American Arachnological Society

2022 Annual Meeting

Summary Schedule

Sat, 6/25	1-4pm	Eight-Legged Encounters	Bohart Museum
Sun, 6/26	12-6pm	Registration	California Hall
	6-9pm	Welcome Reception	California Hall
	8:30pm	Student Night	Woodstock's Pizza
Mon, 6/27	7:30am	LGBTQ+ Breakfast	Briggs Hall 122
	8am-12pm	Registration	California Hall
	8:45am	Welcome and Introductions	California Hall
	9am	Keynote presentation: Eileen Hebets*	California Hall
	10am	Break	
	10:30am	Session 1: Sensory Systems	
	12:00pm	Diversify Arachnology Lunch	California Hall
	1:30pm	Session 2: Morph. Evolution & Taxonomy	
	3pm	Break	
	3:15pm	Session 3: Behavior	
	5:30-9pm	Evening Social at Great Bear Vineyards	Meet at California Hall

Tues, 6/28	8:00am	Announcements	California Hall
	8:15am	Plenary: Paula Cushing*	California Hall
	8:45am	Session 4: Solifugids	
	10am	Break	
	10:30am	Session 5: Mol. Phylogenetics & Syst.	
	12:15pm	Group photo	Outside CA Hall
	12:30pm	Lunch, SLAC Lunch w/ Rebecca Godwin	
	1:45pm	Session 6: Mating Systems I	
	2:45pm	Break	
	3pm	Session 7: Mating Systems II	
	4-5:30pm	Poster Session	California Hall
	5:30-7:30pm	Executive committee meeting	Briggs Hall 366
	7:30-9pm	Casual night with arachnids*	California Hall
Wed., 6/29	8am	Announcements	California Hall
	8:15am	Session 8: Ecology	
	10am	Break	
	10:30am	Session 9: Silk & Web Construction	
	12:15pm	Lunch	
	1:45pm	Session 10: Phylogeography, Biogeog.,& Conserv.	
	3:30-5pm	Business Meeting	California Hall
	5:30-10pm	Closing Banquet	Walter A Buehler Alumni Center
Thurs, 6/30	8:45am-5pm	Field Trip: Calaveras Big Trees	Meet outside Conference Center

Note: All talks and breaks will be in California Hall
(*) indicates live-streamed events

American Arachnological Society

2022 Annual Meeting

Schedule

Asterisk (*) indicates contestant in student competition
Presenter underlined

Sunday, June 26

6:00-9:00pm
Welcome Reception
Location: California Hall
Light hors d'oeuvres, cash bar, a drink ticket for a complimentary beverage (beer, wine or soft drink).

8:30-11:00pm
Student Night
Reservation at Woodstock's Pizza at 8:30pm
Hosted by Ryan Jones richjones327@gmail.com

Monday, June 27

7:30am
LGBTQ+ Breakfast
Location: Briggs 122

8:45am
Welcome and Introductions
Jason E. Bond, Conference Host
Helene Dillard, Dean of the College of Agricultural and Environmental Sciences

9:00am

Keynote presentation: Eileen Hebets

Building community and advancing research 8 legs at a time

10:00-10:30am
Break

Session 1: Sensory Systems
Moderator: Lauren Esposito

10:30am
Assessment of the mechanosensory responses of peg sensilla on scorpion pectines
Hannah M. Peeples*, Douglas D. Gaffin

10:45am
Blink and you'll miss it: Ballistic predatory behavior in the ogre-faced spider
Jay A. Stafstrom, Ronald R. Hoy

11:00am
Cross-modal cues increase retinal activity in a jumping spider
Alex M. Winsor*, Daniel Daye, Elizabeth M. Jakob

11:15am
Quantifying variation in visual signals within a spider clade
Kenna D. S. Lehmann, Rowan McGinley, Mitch Bern, Eileen Hebets

11:30am
Unpredictable vibratory environments affect prey capture and web structure of the funnel-weaving spider *Agelenopsis pennsylvanica*
Brandi Pessman*, Eileen Hebets

11:45am
Effects of the light environment on courtship displays in multimodal signaling wolf spiders
Rowan H. McGinley, James Starrett, Jason E. Bond, Eileen A. Hebets

12:00pm
Diversify Arachnology Lunch or lunch on your own
Location: California Hall

Session 2: Morphological Evolution and Taxonomy
Moderator: Lacie Newton

1:30pm
Unsung Arachnology Pioneers: Harriet Exline Frizzell and the Women of Arachnology
Katherine O. Montana*, Marion Richardson-Beatty, Rebekah Kim, Lauren A. Esposito

1:45pm
Sticky traps producing a sticky mess: The tree-dwelling spider genus, *Neodietrichia* (Araneae: Linyphiidae)
Marc Milne, Caylie Wimmersberger

2:00pm
Description of two new Amblypygid species from China
Shiyang Wu*, Xiaoyu Zhu, Yijiao Liu, Chris R. Reardon, Christian Román-Palacios, Gustavo Silva de Miranda, Zheng Li, Zhuqing He

2:15pm
***Maevia* Revisited: It's a Whole New Ballgame (Salticidae: Dendryphantini: Marpissina)**
G.B. Edwards, Wayne P. Maddison

2:30pm
New insights into the evolutionary relationships of Samooidea (Opilliones: Laniatores) with an emphasis on Samoidae
Daniel N. Proud, Abel Pérez-González, Claudia Vanesa Mamani

2:45pm
Biodiversity catalogs reveal taxonomic and geographic bias: a case study with the World Spider Catalog
Jacob A. Gorneau*, Siddharth Kulkarni, Franklyn Cala-Riquelme, Lauren A. Esposito

3:00-3:15pm
Break

Session 3: Behavior

Moderator: Rowan McGinley

3:15pm
Juvenile Aversion Learning in a Cannibalistic Spider (*Latrodectus mactans*)
Laura Gatchoff*, Laura Stein

3:30pm
Armed but Restrained: The Defensive Behavior of the Southern Unstriped Scorpion (*Vaejovis carolinianus*) While Confined Within a Refuge
Aaron Corbit, Megan Marquez, David Nelsen

3:45pm
Adaptive significance of patterns of prey sharing among 26 species of prolonged subsocial and solitary huntsman spiders
Joseph Giulian*, Linda S. Rayor

4:00pm
Sex, Chemical Cues, and Venom Variation in the Southern Unstripped Scorpion *Vaejovis carolinianus*
David Nelsen, Sonia Joy, Joshua Kim, Stephen Cho, Elizabeth Cannon, Dewell Jimenez, Josh Kim, Phil Moon, Youngbin Cho, Elise Watts, Aaron Corbit

4:15pm
Ant mimicry facilitate milk provision in a jumping spider
Lin Yan, Wei Guo*, Chu Jiang, Yirong Wang and Zhanqi Chen

5:30-10:00pm

Evening Social at Great Bear Vineyards

Meet outside California Hall for transportation at 5:15pm for transportation to the vineyards. There will be a food truck, wine and beer, live music from the Urban Sherpas!

Tuesday, June 28

8:00am
Announcements

8:15am

Plenary: Paula Cushing

North American camel spiders (Arachnida, Solifugae, Eremobatidae): systemic revision and biogeography of an understudied taxon (Arachnida, Solifugae)
Paula E. Cushing, Matthew R. Graham, Warren Savary, Jack O. Brookhart

Session 4: Solifugids

Moderator: Paula Cushing

8:45am
Phylogenomics and morphometrics illuminate patterns of character evolution of historically delimiting characters in camel spiders (Arachnida: Solifugae: Eremobatidae)
Erika L. Garcia, Paula E. Cushing

9:00am
Online Digitalization of North American Solifugae
Felix Channiago*, Cole Logan, Paula E. Cushing

9:15am
Species Delimitation of Grassland & Chihuahuan *Eremobates palpisetulosus* through an Integrative Taxonomic Approach
Goran Shikak, Paula E. Cushing

9:30am
Phylogenomic analyses and species distribution models inform an integrative taxonomic approach of *Eremothera* and the *Eremobates scaber* and pallipes species groups (Arachnida: Solifugae: Eremobatidae)
R. Ryan Jones*, Paula E. Cushing

9:45am
Exploration of morphological characters to support a possible new solifugae genus
Quincy Hansen* and Erika L.Garcia

10:00-10:30am
Break

Session 5: Molecular Phylogenetics and Systematics

Moderator: Rodrigo Monjaraz-Ruedas

10:30am
Evaluating Species Boundaries in Coastal Dune Trapdoor Spider *Aptostichus simus*
Emma E. Jochim, Lisa Chamberland, Jim Starrett, Jason E. Bond

10:45am
Systematics of Western *Antrodiaetus*
Erik Ciaccio, Chris Hamilton

11:00am
10-legged spiders: assessing the functionality of ectopic appendages in spiders exhibiting a Hox knockdown phenotype
Nancy Lo-Man-Hung*, Jakob Zehms, Tatiana Teixeira Torres, Sónia Cristina da Silva Andrade, Federico Brown, Prashant Sharma

11:15am
Understanding the diversity and evolution of the *Aphonopelma marxi* species group across the Madrean Archipelago "Sky Islands" biodiversity hotspot
Karina Silvestre Bringas*, Chris A. Hamilton

11:30am
Multil-locus phylogeny and species delimitation in the segmented spider genus *Liphistius* (Araneae, Liphistiidae) in Thailand
Varat Sivayyapram*, Deborah R. Smith, Chawakorn Kunsate, Natapot Warrit

11:45am
Variation of courtship displays in a group of jumping spiders (*Habronattus americanus* subgroup; F. Salticidae) exhibiting frequent introgression
Tierney Bougie, Damian Elias, Marshal Hedin

12:00am
Introgressive Hybridization, Sexual Selection and the Evolution of *Habronattus* Jumping Spiders
Guilherme H. F. Azevedo, Damian Elias, Wayne Maddison, Marshal Hedin

12:15pm
Group photo
Meet outside CA Hall

12:15-1:45pm
SLAC Lunch w/ Rebecca Godwin
or lunch on your own
Meet up with other folks from small/private/undergrad focused institutions to talk about undergrad research, experiential learning, collaborations, funding, etc.
Contact Rebecca Godwin rgodwin@piedmont.edu for more info.

Session 6: Mating Systems I

Moderator: Trinity Walls

1:45pm
The Effects of Male Competition and Lighting Conditions on Courtship and Female Mate Choice in *Rabidosa rabida* (Araneae: Lycosidae)
Hailey Shannon*, Cami Zuch, Ann Rypstra

2:00pm
Behavioral tracking reveals variation in sexual conflict in Leiobunine Opiliones
Tyler A Brown*, Emily Marinko, Mercedes Burns

2:15pm
A lot of secrets in a tiny spider: the peculiar sexual behavior and genital mechanics of a Ninetinae pholcid
Matías A. Izquierdo, Tim M. Dederichs, Franco Cargnelutti*, Peter Michalik

2:30pm
Disruption of air particle movement affects mating success in multimodal signaling wolf spider
Pallabi Kundu*, Noori Choi, Aaron S. Rundus, Roger D. Santer, and Eileen A. Hebets

2:45-3:00pm
Break

Session 7: Mating Systems II

Moderator: Tierney Bougie

3:00pm
Males make mistakes but females call the shots: female resistance as a partial reproductive isolating mechanism in scorpions
Mariela Oviedo-Diego*, Camilo Iván Mattoni, Alfredo Vicente Peretti

3:15pm
Quantitative comparisons of courtship ornamentation in the *Habronattus clypeatus* species group
Sean D. Kelly*, Marshal Hedin, Guilherme H. F. Azevedo

3:30pm
Mate Choice Patterns Shift Over Time in Regal Jumping Spiders
Trinity Walls*, Damian Elias

3:45pm
Infection detection and female aggression in a well-studied wolf spider
Olivia Bauer-Nilsen*, Megan McConnel, George Uetz

4:00-5:30pm

Poster Session

5:30-7:30pm
Executive committee meeting - Briggs Hall 366

7:30-9:00pm
Casual night with arachnids - California Hall

Wednesday, June 29

8:00am
Announcements

Session 8: Ecology

Moderator: Emma Jochim

8:15am
Access to water impacts foraging in *Pardosa milvina* (Araneae, Lycosidae)
Ann Rypstra, Jun Kim, Natalie Whitehead

8:45am
Burrow sites of *Aphonopelma hentzi* (Texas Brown Tarantula) in Southeastern Colorado
Jackie Billotte*, Ruth Hufbauer, Lorna McCallister, Richard R. Reading

9:00am
Use of Riparian Spiders as Sentinels of Persistent and Bioavailable Chemical Contaminants in Aquatic Ecosystems
Matt Chumchal, Gale B. Beaubien, Ray W. Drenner, Madeline P. Hannappel*, Marc A. Mills, Connor I. Olson, Ryan R. Otter, Andrew C. Todd, and David M. Walters

9:15am
Effects of Taxa and Body Size on Mercury Contamination of Riparian Spiders: Implications for the Use of Spiders as Sentinels
Todd, A.C., Allender, C., Capone, M., Hannappel, M.P., Peterson, R., Williams, T., Drenner, R.W., Chumchal, M.M.

9:30am
Effects of Microclimate Change on Survival Across Life Stages of the Pseudoscorpion *Dactylochelifer silvestris* (Cheliferidae)
Laura Segura Hernández*, Eileen Hebets

9:45am
Eradication of Chinese privet fails to restore forest spider communities within five years
Michael L. Draney, Michael D. Ulyshen, Scott Horn, James L. Hanula

10:00-10:30am
Break

Session 9: Silk and Web Construction

Moderator: Matjaž Kuntner

10:30am
A source of sticky: O-glycosylation of *Argiope trifasciata* aggregate spidroins
Mercedes Burns, Sarah Stellwagen

10:45am
Untangling the behaviors used in orb-weaving
Abel Corver, Nicholas Wilkerson, Jeremiah Miller, Andrew Gordus

11:00am
Water Vapor Transmission Through Spider Egg Sac Silk
Katherine Karkosiak*, Hunter King, Ravi Schwartz, Todd Blackledge

11:15am
The genetics of sticky: comparing the glue sequences of spiders and multicellular Eukaryota
Sarah D Stellwagen, Mercedes Burns

11:30am
Do stabilimenta obstruct signal transmission in Banded Garden Spider webs?
Alissa Coonfield*, Nathan Justus, Ross Hatton, Todd Blackledge

11:45am
Composite nature of spider silks yields superior performance
Paul L. Babb, Matjaž Gregorič, Nicholas F. Lahens, David N. Nicholson, Cheryl Y. Hayashi, Linden Higgins, Matjaž Kuntner, Ingi Agnarsson, Benjamin F. Voight

12:00pm
Orb weaver aggregate glue protein composition as a mechanism for rapid evolution of material properties
Nadia Ayoub, Cooper Lazo, Maria Luzaran, Jamal Magoti, Eman Muamar, Richard Baker, Thomas Clarke, Sandra Correa-Garhwal, Cheryl Hayashi, Kyle Friend, Brent Opell

12:15-1:30pm
Lunch on your own

Session 10: Phylogeography, Biogeography, and Conservation

Moderator: Sarah Stellwagen

1:30pm
Conservation genomics of federally endangered Texella harvester species (Opiliones, Phalangodidae) from cave and karst habitats of central Texas
Shahan Derkarabetian, Pierre Paquin, James Reddell, Marshal Hedin

1:45pm
Biogeographic Connections Between California and Arizona In Dispersal Limited Arachnids
Wyatt Mendez*, Rodrigo Monjaraz-Ruedas, Marshal Hedin

2:00pm
Phylogeny of *Phidippus* using Ultraconserved Elements: preliminary results
Luis C. Hernández Salgado*, F. Sara Ceccarelli, Dariana R. Guerrero Fuentes, Rodrigo Monjaraz Ruedas, Marshal Hedin

2:15pm
Schizomids: little arachnids, big implications for the generality of island diversity patterns in Palau (Micronesia)
Tahnee Ames*, Jesse Czekanski-Moir

2:30pm
Phylogeography and population genetics of two Californian mygalomorph genera (*Calisoga*, F. Nemesidae; *Aliatypus*, F. Antrodiaetidae) uncovers possible parallel ring species dynamics
Rodrigo Monjaraz-Ruedas, James Starrett, Marshal Hedin

2:45pm
A Natural Colonisation of Asia: Phylogenomic and Biogeographic History of Coin Spiders (Araneae: Nephilidae: *Herennia*)
Eva Turk, Jason E. Bond, Ren-Chung Cheng, Klemen Čandek, Chris A. Hamilton, Matjaž Gregorič, Simona Kralj-Fišer, Matjaž Kuntner

3:00-3:30pm
Break

3:30-5:00pm
Business Meeting - California Hall

5:30-10:00pm
Closing Banquet, Walter A Buehler Alumni Center
The Norman Platnick Award for Taxonomic Research and the student presentation awards will be announced. Awards will be livestreamed.

American Arachnological Society

2022 Annual Meeting

Oral Presentation Abstracts

Arranged by presenters''s last name
Asterisk (*) indicates contestant in student competition
Presenter underlined

Composite nature of spider silks yields superior performance

Paul L. Babb, Matjaž Gregorič, Nicholas F. Lahens, David N. Nicholson, Cheryl Y. Hayashi, Linden Higgins, Matjaž Kuntner, Ingi Agnarsson, Benjamin F. Voight.

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Spider silks comprise some of the most versatile natural materials. The dragline silk of Darwin's bark spider, Caerostris darwini, is one of the toughest known biomaterials on Earth, achieved through elasticity beyond that known for other dragline silks. We characterize the various silk ´recipes´ (spidroins, silk genes) and their expression pattern to determine what factors may underlie the superb performance of this silk. We identify at least 31 putative spidroins with notable expansion in elastic silk (flagelliform) recipes relative to the golden orb-weaver, *Trichonephila clavipes*. Broad expression of spidroins across silk gland types suggests that silks emanating from a given gland represent composite materials to a greater extent than previously appreciated. We hypothesize that the extraordinary toughness of C. darwini major ampullate dragline

silk relates to the unique protein composition of major ampullate spidroins, combined with the relatively high expression of stretchy flagelliform spidroins whose union into a single fiber may be aided by novel motifs and cassettes that act as molecule-binding helices. This enhanced understanding of spider silks may facilitate efforts to reconstruct spider silk-like materials in the laboratory.

Session: Silk and Web Construction

Orb weaver aggregate glue protein composition as a mechanism for rapid evolution of material properties

Nadia Ayoub, Cooper Lazo, Maria Luzaran, Jamal Magoti, Eman Muamar, Richard Baker, Thomas Clarke, Sandra Correa-Garhwal, Cheryl Hayashi, Kyle Friend, Brent Opell

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Orb web and cobweb weaving spiders in the superfamily Araneoidea are distinguished by their ability to make a chemically sticky aqueous glue in specialized aggregate silk glands. Aggregate glue is an environmentally responsive material that has evolved to perform optimally around the humidity at which a spider forages. Composite proteins and their post-translational modifications confer stickiness to the glue, but the identities of these proteins have not been described for orb web weavers. Using proteomics, we documented the glue composition in two congeners that live in different environments, Argiope argentata (dry southwest US) and A. trifasciata (humid southeast US). We found that A. argentata glue droplets were many times stiffer than A. trifasciata droplets. Each species' glue included ~30 aggregate-expressed proteins, most of which (24 and 23, respectively) were homologous between the two species. However, the relative contribution and number of gene family members of each homologous group differed. For instance, the aggregate spidroins (AgSp1 and AgSp2) accounted for nearly half of the detected glue composition in A. argentata, but only 14% in A. trifasciata. Additionally, AgSp1, which has highly negatively charged regions, was ~2X as abundant as the positively charged AgSp2 in A. argentata but ~13X as abundant in A. trifasciata. As another example, A. argentata glue included 11 members of a newly discovered cysteine-rich gene family, versus 5 in A. trifasciata. Cysteines form disulfide bonds that, combined with the higher potential for electrostatic interactions between AgSp1 and AgSp2, could contribute to the greater stiffness of A. argentata glue. The ability to selectively express different glue protein genes and/or to extrude their products at different rates provides a faster mechanism to evolve material properties than sequence evolution alone.

Session: Silk and Web Construction

Introgressive Hybridization, Sexual Selection and the Evolution of Habronattus Jumping Spiders

Guilherme H. F. Azevedo, Damian Elias, Wayne Maddison, Marshal Hedin

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Sexual selection is thought to be important in driving sexual trait divergence and, consequently, in promoting reproductive isolation during speciation processes. This reproductive isolation would be especially important in systems with complex multimodal sexual signals, which are predicted to strengthen species identity through efficient pre-mating species recognition. However, recent studies have found signals of introgressive hybridization between species with clearly divergent, multimodal sexual traits. Species rich genera presenting complex multimodal signals, such as the salticid genus Habronattus, are particularly instructive for studying sexual selection, hybridization and species diversification. Habronattus includes over 100 described species with a great diversity of mating behaviors involving displays of colorful morphological ornaments, elaborated body movements, and vibratory signals. Recent work has suggested that hybridization may be relatively common in the genus. We aimed to infer a genus wide phylogeny of Habronattus and explore the role hybridization may have played in the diversification of the genus. We sampled 80 described species, some of them with representatives from distinct populations and morphological forms, as well as 6 outgroups, totaling 125 terminals. We used a transcriptome dataset comprising about 2500 genes to infer the phylogenetic relationships using coalescent methods. Although Habronattus species groups were recovered as monophyletic, most of the basal branches are short and exhibit extensive gene tree discordance. In some cases, an unequal frequency of discordant gene trees suggests possible deep introgression. The mitochondrial genome obtained from RNAseq data recovered a topology discordant with the nuclear transcriptome in regards to the relationships within species groups, suggesting many recent introgression events. F-branch tests also suggest multiple events of recent and deep introgression both within and between species groups. An observed lag between male courtship signal differences and behavioral isolation along with a lack of strong environmental differences between species, indicate that mutation-order sexual selection might be an important process during Habronattus diversification. This process postulates that females share a common general preference landscape for mating signals, generating faster rates of male display and ornament evolution but low rates of reproductive barrier evolution. Consequently, gene flow between recently diverged lineages that come into contact might be frequent. This gene flow might contribute to generating new phenotypes and genotypes, increasing the diversity of the group.

Session: Molecular Phylogenetics and Systematics

Infection detection and female aggression in a well-studied wolf spider

Olivia Bauer-Nilsen*, Megan McConnel, George Uetz

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Resistance to mating by females has been hypothesized as a tactic to assess potential mates and avoid undesirable ones. We examined impacts of infection on mating interactions of the brush-legged wolf spider, Schizocosa ocreata(Hentz 1844). Previous studies show infection with the pathogenic bacteria Pseudomonas aeruginosa triggers a costly immune response and negatively impacts fitness. Infection can be transmitted during copulation and detected by females through chemical cues, suggesting there are fitness costs associated with mating with an infected individual and becoming infected. Spiders were collected from the field, raised to maturity in the lab, and infected at adulthood (24 hours prior to testing). We paired infected and uninfected (control) males and females and recorded their behavior. We found that higher male courtship rates and more frequent female receptivity displays were associated with successful mating, regardless of infection status. However, among unmated pairs, females were more aggressive toward infected males than control males, and males were more aggressive with resistant (control) females. These results suggest females can recognize infected males and avoid mating with them.

Session: Mating Systems II

Burrow sites of *Aphonopelma hentzi* (Texas Brown Tarantula) in Southeastern Colorado

Jackie Billotte*, Ruth Hufbauer, Lorna McCallister, Richard R. Reading

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Tarantulas are a charismatic arthropod of the short-grass steppe, where a main land use is cattle grazing. Little is known about nesting sites of even the most common tarantula species, nor how grazing affects nest density. We compared nesting sites of *Aphonopelma hentzi* living in Southeastern Colorado by examining soil conditions, proximal ground cover, and the density of nests at sites that were grazed and

ungrazed by domestic cattle (Bos taurus). Density of “A. hentzi” nests were determined using distance sampling at five sites within the Southern Plains Land Trust. We visually estimated the ground cover within a 30 cm2 area around each burrow and at control locations every 200 meters. Initial results showed that burrow density was higher in locations that were more frequently grazed with higher amounts of loose soil. Ranching has a strong effect on the lands used for grazing and can drastically alter the ecosystem. Understanding how *A. hentzi* nesting preferences are affected by ranching can help to predict how the populations in Southeastern Colorado may respond to common human activities in the area and we can better co-exist with tarantulas by maintaining habits that encourage tarantulas to nest in areas that will not find them in conflict with humans.

Session: Ecology

Variation of courtship displays in a group of jumping spiders (*Habronattus americanus* subgroup; F. Salticidae) exhibiting frequent introgression

Tierney Bougie, Damian Elias, Marshal Hedin

San Diego State University
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Introgression (gene flow across species boundaries) ultimately depends upon mating interactions between individuals. As such, describing courtship characters and variation within and between them may be necessary to understand the evolutionary history of introgressing groups where sexual selection is important. The Habronattus americanus subgroup is a recently radiating group of jumping spiders, with species now in contact (and exchanging genes) after hypothesized periods of isolation during glaciation cycles of the Pleistocene. We aimed to understand how repeated hybridization between americanus subgroup members has affected variation in courtship displays and male ornamentation and how this variation compares to genomic variation within and between these diverging lineages. We describe courtship displays for many members of the group, including 15 morphs across four species. Displays are stereotyped consisting of mostly the same elements in the same order, where most of the variation occurs in the number of element repetitions and the time to complete certain display behaviors. We use statistical methods to visualize the diversity in courtship displays and evaluate the variation within and between species, identifying three primary groups of courtship displays, with particular centers of divergence in central Utah. We discuss how this pattern of divergence in one small region and uniformity over a large area may have been driven by frequent introgression or changes in the evolution of signaling systems in this region.

Session: Molecular Phylogenetics and Systematics

Behavioral tracking reveals variation in sexual conflict in Leiobunine Opiliones

Tyler A Brown*, Emily Marinko, Mercedes Burns

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In Leiobunine Opiliones there are two mating strategies: 1) an ancestral, solicitous state in which males have sacculate penises and females do not have pregenital barriers and 2) 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. In this study we compare the intensity of sexual conflict between the nonsacculate species L. vittatum and the sacculate species *L. aldrichi* and *L. bracchiolum* using TREX, an automated behavioral tracking program. TREX uses machine learning to recognize and track individual position and posture, greatly reducing hands-on time required by manual workflows. TREX allowed us to rapidly score mating duration, association time between individuals, and behaviors such as chasing, fleeing, guarding, and leg wrapping, while pedipalp hooking, chelicerae clasping, and body angle required manual scoring. Preliminary analysis of behavioral trials has revealed significant differences in conflict behavior between the sacculate and nonsacculate mating systems. A multifaceted scoring protocol will ultimately allow for more robust, large-scale sexual conflict research in this unique arachnid system.

Session: Mating systems

A source of sticky: O-glycosylation of *Argiope trifasciata* aggregate spidroins

Mercedes Burns, Sarah Stellwagen

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The late Edward K. Tillinghast was responsible for a series of critical manuscripts that characterized the post-translational glycans of what would later become known as aggregate spidroins– the massive proteins responsible for conferring hygroscopic adhesion to orb and cobwebs. Tillinghast and others used gas-liquid phase chromatography to identify a host of carbohydrate molecules contributing to these webs, but most striking was the finding of high levels of N-acetylgalactosamine

(GalNAc), an amino sugar derivative of galactose notable for its role in forming the antigen on type-A blood. GalNAc monosaccharides are O-linked to serine or threonine residues, initiating the glycoprotein branches characteristic of mucins. However, these O-glycans cannot be enzymatically cleaved from the protein. We have created a workflow to assess O-glycosylation of arthropod bioadhesives, modeled on the well-characterized fetal blood plasma protein fetuin-A. Briefly, our method requires preparation of two aliquots of protein– one deglycosylated and subsequently trypsin-digested, and one digested only. We compare the peak intensity spectra of variably-collided proteins to identify O-linked GalNAc on bioadhesives with known sequence, here using the first completely sequenced aggregate spidroins of the banded garden spider, Argiope trifasciata. Future use of this methodology will be employed to identify the importance of O-glycosylation in prey capture adhesives, and the potential for plasticity of this post-translational modification under shifting habitat conditions.

Session: Silk and Web Construction

A lot of secrets in a tiny spider: the peculiar sexual behavior and genital mechanics of a Ninetinae pholcid

Matías A. Izquierdo, Tim M. Dederichs, Franco Cargnelutti*, Peter Michalik

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Spider reproduction has remarkable characteristics among arachnids. The male copulatory organs are not physically connected with their primary genital system. Instead, they are located in the pedipalps. In this unique way of reproduction, part of the male and female genitalia are visible externally during copulation. These characteristics place the spiders as excellent models for studying genital interaction. For example, how the different sclerites of the male pedipalps interact with the female genitalia and the placement of the delivered sperm at the first instances of copulation, among others. However, despite the advantages offered by spiders and the astonishing quantity of information related to genital morphology, these studies are still limited. Pholcidae is a diverse spider family, and the males have a unique projection of the pedipalp tarsus: the procursus. This pedipalp sclerite is inserted in the female genitalia in different stages of the copulation, evidencing a relevant role in this process. The subfamily Ninetinae has been proposed as the sister group of pholcids and possesses interesting morphological characteristics. Although genital interactions have been studied in certain species of Pholcidae, this is not the case for the subfamily Ninetinae. Here, we describe for the first time the functional genital morphology of *Gertschiola neuquena* and summarize the main aspects of the copulatory behavior. We performed mating trials and recorded the mating behavior with a digital camera attached to a stereomicroscope. For a detailed study of the genital interaction, a subset of mating pairs was fixed with liquid nitrogen. Selected samples were dried for

micro-computed tomography, scanning electron microscopy, and histology. Our principal results revealed that a hooked sclerite of the bulb is locked in a depression of the female epigastric fold and may serve to stabilize the bulb and as a pivot during the pedipalp movements. In addition, embolus and procursus are simultaneously inserted in the female genitalia. However, the long procursus is deeply inserted into an unpaired, blind-tortuous spermatheca, whereas the embolus reaches only the first section. Sperm cells were observed in the deepest parts of the spermathecae, indicating that the action of procursus movements may transport them to such places. In spiders, the sperm is deposited in the female genitalia by the embolus; our results may indicate that the procursus partially performs this function by pushing the sperm into the spermathecae. Additionally, behavioral observations showed that males use only one pedipalp to copulate, whereas other pholcids use both palps simultaneously. Our results deviate from the general rule in pholcids and allow us to ask different questions. In the first place, why do males insert only one pedipalp during copulation when most other pholcids insert both? In the second one, is the function of the procursus a particularity of *Gertschiola neuquena*, or is it possible to extend it to other Ninetinae or pholcids? This work provides the first data on sexual behavior and fine genital morphology for a Ninetinae and performs the first steps to answering these questions.

Session: Mating Systems

Biogeography and the evolution of eye size in the ogre-faced spiders

Lisa Chamberland, Ingi Agnarsson, Iris L. Quayle, Tess Ruddy, James Starrett, and Jason E. Bond

Net-casting spiders (Deinopidae) comprise a charismatic family with an enigmatic evolutionary history. There are 67 described species of deinopids, placed among three genera, *Deinopis, Menneus,* and *Asianopis,* that are distributed globally throughout the tropics and subtropics. *Deinopis* and *Asianopis*, the ogre-faced spiders, are best known for their giant light-capturing posterior median eyes (PME), whereas *Menneus* does not have enlarged PMEs. Molecular phylogenetic studies have revealed discordance between morphology and molecular data. We employed a character-rich ultra-conserved element (UCE) dataset and a taxon-rich cytochrome-oxidase I (COI) dataset to reconstruct a genus-level phylogeny of Deinopidae, aiming to investigate the group's global biogeography, and examine PME size evolution. Although the phylogenetic results support the monophyly of *Menneus* and the single reduction of PME size in deinopids, these data also show that *Deinopis* is not monophyletic. Consequently, we formally transfer 24 *Deinopis* species to *Asianopis*; the transfers comprise all of the African, Australian, South Pacific and a subset of Central American and Mexican species. Following the divergence of Eastern and Western deinopids in the Cretaceous, *Deinopis*/*Asianopis* dispersed from Africa, through Asia and into

Australia with its biogeographic history reflecting separation of Western Gondwana as well as long-distance dispersal events.

Session: TBD

Online Digitalization of North American Solifugae

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With increasing taxonomic and collections data on camel spiders, the construction of an online digitized catalog of the North American camel spider fauna in the family Eremobatidae can inform morphological and taxonomic evaluation. Herein, the collection records from the Denver Museum of Nature & Science (DMNS) arachnology collection are consolidated to construct the first online field guide for the family Eremobatidae. Species within the family are digitized in the Symbiota Collections of Arthropods Network (SCAN; https://scan- bugs.org/portal/index.php) and information from the original species descriptions are included in this new online field guide. The descriptions are dependent on the type material and provide information on the collections, measurements, and diagnostic features used to identify the species and include an interactive species distribution map. Available photos of the type specimens are also included and digitized. This online field guide to the species of solifuges in North America will provide valuable identification tools for this challenging group of arachnids.

Session: Solifugids

Do stabilimenta obstruct signal transmission in Banded Garden Spider webs?

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Vibrations are an indispensable form of information for web-building spiders, who rely on mechanical senses to detect web-borne signals produced by prey, predators, and conspecifics. The geometry and properties of the web, which can vary drastically within species or individuals, determine how these signals travel from the vibration source to the spider. Select spider species adorn their webs with silken decorations, or

stabilimenta, which have a variety of proposed functions including camouflage, web defense, and prey attraction. Because adding masses to a web or changing its geometry may alter its ability to transmit vibrations, the incorporation of stabilimenta may function at the expense of effective information transfer. We examined the sonic properties of decorated webs built by banded garden spider Argiope trifasciata to determine if stabilimenta impede signal transmission. We utilized a combination of highspeed videography and phase-based video analysis to measure vibration attenuation in decorated and undecorated orb web radii while examining the resulting spider behavior. This study investigates a potential tradeoff between the sensory and ecological functions of orb webs while examining how spiders may interact with their webs to detect and locate stimuli.

Session: Silk and Web Construction

Armed but Restrained: The Defensive Behavior of the Southern Unstriped Scorpion (*Vaejovis carolinianus*) While Confined Within a Refuge.

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Like many animals that live in forest leaf litter, the southern unstriped scorpion, *Vaejovis carolinianus*, must contend with a diverse array of predators encountered under very different conditions. This scorpion has been observed to wonder in the open, uncovered, in search of food and is often found under rocks, bark, and logs within the temperate deciduous forests of southeastern Tennessee. Occasionally, we have encountered the remains (disarticulated portions of the exoskeleton) of scorpions under rocks. This suggests that these scorpions encounter and interact with predators while under rocks and other refugia. This led us to investigate how V. carolinianus alter their defensive behaviors while covered, which presumably affects the range of motion of their appendages, compared to when they are exposed. To test this, we designed arenas furnished with clear plexiglass “rocks” and subjected each scorpion the same behavioral test in both the covered and uncovered conditions. We found that these scorpions use a similar repertoire of behaviors in both the covered and uncovered state and trend toward more costly behaviors as the threat persists. However, covered scorpions tended to use less costly behaviors overall, with high-cost behaviors, like stinging, taking longer to be utilized and being utilized less frequently. While the restriction of movement inherent in the covered state may explain some of these differences, we feel that these differences may also be due to changes in perceived threat suggesting these scorpions are capable of context dependent risk assessment.

Session: Behavior

North American camel spiders (Arachnida, Solifugae, Eremobatidae): systemic revision and biogeography of an understudied taxon (Arachnida, Solifugae)

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Over the past two decades the Denver Museum of Nature & Science arachnology lab's research has been focused on the evolutionary history, taxonomy, morphology, and behavior of solifuges in the North American family Eremobatidae. We will present an overview of the goals of this research that include: revising the phylogeny of specific taxonomic groups within the family using Ultra Conserved Elements (UCE), re-assess the morphological variability and diagnostic utility of characters defining clades, and examine the species distribution and biogeographic implications of those distributions. The family Eremobatidae is monophyetic; however, certain taxonomic affiliations, particularly subfamily designation, were put in question in an earlier multi-locus phylogenetic analysis. Our goals are to ultimately use the revised phylogeny to re-assess the taxonomy, elevate new generic placements, and re-assess current species groups. In addition to the UCE analysis, our lab is also examining potential morphological synapomorphies that may unite well-supported clades, as well as implementing modern techniques for integrated taxonomy and species delimitation.

Plenary

Quantitative comparisons of courtship ornamentation in the *Habronattus clypeatus* species group

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With nearly 50,000 species globally, spiders are one of the most diverse groups of organisms on Earth. Across this diversity is an abundance of morphological forms, with some of the most elaborate structures functioning as courtship display ornaments. Indeed, sexual selection has generated an immense amount of morphological diversity in salticids, particularly in *Habronattus*. Among nearly 100 species, *Habronattus* males exhibit striking colors that may appear on the clypeus, pedipalps, first, and third legs.

Adult males within the *H. clypeatus* species group are known for their elaborate third leg morphology, with patellar shapes that are diagnostic for each of the twelve species in the clypeatus group. Also, there is considerable intraspecific variation in the group, with multiple forms of the purported same species, such as the “black knee” *H. formosus* that forgoes their typical red coloration. The challenge for the arachnologist is to quantify this ornamental diversity objectively so that comparisons can be made between lineages. A software package that can make these comparisons is the recently released “patternize” R package. A software package that can make these comparisons is the recently released “patternize” R package. Using high quality images of the ornament of interest, patternize can align homologous landmarks that form a stack of images to be analyzed. From this newly created raster stack, patternize will extract the distribution of RBG values of a given color or pattern. The primary output of this package are heatmaps that display these RGB distributions and principal component analyses. Using patternize, we compare species of interest in the clypeatus group, including differentiating between forms of H. formosus and putative hybrids between *H. dossenus* and low elevation *H. clypeatus*. patternize differentiates between the patella of *H. formosus* morphs, although other third leg courtship ornaments are less divergent. Additionally, when examining courtship ornaments between *H. dossenus, H. clypeatus*, and their putative hybrids, the latter seem to occupy unique region in PCA space, potentially giving credence to the creative role of introgression in Habronattus. Comparisons such as these are a first steps towards understanding courtship and signal evolution in *Habronattus*.

Session: Mating Systems

Conservation genomics of federally endangered Texella harvester species (Opiliones, Phalangodidae) from cave and karst habitats of central Texas

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Genomic-scale data for non-model taxa are providing new insights into landscape genomic structuring and species limits, leading to more informed conservation decisions, particularly in taxa with extremely restricted microhabitat preferences and small geographic distributions. This study applied sequence capture of ultraconserved elements (UCEs) to gather genomic-scale data for two federally endangered *Texella* harvester species distributed in Edwards Formation cave and karst habitats of central Texas, near Austin. We gathered UCE data for 51 T. reyesi specimens from 46 different caves, seven T. reddelli specimens from five caves, and from relevant outgroup species. For these UCE data we applied a combination of phylogenomic, multispecies coalescent phylogenetic, and single-nucleotide polymorphism machine-learning

analyses. We found that samples of *T. reddelli* and *T. reyesi* together form a single clade in phylogenetic analyses, but that *T. reddelli* samples are not recovered as monophyletic. Instead, T. reddelli samples from three northern caves are embedded within a larger *T. reyesi* genetic clade. Significantly, the genetic structuring of all samples closely follows geologic barriers defined for the region and formalized as karst fauna regions (KFRs). One exception is the Jollyville Plateau KFR, which includes two divergent, non-sister genetic lineages. Levels of troglomorphy, here assessed by a simple scoring of corneal and retinal development, also closely follows clade (and geographic) boundaries, implying that divergent genetic lineages might also have distinct ecologies. Overall, our study has important taxonomic implications, is the first to explore (and validate) regional KFR boundaries using intraspecific genetic data, and provides essential data for future management decisions involving these federally endangered species.

Session: Molecular Phylogenetics and Systematics

Eradication of Chinese privet fails to restore forest spider communities within five years

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Chinese privet (*Ligustrum sinense*) is an aggressively invasive semi-evergreen shrub capable of forming dense understory monocultures with drastic ecological consequences; it is currently recorded from 27 US states (Vogt et al. 2022) and is estimated to increase from < 2% to over 1/3 of forested areas in Alabama and Mississippi within two decades (Wang et al. 2016). We utilized a long-term privet eradication study in northeast Georgia to compare ground-dwelling spider assemblages between still-invaded control plots (N=4) and treatment plots from which privet was removed either by chainsaw (N=4) or mulching machine (N=4). We also sampled in three reference sites with no history of privet invasion. In 2011, five years post-eradication, we ran five pitfall traps in each of the 15 plots for seven days per month during the growing season (Mar-Aug, and Oct). The five traps were pooled into a single sample unit at each site. Samples yielded 5,740 spiders in 27 families, including 4,449 adult spiders identified to 100 species. Species richness was higher, and Shannon's and Simpson's diversity much higher, in the uninvaded reference plots than in the invaded plots, regardless of treatment. Nonmetric multidimensional scaling and ordination shows that the uninvaded reference sites form a distinct grouping, whereas there is significant overlap among control and treatment plot assemblages. The treatment assemblages are closer in ordination space to the reference assemblages than the control assemblages are, though, indicating some recovery

towards the reference sites following eradication. To test for differences in spider composition among treatments, we performed Multi-Response Permutation Procedures (MRPP) analysis, which showed that reference sites are significantly different ($p < 0.05$) from control and mulch sites. We used the R package indicspecies to look for spider species strongly associated with one or more treatments. Five species were significantly associated with univaded reference sites (*Drassyllus aprilinus, Hahnia cinerea, Myrmekiaphila foliata, Varacosa avara*, and *Wadotes bimucronatus)* and one species (Euryopis quinquemaculata) was associated with both the uninvaded reference plots and the mulch treatment plots. No species were significantly associated with the control or chainsaw treatments. Thus, privet favors a suite of generalist species that do well across a range of conditions, and even five years after eradication, privet invasion resulted in an altered spider community composition, similar to changes observed in ant communities (Vogt et al. 2022). This is in contrast with bee communities (Ulyshen et al. 2022), which exhibited more rapid recovery in terms of abundance and species richness following eradication.

Session: Ecology

Maevia Revisited: It's a Whole New Ballgame (Salticidae: Dendryphantini: _Marpissina_)

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Paramaevia Barnes, 1955 is again synonymized with *Maevia* C.L. Koch, 1846 due to the unique synapomorphy of a ventral fringe on the fourth metatarsus, a shared habitus, and clear transitional stages between them in genital structure. In addition, *Paramaevia* as originally conceived is probably not monophyletic. Three new species are described in the inclemens group from the eastern United States, and a new species is described from California, the first records of a species in this genus from the West Coast. The latter species forms a new group and is important because its genital structure retains some features of the poultoni group while also possessing some character states of the inclemens group, to which it appears to be the sister group. Similarly, *M. hobbsae* Barnes, 1955 lacks group synapomorphies with the poultoni group sensu novae; it also lacks the ventral fringe on the fourth metatarsus. Several palpal characters of the hypothetical sister genus *Psecas* C.L. Koch, 1850 are retained into the basal parts of Maevia, and the last of these is not lost until the transition to the inclemens group. The type species, *Maevia inclemens* (Walckenaer, 1837), well-known for its dimorphic males, is no longer unique in that respect; one of the new species and *M. expansa* Barnes, 1955 are found to have dimorphic males of the same phenotypes that occur in *M. inclemens*. However, it is not clear if either of

these two species is a direct sister to M. inclemens, although they are all in the same subgroup. Three new species in the poultoni group related to *M. michelsoni* Barnes, 1955 are described from Florida from different sand ridge systems. *Plexippus vittatus* Banks, 1906 is resurrected from synonymy with Maevia poultoni Peckham & Peckham, 1901, becoming Maevia vittata (Banks, 1906); it is redescribed and the male is described for the first time. As this name is a junior homonym of *Maevia vittata* (Hentz, 1846), it will be renamed; it is known from the sky islands of Arizona and New Mexico. Knowledge of the geographic ranges and habitats of all the species is greatly expanded due to a combination of targeted sampling for rare and new species and utilizing the online photographic databases of BugGuide and iNaturalist. Several of the new species primarily are found above 300m asl. A hypothetical dispersal and vicariance model is presented. A proposal is made that the mechanism by which two male forms is in part maintained is that 'normal' males are more similar to females in color pattern and both are cryptic, whereas black tufted males are ant mimics, with a similarity to minor workers of the common and widespread black ant *Camponotus pennsylvanicus* (De Geer, 1773) in appearance and in their erratic escape behavior. It is further proposed that the enlarged cymbia of males of most species in the inclemens group evolved to accentuate their appearance to the head of an insect, suggesting that males of species in the inclemens group may all be mimics to some extent, but that males with entirely black bodies specifically mimic *C. pennsylvanicus.*

Session: Morphological Evolution and Taxonomy

Exploration of morphological characters to support a possible new solifugae genus

Quincy Hansen* and Erika L.Garcia

The Eremobatidae is a family of North American solifuges which are currently divided into two subfamilies: the Eremobatinae (Kraepelin 1899) containing four genera and over 115 species, and the Therobatinae (Muma 1951) containing four genera and about 80 species. A preliminary phylogenetic analysis using UCEs (ultraconserved elements) and extensive taxon sampling of Therobatine taxa suggests that the subfamily is polyphyletic, specifically among the most diverse genera *Hemerotrecha* (34 species) and Eremochelis (38 species). Here we focus on well-supported clade containing several currently recognized Eremochelis species. Using scanning electron microscopy and stereo microscopy we aim to identify morphological synapomorphies that support a suspected new genus within the Eremobatidae. Results will be included in a proposed taxonomic revision of the previously placed Therobatinae taxa.

Session: Solifugids

Phylogenomics and morphometrics illuminate patterns of character evolution of historically delimiting characters in camel spiders (Arachnida: Solifugae: Eremobatidae)

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Male chelicerae and the female operculum are the leading diagnostic characters sets used in camel spider identification. Structures can vary across multiple taxonomic levels; however, taxonomic descriptions are often restricted to qualitative descriptions of size and complex shapes. Limiting shape descriptions to a single qualitative descriptor excludes the consideration for variation that may exist within genera, or between populations of the same species. To inform patterns of morphological evolution of these character sets within Therobatinae (Arachnida: Solifugae: Eremobatidae), we used a 2-dimensional (2D) morphological analysis using an Elliptical Fourier (EF) approach for closed outlines, in addition to an analysis of traditionally used measures in a phylogenomic context. Using ancestral state reconstruction (ASR) and ultraconserved elements (UCE), we examined how commonly utilized characters for taxonomic identification have evolved across this group. Investigation into ubiquitously used character sets will be used to better inform taxonomic boundaries, including the morphological patterns formerly used to establish current taxonomic boundaries.

Session: Solifugids

Juvenile Aversion Learning in a Cannibalistic Spider (*Latrodectus mactans*)

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Many web-spinning spiders learn to avoid potentially risky prey through experience and recognition of prey vibration patterns. While evidence of this phenomenon is seen in multiple studies, the generalization of spider ability for aversion learning across contexts is still unclear. Spiders can benefit from generalized aversion learning capabilities in several situations other than foraging, such as predator and cannibalization avoidance. Here, we examined individual variation in the ability of juvenile *Latrodectus mactans* (widow spiders) to associate an aversive stimulus with a vibratory cue. We further examined how the number of spiders engaging in certain behavioral responses to the vibratory cue changed over the course of the experiment, and how these changes differed between egg sac. We found no evidence of ability of

juveniles to pair a cue with an aversive stimulus. However, we found a significant decrease in fleeing behavior in response to the vibratory cue regardless of stimulus, and an egg sac dependent increase or decrease in web spinning behavior in response to the cue. Altogether, our results suggest that juvenile *L. mactans* habituate and desensitize to vibratory stimuli but do not associate these stimuli with a paired aversive stimulus. We will discuss our results in the context of learning and its relation to social development in venomous, cannibalistic species.

Session: Behavior

Adaptive significance of patterns of prey sharing among 26 species of prolonged subsocial and solitary huntsman spiders

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Huntsman spiders (Sparassidae) are protective mothers that actively guard their egg sacs and newly emerged young. In solitary species, the young remain with the mother for several weeks before dispersing to live independently. Two subsocial species, *Isopedella leai* and *Iso. pessleri* (Deleninae) remained together for four to five weeks. However, in four prolonged subsocial species (*Delena cancerides, D. lapidicola, D. melanochelis, Damastes sp.*), the immature offspring remain in their natal retreat in interactive colonies with their mother and one to four cohorts of siblings for 5 to 12 months (depending on the species). Over 20-years, we have collected extensive data on patterns of prey captured by mothers and offspring of 26+ species of huntsman spiders in the Rayor laboratory. For each prey capture event, the instar of the spiders feeding was recorded, along with spider species, number of individuals feeding solo or cooperatively, prey type, prey size, and incidences of cannibalism. Our results demonstrate clear phylogenetic patterns in prey sharing. With a single exception, the solitary Heteropodinae did not share any prey or only a tiny percentage of prey they captured. Most solitary endemic Australian Deleninae species shared small prey as 1st instars and into the 2nd instar only, associated with the timing of dispersal in the wild. The two subsocial species extended prey sharing into the 3rd or 4th instar, again associated with slightly delayed dispersal from the natal retreat. In contrast, the prolonged subsocial Delena species shared prey at significantly higher rates and prey sharing occurred throughout development. More individuals shared prey in the prolonged subsocial species - up to 22 individuals simultaneously in *D. cancerides*. The prolonged subsocial species benefit from size asymmetry among the siblings, as older individuals shared large prey items (crickets, moths) with younger animals readily. In contrast, the solitary species only share small prey (*Drosophila* or small houseflies) with one or two other individuals. Prolonged subsocial young solicit prey and share

with their older siblings and mother, while solitary mothers never shared prey and cannibalism was rife. In summary, there were few prey capture benefits to solitary huntsman species of remaining in groups past the first few instars. In contrast, prolonged subsocial species benefited from access to more and larger prey through their development. Finally, our data on prey sharing patterns illuminates how much more cooperative *Delena* cancerides behavior is compared to that of the other prolonged subsocial species which share many behavior and life-history traits.

Session: Behavior

Untangling the behaviors used in orb-weaving

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Many innate behaviors are the result of multiple sensorimotor programs that are dynamically coordinated to produce higher-order behaviors such as courtship or architecture. Extended phenotypes such as architecture are especially useful for ethological study because the structure itself is a physical record of behavioral intent. A particularly elegant and easily quantifiable structure is the spider orb-web. The geometric symmetry and regularity of these webs have long generated interest in their behavioral origin. However, quantitative analyses of this behavior have been sparse due to the difficulty of recording web-making in real-time. To address this, we have developed a novel assay enabling high-resolution tracking of limb movements and web structure produced by the hackled orb-weaver *Uloborus diversus*. With a brain the size of a fly's, the spider *U. diversus* offers a tractable organism for the study of complex behaviors. Using machine vision algorithms for limb tracking, and unsupervised behavioral clustering methods, we have developed an atlas of stereotyped movements used in orb-web construction. The rules for how these movements are coordinated change during different phases of web construction, and we find that we can predict web-building stages based on these rules alone. Thus, the physical structures of the web explicitly represent distinct phases of behavior. In addition to our behavioral efforts, we are also developing biological assays to investigate how this elegant behavior is encoded in the spider's brain.

Session: Silk and Web Construction

Biodiversity catalogs reveal taxonomic and geographic bias: a case study with the World Spider Catalog

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Biodiversity catalogs record the taxonomic history of organisms and serve as a resource for systematic work. Digitization in recent decades has allowed for greater accessibility, improving access to primary taxonomic information and literature for researchers around the world. Among invertebrates, spiders are one of the most diverse groups, with about 50,000 described extant species. The World Spider Catalog currently represents the largest taxonomic database of any animal group, and a unique opportunity to assess the disproportionate documentation of spider diversity globally. In order to evaluate the effect of taxonomic and geographic bias, and highlight poorly-known lineages among the spider tree of life, we develop a taxonomic ratio relating new species descriptions to other taxonomic changes as a proxy for taxonomic "effort". We hypothesize families with a higher number of species descriptions relative to other taxonomic changes are an indication of lower effort to date, and that more taxonomic effort will yield a high abundance of undocumented species. Conversely, if the number of primary descriptions relative to other taxonomic changes in a group is low, the asymptote of effort relative to species adundance has leveled and relatively few undocumented species remain. Our results highlight trends among spider families over time, and zoogeographic regions that warrant priority in species discovery. In particular, we seek to demonstrate the effect of new technologies on species documentation, and lack of access thereof, to researchers in more species-diverse areas, particularly in the Global South. This work informs arachnologists in identifying high-priority groups for species discovery and more broadly, highlights the benefits of maintaining an open-access taxonomic database for scientists studying biodiversity–a necessary step forward in overcoming the taxonomic bias and closing the gap in documenting the world's biodiversity before it is permanently lost.

Session: Morphological Evolution and Taxonomy

Use of Riparian Spiders as Sentinels of Persistent and Bioavailable Chemical Contaminants in Aquatic Ecosystems

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Aquatic ecosystems around the world are contaminated with a wide range of anthropogenic chemicals, including metals and organic pollutants, that originate from point and nonpoint sources. Many of these chemical contaminants have complex environmental cycles, are persistent and bioavailable, can be incorporated into aquatic food webs, and pose a threat to the health of wildlife and humans. Identifying appropriate sentinels that reflect bioavailability is critical to assessing and managing aquatic ecosystems impacted by contaminants. Riparian spiders have been suggested as sentinels of aquatic contaminants in the ecosystem because they can become "labeled" with aquatic contaminants by consuming contaminated aquatic insects, are relatively sedentary, and easily collected in high numbers near most waterbodies. In this presentation we 1) review the research on riparian spiders as sentinels of persistent and bioavailable chemical contaminants in aquatic ecosystems 2) present a "case study" that demonstrates the utility of riparian spiders as sentinels and the important role of ecology in determining contaminant concentrations and 3) discuss the need for additional research on riparian spiders. Our review of the literature on riparian spiders as sentinels suggests that significant progress was made during the last two decades of research. We identified 55 published studies conducted around the world in which riparian spiders were used as sentinels of chemical contamination of lotic, lentic, and estuarine systems. For several contaminants, like PCBs, Hg and Se, it is now clear that riparian spiders are appropriate sentinels. Our case study demonstrates that riparian spiders can be used to identify aquatic systems that contain fish with elevated concentrations of Hg and suggests that water-level fluctuations in upstream reservoirs not only influence Hg concentrations in fish but also spiders. Several studies have assessed biological and ecological determinants of contaminant concentrations in spider sentinels including taxonomic differences, age/size, habitat, and distance from shore. However, there are many spider-specific factors that have not been well characterized (e.g., life histories, feeding area exploited, physiological state, and effects of contaminants on spiders). Further study of riparian spiders and their potential role as sentinels is critical because it would allow for development of national-scale programs that utilize riparian spiders as sentinels to monitor chemical contaminants in aquatic ecosystems.

Session: Ecotoxicology

Phylogeny of Phidippus using Ultraconserved Elements: preliminary results

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The genus *Phidippus* has more than 60 described species, including some of the largest jumping spiders in the world, which can reach up to 20mm in length. The genus is distributed in the American continent, from Alaska to Costa Rica. Until now, only one publication presents the phylogenetic relationships between the different *Phidippus* species, and it is based on morphological characters. To corroborate this morphological phylogeny, and to study the evolution and biogeography of the genus, we are working on inferring molecular phylogenies. The aim here is to obtain the first complete phylogeny of Phidippus, analyzing Ultraconserved Elements (UCEs) by Maximum Likelihood, a technique widely used for resolving complex phylogenetic relationships between species. To date, we captured UCEs of 28 *Phidippus* species and present here a preliminary molecular phylogeny, which already provides an insight into possible re- organizations of some of the previously-established species groups within *Phidippus*.

Session: Biogeography

Evaluating Species Boundaries in Coastal Dune Trapdoor Spider Aptostichus simus

Emma E. Jochim, Lisa Chamberland, Jim Starrett, Jason E. Bond

Mygalomorph spiders are often characterized by morphological homogeneity and cryptic diversity, which has historically led to underestimation of species diversity between genetically divergent groups. It is now generally acknowledged that the application of traditional taxonomic constructs and strict morphological species delimitation may mislead assessments of species diversity in groups with genetically divergent lineages, thus more integrative approaches when delimiting these morphologically homogenous species is necessary. The trapdoor spider species Aptostichus simus is a California coastal dune endemic with little morphological variation, but substantial genetic structuring. Previous assessment of species boundaries was limited to a single mitochondrial locus and failed to draw any firm conclusions of species boundaries. In this study, we used a combination of a larger sample size of morphological data and modern molecular methods (i.e., 10X low coverage genome scans and ultraconserved element data) to test species hypotheses of A. simus. We tested whether A. simus comprises multiple cryptic species based on the cohesion species concept. This concept is ideal for taxa with high population structuring because it considers ecological and genetic exchangeability in addition to genetic diversity. We analyzed morphological cohesiveness between populations using principal component analyses and analysis of variance, with subsequent examination of divergence at the genomic level through identification of SNPs. The evaluation of genomic data in these dispersal limited, non-model organisms will allow us to gain a

greater understanding of the genetic variation between highly structured populations and across the landscape.

Session: Molecular Phylogenetics and Systematics

Phylogenomic analyses and species distribution models inform an integrative taxonomic approach of Eremothera and the Eremobates scaber and pallipes species groups (Arachnida: Solifugae: Eremobatidae)

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The North American family Eremobatidae is the only solifuge family to have an exemplar, Sanger sequence-based molecular phylogenetic framework in which to revise traditional morphology-based taxonomic designations. Next generation sequencing and modern bioinformatics approaches allow reliable, expanded sequencing of historical museum samples to complement and improve upon the previous framework. Here, we take an integrative approach to an ongoing taxonomic revision of *Eremothera* Muma 1951, and species groups of *Eremobates* Banks 1900, leveraging ultra-conserved elements (UCEs), expanded taxon sampling, species distribution modeling, as well as traditional and advanced morphological approaches. The preliminary results of this approach indicates that *Eremothera* and both the *Eremobates scaber* and *E. pallipes* species groups are monophyletic, but current taxonomic designations based off of traditional morphological character systems may overestimate diversity within *Eremobates*, in particular the E. scaber species group. In addition, the results support a clade of undescribed species distributed in north and central Mexico.

Session: Solifugids

Water Vapor Transmission Through Spider Egg Sac Silk

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Many adult female spiders die shortly after oviposition leaving newly laid spider eggs

without maternal care. Spider egg sacs have the challenging job of protecting developing embryos against environmental threats. One potential threat to spider embryonic development is desiccation of the eggs. Previous work shows that spider egg sacs can limit water vapor loss through the egg sac and allow for a more humid internal environment surrounding the eggs; however, other research shows that reliance on the egg sac for survival varies with species. Spider egg sacs may only be one of many factors influencing desiccation threat of embryos. This work explores how egg sacs vary in their ability to prevent vapor loss by finding the water vapor transmission rates through egg sac samples examining the potential influence of fiber arrangement characteristics on water vapor transmission.

Session: Silk and Web Construction

Disruption of air particle movement affects mating success in multimodal signaling wolf spider

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Schizocosa wolf spiders have become a model system for exploring the role of multimodal communication with the focus on visual and vibratory signaling. Yet multiple studies on *S. retrorsa* have found that in the absence of both visual and vibratory cues, female-male pairs are able to successfully copulate. It has been suggested that *S. retrorsa* may rely on a third signaling modality during courtship –air particle movement– which is likely perceived using thin sensory hairs called trichobothria. In this study, we tested the role of air-particle movement on mating success through mating trials with randomly paired S. retrorsa females and males in the dark and on granite in 2 signaling environments – without (No Noise) and with (Noise) introduced air-particle movement. Our treatments significantly impacted mating success, as 54% of pairs mated in No Noise, compared to only 15% in Noise. Higher rates of leg waving – a dynamic movement that has been shown to produce air particle movement – resulted in higher mating success across conditions with the rate being higher in No Noise. Thus, artificially induced air particle movement disrupts mating success and alters male courtship signaling.

Session: Mating Systems

A Natural Colonisation of Asia: Phylogenomic and Biogeographic History of Coin Spiders (Araneae: Nephilidae: *Herennia*)

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Reconstructing biogeographic history is challenging when dispersal biology of studied species is poorly understood, and they have undergone a complex geological past. Here, we reconstruct the origin and subsequent dispersal of coin spiders (Nephilidae: Herennia Thorell), a clade of 14 species inhabiting tropical Asia and Australasia. Specifically, we test whether the all-Asian range of *Herennia multipuncta* is natural vs. anthropogenic. We combine Anchored Hybrid Enrichment phylogenomic and classical marker phylogenetic data to infer species and population phylogenies. Our biogeographical analyses follow two alternative dispersal models: ballooning vs. walking. Following these assumptions and considering measured distances between geographical areas through temporal intervals, these models infer ancestral areas based on varying dispersal probabilities through geological time. We recover a wide ancestral range of Herennia including Australia, mainland SE Asia and the Philippines. Both models agree that H. multipuncta internal splits are generally too old to be influenced by humans, thereby implying its natural colonisation of Asia, but suggest quite different colonisation routes of H. multipuncta populations. The results of the ballooning model are more parsimonious as they invoke fewer chance dispersals over large distances. We speculate that coin spiders' ancestor may have lost the ability to balloon, but that *H. multipuncta* regained it, thereby colonising and maintaining larger areas.

Session: Biogeography

Quantifying variation in visual signals within a spider clade

Kenna D. S. Lehmann, Rowan McGinley, Mitch Bern, Eileen Hebets

One goal in the study of animal communication is to understand the selection pressures, conditions, and constraints that govern the evolution of multimodal signaling and signal complexity. To achieve this goal, we must first appropriately describe or quantify signals in several species with an understood phylogenetic relationship. Such phylogenetic comparisons have been applied to vocal communication to great success and we are at the cusp of applying this approach to multimodal signaling. Here, we use video analysis software and machine learning to quantify the visual mating signals of *Schizocosa* wolf spiders with the aims of i) quantifying the complexity of visual signals within each species, ii) understanding the effects of insufficient diet on mating signal effort and complexity, and iii) comparing visual signals among species. The quantification of visual signals across many

Schizocosa species, when combined with work on visual ornamentation and the vibratory components and production mechanisms of mating signals, will allow us to answer questions about the evolution of complex multimodal signals in a variety of habitats and signaling conditions.

Session: Sensory Systems

10-legged spiders: assessing the functionality of ectopic appendages in spiders exhibiting a Hox knockdown phenotype

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Hox genes are an important class of homeobox genes in the animals that determine the position of body parts along animal body axes, this meaning they are responsible for determining the general body plan, such as the number of body segments, the number and placement of appendages, and animal head-tail directionality. The Antennapedia-1 (Antp-1) is an important Hox gene involved with the establishment of the prosomal-opisthosomal boundary. In arachnids, studies about the functional data on Hox homologs remain limited, Antp-1 is only linked with the establishment of the prosomal-opisthosomal boundary where the morphology of the RNAi spider embryos is reported but, the functionality of the ectopic legs of the pedicel remained unknown - until this study. Therefore, we replicated an experiment wherein we silenced Antp-1 using maternal RNA interference and thus generated 10-legged spiders. We addressed the potential of ectopic legs to form a pair of fully functional appendages. After analysis of innervation and internal morphology during embryogenesis and analysis of morphogenesis of the appendage, we observed that the ectopic leg pair induced by Antp-1 knockdown is functional.

Session: Molecular Phylogenetics and Systematics

Effects of the light environment on courtship displays in multimodal signaling wolf spiders

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Light availability is highly variable, yet predictable, over various timescales and plays an important role in the evolution of visual signals. Courtship displays of the wolf spider genus Schizocosa always involve the use of substrate-borne vibrations, however, visual displays vary substantially among species. We tested the function of visual courtship signaling across distinct light environments in four *Schizocosa* species that vary in their degree of ornamentation and dynamic visual signals. We ran mating and courtship trials at three light intensities and tested the hypothesis that ornamentation interacts with the light environment. We also examined each species' circadian activity patterns. The effects of the light environment on courtship and mating varied between species as did circadian activity patterns. Our results suggest that femur pigmentation may have evolved for diurnal signaling, whereas tibial brushes may function to increase signal efficacy under dim light. Additionally, we found evidence for light-dependent changes in selection on male traits, illustrating that short-term changes in light intensity have the potential for strong effects on the dynamics of sexual selection.

Session: Sensory Systems

Biogeographic Connections Between California and Arizona In Dispersal Limited Arachnids

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The sky islands of Arizona's "Madrean Archipelago" have a diverse arachnid fauna with connections to Madrean communities to the south and temperate communities to the north. Less understood are its connections with the California Floristic Province across the harsh and unforgiving Sonoran and Mojave Deserts. However, phylogenetic connections can be seen in multiple habitat-specialized, relictual arachnid lineages with distributions in the sky islands, desert canyons, and spring oases on either side of this gap. We'll discuss the talus dwelling harvestmen Sitalcina and Texella, the minigaroon Hubbardia, and the tiny, opalescent tarantula relative Hexurella for examples of animals whose previously expansive ranges across these modern-day deserts can be pieced back together with careful microhabitat-focused field efforts.

Session: Biogeography

Sticky traps producing a sticky mess: The tree-dwelling spider genus, Neodietrichia (Araneae: Linyphiidae)

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The tree-dwelling spider, *Dietrichia hesperia* (Araneae, Linyphiidae), was described from California in 1933 by Crosby and Bishop. It was changed to *Neodietrichia* in 2008 by Ozdikmen since *Dietrichia* was already taken by a fossil bivalve. Currently, this rarely collected arboreal spider is the sole member of its genus, but previous unpublished work suggests that Lophomma depressum (Araneae, Linyphiidae) also belongs in *Neodietrichia*. To better understand this relationship and to revise *Neodietrichia*, we examined hundreds of museum specimens, attempted to collect them from trees in central Indiana, and began a community science project whereby participants attempted to collect this spider from locations around North America. Some male palpal variation was observed among collected and museum L. depressum specimens, but we believe this is within-population variation. We used this evidence to create a new combination by transferring the previously misplaced *Lophomma depressum* into *Neodietrichia* as *Neodietrichia depressum* nov. comb.

Session: Morphological Evolution and Taxonomy

Phylogeography and population genetics of two Californian mygalomorph genera (*Calisoga*, F. Nemesidae; *Aliatypus*, F. Antrodiaetidae) uncovers possible parallel ring species dynamics

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Ring species can be defined as a chain of interbreeding populations which expands along two pathways around a geographic barrier, where terminal forms can coexist without interbreeding (i.e., as distinct biological species). Members of the genus *Calisoga* (Nemesiidae) are distributed around the Central Valley of California, and previous genetic studies have shown that this is a lineage-rich complex of mygalomorph spiders, with evidence to suggest that *Calisoga* might be a case of ring speciation. Spiders of the *Aliatypus* californicus group (Antrodiaetidae) exhibit similar distributional patterns as well as high lineage diversity. Both genera display cryptic phenotypic diversity and the presence of sympatric populations, which might suggest a case of parallel ring speciation. In this work we sequenced ultraconserved elements (UCEs) for 190 samples of *Calisoga* and 116 samples of Aliatypus from localities across their distributional range surrounding the Central Valley in California. Using data

matrices comprising ~1,200 and ~880 UCE alignments for *Calisoga* and *Aliatypus* respectively, we explicitly test and compare how genetic diversity is distributed across populations and the influence of gene flow and isolation by distance in maintaining genetic differentiation across populations. Under a ring speciation model, we expect low genetic divergence among populations that increases towards the extremes of the distribution, with important differentiation being explained by isolation by distance and admixture among geographically adjacent populations. Genomic patterns observed in *Calisoga* and *Aliatypus* meet some of these expectations, consistent with a ring species model.

Session: Biogeography

Unsung Arachnology Pioneers: Harriet Exline Frizzell and the Women of Arachnology

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The women of North American arachnology were historically undervalued. One such early pioneer was Harriet Exline Frizzell (1909–1968). An under-acknowledged aranaeology heroine, she was an expert on North American spiders, Agelenidae in particular, and an elected Fellow of the California Academy of Sciences. Through archival research at the Academy, we have uncovered Frizzell's story as part of an effort to surface stories of marginalized scientists throughout the history of the institution. We have analyzed hundreds of archival documents to forefront the stories of hidden figures of the California Academy of Sciences, including that of Harriet Exline Frizzell. The purpose of our study was to tell the stories of Academy staff and affiliates that have yet to be told in order to reveal a fuller and truer picture of the history of our institution, which reflects the history of science as a whole. The untold stories from the archives reveal the trends throughout the history of science that have made science unwelcome to women and people of other marginalized identities in the field. As a research associate at the Academy, Frizzell was unpaid, yet she curated a sizable arachnid collection from her home in Missouri that she contributed to the Academy's collections. She represents a standard for women scientists of her time—intensely dedicated to her research yet underpaid and undervalued. Frizzell's story is but one example of the undervalued contributions of women who have done foundational work in our field and whose remarkable contributions—even while facing explicit bias—should be recognized.

Session: Morphological Evolution and Taxonomy

Sex, Chemical Cues, and Venom Variation in the Southern Unstripped Scorpion *Vaejovis carolinianus*

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Variation in venom composition and how the venom is used appears to be common across animals, especially in sexually dimorphic species that may experience different selective pressures. The southern unstriped scorpion, *Vaejovis carolinianus*, is sexually dimorphic in size and some evidence suggests that males and females prefers different microhabitats. Because of these differences, we investigated if *V. carolinianus* also exhibits sexual venom variation by using a combination of behavioral tests, bioassays, and liquid chromatography. We also investigated if *V. carolinianus* altered the volume of venom it injects based on the presence/absence of biologically relevant chemical cues. While we did not find behavioral differences with respect to chemical cues, we did find behavioral, pathophysiological, and venom composition differences between sexes. Females stung more often and injected more venom than males. Female venom also contained a higher protein concentration than males and was more likely to cause the most common pathophysiological effect: loss of normal motor function. Interestingly the venom of males and females also show unique chromatographic profiles, thus the greater pathophysiological response to female venom is not necessarily explained by its greater protein concentration. This research provides the first evidence of behavioral, compositional, and pathophysiological differences between males and females in *V. carolinianus*. It also opens the doors for further investigation to identify the specific compositional differences in venom between the sexes and if these differences account for the differences we observed in our bioassays.

Session: Behavior

Males make mistakes but females call the shots: female resistance as a partial reproductive isolating mechanism in scorpions

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Courtship behavior is a critical component of pre-copulatory isolation. Both sexes exchange multiple signals to assess the specific identity and the mate's quality, so courtship behaviors and the response to them may experience different selective pressures. In sympatric areas, the correct sexual recognition among conspecifics is critical to prevent heterospecific mating ensuring reproductive isolation. However, the recognition can fail, leading to heterospecific mating and processes like reproductive interference (RI). Scorpions have a wide repertoire of sexual courtship behaviors. Here we focused particularly on "female resistance" (FR) (pulling against the male or not moving in the male's direction during the "promenade" phase). This behavior has been ruled out as a manifestation of sexual conflict in scorpions, being more likely to arise in a mate choice framework as a mechanism to assess male quality. However, to date, FR has not been analyzed in heterospecific courtships where this behavior can act as a barrier contributing to reproductive isolation. Here we assessed the FR in conspecific and heterospecific courtships of two sympatric scorpion species from central Argentina: Urophonius brachycentrus -UB- and Urophonius achalensis -UA-. Given that these species had RI in pheromone chemical attraction, a mating system with scramble competition, and that there is a high chance of encounters between heterospecifics, we expect that FR constitutes a selective filter to prevent the culmination of heterospecific mating. We predict that success in these mating is less likely than in conspecific mating due to behavioral filters as FR, which it's related to interaction networks that are more disorganized and less linear. We collected specimens in the field and performed mating trials in the laboratory in arenas with randomly selected couples: (a) conspecific crosses: UA n=70 , UB n=41 ; (b) heterospecific crosses: ♂UA♀UB n=51 ; ♂UB♀UA n=25. We recorded sexual encounters and considered successful mating if sperm transfer is completed. We quantified the duration and frequency of FR and compared these parameters between conspecific and heterospecific courtships using GLMs in R. Complementarily, we performed an analysis of interaction networks with Gephi, analyzing the linearity and modularity of conspecific and heterospecific courtships and we compared these parameters with a Mann-Whitney U-test. We found that heterospecific mating was less successful than conspecific mating, with sperm transfer

occurring in only 8% (♂UA♀UB) and 18% (♂UB♀UA) of sequences (p=0.004). Compared to conspecific ones, heterospecific courtships had almost three times more FR events (p=0.037) and a longer duration of these events (p=0.037). Consequently, heterospecific courtships were longer (p=0.041) and in many cases, the pair loosened their pedipalps and the courtship was finished or continued but in a disorganized way, giving rise to less linear and more modular interaction networks (p=0.036). We provide evidence that FR is a very plastic behavior, which can be modulated according to the mate's specific identity. Our results confirm that FR could be considered as a behavioral isolating mechanism in heterospecific mating. However, FR represents a partial barrier so we discuss the costs of RI and the use of multiple pre- and post-copulatory barriers in these species.

Session: Mating Systems

Assessment of the mechanosensory responses of peg sensilla on scorpion pectines

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Sand scorpions are faithful to their home burrows, and we are interested in how these animals navigate their environment. Scorpions possess midventral touch/taste organs called pectines which may be important for learning the nuances of the substrate during navigation as well as the detection of spermatophores and food. The pectines possess thousands of minute structures called peg sensilla that are responsive to both chemicals and mechanical deflection of the peg shaft. Morphological reports show that each peg has a single mechanosensory neuron along with at least 10 chemosensory neurons. While quite a lot is known about the chemical responsiveness of the pegs, very little is known about their mechanosensory properties. In particular, we want to know if the peg mechanosensory response is “all or nothing” or graded depending on the intensity of stimulation. Using an electrode attached to a micromanipulator, we recorded neural activity from individual peg sensilla. We then used a minute probe attached to another micromanipulator to deflect the peg and ellicit an apparent mechanosensory response. Our records show the presence of a rapid firing (> 100 Hz), quickly adapting waveform which is indicative of a mechanoreceptor and appears to be independent of previously identified chemoresponsive cells. We tested

mechanosensory response dynamics in two ways. The first test focused on a short touch versus a long touch. For the short touch, the stimulating electrode pushed the peg and was immediately retracted, but for the long touch, the stimulating electrode pushed the peg and maintained contact for one second before retracting. The second test focused on a small touch versus a large touch. The stimulating electrode was advanced 6-8 m for the small touch and 10-12 m for the long touch. Both pairs of stimulations (short vs long touch; small vs large touch) produced repeatable and statistically distinct responses in terms of spiking frequency. These results indicate the mechanosensory responses of peg sensilla are graded, which sheds light on the textural resolvability of the pectines and informs models of how detailed of an 'image' scorpions can obtain from the deflection of the peg sensilla via the textures of their environment.

Session: Sensory Systems

Unpredictable vibratory environments affect prey capture and web structure of the funnel-weaving spider *Agelenopsis pennsylvanica*

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Mounting evidence suggests that air- and water-borne noise are pervasive and emergent threats to animal fitness. Yet we know little about the extent and consequences of substrate-borne noise, despite the ancient and ubiquitous use of substrate-borne vibrations as animal signals and cues. The funnel-weaving spider *Agelenopsis pennsylvanica* is prevalent across urban and rural habitats in North America, and these spiders rely on web vibrations to detect prey. To determine if and how experience with different vibratory environments affects prey capture and (presumably) associated web building behavior, we collected penultimate female *A. pennsylvanica* from urban and rural habitats demonstrated to differ in natural noise levels. Upon maturation, we exposed adult females to two 3-week periods of substrate-borne vibration playbacks (6 weeks total) using a fully crossed 2 x 2 design of 'quiet' (Q) and 'loud' (L) treatments. In addition to our four treatment groups (QQ, QL, LQ, LL), we had a 'silent' control group that did not receive any playbacks (SS). The treatments differed by 13 dB to match naturally recorded amplitude differences between our focal urban and rural sites. Twice a week across the 6 weeks, we measured the latency to attack (i) a live cricket and (ii) an artificial 'prey' stimulus. We also assessed web structure at the end of each three-week period by estimating (a) web denseness, (b) variability of denseness, and (c) dry mass. To see if our treatments influenced foraging and web building behavior, we compared time to attack live and artificial prey and our quantified web characteristics across our time periods. We found

differences in attack latency between treatment groups and interactions between treatment groups and origin on web characteristics. Our results suggest that increased amplitudes of noise negatively impact prey capture and that *A. pennsylvanica* may adjust their web structure to changing vibratory conditions based on prior habitat experience.

Session: Sensory Systems

New insights into the evolutionary relationships of Samooidea (Opilliones: Laniatores) with an emphasis on Samoidae

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The superfamily Samooidea (Opiliones: Laniatores) is comprised of more than 200 species currently divided into three families – Samoidae, Stygnommatidae, and Biantidae. We present new insights into the systematics of this group based on a time-calibrated molecular phylogeny and explore the morphological characters that are used to redefine the families. We focus on the morphology of genitalia and the metatarsal organ of leg III. We place an emphasis on the phylogenetic relationships, morphology, and biogeography of Samoidae.

Session: Morphological Evolution and Taxonomy

Access to water impacts foraging in *Pardosa milvina* (Araneae, Lycosidae)

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Typically studies of predatory behavior focus on the importance of prey density, body size, or nutritional content. However in arid situations, potential prey can also be important sources of water and as such, the moisture content of prey can potentially influence foraging behavior or prey selection. The wolf spider, *Pardosa milvina* (Araneae, Lycosidae), lives in agroecosystems throughout eastern North America. Summer precipitation consists of localized heavy rains followed by longer dry periods. In addition, agricultural fields are designed to drain efficiently. As a result, access to open water or moist soil can be limited in time and space for the spider inhabitants.

We tested the hypothesis that water availability would influence foraging of adult female *P. milvina* in a series of laboratory experiments. We included three treatments involving different level of water access for a 10 day period prior to testing: (1) damp soil throughout the arena, (2) 1cm ball of damp cotton on a plastic tray within the arena, (3) 1cm ball of damp cotton provided on a plastic tray for 3 hrs each day. On day 10, we presented each spider with 5 crickets and documented the prey capture behavior. Spiders that had had access to damp soil the entire time were slower to attack prey and captured fewer of the 5 prey items. In a second experiment, lineages of field caught *Drosophila* that differed significantly in water content were generated. We then documented prey capture of spiders in each of our three treatments. Spiders with limited access to moisture killed more prey of both lineages but consumed less of each prey item. In a choice test where a mixture of flies were presented to the spiders, animals with reduced access to water captured significantly more of the lineages with high water content. Taken together, these results suggest that water access influences predatory behavior, which suggests that the role of spiders in the food web shifts with the frequency of rain events.

Session: Ecology

Effects of Microclimate Change on Survival Across Life Stages of the Pseudoscorpion Dactylochelifer silvestris (Cheliferidae)

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Most of our understanding of current and future climate change comes from measurements and modeling projections across large temporal (e.g. annually) and spatial (e.g. regional) scales. Much less is known about changes over small temporal (e.g. daily) and spatial (e.g. beneath a plant) scales. Daily changes in fluctuating temperature at a small scale, however, are likely to be extremely important for small ectotherms, which comprise the vast majority of Earth's biodiversity. Additionally, taxon-specific studies of the impacts of climate change on animals predominantly focus on a single life stage, overlooking the possibility that temperature-related survival changes throughout development. Many small ectotherms live in secluded spaces (e.g. in soil, under vegetation), and it is poorly understood how (i) climate change may alter the abiotic microhabitat conditions, and (ii) future microhabitat conditions can influence survival across life stages. Here, we evaluated the effects of microclimate changes on the survival of *Dactylochelifer silvestris* (Pseudoscorpiones: Cheliferidae). We first recorded daily summer microhabitat temperatures and used them to calculate future temperature predictions. In the laboratory, we then assessed the life-stage specific survival of pseudoscorpions under (a) current and (b) future temperature conditions.

We found that future microclimate influences survival on all life stages of D. silvestris, with younger nymphs having enhanced risk of dying, and females being most resilient.

Session: Ecology

The Effects of Male Competition and Lighting Conditions on Courtship and Female Mate Choice in Rabidosa rabida (Araneae: Lycosidae)

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Male courtship displays and female mate choice are integral parts of mating for many species. Males from species with visual displays may have variable success dependent upon how well the female can see the display, or if the population density of a species is high males might also compete directly with each other during courtship in front of a female. Investigations into the combined effects of such situations on female mate choice and copulation success however are lacking. The present study examined the effects of both lighting conditions and male density on copulation success in *Rabidosa rabida*, a species of wolf spider which is abundant in agricultural systems and active both diurnally and nocturnally. We reared field-caught, immature individuals to maturity (N= 100) and then performed a series of mating trials in which the number of males (one or two present per one female) and the lighting environment (light or darkness) were manipulated. We observed and recorded the duration of male courtship behaviors, instances of female and male aggressive behaviors, and copulation success for all trials. We found that in single male trials, male courtship timing primarily drove copulation success. In contrast, for the double male trials, the features and behaviors of the female best predicted copulation success. We found no effect of lighting conditions on copulation success for any trial. Ultimately, we saw that courtship dynamics and copulation success change when a female is faced with differing numbers of potential mates, and these drivers persist regardless of lighting conditions. Additional investigations exploring how particular aspects of the courtship displays and aggressive interactions between individuals vary based on the number of males present would be an intriguing next step.

Session: Mating Systems

Species Delimitation of Grassland & Chihuahuan Eremobates palpisetulosus through an Integrative Taxonomic Approach

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The *Eremobates palpisetulosus* species group provides a model to better understand the evolutionary history of solifuges within the Chihuahuan and Great Plains eco-regions. The biodiversity of these regions, currently composed of 16 species, is potentially underestimated owing to the complexity and similarity of diagnostic characters used to identify taxa. The lineages within the broad range may have diverged. The species group will be evaluated using mtDNA for divergence, bioclimate data to produce climatic niche models for the regions, cheliceral morphology in males, and genital opercula morphology in females. For male solifuges, the group is characterized by the presence of a retrodorsal process on the chelicera which provides a character to conduct morphometrical analysis. For female solifuges, the current practice is to image the ventral surface of the genital opercula which aid in the identification of species based on shape. Utilizing multiple approaches for analyses will shed light on the divergence of lineages within the Chihuahuan and Great Plains. My plan is to discuss the approaches to straighten out the paraphyletic mess that is the *E. palpisetulosus* species group and to provide what progress has been made.

Session: Solifugids

Understanding the diversity and evolution of the *Aphonopelma marxi* species group across the Madrean Archipelago "Sky Islands" biodiversity hotspot

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The Madrean Sky Islands are an important biodiversity hotspot housing several endemic species of the southwestern United States and northern México. These mountain ranges are characterized by the unique Madrean Pine-Oak and the stacking of biomes created by their dramatic change in altitude and complex climactic conditions. Since the last glaciation, these forested mountain ranges have become increasingly isolated from each other and limiting genetic interchange between populations creating the perfect conditions for diversification. Aphonopelma is the only tarantula genus residing within the United States and includes 59 described species across the US and México. They are found throughout a variety of habitats including the Madrean Sky Islands where *Aphonopelma marxi* species group resides. Here we infer a preliminary phylogeny of the Marxi group using 1200 UCE loci. This work is the

first representation of some populations of Sky Island tarantulas and lay the ground work determining species diversity and well as the impacts of climate change on the groups distributions. With increase in sampling and the inclusion of tarantulas from mountain ranges in Mexico we will gain a better understanding of the phylogenetic relationships between these Sky Island tarantulas as well as expand our knowledge on how this biodiversity hotspot evolved.

Session: Molecular Phylogenetics and Systematics

Multil-locus phylogeny and species delimitation in the segmented spider genus Liphistius (Araneae, Liphistiidae) in Thailand

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The segmented spider family Liphistiidae is the most basal family among living spiders. These spiders can be differentiated from other spiders by retention of several spider plesiomorphic characters, such as presence of abdominal tergite plates and presence of spinnerets on the median area of the abdomen. *Liphistius* Schiödte, 1849 is endemic in southeast Asia. *Liphistius* includes 59 described species placed in seven species groups based primarily on genitalic characters. In Thailand, there are 34 Liphistius species in four species groups including the birmanicus-group, the bristowei-group, the linang-group, and the trang-group. In addition, the large trang-group has been subdivided into six species complexes. However, there is lack of consensus concerning phylogenetic relationships at the species and species-group levels. In this study, we sampled 162 Liphistius specimens from 52 collecting sites in Thailand and Myanmar. We used five nucleotide loci (mitochondrial COI and 16S, and nuclear H3, 28S, and ITS2) to reconstruct phylogenetic relationships and delimit *Liphistius* species. Bayesian Inferences and Maximum Likelihood phylogeny were analyzed using Mr. Bayes and IQTree 2 respectively. Molecular species delimitations were performed with single-locus alignments (COI only) and concatenated alignments. The single locus delimitation was performed using Assemble Species by Automatic Partitioning (ASAP) method. The multi-locus delimitations were performed using Generalized Mixed Yule Coalescent model (GMYC), Poisson Tree Process model (PTP), and Species Tree And Classification Estimation, Yarely (STACEY) methods. The most likely species number was decided using Bayes Factor Delimitation (BFD). The concatenated alignments include 2,011 bps (COI: 168 sequences, 550 bps, 16S: 168 sequences, 316 bps, H3: 146 sequences, 241 bps, 28S: 159 sequences, 630 bps, and ITS2: 161 sequences, 245 bps). Phylogenetic results are mostly congruent with morphology-based classifications, in supporting monophyly of the genus, the bristowei-group, and the trang-group. However, our results do not support the monophyly of the six species

complexes within the trang-group. Molecular species delimitations recognized 45–72 putative species from the datasets. The best supported species number indicated by BFD is 55 putative species. The results delimited specimens from discrete locations as separate species and recognized possibly cryptic species in several taxa. The undescribed specimens with distinct genital characters were selected to describe as new species. In summary, molecular information is useful to reveal phylogenetic relationship and cryptic diversity within *Liphistius*.

Session: Molecular Phylogenetics and Systematics

Blink and you'll miss it: Ballistic predatory behavior in the ogre-faced spider

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The ogre-faced spider (*Deinopis spinosa*) lives a circadian Jekyll and Hyde life, avoiding predators by day, through total immobility and camouflage, and stealthily ambushing prey by night. Holding a specially made net in their front four legs, these spiders 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 ambush prey walking beneath (forward strike) or flying above (backward strike). To target these prey items, spiders must first accurately detect prey cues with biological sensors (i.e. sensory systems). *D. spinosa* possess both a highly sensitive visual system, as well as a widely tuned acoustic detection system, both of which are used to detect and capture prey. 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 discuss the work being done to better understand the sensory ecology of net-casting, with a special focus on acoustic detecting of flying prey items.

Session: Sensory Systems

The genetics of sticky: comparing the glue sequences of spiders and multicellular Eukaryota

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Many eukaryotic organisms produce glues that function in a variety of ways, including prey capture (e.g. spider webs and sundews), defense (e.g. centipedes and hagfish), and most commonly, substrate attachment (e.g. mussels and caddisflies). The biomechanics and proteomics of many of these glues have been investigated; however, the genetics of a number of eukaryotic glues are still vastly understudied. Many of the genes that encode for glue proteins are extremely large (5-40 kb coding sequences) and repetitive, and only recently has long-read technology begun to allow for reconstruction of their complete lengths and organization. This presentation reviews what is known about the genetics of sticky glues from a diversity of organisms, and describes recent progress in sequencing the aqueous glue of two spider species, the house spider *Parasteatoda tepidariorum* and bolas spider *Mastophora phrynosoma*, which have different web morphologies. The glues from these species vary greatly in length and repeat organization, which likely reflects variable selection pressures experienced by targeting different prey and employing different web structural strategies. Understanding the similarities and differences among animal glue genes will pave the way for biomimetic adhesives produced for a variety of purposes.

Session: Silk and Web Construction

Effects of Taxa and Body Size on Mercury Contamination of Riparian Spiders: Implications for the Use of Spiders as Sentinels

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Riparian spiders are exposed to mercury (Hg) through the consumption of emergent aquatic insects and have been proposed as sentinels of aquatic Hg contamination. Although riparian spiders show promise as sentinels that are used to characterize bioavailable chemical contaminants in food webs, few studies have explored the biological and ecological factors that may influence Hg concentrations in the tissues of sentinel spiders. The objective of this study was to assess the effects of spider taxa and body size on Hg concentrations of four taxa of riparian spiders (*Larinioides sp., Tetragnatha sp., Rabidosa sp., and Pardosa sp.*) collected from two rivers with different levels of Hg contamination. Spiders were collected from the Clear Fork (previously found to have high Hg contamination) and West Fork (previously found to have low Hg contamination) of the Trinity River, Fort Worth, Texas, USA in May and June of 2021. Average concentrations of total Hg (THg) in all taxa of riparian spiders were significantly higher on the Clear Fork than the West Fork. Within each river, THg concentrations differed between spider taxa and were positively correlated with spider

body size in 3 out of 4 spider taxa. These findings suggest that future studies must take these biological and ecological factors into account when using riparian spiders as sentinels.

Session: Ecology

Mate Choice Patterns Shift Over Time in Regal Jumping Spiders

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Many male jumping spiders are known for having complex courtship displays but much less is known about female mating patterns, particularly whether females mate multiply and if mating patterns shift with time. In this study, we paired female *Phidippus regius* with multiple males at different times and observed significant differences in behavior between pairings. While females always mated with the first male they were exposed to, second pairings varied considerably. Males took longer to court and sometimes did not mate with females even after females showed receptivity. Most but not all females mated multiply and this was in part dependent on the amount of time elapsed since their first mating and egg sac production. Females also showed aggression to second pairings of males. This study examines the dynamic nature of mate choice and the importance of studying patterns of multiple mating.

Session: Mating Systems

Cross-modal cues increase retinal activity in a jumping spider

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Most visually guided animals shift their gaze to selectively attend to specific features of their environment. In previous work using a custom-built eyetracker, we showed that jumping spiders (*Phidippus audax*) preferentially direct the gaze of their movable high-acuity principal eyes to objects with particular features. Here, we tested whether gaze direction is also influenced by the presence of conspecific pheromones. Our results show that when exposed to pheromones of the opposite sex, males, but not females,

were more likely to divert their attention away from an initial stimulus to a distractor that suddenly appeared. We also tested whether spiders exposed to pheromones were more likely to look at images of conspecifics. While male spiders exposed to pheromones significantly increased retinal scanning when viewing an image series of neutral shapes, prey, or conspecifics, this increase was independent of stimulus type. Similarly, spiders did not appear to discriminate between ecologically relevant objects presented simultaneously in an array. Thus, while pheromone exposure led to increased eye movements, we found no evidence for higher-order strategies such as search image formation or guided visual search. These results align with other experiments investigating the influence of sound on gaze direction. Shifts in visual attention are thus likely to be a product of general increases in arousal, possibly mediated by simpler mechanisms such as neuromodulation.

Session: Sensory Systems

Description of two new Amblypygid species from China

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Here, we report the discovery of two found in China: *Weygoldtia hainanensis* Zhu et al., 2021 and *Sarax sinensis* Wu et al., 2022, both in the family Charinidae. To validate the description of these two new species, we used both morphological and molecular evidence. The first species we found, Weygoldtia hainanensis, is morphologically similar to W. consonensis Miranda et al., 2021, but they can be distinguished using numbers of tibial segments, teeth on chelicerae, and trichobothria on the tibia. The molecular phylogeny was inferred using the COI gene and maximum likelihood and Bayesian analyses and shows results consistent with morphology , placing *W. consonensis* as the sister species of *W. hainanensis*. The distribution of *Weygoldtia* species on Hainan Island and historically connected regions follows patterns similar to that of other animal and plant taxa in those areas. Hainan Island was once connected to Guangxi, China and northern Vietnam as part of the western Indochina Peninsula during the Mesozoic. As a result, fauna and flora on Hainan Island are more closely related to those found in northeastern Indochina than to those in northwestern Indochina or southeastern China. Additionally, we found and described another species in Fujian, China: Sarax sinensis. To study the evolutionary relationship of Sarax sinensis, we sequenced 12S, 16S, and COI gene regions from our specimens to infer its phylogenetic position. Interestingly, both our morphological and molecular evidence shows that Sarax sinensis, found in southern China, is in the West Asia clade rather than the East Asia clade. It can be distinguished from *S. ioanniticus* (Kritscher, 1959),

S. israelensis (Miranda et al., 2016), and S. seychellarum (Kraepelin, 1898) using the numbers of tarsal segments, cheliceral teeth, and dorsal and ventral spines on the pedipalp femur. The discovery of both *W. hainanensis* and *S. sinensis* suggests that many new species remain to be discovered along the Indochina Peninsula and southern China. *W. hainanensis*, only found in a small region of karst limestone on Hainan Island and are currently being collected and sold at high prices, placing them at risk. Conservation efforts are necessary to protect both species from habitat destruction and the pet trade.

Session: Molecular Phylogenetics and Systematics

Ant mimicry facilitate milk provision in a jumping spider

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Long term parental food provisioning is common in mammals, yet rarely found in invertebrates. Females of an ant-mimicking jumping spider, *Toxeus magnus* provide “milk” to juveniles from hatching until past nutritional independence. We show that “milk” is derived from trophic eggs and that females are capable of producing egg sacs frequently when not provisioning young. *T. magnus* females have a reservoir of maturing oocytes after each oviposition event, thus guaranteeing frequent egg production. Surprisingly, other ant-mimicry jumping spiders without prolonged maternal care also show ovarian physiology and egg production pattern similar to T. magnus. Neither pattern is found in any non-ant mimicking jumping spiders studied. We suggest that ant-mimicry constrains abdominal morphology, shifting females from semelparous to iteroparous reproduction and providing the physiological machinery necessary for the evolution of long term food provisioning. These results suggest an alternative evolutionary trajectory for lactation-like behaviors independent yet comparable to those found in mammals.

Session: Behavior

Poster Presentation Abstracts

Arranged by presenters''s last name
Asterisk (*) indicates contestant in student competition
Presenter underlined

Developmental Influences on Physiology and Behavior in Tarantulas (*Lasiodora parahybana*)

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Animals have a high degree of phenotypic plasticity, but processes eliciting behavioral change are complex and not fully understood. Behavior can be influenced by various physiological factors, such as growth rates and metabolic rates (MRs). With increasing size, both energy demands and metabolic rates increase. Developmentally older individuals may also exhibit bolder behaviors due to increased size and experience. In this study, we examined the effects of developmental stage on both behavior and physiology in the tarantula Lasiodora parahybana, by comparing growth and metabolic rates to locomotory behavior across three age groups. Although total MRs increase with size, we were specifically interested in correlations between physiological and behavioral characteristics. Based on a previous lab study, we hypothesized that the oldest individuals would exhibit the most active/bold behaviors and that there would be a positive correlation with growth/metabolism and levels of activity. To test this, animals of three different age groups (spiderlings, juveniles and subadults) were raised under identical laboratory conditions and given approximately the same energy intake (based on weight). We quantified locomotor behaviors (speed and distance) in a novel arena using video-tracking software (Ethovision, VA). The arena was also divided into a thigmotaxic and center zone, and we compared locomotor activity between these regions across the groups. Growth rates were measured based on weight gain and MRs were measured using an open-flow respiratory system. Although correlations between physiological traits and behavior did not show clear trends, the locomotor data was contrary to our predictions and the spiderlings, despite their small size, moved greater distances and had the highest velocity, especially in the center of the arena. Juveniles were the least active but also showed increased velocity in the center of the arena. A higher percentage of subadults crossed from the thigmotaxic area into the center region. Sample sizes were small and the high velocity of the younger age groups may indicate escape/flight behaviors while the slower pace of the subadults may be more indicative of bolder behavior. More data are needed to further address correlations in physiological and behavioral traits and more specifically phenotypic plasticity associated with these variables and the age/size of organisms.

Unique New Species of Mite Harvestmen in the New Zealand Endemic Genus *Rakaia* (Arachnida, Opiliones, Cyphophthalmi, Pettalidae)

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Terrestrial arthropods present considerable opportunities for species discovery, especially in New Zealand, which is one of the world's biodiversity hotspots. Mite harvestmen are small invertebrates found in leaf litter on forest floors with highly limited dispersal. Our lab focused on the geographic area around Otago and Canterbury in the South Island of New Zealand to explore a group of Rakaia whose species identities and phylogenetic affinities were unknown. We sequenced the mitochondrial locus COI, and combined those data with published sequence data from Rakaia and outgroup taxa. We performed a phylogenetic analysis of the dataset and estimated divergence times using BEAST. We used scanning electron microscopy to capture high definition photos of morphology. Utilizing both morphology and genetic data, we clarified relationships among described and novel species. These exciting new discoveries further our mission to discover new species and piece together New Zealand's biogeographic history.

Can Dietary Supplements Impact Exoskeleton Color? Accessory Pigments (Carotenoids) and Color Change in Tarantulas (*Psalmopoeus irminia*)

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Color variation is well-known in spiders and is indicative of morphological characteristics used for sexual selection and aposematism. This variation is often associated with diets high in accessory pigments. Within spider species, a range of accessory pigments contribute to coloration including carotenoids, melanins, and guanine processed in chromatophores and iridophores. We investigated the role of accessory pigments within prey diet and its potential role in the color of tarantula cuticular hairs. Because tarantulas potentially lack enzymatic processes for building

accessory pigments, we hypothesized that coloration would be intensified by a diet high in carotenoids. We measured coloration in *P. irminia* spiderlings which exhibit a light color patch on metatarsal leg segments. Spiderlings from the same egg sac were separated into two groups that received either prey fed (1) a high carotenoid diet or (2) a colorless starch diet. Color on leg segments was measured from individual molts. Leg segments were imaged with a Leica microscope and compared using ImageJ. Specifically, levels of red, green, and blue (RGB) pixels, total RGB, and color intensity were compared between the diet groups and across molts. Based on just two molts, there are significantly higher color levels/intensity in the carotenoid-diet group. There are also color differences across molts but these differences (in all color measurements except blue) are only significant in the carotenoid-diet group and indicate an increase in color levels with age. Although data are preliminary and only include two molts, our study provides insight into the role of diet in development and display of color in tarantulas.

Group-living in the armored harvestman *Vonones sayi* and potential physiological benefits

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Group-living is a phenomenon prevalent throughout the animal kingdom and its widespread occurrence has garnered considerable interest in many different contexts. Group-living is extremely uncommon in arachnids, with more than 99% of species being solitary, often showing aggressive and even cannibalistic behavior towards conspecifics. However, many species of the Opiliones order show a tendency to form aggregations, which are described as a group of three or more motionless individuals, spread 0-5cm apart with their legs expensively overlapping. Despite its frequent occurrence, observations of harvestmen aggregations are often anecdotal, and little is known about ecological and evolutionary pressures leading to this behavior. One hypothesis proposed for evolution of this phenomenon in harvestmen is that it provides a physiological benefit to participating organisms. Harvestmen are at a greater risk of desiccation than most other arachnids due to their large surface-area-to-volume ratio with long legs and small bodies. By forming aggregations, harvestmen may be able to limit the risk of desiccation by reducing airflow, and therefore, integumental evaporation. Group living has also been shown to present benefits to the energy expenditure of organisms across a variety of contexts (e.g. web-building in spiders, cost of flight in birds, swimming in fish). For harvestmen, aggregating may aid in reducing the metabolic rate of individuals within the group, whether that be through

lower energy allocated towards water regulation, the calming effect, or some other physiological or ecological factor. In the current study, we conducted assays at 9 field sites within the Edge of Appalachia Nature Preserve in West Union, OH over three months. We recorded empirical evidence of *Vonones sayi* aggregations and compared the temperature and relative humidity of retreats where aggregations were present and absent. Following the field study, we collected specimens that were found individually and specimens that were living in aggregations. In the lab, we analyzed the metabolic rates of *V. sayi* individually and in groups to determine whether group living in the form of aggregations presents an energetic benefit to this species. Preliminary field data indicates that 88% of the population sampled was found in solitude or pairs, while only 12% were found in aggregations. Aggregation sizes ranged from 3 to 10 individuals, with the majority containing 3 individuals. Marked individuals also displayed a level of site fidelity. In addition, most organisms were found under rocks rather than logs or other retreat mediums. An initial comparison of our lab data suggests that groups have lower metabolic rates than individuals measured in solitary conditions. Surprisingly, although sample sizes are small, there may be a negative correlation with group size and metabolic rates. Data analysis on the field work and lab work is still underway but will be complete by the time of presentation.

Proteomics Suggest Pyriform Silk Anchors Orb Web Capture Spiral Junctions

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Spider silks are extremely versatile biological materials, with many distinct functions and properties at different parts of a spider's web. Orb web weaving spiders, such as Argiope trifasciata, rely on the capture spiral of their web to intercept and retain prey. The capture spiral is placed on radial lines that emanate from the hub to the outer structural lines. Radial lines, structural threads, and draglines are all made of major ampullate silk. Orb webs additionally require two different kinds of adhesive silks: pyriform silk, which anchors radial and structural fibers to each other and to substrates, and aggregate silk glue droplets, which are distributed along flagelliform capture spiral thread. Based on morphology of junctions, it appeared that aggregate silk glue droplets attach the capture spiral to radial fibers at intersections of the two silks found throughout the web. Large orb webs, such as those made by A. trifasciata, are typically asymmetrical, with a larger bottom region created by a series of switchbacks, prior to the spider initiating the spiral around the entire web. Past research showed differences in material properties between the glues placed on the bottom region of the web, and the innermost spirals. In this study, we used proteomics

to determine whether the differences in material properties between the bottom and inner regions of an A. trifasciata orb web could be attributed to differences in the protein composition of the regions. We found 49 proteins in at least 3 of our 6 samples, with 4 significantly different between the bottom and the inner region. The only protein that was more abundant in the bottom region was aggregate-expressed, suggesting that a spider runs out of aggregate material late in web construction. The three more abundant inner web proteins were not aggregate-expressed, but included the pyriform silk protein, PySp. Because the spirals in this region are more closely spaced, these samples included a higher number of silk junctions. This suggests that pyriform silk may play a previously unidentified role in capture spiral –radial line attachments.

Hiding in plain sight? The phylogenetic position of Leiobunum cretatum (Opiliones: Sclerosomatidae)

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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 nonsacculate 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 specimens and extracted their DNA 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.

Assessing homologies of the tegulum and embolus within dictynids (Araneae: Dictynidae)

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The adoption of the homology hypothesis of a set of determined morphological traits (characters and their states), continues to be one of the critical points within any systematic and phylogenetic study that involves phenotypic information. Within spiders, the male palp has traditionally been used, is phylogenetically informative, and in many cases is correlated with a strong phylogenetic signal. However, many palpal characters, and their states, must be re-evaluated and/or re-encoded depending on the study group. Here, we review the conductor, the tegulum, the subtegulum, and embolus within dictynids and related lineages, and propose homologies based on morphological correspondence. We find that the morphology of the duct, embolus, and tegulum could be placed the genera Aebutina, Brommella, and Qiyunia could be positioned within other families. Additionally, we find that the morphology in Argenna, Banaidja, Scotolathys, Tahuantina and Lathys exhibit putative synapomorphic characters.

Autodesk Sketchbook: An application that minimizes time and maximizes results of taxonomic drawing

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Scientific illustration continues to remain a critical part of taxonomy. Illustrations often require lots of time and, in many cases, the results are not as expected. At present, taxonomy journals only accept high quality digital illustrations; thus, image manipulation programs using vector or bitmap graphics have become the new focus of attention. This paper provides a step-by-step guide to making illustrations using bitmap graphics in Autodesk SketchBook. This application provides an alternative to

other known tools by allowing: 1) faster illustrations; 2) direct drawing with a wide range of tools that simulate traditional drawing; 3) more detailed illustrations; and 4) an easy interface and work-flow for novice illustrators, all while being completely free and compatible with multiple operating systems.

Harsh environmental conditions strengthen pace of life syndrome correlations in male Tigrosa helluo

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The Pace of Life Syndrome (PoLS) hypothesis describes a spectrum on which individuals develop rapidly at the expense of self-investment, or slowly but invest more in long-term survival. Environmental conditions can be expected to influence the relationships between life-history, physiological, and behavioral traits, therefore altering observed PoLS. In this study we collected mature spiders over the course of their active season, measured carapace widths as a proxy for development speed, performed encapsulation assays, recorded coloration, and performed behavioral assays to quantify a range of traits to see which covary with development speed, making up the PoLS in these spiders. Males that developed rapidly were more active and had higher body conditions than males that developed slower. In harsh conditions (early and late season), males with rapid development were more asymmetrical, had lower encapsulation ability, and were darker in coloration. Females did not seem to be as constrained by development speed. Females that developed rapidly were also more active behaviorally and were more asymmetrical than females that developed slowly, and these relationships also seemed to not be impacted by environmental conditions. This study describes PoLS in a wolf spider and gives evidence of strengthening syndromes under harsh conditions.

Using ultraconserved elements to delimit cryptic species in the New Zealand harvester Aoraki denticulata (Arachnida, Opiliones, Cyphophthalmi)

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Aoraki denticulata, a widespread mite harvester species endemic to the Southern Island of New Zealand, has been shown to have high levels of genetic divergence between populations despite a lack of clear morphological differences. The association of deep genetic divergence and geographic structure coupled with morphological conservatism indicates that there may be a complex of cryptic species within A. denticulata. Previous studies have utilized Sanger sequencing which limits the number of loci that can be sequenced and analyzed. Because this method has been exhaustively applied in this system without resolving cryptic species limits, we used target-enriched sequencing using ultraconserved elements to reconstruct phylogenies and conduct our analyses. In total, we sequenced two outgroup taxa and 115 Aoraki specimens, including museum specimens that otherwise would not have been able to be sequenced due to degraded DNA. We recovered 852 and 651 loci at 50% and 75% taxon coverage, respectively. We explored potential cryptic speciation in this lineage using multiple genetic species delimitation analyses, including machine learning techniques. Our findings confirm that A. denticulata exhibits deep genetic divergences and shows strong population structure; we retrieved multiple cryptic species within A. denticulata, each with a distinct geographic range. These results are promising for resolving the species status within one of the most difficult cryptic species complexes known in Opiliones.

Size matters: male-female mating behavior of *Phidippus regius* C. L. Koch, 1846 (Araneae, Salticidae).

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Phidippus regius C. L. Koch, 1846 is a large jumping spider found in the southeast United States and throughout the Caribbean. Little has been documented of the mating behaviors of this species, and here we describe the basic mating behavior and how the sizes of males and females correlate to mating success. We measured of 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. We ran 11 mating trials, with 9 females and 7 males. We documented two successful copulations. The females were on average larger than the average size of males in all measurements taken. The mating pairs had an average

total time of 33.29 minutes, with a high of 54 minutes and low of 12.57 minutes. Additionally, the males that did not mate were on average 2.21 mm smaller in regards to the measurements taken. The average total time of interaction for the non-mating pairs was 7.55 minutes, which is significantly lower than the mating pairs and there were not significant time variations of these tests with a standard deviation of 2.11 minutes. Size similarity between the male and female had a large impact on the interaction time total. The males that mated were significantly larger on average than those that did not mate. These few mm may seem like a minor difference to us, but clearly the females thought that these larger males were better mating material. The females are larger than the males by a noticeable amount, but the closer the male gets to the size of the female the better chance it may have to mate.

Social Resilience in Communal Mygalomorphs: Effects of social deprivation on aggregation patterns in *Neoholothele incei* (Theraphosidae)

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"The current focus of spider sociality is on the diverse patterns of Araneomorph group living. Yet, a number of Mygalomorph species are known to share burrows or silken tunnels beyond early development. Trinidad Olive tarantulas (*Neoholothele incei*: Theraphosidae) are a dwarf species that build extensive silk tunnels above ground and under wood on the hillsides and roadsides in Trinidad and Venezuela. Since these tarantulas can be successfully raised in captivity both solitarily and in social groups, we tested the hypothesis that aggregation in Neoholothele incei is an intrinsic feature of their behavior. To test this hypothesis, we ran two sets of experiments to assess patterns of aggregation derived from Varadínová et al. (2010) experiments assessing aggregation patterns in different species of cockroaches.

Binary choice experiments explored whether an individual would choose to move near a contained conspecific or an inanimate object over 24-hrs (n = 129 trials). The arena contained a size-matched conspecific in a mesh bag, with whom it could exchange volatiles and vibrational cues, but no tactile communication, and a cork plug in a mesh bag on the opposite side. Free interaction tests investigated what happened when four individuals were simultaneously introduced into an enclosure divided into four quadrants each with a potential retreat (half a toilet paper roll). After 24 hours, the location of each spider and its silk were recorded (n = 18 trials). In both experiments, we compared the behavior of tarantulas that had been kept in solitary conditions for

many months and tarantulas that lived in large colonies with multiple individuals (10 to 30 individuals per colony).

Our binary choice test found that socially-deprived and socially-raised tarantulas showed no difference in their tendency to aggregate, with socially-deprived tarantulas aggregating 45.0% of the time and socially-raised tarantulas aggregating 41.6% of the time. In addition, socially-raised individuals lay silk more frequently (70.8%) than socially-deprived individuals (47.5%) in the binary choice test. The free interaction test also found that there was no difference between the tendency to aggregate between the two groups, with 1.22 individuals per quadrant in trials with socially-deprived tarantulas and 1.44 individuals per quadrant in trials with socially-raised tarantulas. Even in experiments where the introduced individuals were unrelated and unfamiliar with each other, individuals tolerated each other. However, there were two instances of territorial killing, and they only occurred with socially-deprived individuals. These results suggest that Neoholothele incei are socially resilient and preferentially aggregate in many situations, even if they have been reared in a socially-deprived situation.

Evidently, when spiders can freely exchange volatile and vibrational cues, socially-deprived and socially-raised spiders aggregate similarly. Even when additional spiders are introduced and can freely interact with each other, socially-deprived spiders and socially raised spiders aggregate similarly. Taken together, while the tendency to aggregate isn't largely impacted by social deprivation, other behaviors are, including silk production and lethal aggression. Our findings suggest that Mygalomorphs with intrinsic subsociality are socially resilient, as their tendency to aggregate is unaffected by social deprivation."

The complete mitochondrial genome of *Pholcus manueli* Gertsch, 1937

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The mitochondrial genome of *Pholcus manueli* Gertsch, 1937 has been completely sequenced and annotated for the first time. Pholcus manueli is a cellar spider found in of Russia, Asia, and North America. This synanthropic species is native to Asia and Russia, and an invasive species spreading across the United States quickly. The mitochondrial genome is 14,745 base pairs long, including 22 transfer RNA genes (tRNAs), 13 protein coding genes (PCGs), 2 ribosomal RNA genes (rRNAs), and a control region. Pholcus phalangioides (Fuesslin, 1775) is a closely related spider

species. The mitochondrial genome of P. phalangioides was acquired from NCBI to compare with P. manueli. Pholcus phalangioides and P. manueli have extremely similar mitochondrial genomes.

Post-Translational Modifications of Spider Aggregate Glue Proteins Vary Across Araneoidea

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Spiders produce various types of silks that serve different functions within the web. The stiffer support fibers of silks used for prey capture by orbweb and cobweb weavers (superfamily Araneoidea) are covered by a layer of aqueous glue produced from their aggregate glands. Spider aggregate glues are composed of low molecular mass compounds, salts, and proteins and are configured as a series of regularly spaced droplets. While the low molecular mass compounds and salts are important for attracting atmospheric moisture, the aggregate proteins, which form each droplet's core, are responsible for material properties of glue, such as extensibility and toughness, that are crucial for the biomechanics of adhesion. Post translational modifications (PTMs), glycosylation and phosphorylation, likely confer adhesive ability or "stickiness" to aggregate glue proteins. We used proteomics to identify aggregate protein components and their PTMs in 16 araneoid spider species, including orbweb and cobweb weavers from a diverse range of habitats. We found that members of the spider silk fibroin (spidroin) gene family AgSp1 and AgSp2, which are expressed in aggregate glands, were the most likely to be glycosylated or phosphorylated in all of our species. While the positions of modification are often conserved, each spider species differs in the extent of the two kinds of PTMs. These differences in degree of glycosylation and phosphorylation likely contribute to variation in aggregate glue stickiness across araneoid spiders.

Investigating Homing by Path Integration in Desert Grassland Scorpions

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Desert grassland scorpions (Paruroctonus utahensis) are faithful to burrows they dig in the sand, yet the mechanisms used by these animals to get back home after hunting excursions is not fully understood. In path integration (PI), an animal integrates its distance and direction throughout the outbound journey when leaving its home, enabling it to compute an approximate home-bound vector for the return trip. The ability of other arachnids to use PI as a navigational mechanism leads us to hypothesize that scorpions may also be using PI. We are testing for PI by allowing a scorpion to establish a burrow in a damp mound of sand in the center of a circular home arena (70.5 cm diameter). Then, when the animal moves to the arena wall we note the location of the scorpion along the wall, the cardinal direction the scorpion is facing, and the angle to its burrow relative to north. We then transfer the scorpion to the center of a larger (77.5 cm diameter) testing arena that is unfamiliar to the test animal. We conduct our tests at night using overhead IR video cameras to monitor the scorpion's movements during the trials. Once a scorpion is transferred, we note its new cardinal orientation, and its movements are recorded until it crosses a fictive decision line that lays 3.5 cm inside of the testing arena wall. The decision line's placement reflects the radius of the homing arena, which is the distance the scorpion would need to travel to return home. We then use a MATLAB script to plot and analyze the scorpions' movements recorded by the IR cameras. We normalize each path, so home is 0o relative to the scorpion's new orientation. We then calculate the average vector of multiple trials for each scorpion and the average vectors of all animals to create a resultant vector. Finally, we use circular statistics to assess the vector's directional significance using a Rayleigh's Z test. If scorpions exhibit PI, they should move in a direction in the test arena that represents the same angle from the capture point to their burrow in their home arena. I am testing 12 animals with each animal running four tests. Trials are currently in progress with data to be presented at the conference.

Understanding Species Distribution in New Zealand Mite Harvestmen Using Paleoclimatic Niche Model Projections

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Originally part of the Gondwanan supercontinent, New Zealand has been isolated from any other landmass for the past 80 million years, giving it a unique array of endemic plants and animals. Mite harvestmen are dispersal-limited organisms; their distribution around the globe today is linked to continental drift tens of millions of years ago. Likewise, their distribution in New Zealand is linked to the geological and climatic history of the islands. The Last Glacial Maximum (LGM) left much of the South Island underneath glaciers and drastically changed climatic conditions of unglaciated regions, profoundly impacting New Zealand's biota. In this study, we constructed a model of climatic suitability for over 1100 collections of mite harvestmen from both the North and South islands, incorporating locality data from museum collections spanning the last century. We found a positive relationship between climatic suitability, found using maximum entropy distribution modeling, and species richness across 29 regions of New Zealand established by previous researchers for meteorological and biological studies. We also projected suitability onto the highly altered landmass of New Zealand during the LGM to find possible species-specific refugia, in order to further understand the historical determinants of diversity for these animals. Projection onto historical data proved difficult, as for one species of interest, areas of maximum projected suitability overlapped strongly with the inferred position of glacial ice. Our results likely indicate that there were small pockets of suitable habitat untouched by glaciers, but one or several large refugia were not identified.

Influence of Nutrient Consumption on Metabolic Rate and Growth Trajectory in a Sexually Dimorphic Tarantula (Theraphosidae: Tliltocatl albopilosus)

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Sexual size dimorphism (SSD) is a physiological phenomenon in which individuals within the same species vary in size, with one sex being predominantly larger. While SSD is widely described, there are limited studies on the mechanisms driving these differences such as developmental and physiological/energetic processes. In tarantulas, larger females size leads to increased fecundity within a single clutch as well as increased survivorship of the offspring. Additionally, SSD is associated with differences in metabolic rates (MRs) which is significantly higher in mature males compared to females. However, when these differences are first evident in maturing animals, has yet to be determined. In this study we examined the relationship between SSD, nutrient intake, and MRs in the curly hair tarantula (Tliltocatl albopilosus). Specifically, we addressed 1) the impact of diet on growth rate and MR and 2) whether diet has a differential impact on these factors based on sex.

Immature male and female tarantulas were randomly divided into two groups: one group was fed prey on a nutrient-rich diet and the other received prey on a nutrient-poor diet.
Although animals in the two groups have not all reached sexual maturity, both males and females on the enriched food have higher growth rates compared to the nutrient-poor group. In addition, males on the nutrient-rich diet tend to reach sexual maturity earlier than males in the nutrient-poor diet. Metabolic data is still being collected and analyzed. As a basal arachnid group as well as a popular pet species, understanding tarantula physiology and how nutrients impact their metabolic rate and growth rate, is crucial.

Size matters: male-male ritual combat in *Phidippus regius* C. L. Koch, 1846 (Araneae, Salticidae).

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Phidippus regius C. L. Koch, 1846 is recognized as one of the larger jumping spider species. They are found in the southeastern part of the United States and in the Caribbean. Male-male ritual combat is not well documented int his species, and we observed the duration of male-male interactions (including ritual combat, if it occurred) while comparing the sizes of the males in each trial. We measured of total length, carapace width, abdomen length, and abdomen width of each male, and we timed the first sighting, duration of both displaying, time until “lock up” between the two males (if occurred), duration of the “lock up” (if occurred), and which male won. In our studies we had a small sample size, but we discovered that in the P. regius world of male-male ritual combats, larger males tend to win. We did 15 trials and got conclusive results from 12 of the trials. When we put two different size males to the test, every test had indicated that even a slight difference in size, the larger male will win. In all of tests that had been done, there were size differences and not once had a smaller male taken victory. For larger males, winning will almost always sway in its favor.

Male rearing temperature affects cytoplasmic incompatibility by endosymbiotic bacteria in a linyphiid spider host

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Bacterial endosymbionts manipulate reproduction in many arthropod host species to increase infection rate within the host population. One such manipulation is cytoplasmic incompatibility (CI), wherein uninfected females produce infertile eggs when mated with infected males. CI is found in both insects and arachnids but is better studied in insects. It is not clear whether conclusions from studies on insect host systems apply to spider hosts. In the spider Mermessus fradeorum (Linyphiidae), CI is caused by a novel bacterial symbiont in the genus Rickettsiella. We have recently found that CI strength has gotten weaker in this system, corresponding with changes in rearing conditions. In parasitoid wasps, it has been found that male developmental time correlates to strength of CI induction, so we hypothesized that male development time also affected CI strength in M. fradeorum. I changed the development rate of Rickettsiella-infected spiders by manipulating both temperature (20°C vs 26°C) and feeding conditions (a fly every 4 vs every 10 days). Average development time increased by 9 days with lower temperatures, 20 days with lower feed, and 27 days with both, relative to the high feed and temperature group. Males were then mated with uninfected females to test CI strength. The same males were mated a week later to Rickettsiella-infected females as a control to test male fertility. Female spiders were allowed to lay up to 3 egg masses, and the hatch rate of the eggs for both groups was then determined via dissection of egg masses. I found that the hatch rate of compatible matings between infected males and infected females was uniformly high (0.992 ± 0.005) and significantly higher than incompatible crosses between infected males and uninfected females (0.274 ± 0.036). Among incompatible crosses, I found that for males reared at the higher temperature, the hatch rate was 2.15x higher than for matings with males reared at the lower temperature (P=0.0011). Male feeding rate was not significantly associated with hatch rate, indicating that temperature, rather than developmental rate more broadly, influenced strength of CI. However, hatch rate across all incompatible matings was highly variable, implying additional factors influence the symbionts' effectiveness at inducing CI. These results suggest that symbiotic manipulation of arthropod reproduction may be quite sensitive to environmental conditions. This may prove important as a factor in changing the structure and functionality of symbiont populations with climate change.

Web Contests between an Crossopriza lyoni (Araneae: Pholcidae) and Pholcus manueli (Araneae: Pholcidae)

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"In Southwest Ohio there are two coexisting species of cellar spiders, Pholcus manueli (Araneae: Pholcidae) and Crossopriza lyoni (Araneae: Pholcidae). About 15 years ago, P. manueli became locally abundant in the area. In 2019, C. lyoni, was identified in Southwest Ohio. The dynamics between the invasive P. manueli and the newly establishing C. lyoni are currently unknown. We hypothesized that the two species would compete over webs as they seek to a) occupy similar spaces and b) conserve energy by not weaving energy intensive webs. Crossopriza lyoni (~7mm) greatly outsize P. manueli (~5mm) as adults and as such, contests over P. manueli webs were conducted between both size matched immature C. lyoni and adult P. manueli and size mismatched adults. Both absolute and relative size, mass, and body condition were measured, and the number, latency to, and initiator of interactions were recorded, along with web contest outcome.
Contest outcome, aggressive interactions, and non-aggressive interactions were recorded. Three of 26 trials ended with C. lyoni as a clear victor; the other 23 trials ended in ties with individuals of both species sharing the web. A model selection was run to determine what variables led to a greater ratio of aggressive interactions (number of aggressive interactions/total interactions). The model selection found the ratio of aggressive interactions increased when the two species were closer in size and condition. As neither species consistently won, the outcome of the web contest do not point towards direct competition being a significant component of the dynamic between these species. However, the model does suggest that the incidence of aggressive interactions will be higher when the species are approximately the same size.

Revealing the effect of movement on background matching using jumping spiders as predators

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Motion has long been believed to “break” camouflage, as abrupt movements can be easily detected even before the animal is recognized. Background matching, for instance, is a well-known, effective camouflage strategy where the colour and pattern of a stationary animal match its surrounding background. Background matching may

lose its efficacy when they move as their edges become more defined. However, recent evidence shows otherwise as camouflaged objects can be less detectable than uncamouflaged objects even when movement is involved, albeit still limited. Here, we explored if there were differences in detectability of computer-generated stimuli (i.e. conspicuous and background matching) moving at varying speeds among jumping spider species (Araneae: Salticidae). Our results showed that jumping spider responsiveness decreased with increasing stimulus speed. More importantly, we observed significant differences in motion detectability among species for conspicuous stimuli, thus suggesting differences in visual acuity within the same subfamily. Whilst no significant differences were found among species for the background matching stimuli, salticid responses were significantly lower compared to the conspicuous stimuli. Our results suggest that background matching stimuli moving against a textured background are more difficult to detect compared to uncamouflaged stimuli, thus highlighting the effectiveness of background matching in reducing the detectability of moving stimuli.

Vibratory courtship signals and mating in Schizocosa saltatrix (Hentz 1844).

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"Wolf spiders in the genus Schizocosa have been studied extensively as a model for the evolution of animal communication. Deciduous forest floor dwelling S. saltatrix occupy the same habitat as S. ocreata, well-known for its multimodal communication with visual and vibratory courtship signals. However, the slightly larger S. saltatrix show no ornamentation, pigmentation in mature males, nor do they exhibit visual displays in courtship, suggesting greater reliance on unimodal signals via vibration. We recorded and analyzed vibratory courtship signals of S. saltatrix, to examine signal variation across different leaf substrates and whether aspects of male vibratory signals are related to mating success.
Courtship vibration signals were recorded with a Laser Doppler Vibrometer (LDV), while behaviors were recorded by video camcorder. Vibration signals of S. saltatrix consisted of complex pulses of low frequency vibration, with three distinct components: “hum”, “rattle” and “strike”. The amplitude and power spectrum of signals varied significantly with different leaf substrates, but not with mating success. While mating probability was not related to amplitude of signals, and there were only subtle differences in power spectra between mated and unmated males, signal pulse rates and complexity (number of individual components) were greater for successful males.

Maternally-inherited symbionts in spiders: diverse, novel, and mysterious

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Arthropods are frequently infected with maternally-inherited bacterial symbionts. In insects, these symbionts have been shown to affect many important aspects of their hosts' biology, including nutrition, reproduction, immunity, ecology, and evolution. In spiders, symbiont infections are as common as in insects, but the scope of phenotypic effects is virtually unexplored. Here we provide initial documentation of diverse symbiont infections across several spider host systems, including at least two novel bacterial clades that appear to have specialized on non-insect hosts. It may, therefore, be premature to infer symbiont function in spiders based on what we know from insects. Given the frequency of infection, however, it is likely that symbionts have important biological effects on their spider hosts that remain to be discovered.

Predicting Past Distributions of Libitioides sayi and L. ornata (Arachnida: Opiliones: Cosmetidae) Using iNaturalist Occurrence Data

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The harvestman family Cosmetidae contains 750 species distributed throughout much of South America and into to the southern USA. Distributional data for most cosmetid species is limited to only a few occurrences. We compiled occurrence data from iNaturalist for two species of Cosmetidae that occur in the USA: Libitioides sayi (Simon, 1879) and L. ornata (Say, 1821). We constructed species distribution models using Maxent implemented the R package 'dismo'. Species distributions were estimated based on three climatic scenarios: present-day, Mid-Holocene (~6,000 years ago), and Last Glacial Maximum (LGM, ~21,000 years ago). Environmental predictor variables included data from WordClim and ENVIREM. Distribution models suggest that L. ornata and L. sayi have distinct present-day distributions, with a very narrow range of sympatry. These present-day distributions were likely well established prior to

the mid-Holocene. Our models further suggest that these two species utilized different refugia during the LGM. In addition to species distribution models, we will discuss the morphological differences between the two species and the high degree of variation in the dorsal color patterns.

International Presentation Abstracts

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Differences in defensive repertoire on harvestman *Pseudopucrolia discrepans* (Roewer, 1943) according to the period of the day

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Among the various organisms groups that comprises the arachnid class, harvestmen correspond to the third order with the greatest species diversity. These arachnids are considered useful models for studies on defensive behaviors due to the fact that they present both primary and secondary defense mechanisms. However, the frequency of use of each defensive strategy can be influenced by the periods of the day (day and night), since the animals will have to deal with different predators types. Therefore, the current study aimed to analyze the behavioral repertoire in individuals of *Pseudopucrolia discrepans* during the day and night. To carry out the work, were used 60 individuals (30 males and 30 females) collected in a Atlantic Forest fragment in the Jaboatão dos Guararapes municipality (08º 06' 46" S; 35º 00' 53" W), Brazil. The animals were tested in each period of the day (15 males and 15 females) and night (15 males and 15 females). The trials were carried out from simulation an predators attack, which corresponded to the act of holding the IV leg of each specimen for 10 seconds, with the tweezer. Our results showed that P. discrepans performs six defensive acts, in which pinching, chemical release, freezing and body tremor were the most used. Pseudopucrolia discrepans females showed a significant difference in the use frequency of strategies during the day and night ($G_{2,4} = 26.60$, $p < 0.0001$), while males showed similar frequency in both periods ($G_{2,3} = 1.63$, $p = 0.44$). During the day, the females used about 20% more freezing when compared to the group that was tested at night period. On the other hand, the chemical release and pinching were

more performed at night, with no discrepancy in the use of these same defenses in the males individuals. In summary, our results suggest that the harvestman P. discrepans exhibit a great variety of defensive strategies. Also suggests that the sexes and periods of the day play an essential role as for the frequency of the defensive responses of this species.

Preliminary assessment of road effect in spider abundance from Brazilian Atlantic forest remnant

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The construction of highways directly impacts the fauna through the formation of new edge environments. However, studies measuring the effect of highways focused on invertebrates such as spiders are scarce. Thus, in the present study we evaluated the effect of road traffic intensity on the abundance of understory spiders in an Atlantic Forest remnant at the Centro de Instrução Marechal Newton Cavalcanti (07°46´55”S, 35°09'02”W) , Brazil. The collections were made from January to March 2022 between 8:00 AM - 15:30 PM, along two roads with different traffic intensities (constant use and disuse). In both areas, spiders were collected at a distance of 10m between the edge and the road, in twelve transects (30m long by 10m wide) spaced 20m apart. All shrubs located inside each transect were sampled using an entomological umbrella (30 cm x 30 cm) and received 10 strokes with a wooden stick. In total, 887 spiders were collected, with a significantly higher number of individuals (one-way ANOVA: $F = 5.5902$, $p = 0.0226$) occurring on the transects of the road with heavy traffic ($n = 521$) when compared to the disused road ($n = 366$). This discrepancy of individuals between the areas is due to the fact that the vegetation of the highway with greater movement is composed of grasses and shrubs, consequently providing suitable places for generalist species. On the other hand, at the disused highway site, the vegetation is largely composed of arboreal and canopy plants, presuming that the area is home to a greater diversity of spiders and specialists in that environment. These preliminary results suggest that roads considerably alter the abundance of this group and probably also put selective pressures on its diversity.

Effect of different insecticide groups on the predatory behavior of the scorpion Tityus pusillus Pocock, 1893 (Scorpiones, Buthidae)

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Scorpions represent one of the biggest public health problems in several tropical countries as Brazil. In this country, most of scorpion accidents are caused by species from genus Tityus Koch, 1836. The main way to control these arachnids is by insecticides application, however, this method not showing a scorpion lethal effect. Scorpion insecticides exposure may possess a sublethal effect causing behavioral changes as increase its search for shelters. Therefore, in this study we assessed the effects of different insecticides groups in scorpion Tityus pusillus Pocock, 1893 front of previously exposed prey. We used 60 T. pusillus individuals from Atlantic Forest fragment in Estação Ecológica de Tapacurá, (8°02'18.4"S, 35°11'29.2"W), Brazil. To avoid sick or pregnant animals all scorpions were conditioned to a 15 days quarantine, at ambient temperature 27 ± 3 ºC, photoperiod 12:12h, with water availability and fed weekly, until seven days before the experiments, with cockroaches Nauphoeta cinerea Oliver, 1789. Scorpions were divided into following groups: control group (without insecticide exposure), pyrethroid group and oxadiazine group (n=20, each). To investigate the effect of different insecticides on the predatory behavior of T. pusillus, cockroaches treated with pyrethroid (contact action) and oxadiazine (internal action) were offered as prey to the animals. Overall, T. pusillus individuals shows a higher interest in offered cockroaches (75%). However, scorpions showed significantly less interest in the oxadiazine treatment cockroaches ($\chi^2 = 5.747$; GL = 1; p = 0.0216), where only 45% (n=9) of scorpions have tried to capture the cockroaches offered. Regarding the latency time of scorpions to capture prey, no significant differences were found between groups (H = 0,8524; GL = 2; p = 0,6530). In addition, the oxydiazine group took longer time (209.55 ± 211,35 seconds) to try to capture the prey than both others groups (control group took 142.40±174.59 seconds and pyrethroid group took 149.33 ± 130.33). Besides that, some scorpions (n=5) showed signs of intoxication soon after catching or ingesting the cockroaches previously treated with pyrethroid. However, these individuals show the ability to reverse the intoxication frame 7 days after prey exposure. The animals that fed on prey from the oxyadizine group did not show any intoxicate signs. Besides that, only one individual died after consuming a pyrethroid-treated cockroach. Therefore, these results suggest that individuals of T. pusillus possess resistance to insecticides from pyrethroid and oxadiazine groups.

Genetic response of Jaguajir rochae (Scorpiones: Buthidae) to environmental radioactivity in Northeastern Brazil

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From back in the Silurian until today, scorpions have faced constant evolutionary pressures. One of them is the natural radioactivity that is known to affect the survival of organisms, increase oxidative stress, interfere with protein activity and the DNA molecule in many taxa. On this basis, we have aimed to evaluate the DNA integrity of scorpions collected on sites of accentuated natural radioactivity in North-eastern Brazil through the comet assay. *Jaguajir rochae* (Borelli, 1910) individuals were collected from the municipality of Parelhas (alpha particle = 200.3±59.0 Bq/m³) in the state of Rio Grande do Norte. Five individuals were submitted to the comet assay methodology as soon as it arrived from the field. We also kept ten individuals under laboratory conditions for three months. After this period, five *J. rochae* were submitted to comet assay, and the last five were exposed for 6 days in the municipality of Cerro Corá (alpha particle = 3374.3±548.72 Bq/m³), also in Rio Grande do Norte, and comet assay was applied anew. The comet assay was made under alkaline conditions, in triplicates with four microscope slides being constructed for copy. To analyze the genotoxicity from the original environment, lab condition and exposure site, two slides from each replica were observed under a fluorescence microscope with 50 µl of GelRed solution applied. The nucleoids were classified from zero (absence of damage) to four (highest damage observed). Damage Index (DI) and Damage Frequency (DF%) were calculated as parameters for evaluation. Analysis of variance (ANOVA) with Bonferroni post-hoc was conducted using STATA 14.2. Our results highlighted that scorpions from Parelhas presented a high DI and DF% (67.67 and 28.67, respectively) on collection, with an accentuated decrease in the animals kept away from environmental radiation (DI: 34.67; DF%: 16.33). When exposed on Cerro Corá, the parameters analyzed demonstarted an increase in the genotoxicity (DI: 48.67; DF%: 28.67). Therefore, we assumed that the environmental radiation may be affecting the DNA integrity of the scorpions, and once that impacting factor is taken, the genetic material repairs itself more efficiently. However, to expose the scorpions to that environmental variable once again may result in an increase of DNA breaks. It may be presumed that if the exposure time was longer, a higher genotoxicity would be observed, since the radioactivity of Cerro Corá is sixteen times greater than that of Parelhas.

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