of *L. geometricus*.

EXPLORING THE DIVERSITY OF COSMETID HARVESTMEN (ARACHNIDA: OPILIONES: COSMETIDAE) IN CUBA

Masten, Riley; Proud, Daniel N.

Moravian University, Department of Biological Sciences, 1200 Main St., Bethlehem, Pennsylvania, USA

In this study, we explore various techniques used for scientific illustration as we study the diversity of the harvestmen family Cosmetidae (Arachnida: Opiliones: Laniatores) with a focus on Cuban species. Based on a recent molecular phylogeny of the family Cosmetidae, we were able to group most cosmetids of Cuba into two valid genera: *Cynortoides* and *Cynortellana*. Illustrations and high-quality photographs are important components that complement a written species description. The detailed study of the morphological structures enables us to identify synapomorphies for genera that were delimited using the molecular phylogenetic framework. By understanding and exploring the cosmetid harvestmen of Cuba, we can learn to better define genera in this mega-diverse family and apply these approaches to other genera in the continental Americas.

RECOMBINANT SPIDER GLUE PROTEINS OFFER AVENUES TO EXPLORE ADHESION AND COHESION MECHANISMS

Omisore Tade; Ayoub, Nadia; Friend, Kyle; W&L Genetics Lab Fall 2022 students

Washington and Lee University, Department of Biology, 204 W Washington Street, Lexington Virginia, USA

Orb web weaving spiders employ various silk types during web construction, with each type having unique functions and impressive material properties. For example, orb web capture spirals consist of a highly extensible axial fiber composed of flagelliform spidroin (Flag), a protein expressed in flagelliform glands, which is coated in sticky aqueous glue synthesized in the aggregate glands. Multiple proteins make up this aggregate glue, but their roles in prey adhesion or glue droplet cohesion are not well understood. The goal of our study was to learn more about protein function by cloning silk genes in three orb weaving species: the garden spiders, *Argiope argentata* and *A. trifasciata*, and the golden silk spider, *Trichonephila clavipes* (Araneidae). We successfully expressed Flag from *A. trifasciata* and *T. clavipes*, as well as three aggregate proteins: AgSp1 from *A. argentata* and *T. clavipes*, AgSp2 from *Trichonephila clavipes*, and a newly discovered cysteine-rich protein from *A. argentata*. We also successfully cloned PySp from *A. trifaciata*, which may play a role in anchoring capture spirals to radial lines of the orb web. We plan to test for interactions between recombinant proteins to investigate cohesion mechanisms.

THE COMPLETE MITOGENOME OF *ERIGONE ATRA* BLACKWELL, 1833 (ARANEAE, LINYPHIIDAE)

Patrick, L. Brian[1]; Santos, Scott R.[2]

[1]Department of Biological Sciences, Dakota Wesleyan University, 1200 W. University Ave., Mitchell, SD, 57301, USA; [2]Department of Biological Sciences, University of Buffalo, 109 Cooke Hall, Buffalo, NY, 14260, USA

The mitochondrial genome of *Erigone atra* Blackwell, 1833 has been completely sequenced and annotated for the first time. This species is found primarily in the continental north-temperate zone, and has also been reported from the Galapagos Islands where it is likely an adventive species. From a male collected in the Czech Republic, DNA was extracted using a Qiagen DNEasy Blood and Tissue kit, then sequenced on an Illumina system for 250 bp paired-end reads. Contigs were assembled in SPAdes and the mitogenome extracted from the resulting contigs. The mitogenome was annotated using MITOS and by comparing to other species in the order Araneae. The mitogenome is 14,474 bp, including 22 transfer RNA (tRNA) genes, 13 protein coding genes (PCGs), 2 ribosomal RNA (rRNA) genes, and a control region. This is the first sequenced and annotated mitogenome for this species and for the genus *Erigone* Audouin, 1826.

SEX DIFFERENCES IN LANDMARK-GUIDED SPATIAL LEARNING IN THE WOLF SPIDER *TIGROSA HELLUO.*

Persons, Matthew; Smith, Annalee; Miller, Brianna; Dao, Tiffany; Morato Vargas, Fern; Yuen, Devin

Biology Department, Ecology Program, Neuroscience Program, Susquehanna University, Selinsgrove, PA 17870

Female *Tigrosa helluo* wolf spiders may use landmarks to locate their retreat while widely ranging males may be less likely to use landmark cues. Using a flooded open arena, we tested the ability of adult male and female *T. helluo* to correctly navigate toward a dry target goal. We measured variation in spatial learning of the target location with and without a landmark. Males and females were trained over four consecutive ten-minute trials. Training trials were then repeated the following day for each subject for a total of eight trials over two days. For landmark and non-landmark conditions, after the eighth trial, we reversed the position of the dry target and non-target to test for a decline in performance. The landmark treatment showed significantly shorter time to locate the target than the non-landmark treatment with females showing faster target acquisition times. Reversal trials also showed significantly longer time to contact the target after the reversal, but only for females indicating significant association between the landmark and the correct choice. Females were significantly better at learning landmark-associated spatial tasks than males. Wolf spiders can learn simple spatial navigation tasks under our testing conditions, but learning is enhanced when landmarks are present.

FAMILIAR FURNISHINGS: REFUGE PREFERENCE FOR SCORPIONS (*HETEROMETRUS SPINIFER)*

Poscente, Spencer; Shillington, Cara

Mark Jefferson Science Complex, Ypsilanti, MI 48197, United States

A suitable shelter is a necessity for many organisms, and scorpions of the genus *Heterometrus* (Asian forest scorpions), are no different. Scorpions seek dark crevices in bark or litter, take advantage of man-made structures, nestle under rocks or logs, and excavate shallow burrows, but their preference when provided with more than one refuge is not well-documented. We provided two refuges, one on each side of a circular arena. Chemosensory cues were added to one side of the arena by feeding a cricket to a conspecific two hours prior to the start of the trial. After feeding, the scorpion was removed and refuges were added to each half of the arena (prey-stimulus versus control). Video-tracking (Ethovision) measured activity in the arena after introducing a new, unfed scorpion. All animals were active for most of the 1-hour trial (>90% cumulative duration) but no preference was shown for either side of the arena. Additionally, only 19% of animals entered refuges, and none stayed for more than a few seconds. Running longer trials, prior exposure to arenas and refuges, and using deeper arenas to discourage escape attempts may provide results more indicative of refuge preference in the future.

SCORPION TOXIN DISCOVERY USING ARTIFICIAL INTELLIGENCE

Psenicnik, Adam F.; Santibáñez-López, Carlos E.

Department of Biology, Western Connecticut State University, 181 White St. Danbury, CT, 06810, USA

Artificial Intelligence (A.I.) is a growing field finding many applications in data processing and classifying. Currently, the process of annotating venom sequences is done through transcriptome sequence similarity searches (mainly through to BLAST); however, this method might lack the sensitivity needed to distinguish venom genes paralogs thus the necessity to run gene trees to validate the annotations. Annotating sequences is an ideal task for A.I to solve, and the large volume of data publicly available makes training and validating an A.I. relatively easier. Here, we used scorpion toxin sequences from the Uniprot's Toxin Annotation Project to build our dataset. Then, an A.I was trained and validated using this dataset to classify the input sequence into several categories with 94% validation accuracy. This A.I. protocol was then tested with published transcriptomes from *Centruroides limpidus* and *Serradigitus gertschi*, and one unpublished from the species *Anuroctonus phaiodactylus.* This test was repeated twice; using BLAST on the transcriptomes prior to using the A.I., and using the A.I. first on the transcriptomes and then conduct a BLAST search. All results were highly congruent with the previously results reported for the respective transcriptomes. To remove the usage of BLAST, a 2nd A.I. was trained using the *Drosophila* proteome to sort out housekeeping genes from the wanted toxins with 96% validation accuracy. The results of using the A.I. with the *C. limpidus* transcriptome listed significantly fewer toxins than what is published, suggesting finer sensitivity to annotate sequences than BLAST.

WEB REPAIR BEHAVIOR IN ULOBORUS DIVERSUS (ERROR 404: STRAND NOT FOUND).

Rabinovich, Anthony; Task, Darya; Corver, Abel; Gordus, Andrew

Johns Hopkins University Department of Biology, 3400 North Charles Street, 209 Bio East Building, Baltimore, Maryland, USA, 21218

If an orb-weaver's web is damaged, their ability to feed is diminished. A spider with a nonfunctional web starves to death in its center. Every time the web is damaged, its spider must decide between waiting, spot repair, or fully replacing it. What are the boundaries or conditions that determine whether, and to what degree, a spider will repair its web? Prior research established that one such condition is web slackness. What about non-tensioning components, like spirals? Our lab has previously established a behavioral arena that incorporates infrared LEDs and an IR camera to track both spider web structure and limb movements. Using this assay, we first recorded *Uloborus diversus* building their webs, then ablated either their capture spirals or entire sectors of the web, then recorded their repair efforts. Web strands were removed under a microscope using a fine-tipped soldering iron. Preliminary results show a variety of behaviors in response to simulated web damage, including both partial and total web repair, absence of repair, or bizarrely, building a second web right next to the unrepaired original. Analyses to determine how limb movements and web behavioral motifs during web repair correspond to those during normal web-building progression are ongoing.

IDENTIFICATION AND EXPRESSION OF PROTEIN REGULATORS OF THE SPIDER CIRCADIAN CLOCK

Ramos, Gia; Wicker, Hannah; Haggett, Hunter; Petko, Jessica

Department of Biology, Penn State York, 1031 Edgecomb Ave, York, PA, 17403

Circadian rhythms are near-24-hour cycles in physiological and behavioral activities that allow all animals to adapt to the Earth's solar day. These rhythms are coordinated by a set of specialized neurons that use a highly conserved transcription-translation feedback loop to regulate daily fluctuations in gene expression. The complexity of this genetic pathway allows for many points and mechanisms of regulation and for input from environmental time cues. Araneoid spiders exhibit exceptional variability in circadian periods making them unique models for the study of clock gene function and evolution. The goal of this study was to identify spider orthologs of insect circadian regulators and to examine expression at different developmental stages and times of day. Blast searches of the *Parasteatoda tepidariorum* genome revealed orthologs for all circadian regulators examined, several with retained duplicate paralogs. The gene expression of selected orthologs was examined by RT-PCR and all showed relatively ubiquitous expression. Lastly, we used 5' RACE to determine the full-length sequence of pigment dispersing hormone, a short peptide signaling molecule used by insects to synchronize the molecular clock of various cell clusters. These studies will allow the future study of protein function to understand the unique biological rhythms of spiders.

THE COMPLETE MITOCHONDRIAL GENOME OF *OPILIO CANESTRINII* (THORELL, 1876) (OPILIONES, PHALANGIIDAE)

Sebert, Katy[1]; Derkarabetian, Shahan[2]; Patrick, L. Brian[1]; Santos, Scott R.[3]

[1]Department of Biological Sciences, Dakota Wesleyan University, 1200 W. University Ave., Mitchell, SD, 57301, USA; [2]Museum of Comparative Zoology, Department of Organismic and Evolutionary Biology, Harvard University, Cambridge, MA, USA; [3]Department of Biological Sciences, University of Buffalo, 109 Cooke Hall, Buffalo, NY, 14260, USA

The mitochondrial genome of *Opilio canestrinii* (Thorell, 1876) has been sequenced and annotated for the first time. This species is native to Europe but has also been introduced to North America. From a male specimen collected in British Columbia, Canada, DNA was extracted using a Qiagen DNEasy Blood and Tissue kit, then subjected to standard protocols for sequence capture of ultraconserved elements and sequenced on an Illumina NovaSeq 6000 system with 150 bp paired-end reads. Contigs were assembled in SPAdes and the mitogenome was extracted from the resulting contigs. The mitogenome was annotated using MITOS2 and by comparing it to other species in Opiliones. The mitogenome is 15,777 bp, including 21 transfer RNA (tRNA) genes, 13 protein-coding genes (PCGs), 2 ribosomal RNA (rRNA) genes, and a control region. This project hints at a larger opportunity, where complete mitogenomes can be pulled out as “bycatch” from arachnid UCE sequence data that is already available for 1000s of samples.

EXTRAORDINARY CIRCADIAN FREE-RUNNING PERIODS OBSERVED IN SPIDERS APPEAR TO BE LIMITED TO ARANEOIDEA

Shepherd, Alexandria E.; Jones, T.C.; Moore, Darrell

East Tennessee State University, Department of Biological Sciences, 1276 Gilbreath Dr, Johnson City, TN 37614, USA

Most organisms have approximately 24-hour circadian rhythms enabling them to anticipate their environment’s daily rhythmicity. We have found numerous spider species with free-running periods (FRP) that deviate greatly from 24 hours. FRP measures an organism’s circadian rhythm by measuring periodicity of activity under constant conditions. These extreme spider FRPs were found only in superfamily Araneoidea. Therefore, we investigated the FRPs of three non-araneoid spider species belonging to the RTA clade: *Schizocosa avida, Agelenopsis pennsylvanica,* and *Mecaphesa celer.* We detected significant free runs (mean ± SD) at $p<0.001$ using Lomb-Scargle periodograms in two out of the three species: *S. avida* (23.84 ± 1.03 h) and *A. pennsylvanica* (23.97 ± 0.32 h). However, *M. celer* was found to be arrhythmic under constant conditions. These findings of near 24-hour FRPs with low deviation among the RTA species, along with previous data, strongly suggest that extreme FRPs are confined to the Araneoidea clade. Thus, we have phylogenetically localized a major evolutionary change in the circadian system of spiders occurring in the Araneoidea clade, approximately 170 million years ago.

DOES *ATYPUS KARSCHI* USE PROJECTILE DEFECATION AS A DRIFT FENCE TRAP?

Shilcusky, Aislinn; Esposito, Amalia; Cline, Zach; Persons, Matthew
Biology Department, Ecology Program, Susquehanna University, Selinsgrove, PA 17870

Purseweb spiders build vertical silk tubes where they wait inside for prey to contact it. These spiders defecate by ejecting excreta from the top of the upper web. We measured the direction, pattern, and distance of excreta ejection over time and tested if projectile excreta functions as a drift fence to funnel prey toward its web. Spiders projectile defecated a maximum of over sixty body lengths (ca. 1.25 meters from web). Ballistic excreta produced directionally non-random linear or V-shaped patterns along 180° vectors ranging an average of 14 to 58 cm from the web. To test for a drift fence function for excreta, individual *Atypus* were placed in the center of an empty wading pool for 16 days and then removed (N=38). We then placed *Porcellio laevis* sowbugs, a known prey of *Atypus*, along the edge of these pools or a control pool not previously occupied and compared edge avoidance and center use of the pool. The sowbugs were significantly more likely to avoid the edge and enter the center of the wading pool in pools with *Atypus* excreta. This suggests that the excreta pattern reduces prey thigmotaxis and could serve as a drift fence and improve prey capture.

EFFECTS OF LEAD-CONTAMINATED SOIL ON MORPHOLOGY AND BEHAVIOR OF GROUND-DWELLING WOLF SPIDERS

Tran, Sunny; Bauer-Nilsen, Olivia; Uetz, George
Department of Biological Sciences, University of Cincinnati, OH 45221-0006

We studied how toxic Lead (Pb) exposure affects body condition and mating behavior of two congeneric ground-dwelling wolf spiders: *Schizocosa ocreata* (Hentz, 1844) and *S. saltatrix* (Hentz, 1844). Juvenile male and female *S. ocreata* and *S. saltatrix* were collected at the Cincinnati Nature Center and raised under controlled lab conditions, then exposed to Pb-contaminated soil after their penultimate (sub-adult) molt. Once matured, male and female spiders were photographed and measured, then paired randomly in mating trials. Mating behaviors were recorded using a Sony Handycam® camcorder apparatus. We also measured morphological traits and calculated a body condition index (BCI). Mating success was not independent of treatment; fewer spiders in the Pb-contaminated soil treatment mated, regardless of species. Spider body condition index (BCI) varied significantly with species, sex and treatment. Female BCI is greater than male BCI and was different between treatments for both species. In the brush-legged wolf spider *S. ocreata*, fluctuating asymmetry (FA) of leg tufts (an indicator trait) was negatively impacted by the lead treatment. These findings suggest that in addition to being good models in behavior studies, wolf spiders may also be useful as biomarkers of ecosystem contamination.

PRE-MATING EXPOSURE AND MATING IN THE WOLF-SPIDER *SCHIZOCOSA SALTATRIX*.

Tymosch, Olenka; Uetz, George; Bauer-Nilsen, Olivia

2600 Clifton Ave, Cincinnati, Ohio, United States of America, 45221

Previous studies have shown that female *Schizocosa* wolf spiders vary mating preferences for males after experience. The goal of this research project is to understand the possible effects of pre-mating familiarity among neighboring spiders on mating success of a lesser-known species, *Schizocosa saltatrix*. We collected juvenile spiders from the Cincinnati Nature Center and raised them to maturity under controlled conditions in the lab. The spiders were assigned to one of three treatment groups: control (no exposure), one week or ~ two weeks familiarity/exposure before mating trials. Each male/female pair in the exposure treatments were placed in side-by-side containers for one or two weeks, while those in the control group were raised in separate containers (no familiarity before mating trials). In the exposure treatments, all sides of the containers except those facing the other spiders were covered to allow familiarity between the individuals. Results show that within the control group, there was a higher frequency of copulation, while in the other groups, there was a decrease in copulation frequency with increased familiarity exposure. Control spiders also had a shorter latency to mate than the other treatments, suggesting a possible hesitancy to mate. Differences may have also been due to an unexplained difference in weight among female spiders, as control spiders weighed less than the other treatments. We conclude that pre-mating familiarity among neighboring potential mates decreases their tendency to mate with each other, which might serve as a mechanism to reduce mating among kin.

DOES FAMILIARITY BREED CONTEMPT? PRE-MATING SOCIAL EXPERIENCE AND MATING IN THE WOLF-SPIDER *SCHIZOCOSA SALTATRIX* (HENTZ 1844)

Tymosch, Olenka; Bauer-Nilsen, Olivia; Uetz, George

Department of Biological Sciences, University of Cincinnati, Cincinnati, OH 45221-0006

Female *Schizocosa* wolf spiders vary mating preferences for males after previous experience with conspecific males. We examined the effects of pre-mating familiarity among neighboring spiders on mating success in *S. saltatrix*. Field-collected juvenile spiders were raised to maturity under controlled conditions in the lab. Spiders were assigned to one of three treatment groups: control (no exposure), one week, or two weeks familiarity/exposure before mating. Male/female pairs in the exposure treatments were placed in adjoining containers with clear barriers between individuals for one or two weeks (to allow familiarity), while those in the control group were raised in separate containers. Results show a higher frequency of copulation in the control group, and a decrease in copulation frequency with increased familiarity. Control spiders also had a shorter latency to mate than the other treatments, suggesting a possible hesitancy to mate with exposure. Differences may have also been due to an unexplained difference in weight among female spiders, as control spiders weighed less than the other treatments. We conclude that pre-mating familiarity among neighboring potential mates decreases their tendency to mate with each other, which might serve as a mechanism to reduce mating among kin.

CHRONOBIOLOGY OF *CYRTOPHORA* SUGGESTS SHORT-CLOCK RHYTHMS LINK WITH DIURNAL CRYPSIS

Upham, Jessica; Jones, Thomas C.; Moore, Darrell

East Tennessee State University, Department of Biological Sciences, 1276 Gilbreath Dr, Johnson City, TN 37614, USA

Circadian rhythms are outputs of the internal clock that regulates the daily functions of almost all living organisms. Circadian rhythms are about 24 hours and can synchronize to external cues such as the natural light/dark cycles of the environment. When external cues are removed, the circadian rhythm "free-runs," thus revealing the organism's endogenous circadian period which is typically close to 24 hours. Recent studies have found that the trashline orbweaving spiders *Cyclosa turbinata* and *Allocyclosa bifurca* have abnormally short circadian rhythms of approximately 19 and 18 hours, respectively. Despite similar circadian rhythms and web-building behaviors, recent genetic findings indicate that these species are *not* closely related. In fact, both genetic and morphological data now suggest *A. bifurca* is more closely related to *Cyrtophora citricola*. This study analyzed the circadian rhythm of *C. citricola* and compared it to the circadian rhythm of *A. bifurca*. *Cyrtophora citricola* was found to have a more typical FRP of 24.0 $\pm$ 0.43 hours. Despite being closely related, *C. citricola* and *A. bifurca* differ significantly in their circadian rhythms, suggesting that short circadian rhythms may be ecologically linked with trashline behavior.