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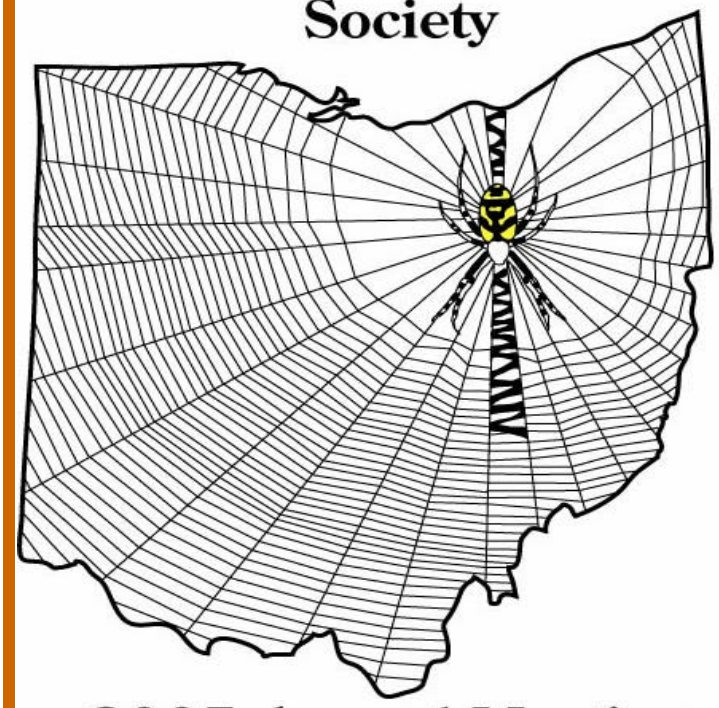

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Future A.A.S. Annual Meeting Sites

2006– 17 ➞ 21 June
College of Notre Dame,
Baltimore, Maryland
2007– Susquehanna University,
Selinsgrove, Pennsylvania
2008– UC Berkeley, Berkeley, CA

AMERICAN ARACHNOLOGY

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http://WWW.AMERICANARACHNOLOGY.ORG. Members of the Society also receive the JOURNAL OF ARACHNOLOGY (published triannually) and have access to electronic resources (e.g. JOA OnLine).

Report from the 29th Annual A.A.S. Meeting University of Akron, Akron, OH, 26-30 June 2005

Hosted by Dr. Todd Blackledge

Dr. Maggie Hodge

Dr. Sam Marshall

The 2005 AAS meeting was meticulously planned and executed by our hard-working hosts (after expertly-managing a change-of-venue) at the University of Akron in Akron, Ohio. All in attendance agreed that it was an informative, relaxed, and entertaining meeting that provided many opportunities for arachnologists to confer, learn, and socialize. Todd, Maggie, and Sam deserve a hearty "**Thanks & Well Done!**".

The 2005 AAS meeting began with a Sunday evening reception in the University's Student Center for a bit of socializing and reacquainting with friends. The meeting began in earnest on Monday morning with a

symposium on "Spider silk: Form and function across biological levels" that included talks ranging from the material properties and molecular composition of silk through the evolution of silk spigots and spinnerets to the use of silk in information transmission. Lunchtime began with the traditional group photograph, which was taken on the steps of historic Buchtel Hall where the University took root as a small college in 1870. The afternoon concluded with a paper session on morphology and physiology. Soon thereafter arachnologists could be found congregating at the local pubs and eateries on Main Street in the heart of downtown Akron.

The next day's sessions included evolution & systematics, ecology, and behavior. Oral presentations were followed by an excellent late afternoon poster session in the student center's ballroom. This gave everyone an opportunity to spread out and discuss their favorite arachnids. Finally, after dinner, it was time for a casual evening with arachnids. Here, we learned about the fierce and mysterious "chicken spider" and just how awful most people are at identifying the brown recluse. A brief history of the AAAFF (Arachnological Association for the Absorption of Federal Funds) was presented by co-founder Al Cady, followed by Rick Vetter who proposed some new spider genus names based on poorly-preserved specimens and electronic images he had been sent for identification.

Wednesday morning found everyone back for a full day of paper sessions on behavior, ecology, and evolution & systematics. The sessions culminated in a preview of the 2006 meetings, which will be hosted by Nancy Kreiter in Baltimore, MD. Finally, it was time for the Wednesday evening banquet and auction. George Uetz reprised his role as auctioneer extraordinaire, assisted as always by Al Cady playing the role of the lovely and talented Vanna. This year's oral and silent auctions raised a total of $2295. The evening ended with a musical performance by Jeremy Miller and Al Cady. They were accompanied by the singing talent of George Uetz who made an on demand performance after a collection of more than $160 from the audience. The money goes to the Arachnological Research Fund to help the next generation of arachnologists.

The meeting concluded on Thursday with two field trips. The more culturally-minded arachnologists headed to Cleveland for a trip to the Rock and Roll Hall of Fame. The more dedicated arachnologists headed into the field at the University's new field station at the Bath Nature Preserve. There they conducted the first survey of arachnids on the preserve while dodging afternoon thunderstorms. Early results have turned up almost 200 species of arachnids, several of which are new state records! Follow this link for more details: http://www3.uakron.edu/biology/blackledge/bath_spiders.htm. In summary, the organizing committee would like to thank all of the participants for making the 2005 meetings a great success and to say that we are looking forward to enjoying next year's meeting.

2004 AAS Field Trip Report

Rich Bradley provides us with this report:

(Many thanks to Rich! -Ed.)

On Thursday June 30, 2005 in conjunction with the 29th meeting of the American Arachnological Society, a field trip was taken to the Bath Nature Preserve and Field Station. This 404 acre tract was, at one time, the country estate of tire magnate Raymond Firestone. The property is now managed through a partnership between The University of Akron and Bath Township. The preserve property has a mixture of grasslands, deciduous, and riparian forests, wetlands, a Tamarack bog, ponds, and streams.

After the short drive to the preserve, the group of 35 attendees were met at the University of Akron's Martin Field Center by Peter Niewiarowski and Randy Mitchell. Randy provided a bit of history about the Firestone property and the community/university partnership in development of the nature preserve. Brian Patrick provided a short introduction to his research work on the influence of nitrogen supplementation on community structure (including work on spiders).

At this point the arachnologists dispersed into the bush. A number of people walked around the reserve, observing and collecting spiders and appreciating the interesting habitats on the station. Brian also guided some members of the group on a tour of his study plots. In addition, a few of us requested that he show us the small remnant Tamarack Bog on the reserve property. Several intrepid arachnologists accompanied Brian to this interesting site. On a trip to this area earlier in the week, Charles Dondale and Brian had located a number of unusual wolf spiders. These included what may be an undescribed species of *Hogna*, and some unusual members of the genus *Pirata*. Charles and Brian also captured the first specimen of *Trochosa ruricola* for the state.

The group found large numbers of interesting spiders and these have been compiled and posted on a web site by Todd Blackledge. Todd is still collecting information, so if you have made determinations on any specimens you collected you should contact him. The site's URL is:

http://www3.uakron.edu/biology/blackledge/bath_spiders.htm

Among the interesting species that have been found (on this field trip and on Brian Patrick's study sites at the preserve) are a number of species new for Ohio including: the wolf spider; *Pirata giganteus* and the linyphiids; *Oedothorax trilobatus, Walckenaeria palustris, Scyletria jona, Eperigone entomologica, Maso sundevalli*, and *Allomengea dentisetis*. One species that I was particularly interested in learning about is the ant mimic salticid *Myrmarachne formicaria* (DeGeer). I handed out a short flier with illustrations, and within a few hours the species had been located. In fact, they were found quite close to the buildings. This spider is thought to be a relatively recent introduction to North America, probably from Eurasia. It is known in Ohio only from sites in the north-eastern portion of the state. The range may be expanding.

The weather was extremely cooperative and the company was delightful. This was another very successful field excursion for the Society.

Podium Presentation Abstracts

SILK SYMPOSIUM ABSTRACTS

* *designates student competition entry

An integrative approach to deciphering spider silk evolution

Nadia Ayoub & Cheryl Y. Hayashi
Biology Department, University of California, Riverside, California

Spiders use silk for a variety of tasks throughout their lifetime. These tasks include safety draglines, prey capture nets, protective retreats, and coverings for eggs. Some lineages of spiders make only a few general-purpose silks while other lineages synthesize many specialized silks. Wide interest in spider silks has stemmed from the remarkable mechanical properties of some silks, which possess both extraordinary toughness and extensibility. Silks are composed of highly repetitive proteins that are encoded by a multi-gene family. To understand the structure, function, and evolution of spider silk genes, proteins, and fibers, the Hayashi research group takes a three-pronged approach. First, we quantify the biomechanical properties of silk fibers spun by a diversity of species. Second, we construct cDNA (gene expression) libraries from the silk glands of phylogenetically diverse species to determine the coding sequences of silk proteins. Third, we have built a genomic library (~3X genome coverage, ~40 kilobase insert size) from the Western black widow, *Latrodectus hesperus*. We are using this library to characterize silk gene architecture and regulatory regions. Our various silk genotypic and phenotypic data are integrated within a phylogenetic framework to trace the evolutionary steps that have led to the present diversity of spider silks.

Spider silk: a 400 million year experiment in materials science

Todd A. Blackledge
Department of Biology, University of Akron, Akron, Ohio

Silk plays an integral role in many aspects of the lives of spiders including protection against predators or the environment, capture of prey, dispersal, communication, and reproduction. Thus, the mechanical performance of spider silk is likely to have been shaped by natural selection and can provide insight into how spiders interact with their environment. The material properties of spider silk result from how the constituent proteins of silk fibers are assembled and interact with one another. Therefore, the biomechanical study of spider silk can potentially link together research ranging from the evolution of silk genes through the ecological function of webs or other silk structures. Here, I discuss some of my recent research on the biomechanics of orb-weaving spider silk. In particular, I demonstrate that *Argiope argentata* spins a diverse toolkit of silks, including five different fibrous silks each of which has its own unique mechanical characteristics.

Overview of spinneret, spigot and web architectures in spiders

Jonathan A. Coddington
Department of Entomology, Smithsonian Institution, Washington, D.C.

Spigot and spinneret diversity is now known for many phylogenetically important spider families and taxa via SEM studies. The increasing functional specialization and morphological complexity from *Attercoppus* to *Uloborus* is undeniable. The latter (and similar derived cribellates) still retain the most diverse set of spigots. Primary homology statements (pre-analytical "binning" of morphological diversity into untested sets), however, are still guided by quite a "orbiculo-centric" worldview. Specifically, only seven homology classes of glands (and spigots) are recognized: cribellar, ampullate, piriform, aciniform, cylindrical, aggregate and flagelliform. Orbweavers remain the only lineage in which silk behavior, function, morphology, histology, and, increasingly, genetics have been studied. As a consequence, we still pack the observed diversity of all other spiders into those few categories. Published information on non-orbicularian gland histology, much less the crystallographic organization, amino acid composition, or genetic underpinnings, is sparse. Yet it seems improbable that the actual evolutionary spectrum of spider silk-spinning can be correctly inferred from just Orbiculariae. This talk reviews the evolution of spinning systems and products, and focuses on some of the probable anomalies and mysteries that non-orbicularian research has uncovered.

Variation in the *Flag* gene among *Nephila clavipes* in Mexico

Linden E. Higgins[1], Sheryl White[1], Juan Nuñez-Farfán[2] & Jesus Vargas[2]
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The gene coding for the spider flagelliform silk, *Flag*, is one of the more recently characterized silk genes, and codes for one of the more recently evolved silks. Like many silk genes in spiders and other arthropods, the *Flag* gene has a nested structure: small glycine and proline rich motifs repeat within larger motifs. In *Flag*, the larger motifs are ensemble repeats of up to 61 small motifs on either side of a non-repetitive glycine-poor spacer. Each ensemble repeat corresponds to an individual exon. Many authors have speculated that the repeating motifs of silk genes may evolve like "minisatellite" DNA, with misalignment during recombination generating variation upon which selection could then act. This misalignment could also lead to homogenization of the sequences across the repeats, or gene conversion. The most effective way to test these models is to investigate variation among individuals within a species, but the majority of silk genes that have been sequenced have only been sequenced once for a particular species. Here, we present a comparison of sequences of one exon from eight individuals from four populations in Mexico.

Analysis of the conserved N-terminal domains in major ampullate spider silk proteins

****Dagmara Motriuk-Smith[1], Alyson Smith[1], Randolph V. Lewis[1] & Cheryl Y. Hayashi[2]**
[1]Molecular Biology Department, Univ. of Wyoming, Laramie, Wyoming
[2]Department of Biology, University of California, Riverside, California

Major ampullate silk, also known as dragline silk, is one of the strongest biomaterials known. This silk is composed of two proteins Major Ampullate Spidroin 1 (MaSp1) and Major Ampullate Spidroin 2 (MaSp2). Only partial cDNA sequences have been obtained so neither the entire sequence nor the N-terminal domain have been characterized for either protein. Here we report the sequence of the N-terminal region of major ampullate silk proteins from three spider species: *Argiope trifasciata*, *Latrodectus geometricus*, and *Nephila inaurata madagascariensis*. The amino acid sequences were determined from genomic DNA. Northern blotting experiments verified that the predicted 5' end of the transcript is present in fibroin mRNA. Silk protein N-termini can be distinguished from repetitive regions by a unique amino acid sequence. Analyses comparing the level of identity of these N-termini show that it is the most conserved part of the silk proteins. Two DNA sequence motifs identified upstream of the putative transcription start site are potential silk fibroin promoter elements. Silk protein N-terminal sequences may provide information useful in a better understanding of biochemistry of silk fiber formation and developing a more efficient production of synthetic silk protein. DNA and amino acid sequences can also be used as new markers to identify silk proteins and their evolutionary relationships.

The evolution of spider prey capture thread and the limitations of cribellar thread

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Spider evolution has been marked by new mechanisms of capture thread adhesion and by the enhancement of existing mechanisms. The origin of the large Infraorder Araneomorphae coincided with the appearance of aerial capture webs and cribellar capture threads that increase the web's ability to retain prey. Cribellar threads produced by members of the basal family Hypochilidae are formed of cylindrical fibrils that rely on van der Waals forces to adhere to smooth surfaces

and on snagging to hold rough surfaces. In contrast, members of the remaining 21 families of cribellate spiders (with the exception of Filistatidae) produce nodded fibrils. These nodded fibrils generate stronger capillary forces in addition to the adhesive forces of cylindrical fibrils. The origin of orb-weaving spiders was marked by an increase in cribellar thread stickiness, achieved by threads formed of a greater number of fibrils. A major increase in capture thread stickiness occurred in araneoid orb-weavers, where viscous threads replaced cribellar threads. This increase may be explained, at least in part, by the ability of these viscous threads to overcome two limitations to the stickiness of cribellar threads. More of the material invested in a viscous thread appears to contribute to its stickiness. Viscous thread architecture appears to overcome the tendency of a cribellar thread to generate effective adhesion only at the edges of its contact with a surface.

Silk reduces plant damage caused by pest insects

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[2]Dept. of Natural Resource Sciences, McGill Univ., Quebec CANADA

Spiders dominate the terrestrial predatory arthropod community and can have strong effects on potential prey even in situations where there is no possibility of predation. Since spiders are ubiquitous predators and they all produce silk, we explored whether the silk dragline could serve as a signal causing pest insects to reduce their activity or relocate. We hypothesized that spiders could reduce plant damage caused by herbivores if the insects reacted to the silk left behind by the spider. We applied freshly produced spider silk and commercially available silkworm silk to snap bean leaves enclosed with either Japanese Beetles or Mexican bean beetles in the laboratory and in field enclosures. In addition, we applied both types of silk to individual leaves of unenclosed leaves in the field. In separate experiments we applied silkworm silk to all the leaves of an entire plant and either enclosed the plant with beetles or left it exposed so that it could experience natural herbivory. In all cases, leaves treated with experienced less leaf damage. These results suggest that silk may be an important signal to insects that a predator is foraging in the area. Thus, silk may play an important role in integrated pest management or biological control.

Molecular characterization and evolutionary study of spider tubuliform (eggcase) silk protein

****Maozhen Tian & Randolph V. Lewis,**
Department of Molecular Biology, Univ. of Wyoming, Laramie, Wyoming

As a result of hundreds of millions of years of evolution, orb-web weaving spiders have developed the use of seven different silks produced by different abdominal glands for various functions. Tubuliform silk (eggcase silk) is unique among these spider silks due to its high serine and very low glycine content. In addition, tubuliform silk is the only silk produced just during a short period of time, the reproductive season, in the spider's life. To understand the molecular characteristics of the proteins composing this silk, we constructed tubuliform gland specific cDNA libraries from three different spider families, *Nephila clavipes*, *Argiope aurantia* and *Araneus gemmoides*. Sequencing of tubuliform silk cDNAs reveals the repetitive architecture of its coding sequence and novel amino acid motifs. The inferred protein, tubuliform spidroin 1 (TuSp1) contains highly homogenized repeats in all three spiders. Amino acid composition comparison of the predicted tubuliform silk protein sequence to tubuliform gland protein indicates that TuSp1 is the major component of tubuliform silk. Repeat unit alignment of TuSp1 among three spiders shows high sequence conservation among tubuliform silk protein orthologue groups. Comparative analysis demonstrates that TuSp1 represents a new orthologue in spider silk gene family.

Effect of starvation and web removal on composition of sticky droplets in orb webs (Araneae, Araneidae)

Mark A. Townley & Edward K. Tillinghast
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Orb web sticky droplets contain a variety of small compounds that often account for half or more of the dry weight of the web. In three araneid species (*Araneus cavaticus*, *Argiope aurantia*, *Argiope trifasciata*), we investigated how starvation affects the composition of the droplets and tested the prediction that organic droplet compounds more readily synthesized by the spider decline less rapidly during fasting than those less readily synthesized. We estimated the ability of spiders to synthesize the organic compounds using radiolabeled metabolites. Many changes observed with fasting were consistent with the prediction. Especially conspicuous was the apparent partial replacement of *N*-acetylputrescine by the similar but more readily synthesized 4-aminobutyramide (GABamide) in starving *A. trifasciata*. Other changes, however, such as a decline in alanine in starving *A. trifasciata*, were not predicted from the synthetic capacity measurements. Moreover, feeding controls often exhibited changes similar to those observed with starving spiders. This suggests that starvation alone did not account for all shifts in composition in starving spiders and that factors shared by starving and feeding spiders also contributed to these changes. Perhaps most important, webs were removed for analysis each day in both starving and feeding groups, thereby denying spiders the opportunity to recover web constituents by ingesting old webs. Another possibility is that some changes that did result from starvation were similarly exhibited by feeding spiders because the latter experienced shortages for web construction as a result of allocating resources to growth, oviposition, or heavier webs.

Information transfer and spider silk

R. Stimson Wilcox
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Spider silk is involved in vibratory, visual, and pheromonal information and disinformation transfer in a wide variety of contexts, including mating and agonistic behavior, species-specific identification, prey luring/capture, predator avoidance and deterrence, orientation on the web, and echolocation. Information transfer using silk has apparently directly shaped the evolution of web design in some species, where physical properties of silk, as they relate to information transfer, are involved in web design.

ORAL PRESENTATION ABSTRACTS

Fluorescence in spiders

Kindra Andrews & Susan E. Masta
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Most studies of the color properties of organisms have focused on the portion of the light spectrum that is visible to humans. However, many animals are able to detect wavelengths in the ultraviolet range, and recent research with birds has uncovered some surprising patterns of ultraviolet reflectance. While examining the potential for ultraviolet reflectance in jumping spiders, we discovered that some spider setae also fluoresce when exposed to UV light. While the fluorescent properties of the scorpion cuticle have been well-documented, fluorescence in other arachnids has not been studied. Therefore, using an ultraviolet light and a digital camera, we have photographically documented the existence and distribution of fluorescence in spider setae and cuticles from diverse taxa. We present data from spiders from the families Antrodiaetidae, Theraphosidae, Gnaphosidae, Thomisidae, Clubionidae, Salticidae, Lycosidae, Araneidae, Agelenidae, and Theridiidae.

Because nothing is known of the potential adaptive value of fluorescence in spiders, we have explored correlations between fluorescence and behavioral and ecological traits, such as time of activity (diurnal or nocturnal), prey capture strategies (hunter-wanderer, orb-weaver, or sit-and-wait), and sensory characteristics (visually oriented spiders versus spiders relying more on other senses). Our studies so far indicate that fluorescent setae are correlated with diurnal activity, but there are complex patterns associated with feeding strategies and visual capabilities. We discuss the potential evolutionary significance of fluorescence in spiders.

Evolution of habitat-use in a desert spider, *Agelenopsis aperta*

Nadia Ayoub

Biology Department, University of California, Riverside, California

In the past, phylogeography has been primarily used to track historical events of species, such as colonization of islands or population fragmentation. A potentially powerful application of phylogeography is to trace the evolutionary history of adaptations to different habitats. The desert spider, *Agelenopsis aperta*, presents a unique opportunity to complete just such a study. An extensive background database exists for *A. aperta* on the genetic basis of adaptations to different habitats: arid and riparian. Furthermore, riparian patches are widely distributed throughout the spider's range of the desert southwest United States making migration between patches unlikely. In order to assess whether adaptations arose once and spread throughout the range of *A. aperta* or arose multiple times via recent natural selection, I used mitochondrial DNA sequences to examine population history of riparian patches and surrounding arid populations distributed across the range of *A. aperta*. Riparian patches exhibited identical mitochondrial DNA haplotypes to surrounding arid populations. On the other hand, geographically distant populations were genetically distinct. These population genetic patterns indicate that adaptations arose as a result of recent natural selection.

A morphometric analysis of mygalomorph carapace shape and its efficacy as a phylogenetic character

David Beamer & Jason E. Bond

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Despite the fact that shape features are often used as characters in cladistic analyses they are seldom delineated in an objective, repeatable fashion. Carapace shape is one such character that is often used in analyses of mygalomorph spider relationships. For example, most analyses (Raven 1985, Goloboff 1993, Bond & Opell 2002) use cephalic region morphology (e.g., steeply arched vs. flat or sloping) as a key feature that delineates (in part) some major clades. In practice carapace shapes at the extremes are relatively easy to identify; however, intermediate carapace shapes have proven to be much more difficult to objectively score in one of three shape categories. In this study carapace shape is used as an exemplar characteristic to evaluate the utility of shape features in phylogenetic analyses and to evaluate our ability to effectively score discrete character states. We digitally photographed 173 spider carapaces from specimens sampled across all 15 nominal mygalomorph families and traced outlines and pseudo-landmarks. An Elliptic Fourier Analysis was then employed in an attempt to both delineate and assess character states.

Molecular phylogenetic analyses of Sicariid species relationships and sphingomyelinase D gene family evolution

Greta J. Binford, Chris Ellison, Kate Baldwin, Melissa Bodner & Melissa Callahan

Department of Biology, Lewis and Clark College, Portland, Oregon

Loxosceles and *Sicarius* spiders are well known for the dermonecrotic effects of their venoms on mammalian tissues. The toxic enzyme sphingomyelinase D (SMase D) is sufficient for causing lesion formation after bites from these species. Inspired by a desire to understand the molecular evolution of SMase D we are using sequence data from mitochondrial markers ND1/16s, CO1, and nuclear 28s to estimate relationships among species representing their native distribution. Analyses to date consistently support: (1) North American *Loxosceles* as monophyletic and their presence on the continent predating the most recent connection of North and South America by the Isthmus of Panama; (2) South African species as basal lineages within both genera. Interestingly, species relationships within *Loxosceles* do not match the gene tree for SMase D. Patterns of relationships among SMaseD cDNAs make it clear that SMase D evolution includes processes that homogenize paralogs within lineages. We propose differential paralog homogenization as an explanation for the gene tree – species tree mismatch.

Light wavelength biases of the desert grassland scorpion

****Greg R.C. Blass & Douglas D. Gaffin**

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Desert grassland scorpions, *Paruroctonus utahensis*, are nocturnal animals that typically emerge from their burrows within a few hours after sunset. Scorpions are negatively phototactic, and physiological data suggest that scorpion photoreceptors are differentially sensitive to light wavelengths ranging from red to ultraviolet. However, behavioral differences to wavelengths have not been firmly established. Responses of animals were monitored in circular (8.9 cm diameter) arenas. Half of each arena received infrared light, while the other half received one of four treatments: red, green, UV, or no light. The three light treatments were matched for intensity. We ran three trials of sixteen animals each (48 total animals) with each animal experiencing the full set of randomized treatments; each treatment lasted 1 h for a total filming time of 64 h. Each animal was monitored for periods of movement into and out of the treated side, and these periods were averaged within a 10 min sampling window for each treatment. Scorpions spent significantly less time in areas exposed to UV than those exposed to green light ($P=0.01$) or red light ($P<0.01$). This does not correlate directly with reported physiological spectral sensitivity of the median and lateral eyes, which indicate peak sensitivity in the green with a lesser but pronounced shoulder in the UV. These observations may relate to extraocular regions of light sensitivity and/or the green fluorescence of scorpion cuticle under UV.

Evolutionary origin and loss of sphingomylinase D in the *Sicarius* and *Loxosceles* lineages

Melissa R. Bodner, Melissa Callahan & Greta J. Binford

Department of Biology, Lewis and Clark College, Portland, Oregon

The enzyme sphingomyelinase D (SMaseD) found in the venoms of brown spiders (*Loxosceles)* causes dermonecrotic lesions in mammalian tissues. Bites from some species of the related genus *Sicarius* cause similar lesions. Previous comparative venom/tissue analyses of representatives from eight families of haplogyne spiders found SMaseD activity only from a worldwide representation of *Loxosceles* and two South African *Sicarius* species, supporting evidence of evolutionary origin of SMaseD in the most recent common ancestor of *Loxosceles* and *Sicarius*. This analysis did not include New World representatives of *Sicarius*. We report SMaseD assays of venoms of the Costa Rican species *Sicarius rugosus* and the Argentine species *S. patagonicus, S. rupestris* and *S. terrosus*. Unlike Old World congenerics, all New World *Sicarius* species showed a reduction or loss of SMaseD activity, yet had proteins of the molecular weight corresponding to SMaseD. To test whether the differences in New World venom represented an ancestral or derived state, molecular phylogenetic analyses of the relationships among the genera *Loxosceles, Sicarius, Drymusa* and *Scytodes* where carried out using a roughly 1.8 kb fragment of 28S. All analyses placed New World *Sicarius* as derived from SMaseD bearing ancestors, indicating the apparent loss of SMaseD activity in New World *Sicarius* is a derived state. A more thorough survey of *Sicarius* species will determine whether the reduction or loss of SMaseD activity is universal in and exclusive to the New World lineage.

Molecular phylogeny of the Mygalomorphae

Jason E. Bond[1] & Marshall C. Hedin[2]

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[2]Department of Biology, San Diego State Univ., San Diego, California

Mygalomorph spiders, which include the tarantulas, trapdoor spiders, and their kin, represent one of three main spider lineages. Current estimates of mygalomorph diversity place roughly 2,500 species into approximately 280 genera and 15 families. Published phylogenies of mygalomorph relationships, based almost exclusively on morphological data, reveal areas of both conflict and congruence, suggesting the need for additional phylogenetic research. As part of a combined evidence study of global mygalomorph relationships, we have gathered ~ 4.2 kb of rDNA data (18S and 28S) for a sample of 80 genera, representing all 15 mygalomorph families. The following primary results are supported by both Bayesian and parsimony analyses of the combined matrices: 1) the Atypoidina, including Atypidae, Antrodiaetidae and Mecicobothriidae, are basal, 2) diplurids

and hexathelids form a paraphyletic grade at the base of the remaining tree, but neither family is recovered as monophyletic, 3) sampled nemesiids form a clade, but include *Microstigmata* and the Australian cyrtaucheniid *Kiama*, 4) other sampled cyrtaucheniids are separated into two clades, including a North American Euctenizinae and a South African clade, 5) of the Domiothelina, only idiopids are consistently recovered as monophyletic, while (surprisingly) migids and ctenizids are not. The Domiothelina themselves are not monophyletic. Overall, the molecular results are more consistent with Goloboff (1993), less consistent with Raven (1985).

Combining genetic and geospatial analyses to infer population extinction in mygalomorph spiders endemic to the Los Angeles region

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Although hyperdiverse groups like terrestrial arthropods are almost certainly severely impacted by habitat fragmentation and destruction, relatively few studies have formally documented such effects. We summarize a multifaceted research approach to assessing the magnitude and importance of anthropogenic population extinction on the narrowly endemic trapdoor spider genus *Apomastus* (Mygalomorphae: Cyrtaucheniidae). We use GIS (Geographical Information Systems) modeling to reconstruct the likely historical distribution of *Apomastus*, and use molecular phylogeographic data to understand population genetic structure and detect genetic signatures of population extinction. In combination, these complementary lines of inference support direct observations of population extinction, and lead us to conclude that population extinction via urbanization has played an important role in defining the modern-day distribution of *Apomastus* species. This population loss implies coincident loss of genetic and adaptive diversity within this genus, and more generally, suggests a loss of ground-dwelling arthropod population diversity throughout the LA Basin. Strategies for minimizing this loss are proposed.

Arachnological concerns of USDA, APHIS, and PPQ

Susan Broda,
USDA, APHIS, PPQ, Baltimore MD

A preliminary general overview will be given of arachnological groups which are of concern to USDA, APHIS, PPQ, as well as the Homeland Security Department. I will then describe in more detail the problems with exotic ticks (Acarina: Metastigmata) being brought in on exotic pets introduced to the USA.

Influences of environmental variation on courtship behavior in the wolf spider *Schizocosa ocreata*

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During the breeding season, male wolf spiders (*Schizocosa ocreata*) expend considerable energy searching for females and run a risk of predation by exposing themselves to potential predators. In the leaf litter there is considerable variation in temperature and ambient light characteristics on leaf surfaces. In this study, we examined; 1) variation in leaf litter temperature and compared these to locations where courting males were found; and 2) reflectance patterns of male spider body parts were compared to the spectra of leaf litter. There was no significant difference between the location temperatures of courting males (22.47 ^{o}C) and non-courting males (22.56 ^{o}C) (students t-test, t=0.139; DF=114; P>0.05). Interestingly, the mean location temperature of male spiders was between the means of leaves found in the sun and leaves found in the shade at 22.52 ^{o}C. Spectral analysis of spider body parts showed that some parts of the spider appear exceptionally dark (e.g., the lateral view of leg tufts), while other aspects (dorsal median stripe) appear to closely match to the spectra of leaf litter. This revealed that leg tufts contrast with the lighter background of leaf litter, but that dorsal coloration contrasted less with the litter background. These results suggest that wolf spiders maximize contrast and exposure when viewed from the side (by female spiders), while minimizing potential for detection from above (predators) by cryptic coloration.

Suctorial organ of the Solifugae (Arachnida, Solifugae)

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The ability of members of the arachnid order Solifugae to climb smooth, vertical surfaces and the organs involved in this behavior are investigated. Macroscopic, microscopic, and scanning electron microscopic observations are made of a palpal organ called the suctorial organ. Observations of the behavior but not the microstructure have been made in the past. Histological examination illustrates the internal gross anatomy of this structure and scanning electron microscopy demonstrates the fine structure in adults of four genera: *Eremobates* (Eremobatidae), *Eremochelis* (Eremobatidae), *Eremorhax* (Eremobatidae), *Ammotrechula* (Ammotrechidae), as well as an unidentified late stage immature and third stage instar. The suctorial organ is most likely primarily used for prey capture in the wild.

Unnatural castration in a spider: are environmental pollutants to blame?

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With the 1962 publication of Rachel Carson's *Silent Spring*, the public began to appreciate more fully the dangers of environmental pollution from pesticides and other anthropogenic chemicals. A particular class of such chemicals, endocrine disruptors, function as sex hormones *in vitro* and/or *in vivo*. Environmental estrogens have been implicated in the feminization of male vertebrates, and androgens contribute to imposex in neogastropods. Despite the importance of arthropods in many ecosystems, studies of the effects of these compounds on arthropod species are scarce and there is currently no information available for arachnid taxa. Here, I report the first evidence that anthropogenic chemicals may affect male spiders similarly. Males collected from a polluted site in Louisiana exhibit palp abnormalities that prevent sperm transfer, effectively castrating these individuals. Field-collected adults show a nearly 2:1 ratio of affected to normal males. Lab-reared penultimate-stage males exhibit a 5:1 ratio—a substantial increase that has profound implications for population dynamics. Possible consequences could include affected populations exhibiting (1) a decreased ability to recover from environmental catastrophes, and (2) increased sensitivity of the population to further exposure by new pollutants, possibly resulting in local population extinction. Future work will include characterizing the specific chemicals involved by mass spectrometry and high performance liquid chromatography.

The spider species of the Great Lakes States

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Critical analysis of existing spider species lists for Wisconsin, Michigan, Ohio, Indiana and Illinois reveal 899 species recorded from the five-state region (284 genera, 40 families). Illinois currently has the highest recorded total with 622 species, followed by 571 from Ohio, 563 from Michigan, 477 from Wisconsin, and 385 from Indiana. All non-native, non-established, or otherwise questionable species records were scrutinized and their status is discussed. The most speciose families in the region are Linyphiidae (almost 24% of species), Salticidae (10.3%), Theridiidae (8.9%), Lycosidae (8.8%), and Araneidae (7.7%). The configuration of the five states, as well as the topography and glacial history of the region enabled us to generate predictions of over 400 new state species occurrences based on their

known presence within each of the five states, and to produce higher minimum estimates of the actual fauna in each state. Richness among states is analyzed and found to be primarily dependent on varying degrees of sampling effort. We feel this work shows that much remains to be learned about the fauna of the Great Lakes region, and we hope this encourages basic faunistic research. We have created a searchable online database which allows access to all published data, returning currently valid taxa starting from any names previously published from this region.

Theotima minutissimus- An update

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The endosymbiont *Wolbachia* occurs in this parthenogenetic spider and is closely related to another found in a seed weevil *Callosobruchus* found in Southeast Asia. Guiliano Calliana (Dept. of Evolutionary Biology, Sienna, Italy), is also involved to see if he can determine the events that take place in the eggs to the end that a parthenogenetic diploid animal results, and if the presence of *Wolbachia* is instrumental in the outcome. The initial recommended dechorionation procedure that had worked well with eggs of other organisms such as *Drosophila* and other dipterans was a total failure. From January to May this year we have been busy examining spiders three to four times daily, collecting and preserving eggs when they first appeared. We do not know as yet whether or not the new dechorionation preservation procedure has been successful. Karyotypes for *Theotima* and another species of normally reproducing Ochyroceratids are now at hand. Frequent examination of the spiders has provided a particularly useful insight into the manner in which the eggs were extruded and then carried about by the *Theotima* mother and two other species in the family. Once extruded the eggs appeared to be totally separate from one another, symmetrically arranged, although attached in some manner to a pad at the anterior end of the egg. There was no clear indication, no webbing for example, of exactly how the mother carried the eggs about. Rather than extruding eggs individually a flexible, sausauge-like sac emerged containing what might best be described as `lumpy potato soup'. Eggs began to take visible shape after 15 minutes or so and at thirty minutes, although still with murky contents, they become symmetrically arranged separate entities. The original sac, somewhat like `shrink wrap', became indistinguishably wrapped around each individual egg. Several hours later the eggs had a relatively settled appearance. One such sac preserved shortly after extrusion was destroyed as a consequence. In another case what had started out as an early five egg clutch became a four egg clutch when the spider plus eggs were placed in the preservative.

Distribution and relations of ground spiders genus *Taieria* (Araneae, Gnaphosidae) in Australasia

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The genus *Taieria* was described by R. Forster in 1979.Earlier, two species were described by L. Koch (1873) as *Drassus erebus* and *Drassus achropus* from New Zealand.R. Forster (1979) showed that those two species were male and female of one species and chose as the valid name *Taieria erebus* (L. Koch). Additionally, R. Forster described four new species of the genus *Taieria* from New Zealand: *T. elongata, T. kaituna, T. obtusa* and *T. miranda.* Recently we found one new species of *Taieria* in New Zealand. Also we found *T. erebus* and *T. kaituna* on the Southern Island (both species were recorded before only from the Northern Island) and *T. elongata*on the Northern Island (earlier known only from the Southern Island). Our revision of *Taieria* in Australasia showed that this genus is also very common in Australia.We found 16 new species of *Taieria* in Australia and two in New Guinea. The distribution of *Taieria* in Australia has an interesting pattern, which shows Eastern Australia more populated and represented by seven species of *Taieria*. Western Australia is represented by six species, two species of *Taieria* related to the southern part of Australia and Tasmania. One species is widely distributed across all Australia. It is important to underline that there is no common species of *Taieria* for New Zealand, Australia and New Guinea.

A morphology-based phylogeny of the *Habronattus tarsalis* species complex and its inconsistency with a molecular phylogeny

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Males of the six species of jumping spiders (Salticidae) belonging to the *Habronattus tarsalis* group are highly variable morphologically throughout their range in California and surrounding states. These morphological differences have been used to derive a "species tree" of the relationships between both populations and species. Neighboring populations in continuous habitat are morphologically more similar to each other than more isolated populations. Therefore, male morphology appears to be a good tool for examining the relationships of these species and the species tree agrees with typical phylogeographic patterns for California. However, a gene tree derived from mitochondrial evidence shows divergence only for isolated desert and island populations, but is unable to resolve even some species relationships. This has lead to the hypothesis that gene flow between neighboring populations in contiguous habitats has caused shared mtDNA sequences, while strong sexual selection has preserved the phylogenetic signal for morphological divergence. Thus, the *Habronattus tarsalis* group could be a clear example of why different data sets provide variable results.

Static and dynamic components of male seismic signals reflect influence of past and current condition in the wolf spider *Schizocosa ocreata* (Araneae: Lycosidae)

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Courtship displays of male *Schizocosa ocreata* (Hentz) are multimodal, consisting of visual and seismic signals. Previous research has shown that male secondary sexual characters (foreleg tufts) are condition-dependent visual signals used in female mate choice. Here we test the hypothesis that seismic signals are also condition-dependent, through two different approaches. In the first study, a test of the effect of rearing environment, seismic signals were compared between spiders raised under 3 different conditions: completely in the laboratory (LR), completely in the field (FR) or partially in the field then the laboratory (FL). A second experimental study tested the effects of current condition on seismic signals. Adult spiders were collected from the field and placed into two treatment groups, then fed to satiation or starved. Spiders were recorded 3 times over the course of the experiment. Rearing environment affected static (e.g. fundamental frequency of signal) and dynamic (e.g. duration of signal) components of seismic signals differently. Static traits were similar between LR and FR but both differed from FL. Dynamic traits were similar for FL and FR but differed from LR. Moreover, static traits did not change over time in response to food availability; however, all dynamic traits did. These findings suggest that lifetime foraging history and/or habitat and experience contribute to static features of seismic signals, while dynamic features change with current body condition. This experiment demonstrates that seismic signals in this species are condition-dependent, and contain information that females may be able to use to asses male mate quality.

Genetic diversity within colonial aggregations of the North American tarantula *Aphonopelma hentzi* (Theraphosidae) in Texas populations

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The Theraphosid genus *Aphonopelma* belongs to the infraorder Mygalomorphae, a group thought to be relatively primitive and highly

conserved morphologically. Adult females and sub-adult males live in subterranean burrows in informal aggregations commonly referred to as colonies although analysis of aggregations of *Aphonopelma hentz*i (Girard 1852) in Wilbarger Co., TX showed the burrows to be over rather than under-dispersed indicating the aggregations may simply be the result of habitat condition and not a reflection of behavior (Janowski-Bell 2001). However, the aggregations may still be matriarchal in nature since although some mygalomorphs have been found to disperse by ballooning (Coyle 1983), theraphosids are not known to do so and this may cause their dispersal distances to be limited in immaturity. Upon maturity, the males disperse, walking from their burrows in search of a mature female, presumably unrelated to the male. Radio-telemetry work suggests that the dispersal range of *Aphonopelma* males may be limited to 1-3 km, at least with *A. hentzi* (Janowski-Bell and Horner 1999). We tested the hypothesis of familial aggregations using two molecular markers from the mitochondrial genome, CO1 and 16S. Although both showed relatively low levels of diversity the results do not support familial aggregations and instead suggest an ad-hoc assemblage based probably on habitat availability.

Molecular evolution and phylogenetic utility of hemocyanin blood protein gene sequences in mygalomorph spiders (Araneae: Mygalomorphae)

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Hemocyanins are hemolymph proteins that facilitate oxygen transport in all major arthropod lineages. The likely basal condition in spiders includes a protein of 620-660 amino acids, duplicated into seven paralogous loci (subunits) that combine to form a 24-mer (4 X 6) quaternary structure. Although paralog structure is fairly conserved in spiders, some lineages reveal dynamic changes in patterns of molecular evolution (e.g., paralog loss and duplication in the RTA clade). To more fully explore patterns of molecular evolution, and assess the phylogenetic utility of this gene family, we have conducted phylogenetic analyses on hemocyanin exon 4 data for a diverse sample of mygalomorphs, and several araneomorphs. Results can be summarized as follows: 1) Mygalomorph sequences fall into seven distinct clades that correspond to the seven well-studied subunits of *Aphonopelma*. Although not all mygalomorph taxa are represented in each paralog group, this is probably evidence for PCR bias, rather than paralog loss; 2) Trees reconstructed using concatenated and combined (molecules + morphology) matrices recover some expected clades (e.g., Atypoidina), but other larger clades (e.g., Domiothelina) and some families are not recovered as monophyletic; 3) Sequences from taxa representing the RTA clade (*Habronattus*, *Zorocrates*, *Allocosa*, and *Cupiennius*) are restricted to the subunit *g* clade. The loss of all paralogs except *g*, and subsequent duplication within this paralog group, may represent a molecular synapomorphy for this spider clade; 4) Hemocyanins represent, in effect, up to seven independent loci that might be used for molecular phylogenetic analysis in spiders. With development, this gene family has considerable phylogenetic promise.

Phylogeography of the *Antrodiaetus unicolor* species complex (Araneae: Mygalomorphae: Antrodiaetidae)

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Antrodiaetus unicolor (sensu lato) is the most abundant and widespread mygalomorph species in the eastern United States. Given the dynamic geological history of this region (including orogeny, coastal plain inundation, and glaciation cycles) and the interesting life history characteristics of these spiders (fossorial burrowers, limited dispersal ability), spatial patterns of genetic variation are expected to be diverse and complex. We investigated the phylogeography of this species complex by sampling over 300 individuals from 100+ populations. Preliminary assessment of these analyses (based upon COI mtDNA and 28S rRNA; ~1800 bp) suggests a complicated history consisting of recent range expansions, vicariance events, and prolonged periods of isolation and divergence *in situ*. Some northern populations (IN, OH, VA, WV) display a genetic signature indicative of recent range expansion into areas previously uninhabitable during the Pleistocene. Furthermore, there have been multiple independent invasions of these spiders to the coastal plains (i.e., coastal populations are not monophyletic). Closely related lineages are sometimes disjunct, indicating that ancestral populations became fragmented; this subsequently allowed the sundered populations to diverge substantially from each other. No mitochondrial haplotypes are shared between populations, and most populations exhibit substantial divergence and genealogical exclusivity. Secondary contact between distantly related lineages is extremely common and provides strong evidence for multiple codistributed species. Future research will focus on testing specific biogeographical hypotheses and delimiting species boundaries.

The rich spider fauna of the Hocking Hills region, Ohio

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The Hocking Hills region is located in Hocking and Fairfield Counties of unglaciated south central Ohio. The system of hills and valleys were, nevertheless, strongly influenced by the glaciers. Glaciers to the north formed a dam that blocked the northwestward flow of the historic Teays River. The region's drainage was redirected southeast into the relatively newer Ohio River, in the Mississippi drainage. This history is revealed in the vegetation, which is very diverse, incorporating southern elements characteristic of the western Allegheny plateau and northern remnants from glacial times. This scenic region is dominated by the Black Hand Sandstone which has eroded to form numerous caverns, arches, and recess-caves. The region is clothed in mature second-growth mixed hardwood forest, hemlock coves, farm fields and pasturelands. The spider fauna of the Hocking hills is similarly diverse. A total of 265 species have been documented for the region to date. Historical collections were made by William Barrows, primarily between 1914 and 1924. Collections of the Ohio Spider Survey were made between 1994 and 2004. Only 37% of the spider species were found by both collection efforts; 43% were found exclusively in our recent work and 20% only in the earlier Barrows work. It is not clear whether or not these differences are due to different sampling methods or possibly actual changes in the spider fauna.

Spiders as conservation indicators at two oases in Baja California, Mexico

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Geomorphologic and evolutionary changes in the Baja California Peninsula created many mesic oases. In these habitats, the spider fauna is almost unknown. Two oases were surveyed every two months during 2002-3 to develop an ecological index. Pitfall traps, foliage nets, and hand collections were made along three transects set perpendicular to the oases streams. Of 184 species (138 at San Isidro and 143 at San José de Comondú), 92 were common to both localities. About 45% have nearctic and 22% have neotropical affinity. About 34% are exclusive to Baja California. Diversity of both communities were similar (H' = 3.73 at San Isidro and H' = 3.94 at San José). Morisita's Index was 0.55%. About 6.5% of the species at San Isidro and 6.3% at San José were dominant; whereas rare species represented about 41% at the first locality and 35% at the second. Previously undescribed species numbered 29, as well as one undescribed genus. In mesic areas, about 18% of the species were abundant; in xeric areas, about 39% were abundant. *Anyphaena* sp. nov. and *Hamataliwa grisea* were the most abundant species. The many spider species at these oases show that this environment conserves diversity, perhaps from geographic isolation and low anthropogenic impact. The spider species associated with mesic vegetation are probably relict populations of the Pleistocene because they are found in the highland oak-pine forest of the Sierra de la Laguna on the peninsula and highland mesic locations on the mainland of Mexico.

Revealing cryptic species in the ancient spider genus *Hypochilus* Marx (Araneae: Hypochilidae)

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The spider genus *Hypochilus* is one of the most distinctive groups of spiders in North America. The southern Appalachian fauna, the focus of this work, includes five species (*H. gertchi*, *H. thorelli*, *H. pococki*, *H. sheari*, and *H. coylei*) distributed in allopatry from northern Alabama and Georgia to West Virginia. *Hypochilus* spiders have limited dispersal ability, making them particularly susceptible to geographic range fragmentation. *Hypochilus* also exhibits morphological and ecological stasis such that evidence for geographic fragmentation may not be readily apparent. To examine comparative patterns of population genetic structure, and discover possible cryptic species, we generated mitochondrial CO1 DNA sequences from a sample of more than 80 populations, representing four of the five eastern species (data for *H. thorelli* has already been published – Hedin & Wood 2002). Bayesian phylogenetic analyses of these data reveal that all eastern *Hypochilus* species exhibit patterns of extreme genetic structuring similar to that found in *H. thorelli*, with extremely low amounts of mitochondrial variation within populations, but high genetic divergence among populations. Isolation by distance analyses support this claim. Additionally, four of the five morphologically defined species are recovered as genetic clades. However, *Hypochilus pococki* is fragmented into at least five clades, which are geographically-cohesive, show extremely high internal genetic divergences, and are not sister taxa. These observations suggest the presence of "cryptic" species within *H. pococki*. Recognition of such cryptic lineages is extremely important, as some of these distinct evolutionary units are restricted to as few as three known localities, and may warrant conservation efforts.

The structure and function of sexually dimorphic hair tufts in *Dolomedes* males

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Taxonomic descriptions of the species *D. triton* generally make reference to a "spinose hump" (Kaston 1981) or a "spiny tubercle" (Carico 1973) located on the hind femur of adult male *D. triton*. These dark, hairy tufts are obvious to the naked eye and are only found on adult males, never juveniles or adult females. They have been hypothesized to function as clasping structures during copulation. Light and scanning electron microscopy revealed that these tufts are composed of a diverse population of modified, socketed hairs. Individual hairs are often characterized by enlarged bases, a lumen and an apical pore opening with a protruding extension, perhaps suggesting a sensory function. In order to distinguish between the clasping and sensory hypotheses, juvenile males were brought into the lab until their adult molt. For some of the males, the hair structures were covered with paraffin, eliminating any sensory function. Males were placed with newly molted adult females and their behavior was videotaped and coded. Males did not typically use the structures for clasping females. In fact, most copulations took place with the hind pair of legs placed distant to the female. Paraffin did not influence most courtship parameters, and males with covered hairs were just as likely to mate with a female than were control males. However, copulations were generally shorter in duration when the hairs were covered. Future studies are planned to continue this investigation.

Phylogenetic implications of mutation biases in arachnid mitochondrial genomes

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Mitochondrial sequences have been widely used to infer phylogenies within arachnids, but few studies have compared the evolution and systematic utility of mitochondrial genes among different arachnid orders. Here, we use new mitochondrial genomes from several arachnids to evaluate phylogenetic relationships between the major arachnid lineages such as scorpions, spiders, amblypigids, and ticks. Given our taxon sampling, phylogenetic analyses of the 13 mitochondrial protein-coding genes typically support the monophyly of each arachnid order. In the spiders (Araneae), we find strong support for the Mygalomorph-Araneomorph sister-group (Opisthothelae), to the exclusion of Mesothelae. However, a subset of protein-coding genes (transcribed on the alpha-strand) do not strongly support the Araneae, and recover unexpected relationships among arachnid orders. We compare nucleotide composition at synonymous sites, and show that true spiders (Opisthothelideae) have reversed comositional bias in several mitochondrial genes, which are overly rich in T or G nucleotides. In contrast, most other arachnids, including spiders of the suborder Mesothelae, show mostly A or C nucleotides at these sites. We show that these differences in codon usage can influence the outcome of phylogenetic analyses, particularly as scorpions show the same (reversed) nucleotide bias as true spiders, as do varroid mites. Here we evaluate the utility of different data coding schemes to mitigate the effect of the codon usage biases on phylogenies based on mitochondrial genomes of arachnids.

Rare genomic changes as phylogenetic characters for arachnid systematics

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The evolutionary relationships among the arachnid orders are not agreed upon, and morphological and sequence data have yielded conflicting phylogenetic hypotheses. We have been sequencing mitochondrial genomes from representatives of all arachnid orders to obtain new data that may aid in resolving relationships. I have been examining genomic data to look for changes in the genome that occur very rarely and hence may be useful for resolving ancient divergences. Such changes include gene rearrangements, changes in the secondary and tertiary structures of the gene products, and changes in gene processing. Here I present new mitochondrial genome data from eight arachnids from Araneae, Amblypygi, Uropygi, Scorpiones, and Solifugae. I find unusual truncated transfer RNA genes in multiple orders of arachnids, such that the size of the inferred tRNAs are about two-thirds those of typical mitochondrial tRNAs. These truncated genes are inferred to code for tRNAs that lack the canonical cloverleaf secondary structure. Additionally, there is a substantial reduction in the size of the large ribosomal RNA gene among multiple arachnid orders, with an inferred loss of multiple stems and helices from the secondary structure. Finally, gene order differs among some of the orders. I discuss the evolutionary and systematic implications for each of these rare genomic changes.

The systematics of widow spiders (Araneae, Theridiidae, *Latrodectus*): Recent progress and future prospects

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New molecular sequence data from over 70 *Latrodectus* specimens provides evidence for the evolution of the genus and the circumscription of *Latrodectus* species. This study builds on the first molecular phylogeny of *Latrodectus*, which was based on a single mitochondrial gene (cytochrome oxidase I). Most specimens from that analysis plus many new specimens were sequenced for two nuclear genes: histone 3 and 28S ribosomal RNA. These data are added to two higher-level studies, one on theridiid genera, and one on Hawaiian linyphiids. This later study provides a calibration point for estimating the ages of historic events, such as the origin of *Latrodectus*. Future sequencing work and plans for a global monograph of *Latrodectus* based on morphological, molecular, and behavioral data are previewed.

Factors affecting substrate choice of crab spiderlings over their lifetime

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Crab spiders (*Misumena vatia:* Thomisidae) choose many different hunting sites over their lifetime, shifting from innate responses to certain substrates as naïve spiderlings to direct responses to prey as

adults. Since the flowers used as hunting sites continually change over the season, the spiders regularly have to make new decisions. Spiderlings retain a constant preference for goldenrod over aster or wild carrot from their first encounter until at least three weeks later. They also prefer wild carrot to wild parsnip, a rare and patchy umbellifer that attracts far more prey than the closely related carrot. By the fourth instar, though free-living individuals in the field exhibit preferences between daisies and buttercups that probably reflect their likely experience, naïve fourth instars reared in the laboratory initially have no preferences. Free-ranging penultimates have acquired the strong prey-dependent substrate choice characteristic of adults. These changes in behavior over ontogeny appear to be gradual, rather than of a stepped nature.

Ground spiders (Gnaphosidae) in Australia: a new characteristic of the subfamily Zelotinae

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One of the major characteristics of the subfamily Zelotinae is a preening comb on the ventral surface of the distal part of the metatarsus of the third (and occasionally the fourth) leg. Australian Zelotinae lack a distinctive preening comb and have only a preening brush, making it necessary to find additional morphological characteristics for all subfamily of Zelotinae. Our recent SEM research shows that this subfamily has a very distinctive characteristic: all representatives of Zelotinae lack covering setae on the body, with all surface of the cuticle covered only with short and strong mechanoreceptive setae. This morphological characteristic is common in Zelotinae from the Northern Hemisphere as well as Australia.

Does bad taxonomy serve conservation purposes? The case of the *Cicurina cueva* complex (Araneae: Dictynidae) in the vicinity of Austin (Travis Co.) Texas

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Urban development in central Texas is a threat to many habitats, especially caves. About a dozen cave-restricted arthropod species are protected by the Endangered Species Act, while many others are classified as *species of concern.* The later category includes *Cicurina cueva* Gertsch, an eyeless spider known from only two caves in the vicinity of Austin. A proposition for a new highway threatens the ecological integrity of Flint Ridge Cave, one of the two known localities for *C. cueva.* Correctly assessing the distribution and species limits of this taxon appears crucial for any conservation decisions. An intense sampling effort resulted in the collection of *Cicurina* spp. from ~70 caves in Travis, Hays and Williamson counties. About 1kb of mtDNA (CO1) was sequenced for 170 spiders and the phylogenetic approach of Paquin & Hedin (2004) was used to assign species names to juveniles. Likelihood and Bayesian analysis gave similar results and extended the occurrence of *C. cueva* from two to ~20 adjacent caves. These results suggest that *C. cueva, C. bandida* and *C. reyesi* are the same biological entity. Furthermore, spermathecal variation is not correlated with geography or mtDNA phylogeny, providing further support for synonymy. The genetic structure of *C. cueva* populations indicates restricted gene flow, as expected for cave organisms. Some conservationists perceive species rarity based on inadequate taxonomy or lack of collections as beneficial as it increases the biological uniqueness of certain caves. However, long-term conservation strategies require adequate taxonomic knowledge, which is still, unfortunately, largely deficient.

Nitrogen enrichment in grasslands alters spider community structure

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Nitrogen enrichment in terrestrial ecosystems significantly increases plant biomass while significantly decreasing plant species richness. However, the effects of these well-documented, nutrient-mediated changes to primary producers on the remainder of the food web have received little attention in terrestrial ecosystems. To address this, we manipulated nutrient availability and plant detritus in grasslands at the Bath Nature Preserve in northeastern Ohio to investigate whether nutrient-mediated changes in plants resulted in increased arthropod biomass and decreased arthropod species richness. While documenting changes in plant biomass and species richness during 2002-2004, we used pitfall traps to sample the epigeal arthropod community. Within 20m diameter circular plots in the grassland (an annually mown, former hay meadow), we manipulated nitrogen (fertilizer added vs. no fertilizer) and plant detritus (following annual mowing in autumn; plant litter removed vs. left in place) to form a blocked 2x2 factorial design with six replicates (N = 24 experimental plots). Four pitfall traps per plot (N = 96 traps) were used to sample arthropods for two-week-open intervals alternated with two-week-closed intervals during late May through mid-August of each year. Within fertilized plots the three dominant wandering spider families (Araneae: Lycosidae, Gnaphosidae, and Clubionidae) significantly increased in biomass, significantly decreased in species richness, and shifted community composition for both biomass and individual counts, essentially losing the largest bodied species. Thus, these results highly correlate with effects of nitrogen enrichment on plant species richness and biomass, clearly demonstrating the effects of eutrophication in terrestrial ecosystems.

Blood-sucking spiders

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Using specialized mouthparts, mosquitoes pierce vertebrate skin and gain access to a rich food – blood. No spiders are known to feed on vertebrate blood in this straight-forward way, but *Evarcha culicivora* (Salticidae), a jumping spider from the Lake Victoria region of Kenya and Uganda feeds indirectly on blood. It does this by finding and capturing its preferred prey, blood-fed female mosquitoes. In other words, the mosquito finds and collects the blood and then *E. culicivora* finds and eats the mosquito. Using first and third instar *E. culicivora* feeding on *Anopheles gambiae* (fed on human blood), we examined the mechanisms used by the spider to extract blood from the mosquito. Smaller instars were used because they were less likely to obscure parts of the prey while feeding. A potential barrier to the spider extracting blood is that the blood meal which is stored in the abdomen of the mosquito is surrounded by a peritrophic membrane which thickens over time. We found that *E culicivora* almost always started feeding from the thorax and using suction from the combined action of pharyngeal muscles and a sucking stomach, could rupture the membrane of recently fed mosquitoes and extract blood. However, after 24 hours, the peritrophic membrane is too thick to be ruptured by suction from the thorax and instead *E. culicivora* would rupture the membrane directly using suction and its fangs.

Effects of detritus subsidy on the abundance and diversity of spiders in an agricultural ecosystem

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Productivity has been shown to have a strong effect on species diversity in some ecosystems. Soybean fields are cyclical ephemeral ecosystems in which an interaction between the annual recolonization and competition may drive spider abundance and diversity. Because spiders are food-limited, insect density, which is an estimate of prey availability, is a measure of productivity available to spiders. The purpose of our study was to investigate the species diversity and community composition of ground-dwelling spiders across the season and in response to a range of productivity levels. In this study we added detritus to plots in agricultural fields in order to impose an experimental productivity range. Detritus was added at four levels in June and July, and insects and spiders were sampled in July, August, and September. Preliminary results suggest that insect abundance did not respond to detrital subsidies. Insect abundance peaked in August, and spider abundance was higher in August and September than in July. In August, overall spider abundance, and wolf spider (Lycosidae) abundance in

particular, were correlated with ambient insect density. Overall spider abundance was related to sampling time but spider abundance was not related to detritus application. Similarly non-metric multidimensional scaling analysis at the family level suggests that community structure was influenced by sampling time but not detritus application Our results suggest that overall abundance and family composition were more closely tied to seasonal shifts than productivity.

Do males of the wolf spider *Schizocosa ocreata* (Hentz) (Araneae: Lycosidae) exhibit social facilitation of courtship?

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Theory predicts that males will exhibit alternative mating tactics that maximize overall mating success. Tactics that exploit dyadic interactions within a communication network could contribute to increased success by reducing investment in mate searching or increasing efficiency of mate quality evaluation. One potential alternative tactic for males in scramble competition mating systems, such as that found in the brush legged wolf spider, *Schizocosa ocreata*, includes eavesdropping on the courtship of nearby competing males to increase the likelihood of primary encounter with a cryptic potential mate. We tested the possibility that male *S. ocreata* exhibit social facilitation of courtship behaviors using a combination of live behavioral trials and video playback to isolate the visual signaling modality of courtship in male competitors. The results of both live behavioral and video playback experiments indicate that male *S. ocreata*, when exposed to the visual component of conspecific male courtship behavior, can discern the presence of another individual whether that individual is courting or not. However, they do not show evidence of social facilitation of courtship or chemoexploratory behaviors in response to visual cues as there was no significant change in the total number or mean duration of these behaviors during or after any stimulus exposure. While visual signals play a role in mate choice in *S. ocreata*, in male/male interactions they may serve to draw attention to vibratory signals, and thus further work involving multi-modal signaling will be necessary before social facilitation of courtship can be ruled out for this species.

Habitat and behavioral characteristics associated with habitat selection in *Antrodiaetus unicolor*: results from preliminary lab and field investigations

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Although habitat selection is the underlying process that determines much of the ecology of an organism, as well as ultimately influencing its fitness, its attributes for many spider species remain undescribed. One species that has gained my attention is the folding-door spider species, *Antrodieatus unicolor*. Among the few mygalomorph species that has a distribution into the temperate regions of the Midwestern U.S, *A. unicolor* appears limited to very specialized habitats within these regions. Presumably, this species is extremely sedentary; consequently, selection of habitat is crucial to its success. To determine suitable characteristics in habitat selection, I conducted a series of preliminary investigations into preferred soil properties, population densities, and settlement decisions. In my initial inquiry into populations in southern Ohio, I found that larger aggregations, along with positive mass and length gains, were associated with slightly higher surface humidity and slightly lower surface temperature compared to sites that did not contain naturally occurring aggregations. Subsurface soil humidity and pH appear to have little influence on individual growth. Additionally, while individuals exhibited a preference for burrowing in the absence of leaf litter, there are no strong indications that individuals make burrowing decisions based on the presence or absence of other individuals. Further, there is some evidence to suggest that individuals create multiple burrows over their lifespan, often abandoning previous burrows soon after molting occurs. Future experiments and observations will focus on decision-making factors regarding habitat selection, shadow competition, limits of population densities and habitat availability, conspecific attraction, prey availability and dispersive ability.

Preliminary analysis of mating in *Leiobunum nigripes* (Opiliones) and diversification of male reproductive structures in *Leiobunum*

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Systematists rely on male-specific structures in circumscribing species and species groups in *Leiobunum*. Presence of paired, distally open, chitinous sacs located subterminally on the penis appears to be primitive but are modified as bulbs in some groups and lost in others. Genital morphology and mating in a sacculate species *L. nigripes* were examined to determine functions that might explain genital diversification. Sacs in the retracted penis receive "nozzles" that drain large accessory glands; sacs are typically filled with fluid. Females display acceptance by orienting to the male with mouth open. The male runs towards the female and clasps her at the trochanter of leg II with his palps. He rapidly inserts the penis in her mouth (apparently delivering a nuptial gift from the sacs), withdraws the penis and begins to probe for the opening of her genital operculum. The female manipulates the inflated basal part of the penis with her chelicerae. After a variable time, the female opens the operculum and the male assumes a "head up" position. Male reorientation exposes the "nozzles" and the female feeds on secretions. Interaction between penis and ovipositor occurs inside the female genital chamber and cannot be seen. Examination of reproductive structures in other species suggests that genital diversification is associated with mechanisms by which males control the quantity of gift fluid offered to females, either by regulating amounts of the primary gift (bulbate strategy) or facultatively substituting coercive restraint for secondary gift (lanceolate strategy) through enhanced clasping mechanisms. This scenario attributes genital diversification to natural rather than sexual selection and suggests that evolutionary plasticity is an inherent property of genitalia.

The *Promyrmekiaphila* World According to GARP

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One of the primary goals of any systematic, taxonomic, or biodiversity study is the characterization of species distributions. While museum collection data and field observation are important for ascertaining distributional ranges, they are seldom exhaustive. The primary objective of this study is to use existing collection records to more accurately estimate the distribution of the spider genus *Promyrmekiaphila* (Araneae: Mygalomorphae: Cyrtaucheniidae) in central and northern California. The approach we employ is a geospatial analysis that uses the artificial intelligence method GARP (Genetic Algorithm for Rule-set Prediction). GARP uses four different rule-sets to infer correlations between geographic information system (GIS) layers representing known species localities and a set of environmental parameters (e.g. elevation and annual precipitation). The algorithm determines which environmental parameters are significant factors in circumscribing species distribution and provides predictive models for present-day population locations. A GARP spatial analysis based on seven environmental layers and 42 known localities of *Promyrmekiaphila* predicted the occurrence of *Promyrmekiaphila* throughout northern/central California. These predictions were then field tested to assess the accuracy of the model.

Burrows, nests and retreats: A comparison of structures built by wolf spiders in the southeastern U.S.A.

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Among wolf spiders in the USA, burrow construction and use is best known in the obligate burrowers, the *Geolycosa*. However, earlier literature noted several species of wolf spiders that may sometimes be found in burrows or retreats. We have done a comparative study of the structures made by wolf spiders. In the laboratory, individual wolf spiders from more than 18 species were placed in containers 14 cm wide x 21 cm tall and were provided with a minimum of 7 cm of top soil and 8 cm of dried grass. Following burrow or nest construction, we photographed the structure, removed the spider and made a cast of the

structure with Plaster of Paris. With the cast, we were able to measure length, width and volume of the excavation. We have now documented tubular burrows for *Artosa littoralis*, *Hogna annexa*, *Hogna* sp. *helluo* group sp. "A" , *Rabidosa rabida, R. punctulata, R. carrana,* as well as for *Geolycosa missouriensis, G. fatifera* and *G. rogersi.* Bowl-shaped excavations or nests, often with silken covers have been seen "*Allocosa"(=Hogna) georgicola, Schizocosa saltatrix, Trochosa acompa*, *Rabidosa hentzi, Hogna lenta* sp. group and *Hogna helluo*. We report on the variety of shapes and sizes of the structures as well as the above ground turrets or silken covers. Understanding the evolution of the behaviors of building retreats will require both a detailed study of the behavior and a much more resolved phylogeny of wolf spiders than now exits. However, this study points to the complexity and variety of burrowing behaviors.

Mechanics and energetics of excavation by burrowing wolf spiders

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Burrowing wolf spiders (Lycosidae, *Geolycosa* sp.) excavate vertical burrows and inhabit them throughout their lives or, in the case of males, until they mature and wander in search of mates. We studied three species, *G. fatifera, G. missouriensis, and G. rogersi,* with the aim of understanding how, and at what expense, the burrowing is accomplished. Normal and high-speed videography, coupled with scanning electron microscopy, revealed (a) that the convex surfaces of the fangs, together, constitute the digging tool, (b) that boluses of soil are transported to the burrow entrance on the anterior surfaces of the chelicerae, held there by the pedipalps, and (c) that each bolus is either incorporated into the growing turret or flung away, propelled by the forelegs. To elucidate the energetics of burrow construction, we first measured burrow volumes and then assessed the costs associated with dislodging, elevating and throwing the known volumes of soil. A typical *G. missouriensis* burrow, at a volume of 30.3 ± 6.7 ml and a depth of 15.8 ± 1.8 cm, required the removal of 1195 boluses each weighing about 34 mg. The aggregate dislodging cost was close to 2.5 Joules, the work against gravity necessary to raise all of the boluses to the surface was about 0.2 Joules, and the aggregate cost of flinging the boluses was close to 0.02 Joules. In soil that is difficult to dislodge, like that in which we found *G fatifera*, the excavation cost per bolus is about 3 times as high.

Insights into the distribution and phylogeography of the enigmatic opilionid, *Fumontana deprehendor* Shear (Opiliones: Laniatores: Triaenonychidae)

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The opilionid species *Fumontana deprehendor* Shear 1977 (Laniatores: Triaenonychidae) is formally known from only four specimens from two published localities, both old-growth forest sites in the southern Appalachian mountains. Its distinctive morphology combined with its perceived rarity make *F. deprehendor* one of the most unique opilionid species in North America. Although other triaenonychids are known from the Pacific Northwest, *Fumontana* appears most closely related to Gondwanan taxa, suggesting an extremely old and relictual distribution. In August 2004, we undertook a focused sampling effort throughout the southern Appalachian mountains to better understand the true abundance and distribution of this monotypic genus. After uncovering a much more complete and perhaps true distribution of the genus, the phylogeographic and species status was analyzed via a combination of molecular and morphological data. Molecular phylogenies generated using Bayesian analysis of mitochondrial and nuclear sequence data suggest four allopatric, geographically cohesive molecular clades. Interestingly, these clades show an almost complete lack of internal divergence, which is surprising given the predicted limited dispersal ability of these animals. The geographic distribution of these clades corresponds remarkably well to patterns seen in other cryophilic arthropods of the region (e.g., *Trechus* beetles), suggesting a shared pattern of vicariance. Preliminary morphological data from representative male specimens, consisting of drawings of the palps and legs 1+2, measurements, and SEM images of penises, were analyzed to look for concordance with the recovered molecular clades. Conservation implications, the possibility of cryptic speciation, and future research directions are discussed in light of the new data provided.

Multi-modal communication and mate choice in wolf spiders: results of studies with live males and audio/video playback

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Male *Schizocosa ocreata* exhibit complex multi-component and multi-modal (visual and seismic) signals in courtship. Previous and current studies of this species suggest female responses to courtship modes are equivalent, but variation in isolated visual signals (decorative leg tufts) and seismic signals (substratum vibration) influences female receptivity. To examine redundancy and possible interaction of male courtship modes in female mate choice, we used isolated and combined stimuli from males and video/audio playback. In cue isolation studies with live males, responses of females varied significantly with stimulus. Latency to orient was shortest for multimodal cues, longer for visual cues, and longest for seismic cues. Female receptivity was greater when females were presented with multi-modal cues compared to isolated modes, which did not differ from each other. Female spiders were presented with replicated playback stimuli in two experiments: 1) unaltered male video exemplars with and without seismic cues, and seismic cues alone; 2) male video exemplars with enlarged and reduced leg tufts, with and without seismic cues. Results of the first experiment confirm earlier studies – female response to multimodal cues is greatest, but is lower and equivalent for isolated modes. Experiments manipulating tuft size show greater female receptivity with larger tufts regardless of the presence/absence of seismic cues. However, latency to orient to the male stimulus was influenced by tuft size and the interaction of tuft size and seismic cues; females responded more quickly to stimuli with larger tufts accompanied by seismic cues. These results support a multi-function "super-signal" hypothesis for multi-modal communication.

The brown recluse challenge: arachnids submitted as possible brown recluse spiders nationwide

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An internet offer was made to identify any spider in the United States perceived to be a brown recluse spider, *Loxosceles reclusa* Gertsch and Mulaik. Over a five-year period, a total of 1,773 specimens from 49 states were submitted, representing three arachnid orders (Araneae, Solifugae, Opiliones). The identifiable spiders consisted of 37 families, 88 genera and 158 recognizable species. Participants from states at least half within the known brown recluse distribution submitted *Loxosceles* spiders 32 to 89% of the time, except Louisiana and Mississippi with no *Loxosceles* submissions. From 25 of 29 states completely or almost completely outside of the range of *Loxosceles* spiders, no recluse spiders were submitted. Only two discoveries of brown recluses and two of the worldwide tramp species *L. rufescens* were submitted from nonendemic *Loxosceles* areas. States on distribution margins of brown recluse or other native *Loxosceles* spiders were intermediate in their *Loxosceles* submissions. This study showed that 1) the general public perceives brown recluses to occur throughout the United States, and 2) brown recluse spiders are frequently submitted from endemic states, almost never from non-endemic states, and, therefore, are virtually limited to their known distributions. This study corroborates opinions that diagnosis of brown recluse spider bites are best restricted to areas historically supporting proven, widespread populations of *Loxosceles* spiders. This research has been accepted as a Forum article by the *Journal of Medical Entomology* and should be published in Autumn 2005.

The effects of preservatives and temperatures on arachnid DNA

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We tested the effects of different preservatives and temperatures on the yield of spider and scorpion DNA useable for PCR amplification. Our experiment was designed to simulate conditions in the field and laboratory over a six week time period, testing the preservatives RNA*later*®, propylene glycol, and various ethanol concentrations. Three replicates of each preservation treatment were stored at five different temperature treatments; -80 °C, -20 °C, 2-4 °C, 19-24 °C, and 40 °C. DNA was extracted and quality was assessed by electrophoresis on mini-gels, and by PCR amplification of high copy mitochondrial DNA fragments (cytochrome oxidase subunit I) and low copy nuclear DNA fragments (actin). Results show that RNA*later*® and propylene glycol are significantly better than the other preservatives for high quality DNA preservation and that tissue is best stored at -80 °C or -20 °C. Storage in 95% ethanol is appropriate if specimens are stored at -20 °C or -80 °C. We believe our results can help guide biologists in choosing preservatives and temperatures for DNA-based research on arachnids, other arthropods and invertebrates in general. We also tested the long-term effects of temperature and preservatives on arachnid tissue, which was stored in either 70% EtOH, 100% EtOH or RNA*later*® at -80 °C, -20 °C, 2-4 °C, and 19-24 °C. These results further illustrates that tissue should be stored at –20 °C or less and that RNA*later*® outperforms ethanol.

Control of copulation duration in a wolf spider (Araneae, Lycosidae)

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Copulation duration can have an important impact on male fertilization success. We examined if males or females seemed to control copulation duration by exploring the relationship between age, size and condition of each sex and mating time in the wolf spider *Hogna helluo* (Araneae, Lycosidae). Male age and size were linearly related to copulation duration but no female characteristics were significant. Further analyses revealed that the linear relationships were an artifact of the group of long copulations influencing the regression. Logistic regression revealed that male age was positively and male size negatively related to the probability of a male engaging in a long copulation. After accounting for differences in long and typical copulations, male condition was negatively related to copulation duration. Males that engaged in long copulations were more likely to be cannibalized following mating. Our data provides support for the hypothesis that males exert the primary influence on copulation duration in *H. helluo*. Older, smaller and poor condition males may engage in longer copulations to increase their paternity with the current female because they may have a lower chance of escaping postcopulatory sexual cannibalism or surviving to find another female.

The effects of leg loss and regeneration on prey capture in *Schizocosa ocreata*

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Previous laboratory experiments have shown no effects of leg autotomy on prey capture in adult wolf spiders. However, these effects may not be the same for juveniles, which have different foraging patterns and are able to regenerate lost appendages. Additionally, none of the previous studies addressed prey capture in a natural setting. Recent studies have shown that juvenile wolf spiders in the field with missing/regenerating legs have reduced body condition. For these reasons, this study tested the effects of autotomy and regeneration on prey capture in juvenile *Schizocosa ocreata* wolf spiders in both artificial and semi-natural settings. Spiders were tested for capture efficiency (i.e., measures of latency to orient to, capture and subdue prey) in a 15 cm diameter circular arena with cricket prey. Sensory detection through vibration (i.e., measures of accuracy of orientation) was also tested by placing spiders in the same type of arena but visually isolating them from their prey. Subsequent analyses showed no effects of autotomy or regeneration on any measures of prey capture efficiency. Similarly, spiders' vibratory sensory abilities were not significantly affected by autotomy or regeneration. However, when spiders were tested in a semi-natural habitat (a mesocosm filled with leaf litter), individuals with a missing or regenerating leg had reduced prey capture rates. This suggests that while negative effects of autotomy and regeneration do not appear to be directly attributable to mechanical or sensory impacts on foraging, they may only be apparent in more complex environments such as the spider would encounter in nature.

POSTER ABSTRACTS

Screening of necrotizing arachnidism in Korea using sphingomyelinase assay

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While spider bites are not a major medical problem in Korea, it would be of great value to know which species of spiders pose a threat to human health. There are now more than 40,000 identified spider species in the world, and considered about 100 species as actually dangerous to human. Spider bites cause a range of symptoms from simple swellings to disfiguring necrotic lesions, and occasionally death. A middle molecular weight protein, sphingomyelinase D, has been identified in the venom of the brown recluse spider and strong evidence suggests that they have a major role in spider bite necrosis (Tambourgi et al., 1998). For the identification of necrotizing species, we have investigated using recently developed non-radioactive assay of sphingomyelinase for rapidly screening the necrotizing venoms. Here, we demonstrate the fetal toxicity of total 122 species among 622 identified spider species of Korea. It has been revealed that one species of the orb-weaving spider, *Araneus ventricosus*, and another species of wandering spider, *Dolomedes sulfureus* has the strongest positive activities among themselves. However comparing to that of the brown recluse spider, *Loxosceles reclusa*, in North America the necrotizing activities of these Korean species are still very low, so it seems to be little possibilities to create serious necrotizing arachnidism in Korean peninsula.

Microstructure of the silk spinnerets in the lynx spider, *Oxyopes licenti* (Araneae: Oxyopidae)

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Lynx spiders are one of free wandering spiders with long legs. They do not build web but hunt small insects on plants. In spite of the facts that the wandering spiders do not produce webs for prey-catching, they also have silk apparatus even though the functions are not fully defined. Here we describe the fine structural organization of the silk glands and its spinning apparatus in the lynx spider, *Oxyopes licenti*, revealed by the transmission electron microscope (TEM) and field emission scanning electron microscopes (FESEM). The silk glands of the adult female spider were located in four groups on the spinnerets including each pair of major and minor ampullates, tubuliforms, pyriforms and aciniforms. Each group of silk gland feed silk into one of the three pairs of spinnerets. Moreover, the tubuliform gland is only observed in female spiders, and the ampullate one is the most predominate gland in both sexes. However the flagelliform and the aggregate glands which had the function of adhesive thread production in orb-web spiders were not observed at both sexes of this spider.

The effects of wolf spider communities on soybean herbivory

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Wolf spiders are common generalist predators in agricultural systems and could potentially have direct or indirect effects on plant herbivory. Many wolf spiders are also significant intraguild predators that may

result in complex interactions between spiders, herbivores, and plants. We conducted a field study using three commonly occurring wolf spiders, *Pardosa milvina*, *Trochosa ruricola*, and *Rabidosa* spp. with soybean as our model agricultural plant. Nine treatments were created by planting the soybean during the summer growing season within enclosures of different wolf spider communities. The treatments were: 1) *Rabidosa* only, 2) *Pardosa* only, 3) *Trochosa* only, 4) *Pardosa* and *Rabidosa*, 5) *Pardosa* and *Trochosa*, 6) *Trochosa* and *Rabidosa*, 7) no enclosure, 8) no spiders, and 9) *Pardosa*, *Rabidosa*, and *Trochosa* (N= 17/treatment). Enclosures were checked on a weekly basis, various vegetative and reproductive measurements were taken. The presence of spiders was recorded, and any non-treatment species were removed. Plants were harvested at the end of the summer and leaves, pods, and root nodules were counted and plant biomass was weighed. Spider treatments were not shown to have a significant impact on any vegetative or reproductive plant traits, but intraguild interactions did impact spider number and body condition, particularly for *Pardosa milvina*.

The Balkan and Aegean *Euscorpius* (Scorpiones: Euscorpiidae): new data for mitochondrial DNA phylogeny

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The systematic composition of the genus *Euscorpius* Thorell, 1876 (Scorpiones: Euscorpiidae) in the Balkans is unclear. This especially refers to so-called "*carpathicus* complex" (Fet & Soleglad, 2002). New material obtained in 1999–2004 from Greece and Bulgaria has been used for DNA extraction and PCR amplification of ca. 400 bp of the mitochondrial gene for 16S rRNA, followed by sequence comparison of 26 DNA sequences via PAUP* 4b10. New data for mitochondrial DNA phylogeny allow to outline several independent lineages, some of which could have species status. A separate Greek lineage is formed by populations from Crete ("*E. candiota*" Birula, 1903) grouping closely with Kithyra, Peloponnese, and western Greece (Corfu and Parga in Epiros). Among other Aegean islands, Thassos population is very different from Paros; the latter shows affinity to *E. tauricus* (C.L. Koch, 1837) from Crimea, Ukraine. Another cluster is formed by populations from Rhodope Mts. (Xanthi in Northern Greece; Trigrad, Kovachevitsa, and Melnik in Southern Bulgaria). Olympus and Ossa (Thessaly, Eastern Greece) refer to "*E. carpathicus ossae*" Caporiacco, 1950. Sliven (Stara Planina Mts., Bulgaria) forms a separate lineage, not close to Romanian *E. carpathicus* (L., 1767); the latter shows affinity to the western Balkan (Slovenia, Croatia)/Italian *E. tergestinus* (C.L. Koch, 1837). Separate status of the Balkan *E. hadzii* Caporiacco, 1950 (Croatia, Herzegovina) and *E. sicanus* (C.L.Koch, 1837) (Thessaly) is confirmed. In total, Greece could house over 10 species of *Euscorpius*, and Bulgaria, at least four.

Mouth parts of important tick genera

Susan Broda

USDA, APHIS & PPQ, Baltimore, Maryland

This poster will present photographs of the mouthparts of important tick genera.

I smell a femme fatale: can males chemically detect a cannibalistic prospective mate?

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Virgin female Hogna helluo wolf spiders cannibalize prospective mates in 13-20% of encounters with courting males. Males may therefore benefit by possessing the ability to detect and avoid cannibalistic females. We tested if prior cannibalistic experience alters female behavior toward males and if males can detect cannibalistic females based on either direct interactions with females or indirectly through cues from female silk and excreta. We reared 36 female spiders on entomophagic diets consisting of house crickets (Acheta domesticus) and an additional 34 females on araneophagic diets consisting of two Hogna feedings at adulthood prior to testing. We then measured male and female mating behavior across the following treatments (14-20 replicates/treatment): 1) cannibalistic female on cannibalistic chemical cues, 2) cannibalistic female on non-cannibalistic chemical cues, 3) non-cannibalistic female on non-cannibalistic chemical cues, and 4) non-cannibalistic female on cannibalistic chemical cues. Male Hogna were placed with females and cannibalism events, courtship duration, courtship latency, mating success, and courtship intensity were recorded. Males significantly decreased courtship duration in the presence of cannibalistic females and significantly increased courtship intensity when encountering silk from females that had cannibalized previously. Cannibalistic females showed higher numbers of leg taps, a putative receptive response, toward males than non-cannibals but we found no significant difference in mating success or cannibalism frequency across treatments. Results suggest that males discriminate between females who have eaten conspecifics and those who have not based on information in silk, but female cannibalism frequency and male mating success is unrelated to recent female cannibalism experiences.

Spider species diversity in some dry forest plants of western Mexico

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Spiders were collected from eight tree and three shrub species in each of two sites in a Mexican dry forest thorough June, July, September, October and November of 1999, and january and abril 2000. A total of 1349 adult specimens, belonging to 21 species were obtained. Plant arquitecture and foliage type have been related to spider species richness, abundance and diversity. We measured relative cover, foliar area, and leaf type and disposition for each plant species in order to determine their influence on the spider community structure. Number of adults, species richness, dominance (Simpson index) and equitability (Pielou index) were measured for the spiders. In both sites, small-leaved bipinnate trees and shrubs, particularly the shrub *Acacia cymbispina* and the tree *Prosopis juliflora*, had more species as well as higher spider abundances. Foliar area was negatively correlated with spider abundance in both sites, and to species richness in one of them. Dominance was particularly high for *Croton ciliatoglanduliferus*, a widespread shrub typical of disturbed sites in the region, in which the Green Lynx spider *Peucetia viridans* was abundant.

Metals in cuticular structures of Palpigrada, Ricinulei and Schizomida (Arachnida)

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Specimens of Palpigrada, Ricinulei and Schizomida were examined by energy dispersive x-ray spectroscopy for the presence of metallic elements in cuticular structures. Manganese was found in the largest tooth of the fixed cheliceral finger in a ricinuleid. Zinc was found in the chelicerae, leg and palpal claws and in the palpal tarsal spur of a schizomid. Zinc was also found in the chelicerae and leg claws of a palpigrade. When presence or absence of zinc is added to a cladogram of arachnid orders, the absence of zinc in the Acaromorpha (Acari + Ricinulei) appears to be derived. Similarly the absence of manganese in the Uropygi (Schizomida + Thelyphonida) may be derived also.

Responsivity of male *Dolomedes triton* to dragline silk from females

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Activities that increase an organism's survival and reproduction are important energetic expenditures for every species. Low density, wandering species must travel long distances in order to locate potential mates. Mechanisms that increase the success of the search and decrease the energetic costs to the animal should be selected for through the evolutionary process. Energy should be allocated where it is most likely to be repaid; in this case in the form of copulation and successful reproduction. We investigated male search tactics in the non-

webbuilding spider *Dolomedes triton*, or fishing spider, which inhabits vegetations around freshwater lakes and ponds in North America. Female *D. triton* are less active than their male counterparts, which exert considerable time and energy locating and courting females. We tested the hypothesis that males uses cues bound to female dragline silk to locate stationary females. Silk from virgin and mated adult females was extracted from the spinnerets and presented to virgin and mated adult males and the subsequent courtship behaviors including various waves and taps with the legs demonstrated by males were recorded. It was expected that (1) males would expend an approximately equal amount of time and energy courting dragline silk as they would true female spiders (2) males would exhibit preference towards unmated, adult females as this should increase probability of copulation as well as reduce the chance of sexually-induced cannibalism and (3) males cue in on factors among the dragline rather than the presence of silk itself. Variance tests indicate males conserve courtship to pads containing female silk but do not appear to discriminate between virgin or mated silk.

Wolf spiders reduce aggression toward conspecifics after repeated encounters

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The "dear enemy" phenomenon suggests that territorial species should exhibit less aggressive behavior toward familiar neighbors as compared to strangers that they encounter. We examined whether this phenomena could be operating in populations of the large burrowing wolf spider, *Hogna helluo* (Araneae, Lycosidae). In a laboratory experiment, we monitored the repeated interactions between adult field-caught females over four consecutive days. On the fifth day we exposed them to unfamiliar animals and observed that interaction. There was an increase in the total number of encounters between spiders after repeated exposure but the frequency with which they approached one another with legs raised decreased as did the likelihood of physical contact during encounters. Thus their interactions appeared much less aggressive after repeated exposure with a conspecific. However, there was no evidence of a neighbor effect as their behavior toward an unfamiliar animal on day five was similar to their reactions to the familiar animal on day four. We conclude that, although *Hogna* females appear to learn to reduce their overall aggression level toward conspecifics in high-density situations, they do not discriminate between individuals they have encountered repeatedly and unfamiliar individuals.

Activity cycles and vertical stratification of spiders in cornfields

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Spider distributions and abundances across the diel period have been investigated in various row crops but are not well-studied in corn. Furthermore, it is unknown if certain families of spiders prefer specific locations on corn plants, as has been found in other crops. Plants near discrete habitat refugia (small straw piles) in soy and corn fields have been shown to have less insect damage and increased crop yield, but the mechanism behind this "refugia effect" is not clear. One hypothesis is that spider assemblages associated with refugia help protect plants from herbivory. Thus, a nine-week observational study of spiders on and around plants in six one-half hectare conventionally-tilled corn fields was conducted to determine daily spider activity cycles, their positions on corn plants, and the composition of spider assemblages. Most variability of spider numbers and their community compositions appeared to be related to spider phenology and corn growth stages. There was a well-defined stratification of spider families on the corn plants. The Lycosidae dominated the ground layer while the Salticidae were most prevalent on the plant tops throughout the season. Other spider families occupying different areas on the plants shifted during the summer. There was an inverse relationship between salticid and thomisid numbers on the plants. Most spiders tended to be active at night, with lycosids and salticids showing a mid-day spike in activity. No significant effects from the presence of refugia were found on spider numbers, but more cursorial spiders tended to be near plants associated with refugia.

Love bites: Evidence of coercive mating in the brush-leg wolf spider *Schizocosa ocreata* (Hentz)

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Coercive mating is defined as forced copulation when the female is not receptive, (at any point during the interaction or just prior to being mounted), and has been noted in many animals, especially arthropods. Obvious benefits to males who coercively mate include reduced energy cost from prolonged courtship, and an increase in the number of offspring sired. Adult male Brush-legged wolf spiders, *Schizocosa ocreata* (Hentz), exhibit elaborate courtship displays when presented with adult females and their silk. In response, females exhibit receptivity behaviors that in most cases determine whether copulation occurs. However, in trials where females are not receptive, mounting and subsequent copulation sometimes happens. Upon re-review of videotapes from previous studies of mating in this species, several instances of coercive mating were identified (in 12 out of 92 [13%] of mating trials). In several of these trials, the females were receptive at some point but not directly prior to mounting, and males often physically pulled down non-receptive females (attempting escape from the side of the arena) and copulated with them. Inspection of several male-female pairs in which mating was apparently coercive revealed that during copulation, males used fangs to maintain position *in copula*. Subsequent examination revealed cuticular wounds oozing hemolymph, which were not seen in consensual matings. The aggressive nature of males in these encounters suggests that further inspection of male behaviors and the potential costs that females may incur should be explored.

Effects of food deprivation on prey capture behavior in tarantulas (*Brachypelma albopilosum*)

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Spiders can survive prolonged periods of food deprivation and previous studies suggest that they may alter their foraging activities depending on their level of hunger. We tested the short-term effects of food deprivation on a tarantula (*B. albopilosum*) in the laboratory. These sit-and-wait predators typically remain within burrows from which they strike at passing prey. In this study, we recorded prey capture ability in relation to hunger level. Feeding trials were carried out on each animal with an increasing number of days of food deprivation between each trial (1, 3, 5, 7, and 14 days). All trials were videotaped and from these recordings we determined the total capture time, awareness field, strike distance, attack angle, and relative prey position. Average capture time decreased substantially as function of time: 97.5s at 1 day and 7.3s at 14 days. Average strike distance was measured after capture success as the distance from the center of the chelicerae to the nearest cricket appendage. These data were more variable but over the entire experiment strike distance increased by 28%. These data suggest that increased hunger levels give rise to increasingly aggressive predator tactics. In addition, there was substantial individual variation in behaviors.

Patterns of silk and excreta deposition in the wolf spider *Hogna helluo*

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We measured the context and pattern of silk and excreta deposition in the wolf spider *Hogna helluo*. *Hogna* were allowed to move freely for four hours on individual grid-bearing 80 mm dia. paper disks. We then quantified dragline silk coverage, number of attachment disks and excreta produced on each sheet. We compared differences in silk and excreta deposition as a function of sex, developmental status, clutch, female reproductive status (virgin and mated), female diet (cannibalistic/not), and the presence or absence of chemical cues from crickets (*Acheta domesticus*). Silk deposition (both dragline and attachment discs) was highly variable and did not differ significantly by

clutch among juvenile spiders. Dragline silk production increased significantly among mature females compared to various juvenile stages (early, mid and penultimate instars) and adult males. Surprisingly, we found no significant reduction in dragline deposition among females after mating suggesting either another function independent of mating, or that female *Hogna* may continue to advertise to acquire multiple mates. We found no significant difference in dragline or attachment disc deposition among cannibals and non-cannibals. Excreta deposition was highly controlled and context specific, significantly increasing in the presence of chemical cues from house crickets. Attachment disks were produced similarly by all developmental stages and both sexes. Adult females significantly decreased attachment disk production in the presence of prey cues. Since prey of wolf spiders use silk information as an early warning for the presence of predators, reduced silk production may increase foraging effectiveness and mitigate antipredator responses in prey.

Cold temperature tolerance and distribution of the brown recluse (*Loxosceles reclusa*) in Illinois

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The temperature tolerance of the brown recluse spider, *Loxosceles reclusa*, has been briefly describe by Hite et al. (1966) as having the range of 4.5ºC to 43.3ºC. In various laboratory experiments the cold tolerance of *L. reclusa* was tested with temperatures ranging from 3º to -14ºC. Three experimental methods facilitated in determining the cold tolerance of the brown recluse. First, an experiment was setup to test a 4h exposure to a certain test temperature during a 16h period. Second was to test if the recluse spider produced a silk retreat when exposed to simulated winter temperatures. The final experiment tested the effects of a 90d exposure to a constant test temperature of 0º C and -5º C. While determining the cold tolerance in a controlled environment, temperature data loggers were used to recorded leaf and grass litter temperatures for 3 months that were compared to ambient air temperatures to describe a correlation between ambient and litter temperatures in northern Illinois. With the gathered information I was able to determine a theoretical distribution of *L. reclusa* throughout Illinois.

Prey availability on the blackbrush, *Acacia rigidula*, for the scorpion, *Centruroides vittatus*

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The scorpion, *Centruroides vittatus*, often feeds in blackbrush, *Acacia rigidula*, and on caterpillars (Lepidoptera). What factors affect the availability of caterpillars on blackbrush? Does caterpillar availability influence the foraging behavior of *C. vittatus*? The availability of caterpillars was sampled with a beating sheet to beat blackbrush from May 20, 2004 to May 12, 2005 on the campus of Texas A&M International University in Laredo, Texas. Blackbrush with scorpions were compared to blackbrush with no scorpions present. Scorpion activity was observed during the same period to compare to caterpillar availability. The season, temperature and precipitation all had significant effects on the number of caterpillars per sample. The average number of caterpillars per sample was higher during September, lower at temperatures < 20 °C, and higher with precipitation greater than 10 cm during the prior two weeks. Scorpions in blackbrush did not select a blackbrush with significantly higher caterpillar numbers than blackbrush sampled at random. Scorpion microhabitat use changed significantly with the average number of caterpillars per sample per night (caterpillar classes). However, the use of blackbrush was not different among the caterpillar classes. The proportion of scorpions with prey did not change significantly among the caterpillar classes. However, the proportion of scorpions with caterpillars as prey did increase with a higher average number of caterpillars per sample per night. The foraging behavior of *C. vittatus* does not appear to change to take advantage of the availability of caterpillars in blackbrush, but the opportunistic scorpions feed on caterpillars when available.

The effect of juvenile experience on adult female mating preferences in *Schizocosa ocreata* (Hentz)

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In spiders as well as other animals, species recognition and mating success are linked to female preferences for male traits and courtship displays. Although social experience is known to influence adult mate recognition and female preferences in some vertebrate animals, relatively little is known about such effects in invertebrates. Recently, Hebets (2003) demonstrated an effect of juvenile exposure on adult mate preference in the wolf spider *Schizocosa uetzi*. In a two-part study, we investigated whether juvenile female experience with male courtship influences adult female mate recognition using the well-studied brush-legged wolf spider, *S. ocreata* (Hentz). In the first study, penultimate *S. ocreata* females were exposed multiply to bimodal (visual + vibratory) courtship of one of two conspecific male phenotypes (males with decorative leg tufts removed; 2. males with intact tufts). In the second study, penultimate *S. ocreata* females were exposed multiply to bimodal conspecific or heterospecific (*S. rovneri*) male courtship. Upon maturing, exposed females were paired with an adult male of the same or opposite phenotype/species to which they had been previously exposed and were observed to determine receptivity and willingness to copulate. Exposure to different male phenotypes (tufts/no tufts) had no significant effect on female receptivity or female willingness to mate. However, exposure to conspecific vs. heterospecific courtship did influence female receptivity. The role of juvenile exposure and plasticity in female mate recognition and choice behavior in these spiders will be discussed.

Identification of glutamic acid decarboxylase (GAD) isoform immunoreactivity in the central nervous system of the barn spider, *Araneus cavaticus*

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The ?-aminobutyric acid (GABA) has long been considered an inhibitory neurotransmitter in the central nervous system (CNS) of both vertebrates and arthropods. The glutamic acid decarboxylase (GAD) catalyzes the conversion of L-glutamate to GABA. As the GAD has a restricted tissue distribution, it is highly expressed in the cytoplasm of GABAergic neurons in the CNS. However it is also present in other non-neuronal tissues such as testis, oviduct and ovary. Recently, there were reports that a GABA-like immunocytochemical reactivity and a ninhydrin-positive GABA derivative, GABamide, exists in the visual ganglia and in the water-soluble fraction of the spider web respectively. So, this experiment initiated to identify exact distribution of the GAD isoform immunoreactivity in the CNS of the spider to reveal the ecophysiological significance of GABA for spider's behavior.

Variation in leg and pedipalp setae in tarantulas from arboreal and terrestrial habitats

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Tarantulas are well-known for their size and hairiness. Although these hairs may appear uniform, they often differ at the microscopic level in both form and function. For example, spiders use the hairs on their body as an important sensory conduit for detecting both mechanical and chemical signals. Because habitats and life styles vary for different species, we hypothesized that there would be differences in the hairs found on the legs and pedipalps of (1) different species and, (2) arboreal and terrestrial species. We used scanning electron microscopy to examine the pedipalps and legs of both arboreal (*Avicularia avicularia* and *Poecilotheria regalis*) and terrestrial species (*Aphonopelma smithi* and *Brachypelma vagans*). On the pedipalps of the two terrestrial species we found some very distinct smooth hairs interspersed among the more typical feathered hairs. These smooth hairs were not found on the arboreal species, nor were they seen on the first pair of legs of either terrestrial species. Further, the ventral sides of the tarsus of the legs and pedipalps in both terrestrial and arboreal spiders were covered with scopula hairs. Although the shape at the base of these scopulae was similar between the two groups, the distal ends varied; the arboreal species had a much flatter distal end compared to the sharply curved end of the terrestrial tarantulas.

Reflectance measurements of the dimorphic male jumping spider, *Maevia inclemens* (Salticidae)

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Males of the dimorphic jumping spider, *Maevia inclemens*, differ in both morphology and courtship behavior. To help understand the differences between these males, we measured reflectance patterns of several body regions using spectrographic techniques. Thirteen grey morphs, 11 tufted morphs, and 18 females were measured for reflectance in predetermined locations the body. As expected, reflectance patterns of males differed considerably. Notably, the black pedipalps of the tufted male have very low reflectance intensities compared to the grey morph and the pedipalps of the grey morph peak in the orange wavelengths. An interesting discovery was that tufted males have a highly reflective area posterior to the tufts on the dorsal prosoma. The location of this bright spot suggests a unique means of illuminating or backlighting the tufts when males position themselves in a courtship stance and are facing females, perhaps silhouetting the tufts for contrast against backgrounds. Such differences in reflectance patterns further support the hypothesis of divergent courtship strategies, which evolved for long distance vs. close displays relative to the female.

Individual recognition in the amblypygid *Phrynus marginemaculatus*

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Individual recognition is extremely important in many animal taxa, especially in the context of repeated agonistic interactions. During the day, adult amblypygids (*Phrynus marginemaculatus*) reside individually under limestone rocks. At night, individuals leave their rock to forage, typically returning at sunrise. Male *P. marginemaculatus* are known to engage in ritualized agonistic interactions and individuals seem able to recognize their individual rock. To discover if *P. marginemaculatus* is capable of individual recognition, we constructed an arena with two artificial entrances opening to potential hide-outs. In a series of four laboratory experiments, cages were attached to the entrances in the following manner: (1) only their own cage, (2) their own cage and an empty cage, (3) their own cage and another individual's cage with whom they had no experience (unknown), and (4) an unknown cage and the cage of an individual with whom they recently had an agonistic encounter. Individuals in experiment 2 and 3 were most likely to enter the first opening they encountered. However, in experiment 2, individuals that explored both entrances tended to enter their own cage, suggesting individual recognition. After staged agonistic encounters, individuals were used in the cage preference trial for experiment 4. Of the individuals that explored both entrances, 100% of the losers entered the unknown cage while 83% of the winners entered their previous opponent's cage, suggesting that losers recognized and discriminated against the cages of opponents which had defeated them, and winners recognized and favored cages of opponents which they had defeated.

Habitat choice and an intraguild predator lead to a reduction in foraging efficiency in the wolf spider, *Pardosa milvina* (Araneae, Lycosidae)

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Spiders often prefer more structurally complex habitats because there is more protection from predators, higher prey abundance and more suitable microhabitat conditions. In the laboratory we designed experiments to determine if the wolf spider, *Pardosa milvina* (Araneae, Lycosidae) had a habitat preference, if that habitat preference changed in the presence of cues from the intraguild predator, *Hogna helluo* (Araneae, Lycosidae) and if habitat and predator presence affected foraging efficiency. In a choice test, *Pardosa* consistently preferred the more complex straw over dirt but the contamination of the straw with *Hogna* cues eliminated that preference. Both habitat complexity and the presence of *Hogna* had negative effects on *Pardosa* foraging efficiency. These results demonstrate that *Pardosa* prefers the more complex substrate but that they shift their habitat use and foraging in the presence of the potential predator. In addition the cost of high levels of habitat complexity in the form of a straw matrix would be that spiders spend more time looking for prey. The results of this study provide a richer understanding of the habitat associations of wolf spiders. Further research will help untangle the specific aspects of complex habitats that *Pardosa milvina* are selecting.

Phylogenetic analysis of the arachnid orders using morphological characters

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Despite ever-increasing reliance on molecules by systematists, morphology still contributes phylogenetic information and is necessary for accommodating fossils in systematic analysis as well as reconstructing organismal evolution. Here 194 binary and unordered multistate characters were coded for 52 chelicerate taxa (37 extant and 15 fossil) from original observations and literature review. Parsimony analyses were performed on the extant taxa alone and on all taxa. Neontological data recovered four arachnid lineages -- 1) Palpigradi, 2) Tetrapulmonata (Araneae (Amblypygi, Uropygi)), Acaromorpha (Acariformes (Anactinotrichida, Ricinulei)) and Dromopoda (Opiliones + Scorpiones) (Pseudoscorpiones + Solifugae) -- whose interrelationships were unresolved in strict consensus. Successive weighting resolved the following relationships (((Palpigradi, Tetrapulmonata) Acaromorpha) Dromopoda). Significantly, Opiliones and Scorpiones were recovered as sister groups and Acari was recovered as diphyletic. Due to analytical problems caused by unknown states in fossil taxa, the full data set was analyzed using the strict consensus from neontological data as a backbone constraint. The unweighted data produced 14069 trees, with no resolution among the four lineages recovered by neontological data. Successive weighting, both with and without backbone constraint, produced a topology consistent with neontological results. Among fossils, Haptopoda was recovered as the sister group to Palpigradi + Tetrapulmonata; Trigonotarbida as sister group to extant Tetrapulmonata. This analysis introduces many new characters, redefines "traditional" characters and corrects errors perpetuated by uncritical recycling of data. The results highlight strengths and weaknesses in our understanding of arachnid phylogeny.

Environmental effects on prey-capture behavior for *Androctonus crassicauda* (Scorpiones: Buthidae) in north-central Iraq, Operation Iraqi Freedom II

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Prey-capture behavior is a fundamental characteristic in understanding a scorpion's narrow gamut of stereotypical behaviors. Quantitative studies of these behaviors, however, are rare and, when studied, are generally (by necessity) performed in a laboratory. This laboratory setting allows easier setup, care, control and analysis than a field setting. Interestingly, one can combine the benefits of a laboratory with the field enviornment; thereby, generating a third, intermediate study location – the "outdoor" laboratory. By contrasting prey-capture conditions in both indoor and outdoor laboratories, demonstratable differences in the behavior of *Androctonus crassicauda* (Olivier, 1807) have been observed. For instance, the total capture time (handling time prior to ingestion), amount consumed, sting frequency, travel timeand inactive periods differ between the indoor and outdoor laboratories. These differences suggest that the indoor laboratory may be inappropriate for observing natural scorpion behaviors. Hence, a scorpion's prey-capture behavior should, when amenable, be studied in an outdoor-type laboratory. By using habitat- and locale-specific outdoor pens, substratum and ambient (local) environmental changes, scorpions are stressed in a manner corresponding to their natural environment. Despite problems with habitat/locale-specific studies in some areas of the world, it can be relatively easy for observers, who

must cohabitate with indigenous scorpion species, to study and observe their behaviors in an easy-to-control, field-like setting.

Fates of male tarantulas (*Aphonopelma anax*) during the breeding season

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At maturity, male tarantulas (*Aphonopelma anax*) leave their burrows and sedentary lifestyles to actively search for spatially scattered females in a non-aggressive scramble competition polygyny. Mate searching activities expose males to a greater risk of predation, high environmental temperatures, dehydration, and potential cannibalism by females. In this study 16 mature males were fitted with radio-tags and tracked over the course of the breeding season which occurs from late May to July. Males experienced a mortality of 50%; 75% from Tarantula Hawk wasps (*Pepsis* sp.). Mate searching was primarily nocturnal and crepuscular but activity often extended into periods of full daylight. Males rarely used burrows for daytime retreats and most often utilized partially concealed shaded areas under brush. Activity occurring during daylight hours and poorly concealed daytime retreats could expose males to an increased risk of predation from diurnal predators like Tarantula Hawk wasps. This may explain the high mortality from Tarantula Hawk wasps. Additional males will be radio-tagged and tracked during the 2005 breeding season.

The effect of male-male competition and information availability on the courtship and copulatory behavior of the wolf spider *Schizocosa ocreata* (Araneae: Lycosidae)

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We measured the effect and interaction of male-male competition and differential access to information about female mating status (presence/absence of pheromone-laden female silk) on male courtship latency, courtship intensity, mating success, and copulation duration. We created six treatments utilizing combinations of the presence or absence of a second "spectator" male and the presence or absence of pheromone-laden female silk. Within 30-minute trials (N = 86 trials), the second male "spectator" was physically isolated from the female via a transparent barrier but received visual and seismic cues in all trials and chemical cues from the female in some treatments. If male-male competition mediates courtship and mating behavior, we expected that the presence of a second male would decrease courtship latency, increase courtship intensity, and increase copulation duration compared to treatments without an additional male. Further, second males that have access to silk and visual/seismic information about females would court more vigorously and for a longer period of time. This would induce higher courtship rates and copulation duration among males with direct access to the female. We found that in general, female advertisements toward males via silk had a much larger impact on male and perhaps female behavior than the presence of a spectator male. However, we found evidence that when spectator males also had access to female silk, this had a significant priming or synergistic effect on the other male's behavior across some treatments resulting in increased copulation duration, increased courtship intensity, and shorter latency to court.

Modified piriform silk glands in adult male *Mimetus* (Araneae, Mimetidae)

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In addition to numerous (range 35-63) typical piriform gland spigots, each anterior lateral spinneret (ALS) of adult male *Mimetus puritanus* Chamberlin 1923 (*N* = 5 pairs of ALS) and *Mimetus notius* Chamberlin 1923 (*N* = 2 pairs of ALS) contains 2 spigots that we interpret as serving modified piriform glands. This pair of modified piriform spigots occurs on a clearly demarcated patch of smooth cuticle, immediately lateral to the major ampullate spigot/nubbin/tartipore complex, within an indentation formed by the typical piriform spigot spinning field. The modified piriform spigots are wider and have larger caliber openings than the typical piriform spigots. They are absent in adult females and penultimate instar males. Presumably, products of the silk glands served by these spigots play some role in reproduction. It may be of taxonomic value to determine if the modified piriform spigots occur beyond the genus *Mimetus*.

Phylogeography of the striped scorpion, *Centruroides vittatus* in the southwestern United States

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Phylogeographic analyses have shown how genetic relationships among populations of a species can be viewed from a phylogenetic perspective. This approach was taken to better understand the evolutionary relationship among striped scorpion populations in Arkansas. Our preliminary analysis of Arkansas and Louisiana striped scorpion populations showed Arkansas populations were difficult to separate with mtDNA sequencing. We expanded the previous analysis to include populations from across the striped scorpion's geographic range. Thirty-one new populations were included in our expanded analysis. We sequenced 602 nucleotides of the Cytochrome Oxidase I mtDNA region from these populations for a total of 82 sequences in our analysis. After sequence alignment, we analyzed the sequences and created phylogenetic trees with parsimony, maximum likelihood, and baysian analyses. The generated trees showed four distinct regional scorpion populations: the Big Bend area, west Texas and New Mexico, Laredo/Pecos, and eastern populations. Our analysis supports a recent expansion hypothesis of striped scorpion populations from the desert southwest, presumably during the Hypsithermal Interval.

Evidence for dragline mediated mate location in the wolf spider, *Hogna helluo* (Araneae, Lycosidae)

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Many spiders produce sex pheromones that carry information on species identity, maturity and mating status of potential mates. In previous studies we have failed to uncover evidence of airborne pheromones in the wolf spider, *Hogna helluo* (Araneae, Lycosidae). The purpose of our study was to determine if males of that species locate and follow female silk draglines. Virgin lab-raised adult male and female *Hogna* were used in our experiments. Silk was collected from females and placed in single lines on a 90x40cm arena. Male *Hogna*, were then placed in the arena and monitored for 30 minutes. The amount of time spent close to the silk, number of passes made over the silk strands, and any courtship behavior displayed were recorded. Silkworm silk was used in separate trials as a control. Male *Hogna* spent more time associated with female silk and made more passes across female silk than with silkworm silk. These results suggest that there are pheromones associated with female draglines of *Hogna helluo* and that males are likely to use those draglines to locate reproductively receptive females.

Web architecture in the western black widow spider (*Latrodectus hesperus*) in relation to prey availability

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Tradeoffs between prey capture and predator defense commonly cause changes in behavior. For instance, starved orb-weaving spiders sometimes construct larger webs, using thinner silk threads, than fed spiders. Within the Theridiidae, the orb web has been transformed into seemingly chaotic cobwebs, which depend upon tangled sheets and gumfooted threads to capture prey. We hypothesized that cobweb spiders with more food resources would invest more silk in webs than starved spiders and that the allocation of silk to gumfooted threads versus the sheet would change with resource availability. To test these hypotheses, we initially fed one group of black widow spiders for eight days while starving a second group. We then quantified web architectures and switched the feeding regimes between groups for a further eight days before repeating the quantification. We found that

black widow spiders with more food resources were heavier than starved spiders and that heavier spiders invested more silk in webs than lighter spiders. We also found that starved spiders invested more silk in prey capture elements, sheets and gumfooted threads, while fed spiders directed resources into the three-dimensional tangle. We suggest that fed spiders are allocating silk resources toward the spinning of a defensive three-dimensional tangle, while starved spiders allocate effort toward foraging.

American Arachnological Society 2005

Don't worry, the **real** 2005 AAS Group Photo will be appearing in the upcoming supplement to *American Arachnology* # 72.

Student Research Awardees 2005

Award winners from the **AAS Research Fund:**

Efrat Gavish, Mitrani Dept. of Desert Ecology and Dept. of Life sciences, Ben Gurion Univ. of the Negev, Sede Boqer Campus, 84990 Midrashet Ben Gurion, Israel: *Control of leaf aphids by linyphiid spiders: a small-scale farm experiment.*

Kindra Hazen, Dept. Biology, P. O. Box 751, Portland State Univ., Portland, OR 97207-0751: *Geographic variation in setae in* Habronattus oregonensis.

Jenai Milliser, Dept. Biological Sciences, Univ. of Cincinnati, Cincinnati, OH 45221: *Species recognition and sensory priming: The influence of juvenile experience on male choice in wolf spiders.*

Mor Salomon, Mitrani Dept. of Desert Ecology and Dept. of Life sciences, Ben Gurion Univ. of the Negev, Sede Boqer Campus, 84990 Midrashet Ben Gurion, Israel: *Cooperative brood care and the effect of colony diet on group structure in the social spider*, Stegodyphus dumicola *(Eresidae).*

Todd Stoltey, Dept. Biology, 316 Mark Jefferson, Eastern Michigan Univ., Ypsilanti MI 48197: *Activity patterns and metabolic rates of male tarantulas (*Aphonopelma anax*) during the breeding season.*

Award winners from the **Vince Roth fund:**

Roberta Engel, Dept. Ecology & Evol Biol., 75 N. Eagleville Rd., Unit 3043, Univ of Connecticut, Storrs, CT 06269: *Divergence in pseudoscorpions (genus* Synsphyronus*) endemic to granite outcrops in the wheatbelt, western Australia.*

Danilo Harms, Coppistrasse 20 7/10, 10365 Berlin, Germany: *Taxonomic studies on Bolivian Theraphosid spiders (Araneae: Theraphosidae)*

Congratulations to the awardees! Information on the 2006 round of funding may be found at the AAS Website (see page 22). Deadline for submission is 15 January, 2006.

2005 A.A.S. Election Results

The A.A.S. members cast their ballots this year for a President-Elect and a Director. In addition, Members made decisions concerning much-needed amendments to the A.A.S. Constitution and By-Laws. Voter turnout was a record number!

Paula Cushing is our new President-Elect, and **Chris Buddle** has become the newest AAS Director. Congratulations to the candidates and Thanks! to the Nominating Committee (Jim Carrel and Deborah Smith.

There were 5 Amendments proposed to the Membership:

Add the Webmaster and Parliamentarian as members of the AAS Executive Committee— **Approved**

Remove the designation of Honorary Member— **Declined**

Allow use of electronic mail for election balloting— **Approved**

Remove requirement that membership list be published every 5 years— **Declined**

Change constitution of Nominating Committee— **Approved**

Student Paper Awardees

The Student Paper Competition at the Akron AAS meeting produced many fine presentations. The awardees were:

Podium Presentations — First place was **Steven M. Thomas:** Insights into the distribution and phylogeography of the enigmatic opilionid, *Fumontana deprehendor* Shear (Opiliones: Laniatores: Triaenonychidae).

Second Place was **Melissa Bodner:** Evolutionary origin and loss of sphingomylinase D in the *Sicarius* and *Loxosceles* lineages.

Poster Presentations — First place for the poster was **Christopher Latanich:** Patterns of silk and excreta deposition in the wolf spider *Hogna helluo.*

Second Place was **Meghan Rector:** Reflectance measurements of the dimorphic male jumping spider, *Maevia inclemens* (Salticidae).

Congratulations to the award recipients, and we look forward to the student presentations in Baltimore!

2006 A.A.S. Annual Meeting

17 — 21 June, College of Notre Dame, Baltimore, Maryland

Hosted by Dr. Nancy Kreiter

The 30th annual meeting of the American Arachnological Society will take place between Saturday, 17 June and Wednesday, 21 June 2006 at the College of Notre Dame in Baltimore, Maryland.

Further information will be available in upcoming issues of *American Arachnology* and at the AAS website. The host may be contacted at:

NKREITER@NDM.EDU; (410) 532-5718

Matt Greenstone writes:

Request for Specimens Genetic Haplotyping Study

Dear Fellow Arachnologists,

One of the most vexing problems facing spider ecologists is the difficulty in identifying immatures, who may be very important in community dynamics, to species. I have a paper in press in *Molecular Ecology* - pdf available from me upon request - demonstrating that we can use a portion of the mitochondrial cytochrome oxidase I gene to identify an assortment of spiders, including immatures, to species. I now want to see how variable this sequence is by collecting 24 individuals of as many species as I can collect from across as much of the U.S. as I can find them in. Since I'm especially interested in biocontrol I have selected a subset of species that are widely distributed in U.S. agroecosystems. They are mostly Eastern species but some may be found further west.

If you should happen to be collecting in appropriate habitats, and find one or more of these species to be abundant, I'd be most grateful if you could collect a bunch of adults, up to as many as 25, place them in 80% EtOH, along with a label in pencil giving date, locality, and habitat – crop, whether in field or margin, etc – and collector's name, and send them to me. We'll handle the molecular biology, and, after the new fiscal year starts on 1 October, we can cover the cost of shipping.

Thank you all for your help. The species list is below.

Matt Greenstone: USDA-ARS-Insect Biocontrol Laboratory; Room 214, Building 011A, BARC West; 10300 Baltimore Avenue; Beltsville, MD 20705;
E-mail: GREENSTM@BA.ARS.USDA.GOV

Theridiidae: *Achaearanea tepidariorum; Latrodectus mactans*

Linyphiidae: *Erigone autumnalis; Bathyphantes pallidus; Grammonota inornata; Grammonota texana; Meioneta unimaculata; Tennesseellum formicum; Frontinella communis*

Tetragnathidae: *Tetragnatha laboriosa*

Araneidae: *Cyclosa turbinate; Leucauge venusta; Acanthapeira stellata; Micrathena gracilis*

Lycosidae: *Hogna helluo; Pardosa saxatilis; Pardosa milvina; Rabidosa rabida; Schizocosa avida*

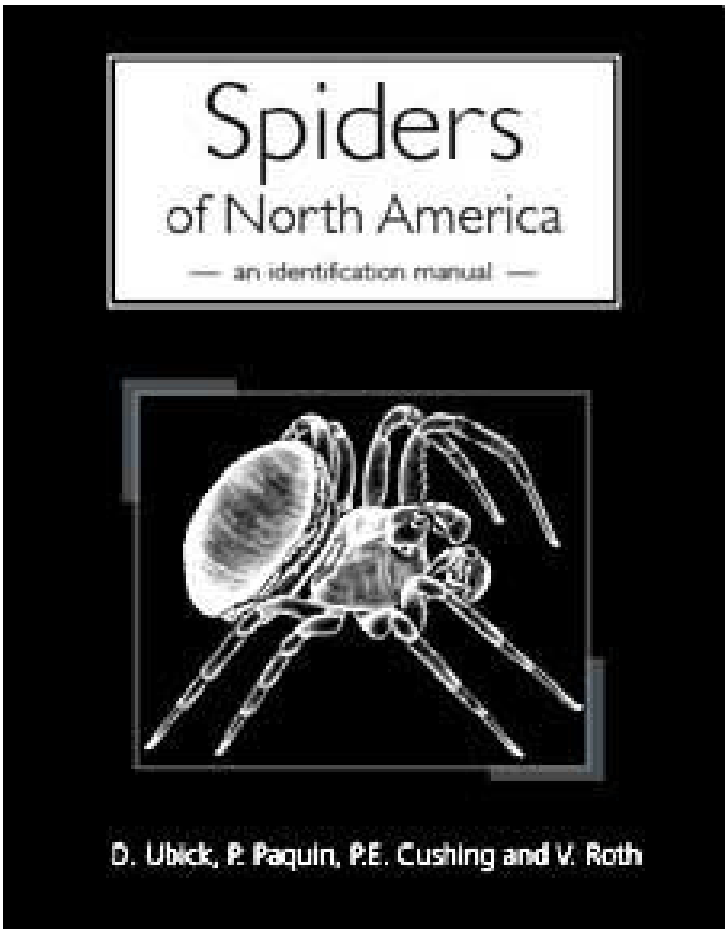
Oxyopidae: *Oxyopes salticus*

Miturgidae: *Cheiracanthium inclusum*

Clubionidae: *Clubiona abboti*

Thomisidae: *Misumenops oblongus*

Salticidae: *Phidippus audax; Metaphidippus galathea*



Spiders of North America An Identification Manual

Edited by Darrell Ubick, Pierre Paquin, Paula E. Cushing, & Vince Roth.
Original drawings by Nadine Dupérré

The Manual is now available! If you have not yet obtained yours, it is gorgeous! It is a must-have for all arachnologists.

ORDER AT:
http://www.americanarachnology.org/AAS_SGNA/SGNA_OnLinePayment.html

New Student Member of the AAS Executive Committee

In 2004, the AAS Executive Committee proposed adding a graduate student as a sitting member. The EC is proud to announce that **Shawn Wilder** (Miami University) has been appointed by President Beth Jakob. Shawn submits this note:

"My name is Shawn Wilder and I am the Graduate Student Executive Committee Representative for the AAS. My role on the Executive Committee is to represent the interests and concerns of graduate students. Feel free to contact me (WILDERS@MUOHIO.EDU) with any questions or concerns and I will relay them to the Executive Committee."

David Shorthouse writes:

I'm very excited to see the Nearctic Spider Database I developed and maintain really taking off, and I am confident it will be a remarkable collaborative effort and very unique in biodiversity circles. All kinds of fascinating pure and applied research questions can be posed once we have a common pool of data from which to draw. For example, I am interested in alien introductions and the rate founding populations spread across the landscape, country, or even the entire continent. We know so little about native fauna that for many species, endemism is guess-work. With a unified, geospatially-aware database, we just might be able to address these sorts of questions. It would be child's play to run spatially-constrained, time-series analyses on individual species' collection records. Similarly, national or regional species phenologies could be constructed based on collection dates. You likely have similar sorts of questions that can only be answered with a large, comprehensive bank of data. The Canadian Arachnologist Nearctic Spider Database is a recognized Global Biodiversity Information Facility data provider and is connected to a large community of ecologists and systematists. While the data are shared with GBIF, what I provide to them are tallies of individual species in geographic locations; the raw, gender-specific counts are not shared. These data are for us and this is my attempt at safeguarding our opportunity to use them in meaningful ways. I also have instructions in place for global users to appropriately cite your records when possible.

Some of you are sitting on truly amazing collections and I understand your reluctance to contribute. You might be waiting for the database structure to gel before suffering through an assumed chore of reconfiguring your spreadsheets or personal databases or, you fear the database could be dumped in the future and all your contributions lost (i.e. this database isn't formally married to an institution), or you don't quite see the value of this sort of thing. After all, it's a web-based tool that naturally doesn't have longevity as does paper. Believe me, I have thought about all these issues and have compelling reasons for taking a web-based approach, independent from a recognized institution.

It is far easier to convert digital data to paper than the other way around and institutions are perpetually fraught with computer and funding issues. If it weren't for the Internet, it would be near impossible to compile a comprehensive database of Nearctic spider collection records. If you simply have been too busy to contribute, I solved that problem by making a data template as easy and pain-free as possible with some bundled instructions for copying and pasting your data from existing Excel spreadsheets or personal Access databases. This secure, compiled, customized, and form-based Microsoft Access template synchronizes your collection records with your table in the server's database for which only you have permission to modify. It works using Access 2000, 2002 (XP) or 2003. Your template acts as your 'master' data and records may be added, deleted, and modified at your leisure. One quick press of a button in the template's interface and your records are added or updated on the server. The template has been field-tested on multiple different Windows operating systems and versions of Access in Denver, CO to Pincher Creek, AB and has a number of useful tools. For example, you may plot all your collection records and develop your own map, check your records for nomenclatural issues, and examine your data for duplicate records. If you do not have any intention of installing and using Access on your machine, I can send you a CD with a distributable runtime that will permit you to use this template even if you haven't purchased Access. If you use a Mac, unfortunately, you must have Access already on your machine and I can send you the template independent from the Windows-based installation package. Sorry, I haven't yet taught myself how to design installation packages for the Mac.

The web address for the Canadian Arachnologist Nearctic Spider Database will never change because I make use of a dynamic name service; I may plug-in the computer anywhere in the world and the connectivity between your template and the server remains as stead-fast as always, and the website will always be http://canadianarachnology.webhop.net. The contents of the database are backed-up every night and the entire machine is backed-up every week. Once a month, everything is transferred to an off-site, external hard drive. If heaven-forbid, the server crashes or something catastrophic happens to the database (or the machine stolen or down in flames!), I can get it up and running once again. Because all your data are contained in your Access template, even if all the data on the server were lost and I had to start from ground zero, a synchronization from your template interface restores all your data to the server once again.

So, I hope you agree this endeavour has progressed to such an extent that we are now ready to really make use of our collective efforts. When you have a moment, install the Access installation package available via the Canadian Arachnologist Nearctic Spider Database on the Canadian Arachnologist website, http://canadianarachnology.webhop.net. The small download can be found under "Submit Data". If you haven't got Access installed on your machine, get in touch with me and I'll send you a bundled CD-R with the Access runtime and template. This latter tool will consume approximately 30MB on your machine, but the downloadable installation package for folks with Access already installed is a mere 300kb. Either flavour can later be uninstalled if you so desire. All you need to get up and running is a username and password provided by me once you have installed the package and are ready to begin. In the case of museum collections, the username may be your institution's code such that anyone in your facility can work on the template and contribute. I merely need to be told the code and the email address and name of the person responsible for the curation of specimens. These are one-time entries into your template.

As incentive to contribute, I configured a wall of fame on the database's website. To date, Wayne Nordstrom in Edmonton, AB is leading the pack with 777 submitted records. I also configured a graphical representation of the server load; the website receives approximately 150 unique visitors a day and is nearing 5,000 unique visitors a month.

David P. Shorthouse; Department of Biological Sciences; CW-403, Biological Sciences Centre; University of Alberta; Edmonton, AB T6G 2E9; Phone: 1-780-492-3080; **e-**mail to:DPS1@UALBERTA.CA

Wolfgang Nentwig Announces a Ph.D. position on the biochemistry of spider venoms. Please contact Dr. Nentwig for further information.

Prof. Dr. Wolfgang Nentwig, Zoological Institute, University of Bern; Baltzerstr. 6, CH 3012 Bern (Switzerland, old Europe); Tel. +0041-31-631-4520 (direct), -4511 (secretary), -4888(fax); WOLFGANG.NENTWIG@ZOS.UNIBE.CH
http://www.zoology.unibe.ch/nentwig/
http://www.zoology.unibe.ch/ecol/

Claim Your 2005 AAS Meeting Group Photographs !!

Todd Blackledge reminds attendees of the 2005 AAS meeting in Akron, Ohio that some folks forgot to pick-up their group photo. Please contact Todd to claim it. (TAB27@UAKRON.EDU)

American Arachnology

The Newsletter of the American Arachnological Society

Number 72 November 2005

AMERICAN ARACHNOLOGICAL SOCIETY WEBSITE

HTTP://WWW.AMERICANARACHNOLOGY.ORG

Ken Prestwich has developed our website where one may find membership information, **Annual Meeting Info & registration**, announcements & Bulletin Board, officers, meeting minutes, instructions to JOA authors, an electronic JOA index, graduate study opportunities, a photo gallery, links to other arachnological sites, and **JOA OnLine** (electronic versions of the Journal of Arachnology; available to A.A.S. Members). Many, thanks and kudos to Ken for his work with the Website!! Thanks to Holy Cross for sponsoring the site.

ARACHNOLOGY IN CYBERSPACE

International Society of Arachnology—HTTP://WWW.ARACHNOLOGY.ORG
World Spider Catalog—http://research.amnh.org/entomology/spiders/catalog/index.html
Spiders of North America—http://kaston.transy.edu/spiderlist/index.html
Internet Key for European Spiders— http://www.araneae.unibe.ch/

JOURNAL OF ARACHNOLOGY ELECTRONIC INDEX

The electronic index for the Journal of Arachnology is available at: **http://vassun.vassar.edu/~celt/suter/spiderform.html**
Note that the main search keywords are: **SCORPION, SPIDER, HARVESTMAN, MITE.** Any word or taxon that is in a title may be found with a search of the Index. Thanks to Bob Suter: **SUTER@VASSAR.EDU** HTTP://FACULTY.VASSAR.EDU/~SUTER/SUTER.HTML

AMERICAN ARACHNOLOGY

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