

Meeting Abstracts

**Thirtieth
Annual
Meeting**

**Saturday June 17
through
Wednesday June 21
2006**



**College of Notre Dame
of Maryland**

Hosted by

Nancy Kreiter

Revised June 12, 2006

A, B and C

Influence of Spider Silk on Microhabitat Preferences in Tarantulas (*Grammastola aureostriata*)

Authors

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Abstract: Microhabitat selection by spiders may involve a number of parameters including optimization of foraging success and microclimate. We observed microhabitat preferences of juvenile tarantulas (*Grammastola aureostriata*) based on the presence/absence of spider silk. In separate trials using a Y-maze, tarantulas were given a choice of (1) conspecific web versus no web and, (2) web from a different spider species (Araneae: Agelenidae) versus no web. Activity and behaviors were video-taped for twelve hours to determine how many times spiders entered the web versus no-web sides of the y-maze and the amount of time spent on each side. Although individuals demonstrated a high degree of variation in their choices, tarantulas preferred the web-side, regardless of the origin of the web. In addition, tarantulas were more active in their first trials than in the second trials suggesting a degree of familiarization with the testing apparatus. (posted June 2, 2006)

Watching your friends get eaten: bystander effects on predator recognition and subsequent survival in the wolf spider *Pardosa milvina*

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Abstract: Observational learning by witnessing predation may be important for predator recognition and subsequent survival yet studies of this phenomenon among arthropods are lacking. We manipulated prior predator experiences of the wolf spider, *Pardosa milvina*, and then placed the spiders in open arenas with the larger co-occurring predatory wolf spider, *Trochosa ruricola*, to test for experience-based differences in defensive behavior and survival. We set up five

experience treatments (N = 140): 1) *Pardosa* that observed a conspecific for 1 h, 2) *Pardosa* that observed the predator, *Trochosa rucicola* for 1 h, 3) *Pardosa* that observed the predator *Trochosa* consume a *Pardosa* during a 1 h period, 4) *Pardosa* that observed a conspecific evade predation by *Trochosa* for 1 h., and 5) *Pardosa* in an empty container. We then placed individual *Pardosa* in 20 cm d. arenas with a live *Trochosa* for 1 h and recorded predation latency, time spent moving, the number of lunges by the predator and the number of evasive hops by *Pardosa*. We found a significant difference in the rate of evasive hops but no significant difference in time spent moving in the arena or the number or rate of lunge responses by *Trochosa* across treatments; We also found significantly higher predation and shorter predation latency for the control treatment and *Pardosa* that witnessed *Trochosa* consume a conspecific relative to all other treatments. Our results suggest that prior predator experiences can influence subsequent survival of *Pardosa* and that witnessing predation of conspecifics can significantly increase predation risk. (posted May 25, 2006)

Phylogeny of the spider family Tetragnathidae (Araneae) based on molecular and morphological data

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Abstract: The phylogenetic relationships and taxonomic limits of Tetragnathidae have been subject of considerable debate for more than a century. Traditionally, tetragnathid spiders have been assigned to three groups usually ranked as the subfamilies: Tetragnathinae, Nephilinae and Metinae. Current phylogenetic analyses based on morphology and behavior concluded that Tetragnathidae included the subfamily Tetragnathinae plus a paraphyletic Metinae; however, they differ in the placement of Nephilinae as sister to the remaining tetragnathids or as sister to other araneoid clades. Furthermore, a recent molecular analysis suggested that nephilines could be sister to araneids, but the taxon sample of this study was insufficient to thoroughly test this hypothesis. Our study aims to test the monophyly of Tetragnathidae, represented by a large and diverse taxonomic sample, using molecular and morphological data. We also explore the phylogenetic relationships of tetragnathids with emphasis on the "metines" problem and investigate the phylogenetic placement of nephilines. We sequenced nuclear and mitochondria genes (18S, 28S, 12S, 16S, CO1 and H3) for 26 tetragnathid taxa (including nephilines), and 18 orbicularian species as outgroups plus *Nicodamus* (Nicodamidae) as the root (total 45 taxa). The sequence data were aligned with dynamic and static homology criteria and analyzed with parsimony, likelihood, and Bayesian methods for phylogenetic reconstruction. We also combined the molecular data with the morphological and behavioral characters in a total evidence analysis. (posted May 25, 2006)

Visual cues used by jumping spiders in prey identification

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Abstract: Most jumping spiders are generalist predators that must rapidly identify a potential prey item and attack it before it escapes. We used video techniques to examine the visual cues *Phidippus princeps* uses to identify a stimulus as prey. Using a V-maze, we gave spiders a simultaneous choice between live crickets vs. live video feed of the same crickets and found no significant preference, suggesting that *P. princeps* interprets video images as reasonable approximations of real images. However, spiders responded differently to videos created by different methods, even though these stimuli were indistinguishable to our eyes. When given a choice between identical video clips run in Quicktime directly from a computer or burned onto a DVD, spiders chose the DVD format significantly more often. We also examined stimulus motion. Crickets, like many prey insects, move intermittently with frequent pauses. Spiders were equally likely to choose videos of crickets moving normally vs. the same clips with pauses removed, suggesting that intermittent locomotion may not be important for prey identification. These techniques hold promise for understanding visual perception in salticids. (posted May 25, 2006)

A morphological perspective of assembling the spider tree of life

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Abstract: Assembling the Tree of Life (ATOL-spiders) aims to provide a phylogenetic framework for the study of spider evolution. The goal is to use morphological and molecular data to generate a robust phylogenetic hypothesis of the interrelationships of all spider families. This project is undertaken by an international team of 19 investigators from 14 institutions. However, putting together a large cladistic matrix of around 1,500 morphological characters from ca. 500 taxa has never been attempted before and presents many challenges. Working at this scale transforms some of the routine standard operations of systematic research because no single investigator can easily tackle empirical comparisons that involve hundreds of taxa or hundreds of characters. We will present a selection of the preliminary morphological data collected by us so far to discuss some of the issues and challenges of this component of the project. (posted May 24, 2006)

***Loxosceles alagoni*, a new species from Ixtapa Zihuatanejo, Guerrero State, Mexico (Araneae, Siicaridae)**

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Abstract: *Loxosceles* (Siicaridae) species diversity is of interest for understanding their diversification history and because their venoms are medically important. In the most recent revision of North American *Loxosceles* Gertsch and Ennik (1983) cataloged ~50 species with 39 described in Mexico. In the last 4 years, Instituto Bioclon, has been developing an antivenom for *Loxosceles* spider bites. The goal is for this antivenom to be effective for treatments of bites of all members of this genus. To facilitate this work Octolab, arachnid venom provider of Instituto Bioclon, has extensively collected *Loxosceles* with an effort to fully understand species diversity in Mexico. In the process of this

work we have found at least two populations that are sufficiently distinct from described taxa to warrant new species status. Here we describe one of these based on examination of 15 adult males and 15 adult females from Guerrero State in Southwestern México. We propose the name *Loxosceles alagoni* after Dr. Alejandro Alagon, a researcher of Mexican *Loxosceles*. This species is most similar *Loxosceles boneti* and *Loxosceles colima* (Gertsch, 1958). These three species are big and dark with a star or triangle pattern on the dorsal carapace. The *Loxosceles alagoni* epygyna receptacles have a simple large lobe projecting forward, while receptacles of *Loxosceles colima* present small extensions at the top of the lobe and receptacles of *Loxosceles boneti* present a curved lobe attached near middle. The male palpi of all three taxa have a curved embolus with a broad region in the middle. (posted June 5, 2006)

Unraveling the mechanical properties of composite silk threads spun by cribellate orb-weaving spiders

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Abstract: Orb web weaving spiders depend upon the mechanical performance of capture threads to absorb the energy of flying insect prey. Most modern orb-weavers spin wet capture threads with core fibers of flagelliform silk. These threads are extremely compliant and extensible due to the folding of their constituent proteins into molecular nanosprings and hydration by a surrounding coating of aqueous glue. Yet, phylogenetic evidence demonstrates that cribellate capture threads predate the use of viscid capture threads in orb webs. Cribellate capture threads are composite structures consisting of core fibers of pseudoflagelliform silk surrounded by a matrix of fine dry cribellar fibrils. To better characterize how pseudoflagelliform and cribellar fibrils function, I investigated the mechanical performance of cribellate capture threads for three genera of spiders (*Deinopis*, *Hyptiotes*, and *Uloborus*) that spin very diverse web architectures. Pseudoflagelliform core fibers were stiffer and stronger, but also much less extensible, than flagelliform silk. However, cribellate capture threads achieved overall high extensibilities because the surrounding cribellar fibrils contributed substantially to the tensile performance of threads long after the core pseudoflagelliform fibers ruptured. In the case of *Deinopis* capture threads, up to 90% of the total work performed could be attributed to these fibrils. These findings yield insight into the evolutionary transition from cribellate to viscid capture threads. (posted May 15, 2006)

Scorpion locomotion regulation by light wavelengths

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Abstract: The activity of scorpions is regulated by the photoperiod of their environment. A few hours after sunset, scorpions reach their peak level of activity. Physiological recordings indicate that scorpions have varying sensitivities to different wavelengths of light. Recent behavioral studies in choice chambers with half treatment light and half no light have suggested biases for different wavelengths of light. Those results did not correlate directly with reported physiological spectral sensitivity of the median and lateral eyes, which show peak sensitivity in the green and a slightly lower shoulder in the UV. In this study, we have modified our previous assay to look at the effect wavelength has on scorpion locomotion. Scorpions (*Centruroides vittatus*) were confined to small circular arenas containing a smaller circular barrier in each arena's center. The scorpions were presented with one of four light treatments (infrared, red,

green, and ultraviolet) all of the same intensity. Every animal experienced all four light treatments, each lasting 30 minutes and separated by fifteen minutes of no light. While light treatments did not significantly affect the level of locomotion ($P > 0.01$), the order of treatments was significant ($P < 0.01$), and an overall decrease of locomotion was observed during all treatments. We are currently developing a refined behavioral assay to reduce scorpion light adaptation and behavioral variability to determine if consistent differences exist in scorpion locomotion under different wavelengths of light. (received May 17, 2006)

Energetic investment and reinforcement of the function of different components of the cobwebs of black widows in relation to physiological status

Authors

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Abstract: Webs are usually considered as a way for spiders to capture prey; however, webs could also function as anti-predator devices, particularly for three-dimensional webs which surround spiders with barriers of silk. Previous studies in our lab have shown that black widows (*Latrodectus hesperus*) modify their web architecture as a function of their hunger state. In particular, hungry spiders emphasize components of the web involved in prey capture while sated spiders emphasize features that are likely to increase the defensive value of the web. However, black widows could also modify the thread diameters between the different components. This variation may either reinforce the function of certain parts of the web or compensate for energy invested in the different parts. We measure the thread diameters of the three components of the cobweb (sticky gumfooted threads, sheet and support threads) in spiders fed varying numbers of crickets for one week. We also weigh each part of the web to estimate energetic investment by the spiders and gain insight into the spiders' priorities. Sticky gumfooted threads and sheet threads function directly in prey capture; therefore, starved spiders should give these structures high priority by investing relatively greater mass of silk in them. Support threads could be used physically to stop predators such as wasps; and this could be made more effective by increasing thread diameters. In general, we expect fed spiders to give priority to protection against predators by allocating relatively more silk to support threads than do starved spiders. (posted May 17, 2006)

Rediscovery of *Tapinocyba emertoni* after 62 years

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Abstract: The species *Tapinocyba emertoni* Barrows and Ivie, 1942 was described by William Barrows and Wilton Ivie based on two male specimens collected on 23 March, 1928. I am aware of no additional records that have been published for this species since the original description. During curation of the Ohio State University's spider collection I discovered four additional specimens, one male and three females (undescribed). These were collected at Cantwell Cliffs, Ohio on 06 November, 1938 by William Barrows. There is a label in Barrow's handwriting that indicates that these are "paratypes". I do not know why Barrows did not include these additional specimens, particularly the only known females in the original description. All of the specimens were collected by "litter sifting". In an attempt to re-locate specimens of this species, I have collected 19 1m² litter samples from four localities in the Hocking Hills vicinity. These small samples, only 146 specimens, contained a rich diversity of spiders with representatives of 47 species. Among the samples were three additional males and eight additional females of *T. emertoni*, all from Cantwell Cliffs State Park, bringing the total number of specimens for the species to 17 (6 males and 11 females). These data are too sparse for any definitive conclusions, but it appears that *T. emertoni* is locally endemic in deep litter of the Hocking Hills

region. (posted May 25, 2006)

Constellation array: a new sensory structure in scorpions (Arachnida: Scorpiones)

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Abstract: A peculiar constellation-shaped microscopic array of several chemosensory sensilla is described for the first time in scorpions. This sensillar array is located on the external aspect of the distal portion of the fixed finger of pedipalp. We present data on the constellation array across four parvorders, six superfamilies, 12 families, 23 genera, and 28 species of extant (orthostern) scorpions. The constellation array was observed in all scorpion taxa. Observed number of sensilla in the constellation array varied from one (*Vejovoidus*) to 15 (*Calchas*), on average 6 ± 3 ; the size of the sensillum is 5-10 micrometers, their shape varying from conical to hair-like. The sensilla are socketed, and appearance of their "button-like" socket areola differs from other mechanosensory and chemosensory setae common on the scorpion's body and appendages. As observed in *Calchas nordmanni* (Luridae) and *Euscorpius tergestinus* (Euscorpiidae), there was no difference in number of sensilla between juveniles and adults. The constellation array size (maximal distance between two sensilla) usually varied between 100 to 300 micrometers, with Buthidae arrays markedly smaller in size. There was no apparent correlation between the size of a species and constellation array size. This ultrastructural character can be potentially of diagnostic use in scorpion systematics at family and genus levels. We suggest that the constellation array could be a contact chemosensory organ. (posted April 17, 2006)

Leg autotomy affects both terrestrial and aquatic locomotion in the wolf spider *Pardosa valens*

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Abstract: Many spiders voluntarily amputate (autotomize) a leg as an antipredator behavior. While beneficial in the short term (as it can allow the spider to survive encountering a predator), leg autotomy may have detrimental effects over the longer term. In several species of wolf spiders, leg autotomy causes a reduction in burst sprint speed, an important trait both for avoiding predators and capturing food. In this study we examined burst sprint speed before and after leg autotomy in males and females of the riparian-zone wolf spider *Pardosa valens*. Since this species moves readily both on land and the water surface, we conducted experiments in linear race tracks mimicking both these surfaces. In terrestrial trials, males and females did not differ in speed, but both sexes ran significantly slower following loss of a leg. In aquatic trials, females ran significantly faster than males, and leg loss led to a significant decrease in speed for males but not females. We also found a potential temperature effect, as spiders run in the evening (when they

were presumably warmer) were generally faster than those run during the morning. Despite females weighing nearly twice as much as males, all of the above results held when adjusting for body mass. Finally, males were more likely not to run on the aquatic track than were females, and to go shorter distances when they did run. These results suggest that both aquatic and terrestrial locomotion are impaired by leg loss in *P. valens*, and these costs may differ between SEXES. (posted May 23, 2006)

Effects of experimental harvesting on boreal forest spider assemblages: a cross-Canada comparison

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Abstract: Two large-scale forestry experiments, in eastern and western Canada (Québec and Alberta, respectively), were established in the late 1990s to test the effects of alternative silvicultural strategies on biodiversity in northern boreal mixed-wood forests. We collected spiders in pitfall traps several years after various partial cutting treatments were established in each experiment. Our objective was to compare the effects of partial cutting on spider assemblages (diversity and community composition), and to assess whether effects were similar in projects located over 3000 km apart. Overall, 98 species (6107 individuals) were collected from Alberta and 86 species (3414 individuals) were collected from Québec. Of these 44 species were common to both regions. Ordination analysis and indicator species analysis revealed a distinct regional effect, as the composition of the fauna from the boreal plains ecoregion of Alberta was distinct from the fauna of the boreal shield (Québec). However, the effects of partial cutting were similar in each project, and the removal of between 25 and 33% of the trees shifted the fauna from one typical of old-growth conditions to an assemblage approaching what was found in clear-cut sites. Clear-cutting also resulted in the homogenization of the spider assemblages. Indicator species analysis revealed the same wolf spider species dominated the clear-cuts in both projects. The old-growth forests contained a fauna that was easily disrupted by moderate partial cutting, and thus conservation of the spider fauna in northern forests subjected to harvesting will require retention of old-growth forests. (posted May 17, 2006)

Activity cycles and vertical stratification of spiders in cornfields

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Abstract: Spider distribution and abundance across the diel period has been investigated in various row crops but is not well-studied in corn. It is unknown whether certain families or groups of spiders prefer specific locations on corn plants, or if spiders change position over the diel period or across the season. Thus, a nine-week observational study of spiders on and around corn plants in six one-half hectare conventionally-tilled corn fields was conducted to determine daily spider activity cycles, their positions on the plants, and the composition of spider assemblages. Most variability of spider numbers and their community compositions appeared to be related to their 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 the

plants shifted their location during the summer. Web-building spiders (Theridiidae, Tetragnathidae) were sensitive to changing corn plant structure as the growing season progressed. Salticid and thomisid numbers on the plants were inversely related. There was evidence for interactions among foliage-running spider families, but they seemed not to impact web-building spiders. Most spider activity was at night. Lycosids and linyphiids contributed most to a mid-day activity spike early in the season. Salticids and theridiids added to this peak later on. No significant effects on spider numbers from the presence of straw refugia were found, but more lycosids tended to be near corn plants associated with refugia. (posted May 25, 2006, revised June 1, 2006)

Molecular phylogeny and biogeography of *Loxosceles* and *Sicarius* (Araneae: Sicariidae): Gondwanan vicariance?

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Abstract: *Loxosceles* and *Sicarius* spiders are notorious for their ability to cause dermonecrotic lesions in mammalian tissue. Species in both genera are native to Africa, Central and South America, and *Loxosceles* are also native to North America, the West Indies, Mediterranean Europe and China. We used a molecular phylogenetic approach to uncover the continental-level relationships within this lineage in order to 1. understand what factors have lead to diversification of the lineage, and 2. to gain a framework for understanding evolution of venom in this group. The age of this lineage is not known; however their present day distribution suggests that they were present on Western Gondwana (Africa & South America) before the continents split. We analyzed phylogenetic relationships among representatives from each of these continents using the nuclear marker, 28s, and the mitochondrial markers, ND1/16s. Tree topologies consistently support that divergences largely correspond with the break-up of Gondwana. With current taxon sampling we uncovered two distinct clades of *Loxosceles* in Southern Africa that are paraphyletic with respect to New World species. These results suggest that *Loxosceles* and *Sicarius* diverged long before Africa and South America split and *Loxosceles* began to diversify before the split. (posted May 26, 2006)

Responses of *Geolycosa wolf* spiders to fire and flood in Florida scrub

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Abstract: Two species of rare burrowing wolf spiders, *Geolycosa xera archboldi* and *G. hubbelli*, co-occur in xeric, fire-maintained scrub only on the Lake Wales Ridge in south-central Florida. This ancient, sandy ecosystem is a globally important center of endemism threatened by rapid development. Annually for 20 years (1987-2006) I conducted censuses of both spiders in 15 permanent plots, each 10 x 10 m, to determine whether the *Geolycosa* species, like many native plants and vertebrates, benefit from periodic burning of scrub. Previous studies show most spiders (80-90%) survive fires because they are protected in their burrows, several cm beneath the soil surface. Densities of both *Geolycosa* rose significantly within a year after two wildfires (May 1989 and February 2001), but thereafter their numbers declined because gaps of open sand quickly disappeared as the scrubby matrix resprouted and leaf litter accumulated. However, the rate of decline in spider densities after the 2001 wildfire was precipitous. A post-hoc analysis showed that chronic flooding caused by above-normal precipitation for 5 years in a row starting in summer of 2001, which was augmented by hurricane events, resulted in decimation of *Geolycosa* populations in many plots. The last time such flooding occurred was at least 55 years ago. Hence, burrowing wolf spiders seem to be adapted to

frequent fires but not infrequent floods. (posted May 16, 2006)

Environmental influences on silk age and how it affects courtship behavior of the wolf spider *Schizocosa ocreata*

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Abstract: The adult female wolf spider (*Schizocosa ocreata*) releases a dragline of silk when walking which is known to possess pheromones. These chemicals induce various courtship behaviors from the male spider when he is exposed to the silk. This study examined two things; 1) How the length of time males spent on courtship behaviors was influenced by various ages of silk; and 2) Whether or not the silk being aged in the field under natural conditions or in a controlled laboratory environment made a difference on the length of time spent on courtship behaviors. For silk aged outdoors, results show a decrease in the number and duration of behaviors from time #1 (0-2 hour old silk) and times #2-5 (2-4 hours old, 4-6 hours old, and 6-8 hours old, and 24 hours old) with time #5 inducing a minimal amount of courtship behaviors for a short period of time. For data collected for silk aged indoors, there does not appear to be a decrease in male response across time periods. Taken together, these results imply that the signals from the female pheromones are weakened with age when exposed to natural environmental conditions. (posted April 28, 2006)

Growth rates in three species of tarantula: *Lasiodora parahybana*, *Eupalaestrus Campestratus* and *Grammostola aureostriata*

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Abstract: Tarantulas, while long feared by humans, have only recently become the subject of scientific investigations. Consequently, many aspects of their life history are not well understood. The purpose of this study was to compare the average growth rates for three species of tarantula (Araneae: Theraphosidae): *Lasiodora parahybana*, *Eupalaestrus campestratus* and *Grammostola aureostriata*. We hypothesized that the growth trends for the three species would differ based on life history patterns. Because of the differences in life history and morphology between males and females, we hypothesized that the measured exoskeletons of all species would also exhibit a distinct sexual dimorphism. Growth rates were based on the increase in size between successive molts. Using the exuvia from all individuals for each species, carapace length and width, femur length and tibia length were measured. The average number of days between molts was also determined. Current analyses suggest that sexual dimorphism exists in all three species. In addition, initial findings also indicate that *G. aureostriata* has the fastest growth rate while *E. campestratus* has the slowest growth rate, supporting the proposed hypotheses. (posted May 26, 2006)

Structure of papillae on the pedipalps of solifugae (Arachnida, Solifugae)

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Abstract: Some male solifugids in the families Eremobatidae, Karshiidae and Solifugidae (Arachnida, Solifugae) have clusters of conical to hairlike projections on the ventral surface of the metatarsus of the palpal papillae. The function of these structures is unknown. We examined the ultrastructure and microstructure of the papillae found on representatives of the three families using Scanning Electron Microscopy (SEM), histological techniques and Transmission Electron Microscopy (TEM). We found similarities in the ultrastructure of papillae among genera within a family and distinct family-level differences in ultrastructure. Structures evident from the histological examination suggest that the papillae are chemoreceptors. Behavioral observations suggest that the papillae may be used as contact chemoreceptors during copulation when the male solifugid grasps and maintains contact with the female's body using the pedipalps. (posted May 24, 2006)

Colorado spider survey update

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Abstract: The Colorado Spider Survey (CSS) began in May 1999. This project was modeled after the Ohio Spider Survey. The objectives of the CSS were to gather baseline information about the biodiversity of spiders throughout Colorado and the Rocky Mountains/Great Plains ecoregion and to involve citizen scientists in this biotic survey. In the seven years of the CSS, 670 people have attended training workshops or classes. Of these, 137, or 20%, have remained actively involved past the initial training activity, 11 have joined the American Arachnological Society, four have presented papers at AAS meetings, one has had a paper accepted in the *Journal of Arachnology*, and three others are currently working on a research project. Six CSS participants have given lectures about spiders to school groups, park personnel, or members of the general public. CSS participants have helped build the DMNS arachnology collection from less than 50 vials in 1998 to over 22,250 vials today representing 645 species in 44 families. Data from

the survey is regularly published online at <http://www.dmns.org/spiders/default.aspx> and at http://canadianarachnology.dyndns.org/data/canada_spiders/. (posted May 24, 2006)

The identity of the small synanthropic *Pholcus* (Pholcidae) in the northeastern quadrant of the United States

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Abstract: *Pholcus manueli* Gertsch, originally described from New Jersey, has been found in six other states. It is a small, widespread, synanthropic species found both inside and outside buildings and manmade structures. It has been frequently misidentified as *P. opilionoides* Schrank a widespread synanthropic European species. However, *P. opilionoides* has yet to be found in North America. Diagnostic characters that separate the two species are shown which can easily be seen with a 10X triplet hand lens. Male *P. manueli* have a slender and straighter palpal procurus than males of *P. opilionoides* in which the procurus is broad and distinctly elbowed. Female *P. manueli* have the sides of the epigynum deeply scalloped, female *P. opilionoides* have the sides of the epigynum shallowly excavated. The other synanthropic *Pholcus* in the region, *P. phalangioides* (Fuesslin), is much larger with a much longer leg span. Both *P. manueli* and *P. phalangioides* may be found together at the same site. (posted May 16, 2006)

D, E and F

Phylogenetic systematics of the spider genus *Cyrtognatha* (Araneae, Tetragnathidae)

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Abstract: We present the results of an ongoing research project on the taxonomy and phylogenetics of the araneoid genera *Agriognatha* O.-P. Cambridge and *Cyrtognatha* Keyserling (Tetragnathidae). All members of this lineage of tetragnathine spiders live in the Neotropical region where they are often found in tropical cloud forests. We document for the first time the web architecture of some of the members of this group. *Agriognatha* is a junior synonym of the *Cyrtognatha*. The results of our monographic work suggest that *Cyrtognatha* includes 23 species; eleven of them are new to science. A cladistic analysis of more than 120 morphological and behavioral characters scored for 22 species of *Cyrtognatha* and a diverse array of tetragnathid and araneoid taxa has provided robust support for the monophyly of the genus and for its placement within the subfamily Tetragnathinae. We will discuss some of the synapomorphies of *Cyrtognatha*, including the very unusual female genitalia in which the spermathecae have been greatly reduced and the sperm storage function has shifted to a specialized sac. (posted May 23, 2006)

Evidence that evolutionarily convergent spine microstructure facilitates sand adhesion in the cryptic spider

genera *Sicarius* (Sicariidae) and *Homalonychus* (Homalonychidae)

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Abstract: Spiders from the unrelated genera *Sicarius* (Sicariidae) and *Homalonychus* (Homalonychidae) live in deserts and cover their bodies in sand, which is likely a form of camouflage. Sand adhesion correlates with the densely distributed spines found in both genera and Levi and Levi (1969) briefly noted that in *Sicarius*, sand particles adhered to the feathery protrusions of spines in the spinneret region. To determine the importance of spines and their morphology in sand adhesion, we (1) conducted hair removal experiments to test the necessity of spines in sand adhesion in *Sicarius*; (2) used scanning electron microscopy to observe interactions between particles and spines; (3) compared spine microstructure of *Sicarius* to related taxa that do not adhere sand; and (4) compared spine microstructure of *Sicarius* to that of *Homalonychus*. In *Sicarius*, a significant increase was observed in the number of particles that adhered to the cuticle when spines were present. Particles associated strongly with regions of the *Sicarius* cuticle that contained spines and adhered directly to long, thin hairlettes that protruded anteriorly and laterally along the proximal distal axis of spines. The lack of hairlettes in genera related to *Sicarius* suggests that hairlettes originated in the ancestors of this genus coincidentally with the origin of sand adhesion. Interestingly, *Homalonychus* also possessed hairlettes anteriorly and laterally on spines. This convergent feature suggests that hairlettes play a key role in sand adhesion and that they may be an adaptation to confer crypsis. (posted May 26, 2006)

Review of the described species of *Metacyrba* (Araneae: Salticidae)

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Abstract: *Parkella* Chickering 1946 = *Metacyrba* F. O. P.-Cambridge 1901, **n. syn.**; *Parkella venusta* Chickering 1946 = *Metacyrba venusta* (Chickering 1946), **n. comb.**; *Parkella fusca* Chickering 1946 and *Dendryphantès franganilloi* Caporiacco 1955 = *Metacyrba venusta* (Chickering 1946), **n. syn.** The six valid described species of *Metacyrba* [*floridana* Gertsch 1934, *insularis* (Banks 1902), *pictipes* Banks 1903, *punctata* (Peckham & Peckham 1894), *taeniola* (Hentz 1846), *venusta*] are diagnosed and re-illustrated to show previously unrecognized genitalic differences. *Metacyrba similis* Banks 1904 is resurrected as a subspecies, becoming *Metacyrba taeniola similis* Banks 1904, **n. status**. The female of *Metacyrba pictipes* Banks 1903 is described for the first time. *Metacyrba arizonensis* Barnes 1958 = *Platycryptus arizonensis* (Barnes 1958), **n. comb.**, and *Marpissa magna* (Peckham & Peckham 1894) = *Platycryptus magnus* (Peckham & Peckham 1894), **n. comb.** *Platycryptus broadwayi* (Peckham & Peckham 1894) = *Platycryptus magnus* (Peckham & Peckham 1894), **n. syn.** *Metacyrba nigrosecta* (Mello-Leitão 1945) = *Balmaceda nigrosecta* Mello-Leitão 1945, **comb. restored**. The genera *Balmaceda* Peckham & Peckham 1894, *Metacyrba*, and *Platycryptus* Hill 1979 are compared morphologically among themselves and to *Breda* Peckham & Peckham 1894 and *Fuentes* Peckham & Peckham 1894. The distributions of *Balmaceda picta* Peckham & Peckham 1894 and *Metacyrba* species are updated. *Metacyrba punctata* is newly introduced into Florida. *Marpissa melanura* F.O.P.-Cambridge 1901 is resurrected; it is not a synonym of *Marpissa minor* F.O.P.-Cambridge 1901 nor of *Platycryptus californicus* (Peckham & Peckham 1888). (posted May 16, 2006)

Assessing predation risk in *Schizocosa* wolf spiders: Environment matters more than sex, speed or ornamentation

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Abstract: While benefits of elaborate secondary sexual traits can frequently be realized by assessing male mating success, costs of production or maintenance are often more elusive. Elegant laboratory studies using video playback previously suggested that male foreleg ornamentation and active courtship in some *Schizocosa* wolf spiders increases visual detection, thus increasing predation risk and representing a cost of ornamentation. Under more natural conditions however, predation risk is likely influenced by many factors including, but not limited to, conspicuousness against the background and locomotory performance. Here, using artificial enclosures in the field, we compare actual predation rates of two naturally co-occurring *Schizocosa* male forms (brush-legged and non-ornamented) and females. Prior to release in the field, individual locomotory performance (*i.e.* speed) was determined in the laboratory. Enclosures were set up on each of two field substrates (rocks and leaf litter) and predation rates were recorded during the day and night using a co-occurring *Hogna* species as the predator. Predation rates were highest at night with more predation occurring on rocks than leaf litter. Predation rates did not differ among any groups (brush-legged males vs. non-ornamented males vs. females) on either substrate. Locomotory performance also did not differ among groups and individuals escaping predation were not significantly faster than those suffering predation. Our results suggest that while secondary sexual traits may increase visual detection and thus predation risk in a simple environment, other environmental factors such as microhabitat and time of day may be more important in determining predation risk under natural conditions. (posted May 31, 2006)

G, H and I

Does $A1 + A2 = B$ in scorpion peg sensilla?

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Abstract: Peg sensilla on scorpion pectines appear to have a dense plexus of synaptic interactions between primary chemosensory afferents. These unusual interactions may be important to the information processing power of these mid-ventral organs as the animal samples ground-based chemical information. However, there is some question as to whether the previously reported inhibitory 'B' unit is actually distinct from the A1 and A2 units or if it is an electrical coupling of A1 and A2. I looked closely at the B waveform to see if it is derivable from the A1 and A2 waveforms. In addition, I examined waveforms where two or more units fired in close temporal proximity. Several of these waveforms classified to type B with A1 or A2 type waveforms clearly within the refractory periods of their waveforms. Furthermore the number of these B/A1 or B/A2 doublets was in line with the number predicted based on the firing frequency of the B, A1, and A2 units in the peg. As such, this analysis corroborates the original conclusion that the B unit is an event separate from A1 and A2 and that it has an inhibitory influence on the behavior of A1 and A2 in scorpion peg sensilla. (posted May 16, 2006)

The effects of spider cues on Colorado potato beetle (*Leptinotarsa decemlineata*) foraging behavior

Authors

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Abstract: Colorado potato beetles, *Leptinotarsa decemlineata*, are chemically-protected crop pests on economically important solanaceous plants. We measured predation on potato beetles by two species of wolf spider, *Hogna helluo* and *Pardosa milvina*. We found no predation on beetles by either species of spider during a 4 h test period (n = 24/spider species). We also measured leaf damage by beetles on eggplants, *Solanum melongena*, in the presence of *Hogna* and *Pardosa*. We found significant reductions in herbivory in the presence of *Hogna* but not the smaller *Pardosa* (n = 24/spider species). In another experiment, we measured leaf preference or avoidance for leaves previously walked on by one of four spider species for 24 h (*Tetragnatha laboriosa*, *Misumenooides formipes*, *Hogna helluo*, or *Pardosa milvina*). When given a simultaneous choice between eggplant leaves with spider cues and those without, beetles showed a significant initial avoidance for leaves previously occupied by *Hogna*, but beetles showed no significant initial avoidance of spider-cued leaves of any of the other three spider species (n = 48/spider species). In the absence of live spiders, beetles showed significantly lower herbivory levels on leaves previously occupied by *Hogna*, *Pardosa*, or *Tetragnatha*, compared to leaves without spider cues, but beetles showed no reduction in herbivory on leaves previously occupied by *Misumenooides*. Our results suggest that even chemically-protected herbivores show reduced feeding in the presence of some generalist predators and that chemical cues from predators (silk and excreta) may also reduce herbivory even when these predators present no predation risk. (posted May 25, 2006)

The influence of substrata on seismic signals of the wolf spider *Schizocosa ocreata* (Araneae: Lycosidae)

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Abstract: Courtship displays of male *Schizocosa ocreata* (Hentz) are multimodal, consisting of visual and seismic signals. Previous research has shown that variation in seismic signals is condition-dependent and influences mating success. Although isolated male seismic signals are sufficient to elicit female receptivity, it is possible that other (environmental) factors might affect signal transmission and perception in the field. In our current research, we are testing the effects of substratum type on seismic signals by recording adult male spiders in the lab and field on different substrata.

We used a Polytec LDV-100 laser vibrometer system to record spider signals and analyzed digital files with the AviSoft sound analysis program. We conducted studies in the laboratory, recording male wolf spider courtship on four different substrata typical of the natural habitat of the spiders -- leaves, bark/wood, soil, and rock. We also conducted studies in the field using maple leaves. Female wolf spiders were placed on substrata for 24 hrs to deposit silk (with pheromones), and then removed. Males were placed on the substrate, and courtship signals were recorded for 5 minutes using the LDV.

Analysis of recordings revealed that leaves are highly conductive substrates for seismic signals in contrast to other habitat surfaces (soil, wood, rock). We also tested different species of leaves to determine whether varying degrees of leaf thickness or stiffness might affect transmission of seismic vibrations, and found no differences. Additional studies will investigate changes in power spectra of seismic signals as a function of distance, leaf structure and composition. (posted May 26, 2006)

Diagnostic DNA barcoding of spiders: utility, variability, and choice of sequence

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Abstract: Barcoding is the use of a DNA sequence to identify an organism to species. Since all life stages share the same DNA, it should be particularly useful for identifying immature individuals. This is a critical need for spider ecological research, where the majority of animals collected in a field study are apt to be immatures and hence difficult or impossible to assign to species. A group calling itself the Barcode of Life Initiative has proposed using mitochondrial cytochrome oxidase I (CO I) as a universal barcoding sequence for all animal species. Among its virtues for this task are multiple copy number, which will make PCR assays to detect them sensitive; rapid rates of evolution, which ought to enable distinguishing recently diverged species; and a catalog of universal primers that simplifies "fishing" them out of previously uncharacterized genomes. In published research on species in the genera *Cheiracanthium*, *Frontinella*, *Grammonota*, *Hibana*, *Pardosa*, and *Rabidosa*, we and colleagues showed that CO I is indeed able to distinguish even closely related species from one another, and to assign immatures unequivocally to the correct species. Here we provide the first data on spider CO I haplotype variability. We also suggest why other sequences might be more appropriate for spider DNA barcoding than CO I. (posted May 12, 2006)

Male-male aggression in a wolf spider (*Pardosa milvina*)

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Abstract: The evolution of fighting behavior has been extensively studied for several decades with a strong focus on male-male competition for resources. Since fighting is costly, it is to an animal's advantage to assess its mate correctly before engaging in such interactions. In this study, we specifically address how female mating status and condition affect the frequency of aggressive male behavior in male-male contests. The wolf spider *Pardosa milvina* is abundant in the fields, are easy to rear in the lab and have conspicuous aggressive behaviors. In our study with *Pardosas*, we looked at male-male competition in the presence of a female. The males used for this experiment were subjected to a uniform diet regime and were all field caught. The females were randomly distributed into four groups: non-virgin well fed, non-virgin food limited, virgin well fed and virgin food limited. The competitive interactions between the two males in presence of each of these types of females were video taped and recorded as contact or non-contact forms of aggressive behavior. The data was analyzed using the contingency test and the Kruskal-Wallis test. Our results indicated that both female mating status and condition influenced the level of aggression in male-male contests. The well-fed virgin females specifically showed more instances of all types of aggressive behaviors. (posted May 31, 2006)

Neurohaemal organ of the scorpion *Heterometrus swammerdami*

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Abstract: In *Heterometrus swammerdami* there are no known endocrine glands. In the brain and the subesophageal ganglion there are groups of specialized neurons. These nerve cells synthesize a variety of biologically active compounds. Some of these products can clearly be visualized with special staining methods in paraffin sections under the microscope. Since the nervous tissue is enveloped with four layers thick perineurium, a 'blood brain barrier' exists. For this reason the synthesized neurosecretory material cannot be discharged directly in to the haemocoel and must be delivered to the cephalic blood vessels. The neurosecretory product is transported through the axons and the neurofiber tract pathways, forming neurohaemal organs terminating in the blood vessels surrounding the cephalothoracic nerve mass. A variety of specialized neurons which secrete biologically active compounds will be presented and their transport through the nervous system discussed. (posted May 17, 2006)

Tracking the role of Diptera in complex spider food-webs

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Abstract: Generalist predators are widely acknowledged to contribute to valuable levels of biological control in agroecosystems throughout the world. Although their feeding habits can result in the rejection of target pests in favor of preferred and often more nutritious alternative prey, these predators are capable of colonizing habitats prior to the arrival of pest species. The effect of this subsistence upon alternative, non-pest species can be twofold. Whilst feeding upon such items generally enhances their fecundity thus improving population growth and levels of biological control exerted by the entire population, the presence of non-pest species during times when pest regulation is required can result in a reduced level of pest consumption per individual predator. Until recently, the role of alternative prey in sustaining predator populations has been limited to laboratory studies and field trials examining the fecundity, feeding behavior and growth rates of species subjected to diets of varying quality. However, antibody and molecular techniques have allowed predation rates to be evaluated in the field, quantified the strengths of specific trophic linkages and identified the structure of complex food webs. The development and application of a Diptera-specific monoclonal antibody is discussed in the context of evaluating biological control by spider communities in the field. Evidence was gathered to suggest that Diptera form an important non-pest food resource early in the season, but predation on non-pest prey items when pests arrive potentially disrupts biological control. (posted April 17, 2006)

Female mate choice varies with female quality

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Abstract: Until recently, most studies of female choice have assumed that mating preferences are fixed within a population or species. New studies however have highlighted the importance of factors such as female age and prior experience on mate choice. Among-female variation certainly exists in natural populations and one way in which females may vary relates to quality. For example, prior research on *Schizocosa ocreata* has demonstrated that juvenile feeding regimes influence adult body size and body condition. Here, using spiders collected from a mixed population of *S. ocreata/rovneri* and raised in the laboratory on two different diets that varied in both quality and quantity (low/high nutrient), we tested whether adult female mate choice varies with female quality (*i.e.* juvenile diet treatment). First, consistent with previous work, we found that high nutrient spiders matured more quickly than low nutrient spiders and were significantly larger as adults. Males also matured earlier than females. Upon maturation, females from both high and low nutrient groups were paired simultaneously with a low and high nutrient male. We found no obvious differences in courtship effort between the males, however we did find female mate choice to be dependent on diet treatment as high nutrient females mated more frequently with high nutrient versus low nutrient males while low nutrient females showed no mating preference. These results further support the notion that female mate choice is not fixed and suggest that experiments using well-fed laboratory subjects could potentially provide an artificially enhanced picture of the strength of female choice. (posted May 26, 2006)

A tale of one species where experience matters???

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Abstract: Classic studies using isolated populations of *Schizocosa ocreata* and *S. rovneri* have previously demonstrated these two species to be ethospecies, isolated only by courtship behavior. Recently however, we discovered a mixed population of brush-legged (nr *S. ocreata*) and non-ornamented (nr *S. rovneri*) males. In this more southern population, males of both forms overlap in time and space and both molecular as well as behavioral results suggest that the two forms are freely inter-breeding. Initially, in an attempt to distinguish between the species, we conducted exposure trials in which subadult females were randomly assigned to either a brush-legged or a non-ornamented exposure treatment. As penultimates, these females experienced courtship advances from their assigned male form. Upon maturation, adult females were paired with either a familiar or an unfamiliar male form in a mate choice trial. Unexposed adult females were also run through mate choice trials. During exposures, brush-legged males were more sexually aggressive than non-ornamented males. Females exposed to brush-legged males received more attempted mounts and more forced mounts on average than those exposed to non-ornamented males; however, neither the number of attempted mounts nor the number of forced mounts a female experienced influenced her likelihood to copulate. Mating frequency did depend on exposure/mate choice treatment. Exposed females mated more frequently with brush-legged males versus non-ornamented males regardless of their exposure treatment while unexposed females mated equally with both male forms. These results suggest that a subadult female's experience with mature males may increase her adult mate choice "choosiness". (posted May 26, 2006)

Geographic patterns of phenotypic plasticity in *Nephila*

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Abstract: Phenotypic plasticity, the development of alternative phenotypes in different environments, has been documented in three species of *Nephila*. However, it is impossible to investigate the evolutionary significance of plasticity without a strong phylogenetic model. Recently, Kuntner (2005) finished a phylogenetic analysis of *Nephila*, and we took advantage of the collection of large numbers of *Nephila* in one place to document patterns of variation in adult male and female size across all members of the genus and the sister genus *Nephilengys*. There are significant among-species differences in the variation in adult female size, which we have mapped to the phylogeny. With this mapping, we develop hypotheses concerning the evolution of plasticity in this genus. Moderate degrees of plasticity are ancestral to both genera, and reductions in degree of plasticity have occurred in both *Nephilengys* and *Nephila*. We will discuss the patterns of evolutionary changes in phenotypic plasticity and apparent con-current changes in geographic distribution and degree of habitat specialization. (posted May 4, 2006)

Diel and hunger effects on silk deposition in females of the wolf spider *Hogna helluo*

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Abstract: Adult female cursorial spiders deposit pheromone-laden draglines that attract males and convey information about their mating status however little information exists on variation in the quantity, context, or timing of dragline deposition. We measured variation in the amount of dragline silk, attachment disks and excreta produced by adult virgin female *Hogna helluo* wolf spiders by time of day (day/night) and hunger state (14 days without food and satiated). We placed unmated adult female *H. helluo* on grid-bearing 80 mm dia. paper disks for four hours within plastic containers. Each spider was exposed to each of four treatments in random order using a repeated-measures design (Day/Hungry, Day/Satiated, Night/Hungry, Night/Satiated; n = 50). Spiders produced significantly more small-gauge and heavy-gauge dragline silk at night compared to during the day with both silk types being three to eight times more prevalent at night. Hunger level had no significant influence on the quantity of small-gauge or heavy-gauge silk deposition. Attachment disk deposition increased significantly at night when spiders were satiated, but all other treatments showed similar levels of attachment disk deposition. Excreta deposition only varied significantly with hunger level, not time of day. Silk deposition appears to follow the activity patterns of these spiders suggesting that female *H. helluo* are active primarily at night and females may preferentially attract adult males at night. Feeding regimen had little influence on the quantity of silk deposition with the exception of attachment disk silk suggesting modest metabolic costs of dragline deposition. (posted May 25, 2006)

Web architecture in the spider family Linyphiidae

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Abstract: The spider family Linyphiidae is the largest clade of web weaving spiders, with 560 genera and more than 4,300 described species. In terms of known species diversity linyphiids are second only to the family Salticidae. Despite of their high diversity, widespread distribution and abundance very little is known about web architecture in linyphiids. Most of the published data come from a few species in the temperate regions of the northern hemisphere. I review the available information about linyphiid webs and present new data, based on observations of species from around the world, on the diversity of web architecture in this araneoid family. Although most of the linyphiid webs

studied so far seem to be elaborations of a basic theme, the sheet web, there seem to be two main types of webs: aerial and substrate webs. The distinction between these two types resides in the richness of attachment points delimiting the web, rather than the substrate on which the web is spun. The sheet-like platform varies, across species, in its degree of concavity (or convexity). An "irregular" structure of variable complexity can be found above and/or below this main platform. (posted May 24, 2006)

The invasion of *Linyphia triangularis* in Maine: Ecological and behavioral interactions between the invader and native spiders

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Abstract: The European hammock spider, *Linyphia triangularis* (Araneae: Linyphiidae), has recently become established in Maine, with very high densities occurring at some coastal locations, e.g. Acadia National Park. In these high-density areas, our annual transect data suggest that native sheet-web spiders, such as *Neriene radiata* and *Pityohyphantes* spp., are scarce and in decline. We present findings from two press addition/removal experiments indicating that, in high density conditions, the presence of *L. triangularis* reduces the ability of *Pityohyphantes* spp. to colonize and remain on experimental plots. In addition, results from other experiments provide some insight into the mechanisms of this negative interaction. In its native range, *L. triangularis* aggressively invades the webs of both conspecific and heterospecific spiders, taking over webs by driving off or preying upon the resident. We document similar interactions between *L. triangularis* and native spiders in Maine. We also discuss how phenological differences between *L. triangularis* and natives may influence the impact of the invasion. (posted May 26, 2006)

J, K and L

Rough sex: aggressive and/or coercive mating behavior in the brush-legged wolf spider *Schizocosa ocreata* (Hentz)

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Abstract: In mating systems where sexually receptive females are limited, sexual selection is driven by increased competition between males and/or the degree of female choosiness. In the latter case, increased selection pressure may result in aggressive and/or coercive male mating behaviors to counter female choosiness and/or resistance. Coercive mating, i.e., forced copulation when the female is not receptive (at any point during the interaction), has been noted in many taxa. Potential fitness benefits to males who mate coercively include reduced energy cost from prolonged courtship, and an increase in the number of offspring sired. Potential female costs associated with aggressive male mating behavior include: injury (or even mortality), re-directed energy allocation (potential reduced

capacity to provision offspring), increased risk of predation (male harassment makes the female more conspicuous), and decreased prey capture abilities.

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, even when females are not receptive, mounting and subsequent copulation sometimes occur. Analysis of mating trials and review of videotapes from previous studies indicate that aggressive male mating behavior may lead to forced copulation (7 % - 13 % of trials). Additionally, males have been observed to use fangs during copulation, resulting in hemolymph loss and scarring in females. Ongoing research and analysis of mating behaviors may reveal an alternative male behavioral tactic in this species. (posted May 26, 2006)

Population genetic studies of Korean and Japanese individuals of *Nephila clavata* using AFLP marker

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Abstract: In this study, we performed population genetic studies on 98 individuals from eight Korean populations and one Japanese population of *Nephila clavata* using amplified fragment length polymorphism (AFLP) marker. Analyzing AFLPs which were amplified by primers ECO+AGG and MSE+ACC, we got 167 loci with size ranging 40-703bp. Jeonju population of Korea showed the closest genetic relationship with Japanese population. According to principal component analysis (PCA) by which all individuals were divided to three groups, most of Korean genotypes were in the GROUP 1 and most of Japanese ones were in the GROUP 2 in which nine individuals of Korean populations were also included. As a result of AMOVA (analysis of molecular variance), genetic diversity was more concentrated on within populations than among populations. These results suggest that there is not obvious genetic-geographic association among Korean and Japanese populations of *N. clavata*, which could be explained by gene flow via ballooning or anthropogenic introduction or ecological adaptation or historical processes. (posted May 17, 2006)

Responses of *Schizocosa ocreata* (Hentz) wolf spiders to sensory cues from potential avian predators

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Abstract: Elaborate male signals and displays can influence mating success by increasing conspicuousness to females, and serving as indicators of male quality. In addition to attracting the attention of females, these signals may also attract the unwanted attention of predators. If the risk of predation during courtship is high, spiders might be expected to exhibit protective responses to predator cues (as demonstrated by Persons et al., 2001, 2002). The Brush-legged wolf spider, *Schizocosa ocreata* (Hentz) is sympatric with a number of generalist predators, including other species of spiders, toads and birds. Male courtship communication in the wolf spider, *S. ocreata*, is highly conspicuous, and both visual and seismic signals of this species have been shown to increase detection by vertebrate (toad) and invertebrate (spider) predators.

We measured the responses of juvenile and courting adult male *S. ocreata* to sensory stimuli representing avian predators (including acoustic, seismic and visual cues). In preliminary analyses we found that spiders' responses ("freezing", running away, cover-seeking) varied with the nature of the stimulus (airborne sound, seismic vibration, shadow). Males cease courtship in response to a blue jay call (airborne), but increase locomotion, run away and seek cover from shadows (visual) and vibrations (seismic). Additional analyses of response behaviors, latency to respond and/or resume courtship, as well as comparisons of juveniles and adults will be discussed. (posted May 26, 2006)

Silk deposition and conspecific communication in the wolf spider *Hogna helluo*

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Abstract: All spiders presumably produce draglines as they move through the environment. Adult female wolf spider draglines convey information to adult males about their maturity and mating status, but whether or not females mediate dragline production in the presence of males remains unknown. Furthermore dragline function among males remains unclear. We tested the function of dragline silk in intersexual communication among adult males and adult females of the wolf spider, *Hogna helluo*. We placed adult male and female *H. helluo* on grid-bearing 80 mm dia. paper disks for four hours within transparent plastic containers. Spiders were then allowed to observe a conspecific adult female, adult male, juvenile, or no spider through the transparent container. We then quantified the amount, type, and pattern of silk and excreta deposition for each spider on the grid. We found significant differences in attachment disk silk production based on the presence of a conspecific, the sex of the test subject, as well as the origin of the spider (field caught or lab reared). Fine gauge silk was produced significantly more by females than males and total silk production was found to be significantly higher among field-caught spiders and was not contingent upon the sex or age of the conspecific stimulus. Fine gauge silk deposition occurred almost exclusively among mature females suggesting a sex-specific function of this silk type. The significant differences in attachment disk production based on the age and sex of the conspecific suggests an as yet unresolved communicative function. (posted May 25, 2006)

An attempt to understand males... Hypotheses of primary homology for the palps of mysmenid spiders (Araneae, Mysmenidae)

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Abstract: We present the first detailed comparison of male palp morphology of mysmenid spiders (Araneoidea, Mysmenidae). The goal of this work is to establish hypotheses of primary homology for the male copulatory structures. We will test such hypotheses within the context of an analysis of the phylogenetic relationships of Mysmenidae using both morphological and molecular character data. To account for mysmenid morphological diversity we have selected at least one species of the following genera: *Maymena*, *Mysmena*, *Microdipoena*, *Trogloneta*, *Calodipoena*, *Isela*, *Kilifina*, *Mysmenopsis*, and *Acrobleps*. We also have studied the male palpal morphology of some mysmenid close relatives such as representatives of the families Anapidae and Synaphridae. Mysmenids have cymbial modifications

usually related to the embolus, in the manner of a "cymbial conductor", which could turn out to be synapomorphic for the family. Expansions, apophyses and foldings of the cymbium, as well as thick tibial spines could also define clades within the family. Homology propositions for "conductors" and other tegular apophyses are open to multiple interpretations and their distribution varies at the generic level. Although the establishment of robust hypotheses of homology is far from being resolved, this study provides a starting point towards a better understanding of a group of small spiders that lacks detailed comparative studies. (posted May 23, 2006)

M, N and O

The effects of autotomy, habitat complexity and predator cues on foraging in the wolf spider *Pardosa milvina*

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Abstract: The success of a spider's foraging attempts can be affected by environmental conditions and by the individual's physiology and behavior. We tested the effects of leg autotomy (yes/no), habitat complexity (straw/dirt), and predator cues (*Hogna helluo* silk present/absent) on foraging success and body condition in juvenile *Pardosa milvina* using a fully crossed design. Although these factors have been studied independently of one another for this species, our study is the first to examine the interactions between them. For each trial a *Pardosa milvina* was placed in a circular container along with 10 pin head crickets. The response variables measured were number of crickets remaining after 24 hours and change in weight and abdomen width of the spider. Our results showed that the number of crickets captured by *P. milvina* decreased in the complex habitat, but spider weight and abdomen width was unaffected. Conversely, predator cues had no effect on number of crickets captured, but spiders gained substantially less weight in the presence of cues. Autotomy had no effect on any measure of foraging success and furthermore there were no interactions between any of the factors tested. These results match those of previous studies for each independent factor. Although no interactions were significant between the factors in the lab, further studies should be conducted to determine whether these interactions may be more important under field conditions. (posted May 25, 2006)

The effect of size on microhabitat preferences by the scorpion, *Centruroides vittatus* (Scorpiones, Buthidae)

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Abstract: The scorpion, *Centruroides vittatus*, uses microhabitats for foraging and/or a refuge from predators and environmental conditions. What effect does scorpion size have on microhabitat preferences by the scorpion? Scorpion size classes were estimated in the field based on the length of the scorpion from the anterior of the prosoma to the posterior of the mesosoma. The classes were class I (< 5 mm), class II (5-10 mm), class III (10-15 mm) and class IV (> 15 mm). Data on size classes collected on campus of Texas A&M International University during many nights from June 10, 2003 to May 12, 2005. Microhabitat use was significantly different among scorpion size classes. The frequency of scorpions on prickly pear cactus (*Opuntia engelmannii*) and strawberry cactus (*Echinocereus*

enneacanthus) was higher for size class IV than classes I-II (pooled) or class III. The frequency on grass was higher for classes I-II than for class III or class IV. Temperature but not precipitation had an effect on microhabitat use by the different scorpion size classes. Two alternate hypotheses to explain the effect of scorpion size on microhabitat preferences are: (1) Scorpions of different sizes prefer different microhabitats. (2) Interactions among scorpions of different sizes affect microhabitat use. A preferred microhabitat for all scorpions is cacti (prickly pear cactus and strawberry cactus), but smaller scorpions avoid the larger scorpions and thus cacti because of the risk of cannibalism. Further research is planned to test these hypotheses. (posted May 31, 2006)

Repeated evolution of male sacrifice behavior in spiders correlated with genital mutilation

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Abstract: According to sexual cannibalism theory, male complicity in terminal mating can be adaptive when the male's future reproductive value is low relative to the benefits of self sacrifice. Characteristics that lower the male's chances of successfully mating with a second female may make such male sacrifice behavior more likely to evolve. Spiders and insects that exhibit male sacrifice often also have male genitalia that become broken or disfigured during copulation. Male genital mutilation has great potential for lowering the future reproductive value of the male, which could easily tilt the equation in favor of various forms of male sacrifice. Here I test the hypothesis that the evolution of male sacrifice behavior (either complicity in cannibalism or spontaneous death associated with copulation) is concentrated in taxa where male genital mutilation is a typical consequence of copulation. The concentrated changes test, a phylogeny-based statistic, is used to investigate character correlations. This investigation focuses on araneoid spiders because several independent origins of sacrifice behavior are known for this group and the phylogenetic structure of the lineage is relatively well tested. I report that male genital mutilation is significantly correlated with sacrifice behavior and argue that this finding is consistent with sexual cannibalism theory. Male genital mutilation and male sacrifice behavior both tend to evolve under conditions of intense male-male competition. This pattern may also hold for some insect systems. No previous study has identified a morphological characteristic that may be correlated with the repeated evolution of male sacrifice behavior. (posted May 17, 2006)

Behavioral plasticity and mate preferences: the effects of juvenile experience on mate choice in two sympatric wolf spider sibling species *Schizocosa ocreata* and *S. rovneri*

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Abstract: In a variety of spiders, female preferences for male traits and/or courtship displays are not only linked to mating success but often play an important role in maintaining species isolation. Social experience is known to influence female mate preference in vertebrate animals, but little is known about such effects in invertebrates. Here we investigated whether juvenile exposure to male courtship influences adult female mate recognition in the wolf spider *Schizocosa ocreata* and its sympatric sibling species *S. rovneri*. Because these species have overlapping home ranges and/or habitats, contact between species is probable in regions where they co-occur, and interspecies hybrids are occasionally found in nature. In this study we tested the hypothesis that juvenile exposure to courtship of heterospecific males influences adult female *S. ocreata* and *S. rovneri* mate recognition. Juvenile *S. ocreata* and *S. rovneri* females were exposed multiply to conspecific or heterospecific male courtship. Upon maturing, exposed females were paired with an adult male of the same or opposite species to which they had been previously exposed and were observed to

determine receptivity and willingness to copulate. Juvenile experience appears to influence adult female aggressive and/or receptive responses to heterospecific males, but affects each species differently. In *S. ocreata*, the overall amount of juvenile experience influenced female receptivity and aggression toward heterospecifics, whereas in *S. rovnneri*, the type of juvenile exposure may be more important. The role of experience in mate recognition will be discussed. (posted May 26, 2006)

Spermatogenic development of the testicular cyst cells in the black widow spider, *Latrodectus mactans*

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Abstract: Spider spermatozoa possess a remarkable ultrastructural diversity at three different level: the transfer level, the cellular level and the level of organelles (Michalik et al., 2004). Here, histologic and microstructural differentiations of the spider testicular cyst cells during the spermatogenetic development were examined with light and electron microscopes. The testis in the black widow spider, *Latrodectus mactans* consists of two strands located ventrally in the opisthosoma. Each testicular stand is composed of large somatic cells that support the outer wall of the testis and testicular cysts that contain the germ cells. The early development of spermatogenic cells are took place in the periphery of the testis and are closely attached to each other and to the somatic cells. More toward the center of the testis, testicular cysts with germ cells are found. Each cyst contains many further developed germ cells mostly in the same stage of spermatogenesis. The cysts containing spermatogonia or early spermatocytes were located at the periphery of the testis but the cysts of spermatids or spermatozoa were observed at the vicinity of the lumen. As a result of flagellar coiling, each spermatid was converted into a roundish sperm called spermatophore. (posted May 5, 2006)

Microstructure of silk spigots of the green crab spider, *Oxytate striatipes* (Araneae: Thomisidae)

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Abstract: The genus *Oxytate* L.Koch, 1878 comprises a homogeneous group of night active crab spiders. The crab spiders also have silk apparatuses even though they do not spin webs to trap a prey. We have examined the microstructure of the silk spinning apparatus of the green crab spider, *Oxytate striatipes* by using a field emission scanning electron microscope (FESEM). The silk glands of the spider were classified into three groups: ampullate, pyriform and aciniform glands. The spigots of these three types of silk glands occur in both sexes of spiders. Two pairs of major ampullate glands send secretory ductules to the anterior spinnerets, and another two pair of minor ampullate glands supply the median spinnerets. In addition, the pyriform glands send ductules to the anterior spinnerets (45 pairs in females and 40 pairs in males), and the aciniform glands feed silk into the median (9-12 pairs in females and 7-10 pairs in males) and the posterior spinnerets (30 pairs in both sexes). It has been revealed that the spigot system of this spider is more simple and primitive than other wandering spiders. Since, even the female spiders do not possess the tubuliform glands for cocoon production as well as the triad spigots for web-building. (posted May 5, 2006)

Hunting the hunters: young spiders that share the same sites

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Abstract: Flowering goldenrod attracts many small insects and their predators, especially young crab spiders *Misumena vatia* and jumping spiders *Pelegrina insignis*. The earlier emerging jumping spiders are larger than the *Misumena* and often prey on them. However, I found a weak positive relationship between their numbers on goldenrod clones, suggesting that the jumping spiders did not consume all the *Misumena* or drive them from the goldenrod. To test their relationship, I cleared goldenrod clones of spiders and restocked them with dyed spiderlings. Assuming that *Pelegrina* would recolonize and feed on the spiderlings, I predicted an initial strong positive correlation that would decrease back to the original weak relationship recorded. On Day 1, no correlation occurred, but on Day 2 a strong positive correlation occurred -- the jumping spiders did not recruit as rapidly as predicted. Unfortunately I did not accommodate for a Day 3. The results were not merely the consequence of predator avoidance, because several *Pelegrina* had pink dye about their mouthparts. *Pelegrina* can probably inflict a major cost on *Misumena* at this time. (posted May 25, 2006)

Systematics of south-central US tarantulas (*Aphonopelma*, Theraphosidae), as inferred from molecular and morphological characteristics

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Abstract: Tarantulas in the south-central US region were historically included in one far-ranging species, *Aphonopelma hentzi*. Subsequent studies, however, have split this original taxon into about ten new species. Unfortunately the majority of these putative species were named from only one or two specimens, with variability not taken into account. In order to reevaluate the taxonomic status of the *A. hentzi* and its peripheral species, we have examined samples collected from a wide geographic area including the historical *hentzi* range. The historical *A. hentzi* is defined as including the current *hentzi* species along with the extremely similar south-central neighbors having been previously included in the far-ranging species. We examined both molecular and morphological characteristics for this study; which combined to give a more robust analysis of the *hentzi* tarantulas and the peripheral species. We focused on the mitochondrial DNA marker cytochrome oxidase I, where we found only a few to no polymorphisms among individuals in the historical *hentzi* distribution, while tarantulas outside of the range showed exceptionally high variation. The molecular data were used to develop a phylogeny of the tarantulas, which supports the hypothesis that the south-central *Aphonopelma* species should be consolidated. In addition, we found that variations in morphology of the specimens support the molecular data, and therefore we aim to discern reliable characters for species identification. We have found there is not adequate variability for the historical *Aphonopelma hentzi* to be considered ten separate species as it is presently. (received May 26, 2006)

Determinants of female and male mating behaviors in *Rabidosa punctulata*

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Abstract: *Rabidosa punctulata* are large-bodied wolf spiders common in the eastern US and specific to open grassland habitats. Barring one brief account by Eason and Whitcomb (1965) little is published about the mating behavior of this species. We describe the mating behavior of both female and male *R. punctulata* and examine an alternate male mating tactic we term 'grappling'. Males of *R. punctulata* use courtship, grappling, or a combination of each to achieve copulation. Similar to other lycosids, the courtship display in *R. punctulata* contains both a visual and vibratory element. Grappling consists of the female and male interlocking legs and occasionally tumbling end over end before either disengaging or copulating. Our objective was to determine whether males vary their use of tactic (courtship vs. grapple) depending on the quality of female encountered. Female quality was defined by body size. In laboratory experiments, 50 males were presented with low (mean= 0.33 g) and high (mean= 0.51 g) quality females and the tactics each employed were recorded. Preliminary analysis suggests that male mating behavior and success may be dependent on both female receptive behavior and the size of the male relative to the female. Large males were more likely to grapple when not given receptive signals from the female. Female receptive behavior appears to be influenced by the rate of leg waves performed by the male during courtship. (posted May 31, 2006)

The metabolic cost of regenerated *Parabuthus transvaalicus* venom and its protein content

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Abstract: Scorpion venom has many components and generally is composed of water, salts, small molecules, peptides, and proteins. One can reasonably assume that the production and storage of this complex secretion is an expensive metabolic investment. However, to date, no study has addressed the costs associated with the regeneration of venom by scorpions. We examined the difference in oxygen consumption between milked and unmlked scorpions to determine the metabolic costs associated with venom production. During the subsequent 72 hours, milked scorpions had a significantly higher metabolic rate (39% increase) than unmlked scorpions. Furthermore, venom milked from the scorpions had significantly higher protein content (73% more) than the venom regenerated after 72 hours. However, the amount of protein in the regenerated venom was not correlated with the metabolic rate. The significant increase in oxygen consumption after milking supports existing hypotheses about the metabolic cost associated with venom regeneration and provides further insight on why scorpions use their stinger sparingly (i.e. metering their venom) for both defensive and predatory encounters. (posted May 23, 2006)

The recruitment of adhesion enhances the stickiness of viscous capture threads spun by araneoid orb weaving spiders

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Abstract: By retaining prey that strike an orb web, a web's spirally arrayed capture thread allows a spider time to locate and subdue prey. In araneoid orb-weavers viscous capture threads replace the dry, cribellar capture threads spun by deinopoids. To examine differences in the way these two types of threads operate, we measured their stickiness using contact plates of different widths. The adhesion of cribellar thread was unaffected by plate width. In contrast, the adhesion of viscous threads increased with plate width, showing little difference in threads with small, closely spaced droplets and increasing differences in threads with larger, more widely spaced droplets. These results support the hypothesis that the stickiness of viscous capture threads is enhanced by its ability to effectively recruit the adhesion of multiple droplets, whereas the stickiness of cribellar thread is limited to adhesion generated at the edges of its contact. We develop models that illustrate how the adhesion of viscous threads is distributed and explain the performance of threads with different droplet profiles. (posted May 23, 2006)

Ground spiders (Araneae, Gnaphosidae) of semi-desert of western Kazakhstan

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Abstract: Ground spiders of Gnaphosidae were studied in the transitional region between Euro-Asian steppe zone and the Asian desert zone. The region of our investigation is located in the flat plain of the North Western Caspian sea lowland at the boundary between Russia and Kazakhstan (49° 23'N; 46°47 5'E), near the small town of Dzhanybek. Spiders were studied in five biocenoses. Two of the five are natural biocenoses. The two natural biocenoses are microelevations and microdepressions with their own type of soils and plant community. The three introduced biocenoses are oak (*Quercus robur*) forest belts, oak community in local park, and elm (*Ulmus pumila*) forest belts. Gnaphosids of 42 species and 15 genera were found in this region. Of those found, 37 species are located only in two natural biocenoses - microelevations and microdepressions. Only 11 species occur through all five biocenoses. In the introduced biocenoses, ground spiders are represented in very low numbers with only 5 species. A significant number of the species from the studied gnaphosid community are commonly found associated with the steppe zone of Euro-Asia. The most common species are: *Gnaphosa steppica*, *G. taurica*, *Drassodes rostratus*, *Drassyllus sur*, *Zelotes atroceruleus*, *Z. orenburgensis*, and *Z. rufa*. The spiders typically associated with the Asian desert are less common here and only are represented by a few species. Among the species is a new species of genus *Haplodrassus* and one new genus. Species with wide Euro-Asian range distribution are mostly occurring in introduced biocenoses. The most common are *Gnaphosa lucifuga*, *Zelotes caucasicus*, and *Z. electus*. (posted May 26, 2006)

A peculiar Encoptarthria group of ground spiders (Araneae, Gnaphosidae) from Australia

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Abstract: The genus *Encoptarthria*, with the species *E. serventui*, was described by Australian arachnologist B. Main from Sandy Hook Island off the southern coast of Western Australia in 1954 on the basis of one penultimate female. Sandy Hook Island is a small island near the town of Esperance. In 1998, this island was visited to collect specimens from the type locality of *Encoptarthria*. The genus is endemic to Australia but occurs widely, and is represented by more than 40 species. Spiders of this genus possess elongated anterior lateral spinnerets with large piriform spigots and also large posterior median eyes. In 1908, Simon described five of these species in the genus *Megamyrmaekion* (which actually occurs only in the Middle East). These species were transferred to *Encoptarthria*. A curious genus *Ceryerda* was described by Simon on the basis of an immature female from Western Australia. In our expedition to Western Australia in 1998, spiders were collected at the type locality, Daydawn, and presently mature males and females of this genus are available. Currently the *Encoptarthria* group includes 8 genera and approximately 100 species: *Encoptarthria*, *Taieria*, *Ceryerda* and 5 new genera. (posted May 26, 2006)

P, Q and R

Microstructural analysis on the silk-spinning nozzles of the spider, *Nephila clavata*

Authors

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Abstract: Spider silks are composite materials with complex microstructures. Especially, dragline silk is an extremely strong biopolymer. Even though the orb-web spiders are capable of producing up to seven types of silk, the silk of major ampullate gland is the most predominant one in both sexes. The ampullate gland is composed of three functional parts - excretory duct, storage ampulla and convoluted tail regions. The duct is basically composed of three superposed types of the layers which are inner cuticles, monolayered epithelial layer and peripheral connective cells. The electron lucent subcuticles which have the functions of water removal and orientation of silk fibers during polymerization are well developed at the anterior region near the spinning nozzle. Whereas the endocuticles which containing the banding patterns at the cross section are developed at the rest of duct region. This study initiated to reveal the relationship between the microstructure and the mechanical properties of natural silk fibers to increase understanding the behavior of the synthetic fibers, potentially resulting in the development of new synthetic nanofibers spun from electro-spinning process. Here, we demonstrate the microstructural characteristics of the cuticular spinning nozzles in the major ampullate silk glands using various visualizing techniques of light and electron microscopes. (posted May 5, 2006)

Weight Dynamics of *Loxosceles reclusa* and *Rabidosa rabida*

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Abstract: Two common Missouri spiders, the brown recluse (*Loxosceles reclusa*) and the rabid wolf spider (*Rabidosa rabida*), are compared in relation to feeding efficiency. In this study, we examined weight fluctuations, relative growth rates, and relative consumption rates of these two spider species feeding upon domestic house crickets (*Acheta domestica*). Predator weight gain vs. prey weight loss was also analyzed to determine the feeding mass transfer ratio. Our preliminary studies suggest that *R. rabida* gains significantly more weight during feedings over a shorter feeding duration, and correspondingly loses weight more rapidly between feedings than *L. reclusa* does, and transfers a greater fraction of the prey mass. We modified the classic herbivore feeding efficiency indices of Waldbauer to obtain predator-prey feeding indices. The differences in the calculated feeding indices are correlated with different feeding and inter-feeding behaviors of the two species. (submitted May 23, 2006)

On the New World range of two Eurasian introduced spiders (Araneae): using museum specimens to track a biological invasion

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Abstract: Many biological introductions are well documented because of their direct impacts on human interests of medical and economic importance, with coastal ports often the points of entry into foreign lands. However, many biological introductions go unnoticed for long periods because they do not seem to directly affect human interests, making it difficult to assess the impact of many exotic species on ecosystems and biological communities. Here we report for the first time the New World ranges of two introduced Eurasian spiders, *Tenuiphantes tenuis* (Blackwall 1852) (Linyphiidae) and *Trochosa ruricola* (De Geer 1778) (Lycosidae), including several new state (USA) records for each species. To document their ranges in North, Central, and South America, as well as the Caribbean and the Atlantic Islands (collectively, the New World), we examined specimens collected ourselves, as well as specimens from museum, institutional, and personal collections throughout the New World. In the New World, neither species appear to directly affect human interests of medical or economic importance, and have gone largely unnoticed in the scientific literature over the last century, resulting in confusion regarding their actual ranges, and indeed their correct identification as introduced species. Our results demonstrate a clear pattern of invasion via the coasts, with the Great Lakes states as an interesting route for continental penetrance, bypassing other natural dispersal barriers (e.g., mountain ranges) to the continental interior. Further, our results demonstrate that museum and other collections are excellent resources for helping to establish ranges of both native and invasive species. (posted June 1, 2006)

The effect of prey availability on metabolism and activity in the tarantula *Phormictopus cancerides* (Araneae: Theraphosidae)

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Abstract: Spiders have been shown to exhibit very low resting metabolic rates (RMR) and altered feeding behaviors as mechanisms to survive extended periods of limited food availability. We examined the effect of different periods of food deprivation on RMR and foraging activities in tarantulas (*Phormictopus cancerides*). Juvenile tarantulas were separated into two feeding groups and fed either once every five or 30 days. Monthly feeding trials were preceded by RMR measurements. During feeding trials we compared differences between the two groups in 1) prey capture rates, 2) time to prey capture, and 3) the predator's prey detection distance. We predicted that the food-deprived group would have lower RMRs and shorter times for prey capture, as well as higher prey capture rates and detection distances compared to the well-fed group. Results showed that the RMRs increased for the well-fed group but remained consistent for individuals fed only once a month. Time to prey capture decreased for food-limited individuals and the proportion of individuals that ate in the 30-day group was much higher than the well-fed group. However, results for detection distances were inconclusive. Overall, changes in metabolism and behavior were more noticeable in the well-fed group compared to individuals fed once a month. (posted May 24, 2006)

Fishing crab spiders in the hanging stomachs of Borneo

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Abstract: *Misumenops nepenthicola* lives within the pitchers of pitcher plants in Asia. It can remain underwater in the pitcher plant fluid for up to 40 minutes because it can trap a bubble of air on its ventral abdomen. Although this behavior is used to avoid predators, how it is used in foraging has not been examined in detail. To watch the spider inside the pitcher, longitudinally-sectioned pitchers of *Nepenthes gracilis* were glued to glass. *M. nepenthicola* was seen fishing for mosquito larvae living in the pitchers by using a variety of different strategies. These ranged from only submerging legs 1 and 2 and scooping larvae out of the fluid as they came to the surface to breathe, to going underwater and catching larvae. The spider also flushed larvae out of the dead arthropods lying at the bottom of the pitcher by going into the necromass and throwing the equivalent of a spider tantrum. Spines on the tarsus, metatarsus and tibia of legs one and two may be used to hold onto captured larvae. A different strategy was used to catch potentially dangerous green weaver ants (*Oecophylla smaragdina*). The spider detected ants that had fallen into the fluid and then waited until the prey had drowned and sunk, before submerging and retrieving the freshly-dead ant. Because crab spiders use refluxing extra-oral digestion, a different mechanism was used to extract nutrients from soft-bodied larvae compared to ants which have a rigid cuticle. (posted May 25, 2006)

Relationships between nest site ecology and colony demographics in the social huntsman spider, *Delena cancerides*

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Abstract: The endemic Australian huntsman spider, *Delena cancerides* (Sparassidae), is the most atypical of known social spiders. These large non-web building spiders form matrilineal colonies in nest retreats under the bark of *Acacia*, *Eucalyptus*, and *Casuarina* trees. Based on 195 colonies captured in the field during the Austral summer, their social

demography varies from single adult females with offspring to uncommon multiple adult colonies. Based on laboratory studies, *Delena* females compete for control and inheritance of retreats, and respond aggressively to non-colony migrants. Here we test some of the ecological predictions that the atypical patterns of sociality are associated with constraints imposed by habitats with limited retreat sites. Suitable colony retreats are patchily distributed. Within suitable habitats, unoccupied retreats are limited in number in most habitats and relatively small compared to the large bodied spiders. We explore relationships between retreat size, alternative retreat sites, and social demographics for *Delena cancerides*. (posted May 26, 2006)

Seasonality and productivity affect spider abundance and diversity in an annual agricultural ecosystem

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Abstract: Soybean fields are cyclical ephemeral ecosystems in which spider diversity may be determined by an interaction between annual recolonization and competition for prey. The purpose of our study was to investigate the effects of seasonality and insect abundance on spider diversity in a no-till soy agroecosystem. We sampled insects and spiders in July, August, and September and constructed a randomized complete block ANOVA model to test for the effects of sampling time on insect abundance, spider abundance, and spider diversity. Spider abundance and diversity were strongly affected by seasonality, but there were no significant seasonal effects for insect abundance. Because species richness was highest in August, we elected to use Principle Components Analysis (PCA) and regression analyses to explore relationships between the August spider community and insect abundance. Hemiptera, Diptera, and Collembola were strongly associated with the first three axes, which cumulatively accounted for 47% of the variance. Our PCA results suggest that complex linkages exist between the August spider community and these insect groups. Our regression analyses showed that overall insect abundance and abundances of the orders Diptera and Collembola were significant positive predictors for spider abundance. Overall insect abundance and Diptera abundance were significant positive predictors of the abundance of sheetweb weavers (Linyphiidae) and *Erigone autumnalis*, the dominant species. Diptera abundance was also a significant positive predictor for spider dominance and a significant negative predictor for spider diversity. Our regression results suggest that *E. autumnalis* dominates the August spider community because it is a good competitor for Diptera. (posted May 23, 2006)

Nephila madagascarensis (Vinson) (Araneae: Tetragnathidae) at the National Zoo

Authors

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Abstract: In 1988, sixty one, live *N. madagascarensis*, were given to the National Zoo by Madagascar's Director of Environmental Research. Three females were established near the exit of the exhibit, in a dark corner. Selecting a corner where no drafts could carry spider silk away, by lighting the exhibit well from above, and by feeding and spraying mists of water several times during the day, it has been possible to contain the spiders within this area without any glass

barrier between them and the public. While the absence of a barrier scares a small percentage of the visitors, the majority of them are so fascinated by the idea that the spiders are completely free, that they stay to learn more about why they don't "escape", and in so doing, can observe predatory behavior, size dimorphism and occasional courtship behavior. Most children and some adults love the exhibit; if they stay to watch, most visitors leave with a new appreciation for spiders.

In this paper we discuss how the behavior of *N. madagascarensis* makes it an ideal animal to be exhibited in this way, and its value as a teaching tool. (posted May 1, 2006)

The evolutionary origin and dispersal pattern of *Loxosceles rufescens* (Araneae:Sicariidae)

Authors

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Abstract: *Loxosceles rufescens* is a cosmopolitan, synanthropic spider with a bite that causes dermonecrotic lesions in mammals. These lesions are caused by the enzyme sphingomyelinase D (SMaseD). This species is unique within *Loxosceles* with respect to its broad geographic distribution, and in being the only described species native to Mediterranean Europe. The goal of this project was to investigate the evolutionary history of the colonization of this species in Europe and its subsequent distribution pattern. We analyzed the phylogenetic relationship of this species to *Loxosceles* from North, Central and South America and Southern Africa using the nuclear gene 28S and the mitochondrial gene 16S; and the relationships between populations of *L. rufescens* using the mitochondrial markers COI and 16S. We also asked whether the phylogenetic position of *L. rufescens* would allow accurate prediction of the gene tree relationships of *L. rufescens* SMaseD to other *Loxosceles* SMaseDs. To study within-species relationships we used haplotype networks, F-statistics, and coalescence methods. We found that populations of *L. rufescens* from Australia, Spain and the United States are genetically very similar, suggesting recent human-mediated dispersal. Analyses of the DNA sequence data using maximum likelihood, Bayesian, distance, and parsimony methods consistently support *L. rufescens* as derived from South American *Loxosceles* given current taxon sampling. However, the phylogenetic position of *L. rufescens* SMaseD cDNA on a gene tree does not follow a simple pattern predictable based upon the species relationships. (posted May 31, 2006)

Differential exposure of males and females to predator information has differential effects on mating in the wolf spider, *Pardosa milvina* (Araneae, Lycosidae)

Authors

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Abstract: It is generally assumed that males and females have different agendas during mating. Males engage in an active search for females and then try to impress them with courtship activities. Females are assumed to attract, evaluate and select males with features that signify good genes. These role differences may lead to differences in the sensory modalities that they prioritize during mating and affect their response to differences in predation risk. The small wolf spider, *Pardosa milvina*, displays anti-predator behavior in the presence of visual and chemical cues from the larger wolf spider, *Hogna helluo*. In a divided arena, we varied the exposure of *Pardosa* males and females to chemical cues from the predator or the actual predator. The time it took males and females to find one another, and the frequency of courtship were proportionate to the nature of the cues if they were presented to the male, whereas when

cues were presented to the female, the differences were not proportionate to the nature of the cues. In a second experiment, males and females were exposed to visual cues, chemical cues or both in a separate arena and then put together and mating was observed. Exposure of males to different cues produced distinct declines in the timing and intensity of courtship. Exposure of females to chemical cues affected the number of matings that occurred. Because males must be active in order to mate, they may integrate predation information from various sensory modalities to gauge their response. (posted May 23, 2006)

S, T, U and V

Spider diversity patterns: explaining non-random aggregations

Authors

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Abstract: The influence of random processes on patterns of species diversity, as opposed to interaction-based processes (e.g. competition), is not always clear. We are interested in the relative strength of these processes in determining spider species diversity. We use data from several biodiversity studies to test for random versus non-random aggregation patterns of spider communities. Spider assemblages differ from random expectations with respect to intraspecific aggregation patterns. We test for correlations of intraspecific aggregation with factors such as spider size, family, and geographical scale. (posted June 2, 2006)

Habitat preference and movement of the wolf spider *Pardosa milvina* in a strip crop system

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Abstract: We measured habitat preference of the agrobiontic wolf spider *Pardosa milvina* across different developmental stages (juveniles, subadult males, subadult females, adult females, adult females with egg sacs, adult females w/ spiderlings) within different crops (tilled corn, no-till corn, no-till soybean, and a fallow field). We used three methods to quantify preference: field censuses using 0.5 square meter rings (N = 654), two-choice laboratory habitat tests (N = 438), and direct observations of spider movement within different tillage and crop types (N = 180). Spiders of all developmental stages preferentially avoided hedgerows and spider numbers increased with increasing litter depth. All three habitat preference measures (censusing, choice experiments, and direct observation) found significant avoidance of bare soil and significant differences in preference based on the age and sex of the spider. Results indicate that *P. milvina* habitat preference varies by sex, age and reproductive status of the spider and that no-till agriculture greatly increases *P. milvina* density. (posted May 25, 2006)

Structural complexity elevates density and reduces foraging efficiency in the wolf spider, *Pardosa milvina* (Araneae, Lycosidae)

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Abstract: Cursorial predators, such as wolf spiders, occur at higher densities in areas containing more diverse substrates. The wolf spider, *Pardosa milvina*, achieves high densities in agricultural systems in the United States, and responds to increases in soil texture and quantity of plant debris on the soil surface. Therefore, habitat complexity appears to be an important predictor of density. Here we explore the connection between structural complexity and density of *P. milvina* to address the question: how do levels of habitat structure influence density and foraging patterns of *P. milvina*? In soybean fields, we manipulated natural habitat structure through addition and removal of soybean plants and wheat thatch, and simulated natural structures using artificial replicas of soybean plants and wheat thatch. *Pardosa milvina* was more common in complex habitat offering both plants and thatch, but the highest density was observed in the artificial structures containing the lowest density of prey orders Collembola and Diptera. In the laboratory, we tested for the interactive effects of habitat structures (used in field manipulations) and different density levels of *P. milvina* on foraging success of *P. milvina*. Foraging efficiency was reduced in treatments containing more complex structure, and the presence of soil substrate, as opposed to vegetation, had a stronger negative effect on foraging success. There was a significant interaction between habitat complexity and density; our data suggests that interference occurs between conspecifics in less structured habitats, which provides an explanation for the attraction to sites consisting of more diverse substrates. (posted May 11, 2006)

The features of insect surfaces and viscous capture threads interact to determine how securely spider orb webs hold insects

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Abstract: As spider orb webs intercept a broad range of insects, their capture threads must adhere to a range of surface textures. In araneoid species, these capture threads are formed of droplets whose size and spacing differ among species. To determine how droplet profile and insect surface texture interact, we measured the stickiness of viscous threads produced by four araneoid species using four insect surfaces that ranged from smooth to coarsely setose. Threads with larger, more widely spaced droplets achieved the greatest stickiness and surfaces with small, closely spaced setae were held the most securely. The stickiness of these 16 combinations of thread and surface features was explained by a model that included the volume of viscous material in a mm length of capture thread, the non setal contact area of an insect's surface, the surface area of the setae on the insect surface, and the ratio of a thread's mean droplet dimension divided by the length of the setae on the insect surface. These results show that setae play a crucial role in determining how strongly an insect surface is held, that a thread adheres more strongly to setae than to insect cuticle, and that the larger the size of a viscous droplet relative to the length of setae it contacts, the greater is the stickiness achieved. (posted May 23, 2006)

Juvenile diet influences adult characteristics in the wolf spider *Schizocosa uetzi*

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Abstract: Previous studies using the wolf spider *Schizocosa ocreata* have demonstrated that feeding regime influences adult body size, body condition, and secondary sexual ornaments of mature males, suggesting that these traits may be 'honest indicators' of individual quality. Mature males of a closely related species, *S. uetzi*, also possess secondary sexual ornamentation in the form of dark pigmentation on their foreleg tibiae which varies among individuals in both proportion of tibia covered and contrast value of pigmentation. Here, we explore the influence of feeding regime on adult characteristics of *S. uetzi*. Immature spiders were collected from the field in early spring and raised to maturity on two different diets (low and high nutrient), which varied in both quantity and quality of food. High nutrient individuals gained more weight than low nutrient individuals and females gained more weight than males. The difference in weight gain between low and high nutrient groups was greater for females than for males, suggesting that females may be better at allocating resources to weight gain as there were no differences in initial weights between the sexes. High nutrient individuals took fewer days to reach sexual maturity, yet went through significantly more molts than low nutrient individuals. The forelegs of mature males from each group were mounted on slides, digitally photographed and analyzed using imaging software. Results of the influence of feeding regime on male secondary sexual ornamentation will be discussed. (posted May 26, 2006)

Maternal and juvenile interactions within the maternal retreat: Growing up in the lab

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Abstract: Interactions between offspring and mother were observed in a laboratory setting for two species of tarantulas, *Hysteroocrates gigas* and *Psalmopeous irminia*. *H. gigas* is considered a sub-social species and spiderlings may remain in maternal burrow for several months and cooperate in prey capture and/or consumption. In this study, I observed many feeding events where the mother would actively hunt and share portions of captured prey items with her offspring. Prior to their third molt, spiderlings remained within the maternal retreat during daylight hours. However, once they reached the fourth instar, they were often observed in the area directly surrounding her retreat or they left the vicinity of her retreat entirely.

Little is known about Venezuelan suntiger, *P. irminia*. As sexually mature adults, males and females show striking dimorphism in coloration and hairs. Although this is an arboreal species, in the laboratory, females build web and soil covered retreats at the base of wood or cork bark structures providing for climbing. With *P. irminia* there was no indication of maternal feeding of offspring and the adult female rarely left her retreat or ate while offspring remained with her. Temperature appeared to play an important role in the timing of departure from the maternal retreat and this event occurred before spiderlings underwent their third molt. (posted May 31, 2006)

Jumping spiders and aposematic prey: attending to context during learning bouts influences future choice

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Abstract: Jumping spiders (*Phidippus princeps*) learn to avoid aposematic milkweed bugs, but resume attacking bugs when background cues are changed. This attention to context, or background cues, is known as context-dependent learning. While well-studied by psychologists, its role in ecologically relevant tasks is less well known. Therefore, I tested whether the spiders' experience during foraging influenced future choice of habitat cues. Food-deprived spiders (n=76) experienced one of two types of compound cues (A or B), either associated with palatable milkweed bug nymphs, unpalatable milkweed bug nymphs, or no prey. In a choice test, spiders trained with palatable prey preferred cues paired with the prey, spiders trained with unpalatable prey showed no cue preference, and spiders experiencing no prey also showed no cue preference. In a subsequent experiment, I trained spiders with a more aversive stimulus (electric shock), paired with compound cues to determine whether spiders avoid habitat cues paired with electric shock. Food-deprived spiders (n=27) experienced one of two types of compound cues (A or B), paired with a series of 33V, 8mA shocks. In a choice test, spiders trained with electric shock actively avoided habitat cues used during training. I will also discuss potential factors underlying the lack of active avoidance of cues when paired with unpalatable prey as opposed to electric shock. (posted May 26, 2006)

Unusually long *Hyptiotes* (Araneae: Uloboridae) sequence for small subunit (18S) ribosomal RNA supports secondary structure model utility in spiders

Authors

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Abstract: Here we describe the structure of the small-subunit ribosomal RNA (18S rRNA) sequence from *Hyptiotes gertschi* (Araneae, Uloboridae), which is the largest 18S gene sequenced in any arachnid to date. We compared this remarkable sequence to those from a range of other spiders and arachnids, and develop base-pairing models of its insert regions to determine its overall secondary structure. The *H. gertschi* sequence of 1902 bases is 86 nucleotides longer than any comparable spider sequence and contains 5 inserts between 5 and 28 bases in length, all at regions characterized as among the most variable in eukaryotic 18S genes. Inserts were also found in one of these variable regions in published sequences of 3 species of hard ticks (Acari, Ixodidae). Other arachnid taxa were remarkably uniform in 18S primary sequence length, ranging from 1802 to 1816 nucleotides. Thermodynamic modeling of the *H. gertschi* inserts suggests they are largely self-complementary, extending the stem portions of the variable regions. In addition, preliminary data from uloborid taxa *Tangaroa* and *Daramulunia* suggests that the 18S inserts are not universal in Uloboridae, and may be a marker for a less-inclusive group. (posted May 26, 2006)

Harvestmen (Arachnida: Opiliones) occurring in the canopy and understory of beech-maple forests of southern Québec, Canada

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Abstract: Few authors have documented Opiliones distributed in northeastern North America. This is well illustrated in the large province of Québec, where only 15 species have been recorded, although 27 species are known to occur in New York. Additionally, no published quantitative data exists on either the distribution of harvestmen in the North American forest canopy, or on the efficacy of different collection methods. A new faunal inventory is presented, which includes information on vertical distribution, and a comparison of the primary collection methods. All data came from two ongoing arthropod biodiversity surveys in southwestern Québec beech-maple forests. Harvestmen were collected by two primary means: foliage beating during daylight hours, and sticky traps left in place for over 48 hours. In all, 23 species (874 individuals) from 5 families were collected. Novel records were found for both Québec and Canada. Opiliones occurred in both the canopy and understory of the beech-maple forests surveyed. The understory held higher levels of abundance, but only slightly higher species richness. Rarefaction estimates predicted that increased collection effort would result in higher canopy species richness. Ordination analysis found distinct groups in the canopy and understory layers. No differences were found between the two primary collection methods. (posted May 26, 2006)

Mitigating scorpion-sting syndrome in the Middle East: *Androctonus crassicauda* (Scorpiones: Buthidae) and its substratum preferences

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Abstract: Hundreds of medical and toxicological reports have been published concerning the venom of medically important scorpion genera (e.g., *Androctonus* and *Leiurus*). Two particular studies (Radmanesh, 1998; Al-Sadoom & Jarrar, 2003) noted over 100,000 scorpion-sting cases in Iran and Saudi Arabia in a five-year period. This "scorpion-sting syndrome" is significant and, as a result, counter-productive for human well-being and economic growth. A better understanding, therefore, of scorpion (especially, *Androctonus* spp.) habits and preferences should allow the design of mitigating strategies, which may reduce envenomation cases in poor/developing communities in the Middle East. A substratum-based study was devised to interpret the burrowing and roaming preferences of *Androctonus crassicauda* (Olivier, 1807). Observations (n=385) of 15 *A. crassicauda* specimens were recorded in North-Central Iraq during the summer of 2004. Each scorpion was given a choice between either a sandy or rubble-like substratum, which mimicked those found in Iraqi communities. Two main results were obtained: *A. crassicauda* is (1) ~2.5 times more likely to choose already-made burrows in the sandy substratum, and (2) ~2.0 times more likely to roam on the sandy substratum than on the open-framework rubble. Four strategies, consequently, are suggested to militate against infestation: (1) ensure all wall-floor connections are sealed; (2) fill cracks at concrete/sand interfaces; (3) remove crumbled stucco/wall covering piling at wall bases; and (4) use an ultraviolet light to locate scorpions in small crevices/cracks (primarily in sandy substratum) in house foundation/walls. (posted May 16, 2006)

Metabolic rates and movement of male tarantulas (*Aphonopelma anax*) during the breeding season

Authors

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Abstract: Mature male tarantulas (*Aphonopelma anax*) leave the safety of their burrows to search for spatially scattered females each spring. Mate searching not only increases a male's exposure to predators and extreme environmental conditions, but is also energetically expensive. Energy expenditure or activity capacity can be assessed by measuring the resting metabolic rate (RMR). High RMRs have been shown to correlate to high levels of activity in many species. We hypothesized that males with higher RMRs would have the ability to search larger areas and that this would be advantageous as it could increase the chances of locating females. Our goals were to: 1) Observe radio-tagged males over the course of two breeding seasons. 2) Measure RMR every 5-7 days. Results indicated no correlation between RMR and the distances males moved. Males traveled up to 365 m during a night and wood rat (*Neotoma micropus*) middens were frequently utilized as daytime retreats. Movement was interrupted by pauses of varying length and directionality was random. Some males were found to move up to 3.4 km and have search areas of 29 ha during the breeding season. Male mortality was found to be high and the average life expectancy of radio-tagged males for both years was nine days. Parasitoidism by Tarantula Hawk Wasps (*Pepsis* sp.) was the major cause of male mortality in 2004. Our results suggest that males are able to walk large distances and that RMR is not significantly correlated with this ability. (posted May 31, 2006)

Evolution of burrowing behavior in lycosids: insights from phylogenetic studies

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Abstract: Some members of Lycosidae create permanent burrows while others may make temporary retreats or nests that involve excavation of soil. In a world-wide systematic study of lycosids, Murphy et al. (2006) document numerous examples of burrowing and suggest that burrowing has evolved multiple times within the family. They also suggest that permanent burrowing is seen only in the subfamily Lycosinae. Within the southeastern US, many species of lycosids are known to make either tubular burrows (all *Geolycosa* species, many *Hogna* spp., *Arctosa*, *Gladicosa* and *Rabidosa*) or bowl-shaped excavations or nests, often with silken covers ("*Allocosa*"(=*Hogna*) *georgicola*, *Schizocosa saltatrix*, *Trochosa acompa*, *Rabidosa hentzi*, *Hogna lenta* sp. group and *Hogna helluo*) (Stratton, Nicholas & Reed 2005). However, uncertainty of taxonomy and taxonomic relationships of the *Hogna* species has to this point made it difficult to suggest evolutionary relationships or pathways for the evolution of burrowing. As a step in understanding how burrowing behavior evolved, I used sequence data from 2 mitochondrial regions (CO1 and 12S, ~1200 bp total) to estimate relationships among 14 species of lycosids from the southeastern US. Although sequencing is ongoing, I present preliminary hypotheses of relationship among the *Hogna helluo* group, the *Hogna lenta* group and the *Rabidosa*. Data from this study, from behavioral observations and from other published studies suggest that burrowing behavior has evolved multiple times and is quite variable. (posted May 26, 2006)

The function of bright male coloration in the sunset spider, *Frigga pratensis* (Salticidae)

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Abstract: Several jumping spiders (Salticidae) are sexually dichromatic -- females are inconspicuous while males have vivid colors. Here, I test three hypotheses about the function of male coloration in the sunset spider (*Frigga pratensis*), in which females are cryptic, whereas males have a conspicuous red abdomen. The first hypothesis ('female choice hypothesis') proposes that, because males often engage in elaborate courtship displays, male colors may serve as honest signals to females of a male's quality as a potential mate. The second hypothesis ('male-male competition

hypothesis') proposes that, because males often guard and/or fight over access to females, bright colors may reliably signal fighting ability to rivals. The third hypothesis ('mimicry hypothesis') proposes that, due to increased mobility compared to females, males may have developed conspicuous coloration to mimic potentially dangerous organisms. I found no support for the female choice or male-male competition hypotheses. Specifically, while the intensity of male color was variable, aspects of coloration did not correlate with body condition, suggesting that color is unlikely to provide reliable information about a male's quality as a mate or his fighting ability. Further, males did not overtly display their colorful abdomens to females during courtship or to other males during competitive interactions. My results are most consistent with the mimicry hypothesis. When clay spider models were placed on leaves in the field, those that were painted with the color pattern of male *F. pratensis* were attacked less often by predators than unpainted control models, suggesting that such coloration has the potential to deter predators. (posted May 26, 2006)

Potential maintenance costs of elaborate male ornaments: grooming behavior in wolf spiders (Lycosidae)

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Abstract: Recent studies have suggested that elaborate male ornaments are effective as 'honest' handicaps and condition-dependent signaling traits - not only because they are costly to produce, but also because they are costly to maintain. We tested this hypothesis with wolf spiders of the genus *Schizocosa* (Lycosidae), in which some species have male ornaments (leg tufts) and all species exhibit grooming behavior (both leg-chelicerae grooming and leg-leg rubbing). Grooming behavior (number of bouts, mean bout length, total time) varied between species depending on male ornaments; i.e., ornamented *Schizocosa ocreata* groomed significantly more often and for longer periods of time than non-ornamented sibling species *S. rovnari*, as well as other species. Grooming in *S. ocreata* is most frequently of the leg-leg rubbing type. Grooming also varied with the presence of female cues; i.e., grooming was more likely to occur and take more time in males exposed to female silk. Grooming did not vary with ornament (tuft) size, but the logistic probability of grooming did vary significantly with relative (scaled) tuft size, suggesting a possible threshold effect for males with above average tuft size. As leg tufts serve as a visual indicator trait in mate choice by *S. ocreata*, investment in ornament maintenance may increase signaling efficacy. (posted May 10, 2006)

A web of intrigue: factors influencing hunting success of mud-dauber wasps

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Abstract: Sphecid wasps are major predators of spiders. Each female wasp hunts spiders, paralyzes them and provisions them in a mud nest for her offspring to feed on. Examination of provisioned nests reveals that two-dimensional (2D) web-building spiders are more common in nests than are three dimensional (3D) web-building spiders, despite the higher relative abundance of 3D web-building spiders in surrounding habitats. The present study investigates whether web architecture and/or anti-predator behavior of 2D and 3D web-building spiders influence hunting success by mud-dauber wasps. Field-caught *Sceliphron caementarium* (Sphecidae) wasps built mud nests and

were trained to forage in out-door cages. Field-caught *Araneus cavaticus* (Araneidae, 2D, orb-web) and *Achaearaneatepidariorum* (Theridiidae, 3D, cob-web) spiders were allowed to build webs within wooden frames, and one of each was then offered in random sequence to foraging mud-daubers. Preliminary results show that wasps caught significantly more orb (10 out of 14) than cob-web spiders (1 out of 14). Thus 3D webs may act as physical barriers to prevent wasp predation. Orb and cob-web spiders also differed in their anti-predator behavior, which in turn influenced their capture by wasps. Upon wasp attack, orb-weavers that remained on their webs were killed, whereas most of those that left their webs survived. In contrast, cob-web spiders, most of which stayed within their webs survived, while the one that left the web was killed. Wasps searched for orb-weavers that had left the web for 10-12 min, but ceased to pay attention to cob-web spiders in the web after about 3 min. (posted May 5, 2006)

Predation risk of males and females of the wolf spider *Pardosa milvina* (Araneae: Lycosidae) during courtship and copulation

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Abstract: Courtship and mating may impose substantial predation risk to wolf spiders however the level of risk may differ by sex. The wolf spider, *Pardosa milvina*, modify their courtship and mating behavior in the presence of silk cues from a larger co-occurring predatory wolf spider, *Hogna helluo*. We compared male and female *Pardosa* predation by *Hogna* during courtship interactions or copulation with or without silk cues from *Hogna* (n =21 pairs/treatment). We measured mating success, courtship latency, courtship intensity, and copulation duration in the presence of predator cues and a live predator. We also measured attempted and successful predation by *Hogna* or female *Pardosa* in the presence of predator cues. We found that females have significantly higher predation rates during copulation with predator cues compared to males, however, the other three treatments showed no significant difference in predation between males and females. We also found no significant difference in lunge rates by *Hogna* toward males and females across silk deposition treatments. Female *Pardosa* were significantly more aggressive towards males when there were no predator cues present suggesting females may reduce sexual cannibalism while under predation risk. Mating success was significantly lower with *Hogna* cues and when *Hogna* were released during courtship. Male *Pardosa* delayed courtship in the presence of chemical cues from *Hogna* and male courtship display rates were greatly reduced after *Hogna* introduction. Male *Pardosa* may not suffer greater predation risk from *Hogna* than females because males may already be vigilant to avoid sexual cannibalism during courtship and mating. (posted May 25, 2006)

Verified bites by yellow sac spiders (genus *Cheiracanthium*) in the United States and Australia: Where is the necrosis?

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Abstract: Spiders of the genus *Cheiracanthium* are frequently reported in review articles and medical references to be definitive causes of dermonecrosis or necrotic arachnidism in humans. We provide 20 cases of verified bites by *Cheiracanthium* spiders from the United States and Australia, none with necrosis nor allergy. All bites manifested in minor, self-limiting symptoms that disappeared after a few days. A review of the international literature on 39 verified *Cheiracanthium* bites found only one case of mild necrosis in the European species, *C. punctorium*. The basis for *Cheiracanthium* spiders causing dermonecrosis seems to be mostly inference from venom experiments in rabbits and guinea pigs, circumstantial spider involvement in human skin lesions and repetitive citation of non-definitive reports in the medical literature. This is a repeated pattern in the medical literature where spiders are erroneously incriminated through inference and speculation rather than evidence-based science. Replacing speculation, the current gold standard for the medical effects of spiders is a series of verified spider bites in humans. As difficult as it is to assemble this data, by doing so, medical information regarding several species including *Cheiracanthium* spp., has been shown to be incorrect. Unfortunately, once a spider taxon is christened as having deleterious bites, it is difficult to expunge this misconception from the medical and popular literature. In our paper in the *American Journal of Tropical Medicine and Hygiene*, we discuss factors that lead to the erroneous elevation of virtually-innocuous spiders to that of significant medical concern, a recurring problem in the medical community. (posted April 3, 2006)

Community-acquired methicillin-resistant *Staphylococcus aureus*: a contagious bacterial infection frequently mistaken for spider bites

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Abstract: Community-acquired methicillin-resistant *Staphylococcus aureus* (CA-MRSA) bacterial infection is a recently emerging disease of worldwide concern as bacteria develop resistance to a large suite of antibiotics. CA-MRSA is becoming the single most common medical affliction misdiagnosed as spider bites when the actual etiology of lesions can be determined. It is a condition that is fostered and maintained by poor hygiene in facilities where people are housed in high density for long periods of time such as military barracks, prisons, nursing homes, long-term health care facilities, sports camps, etc. Recent outbreaks of mysterious skin lesions on multiple personnel at several military facilities were initially blamed on spiders. Requests were made for pest inspection and control to remedy the situation. Greater scrutiny of the situation led to a hypothesis that instead of spiders that an infectious outbreak of CA-MRSA should be investigated as the etiology. Subsequent culturing of lesions on personnel at one facility confirmed this bacterial etiology. Officials who deal with facilities housing humans in high density should consider CA-MRSA as a more likely causative agent than spider bites for cutaneous eruptions in which there are multiple lesions on one person or multiple patients with similar lesions. The repeated use of spiders as scapegoats for mysterious skin lesions will continue to result in decreased health care. At the time of abstract submission, the manuscript detailing this research was in press with the journal *Military Medicine*. (posted April 3, 2006)

W, X, Y and Z

Delimiting species boundaries of desert Southwest North American *Loxosceles*

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Abstract: The medically important spider genus *Loxosceles* (the violin or brown spider) is widespread and diverse in North America (see Gertsch and Ennik, 1983). High intraspecific genitalic variation casts doubt on the use of subtle interspecific morphological differences to delimit species. Here we present preliminary results of a study that aims to examine species boundaries and interspecies sexual behavior of closely allied species of *Loxosceles* in North America's desert Southwest. We do this through (1), a distribution analysis determining areas of possible sympatry and hybridization; and (2) single-choice mating trials of potentially sympatric species and pairs of sister species that live allopatrically. Distribution analyses revealed five species groups with possible sympatry: (1) *L. deserta* and *L. russelli* (2) *L. deserta* and *L. palma* (3) *L. deserta* and *L. arizonica* (4) *L. deserta*, *L. sabina* and *L. arizonica* (5) *L. apachea* and *L. blanda*. We observed ten courtships including members of *L. variagata*, *L. apachea*, *L. blanda*, *L. arizonica*, *L. deserta* and *L. sabina*. In total, we identified eleven distinct courtship behaviors. While sample sizes are currently limiting, preliminary observations suggest potential differences among *Loxosceles* species in the sequence, frequency and duration of these behaviors. Mating trials resulted in two cases of interspecific copulation (male *L. apachea*, female *L. blanda* and male *L. arizonica* female *L. sabina*) as well as 5 cases of males courting interspecific females. Future work will increase sample sizes of matings, determine whether interspecific mating result in viable offspring and use genetic analyses to examine the possibility of introgression. (posted May 31, 2006)

Using wavelet analysis to discriminate between smokescreen signals and environmental noise in *Portia* jumping spiders

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Abstract: When using aggressive mimicry to stalk prey spiders in webs, some species of the jumping spider *Portia* use large, brief signals to mask forward motion toward the prey. These signals, which we call smokescreen signals, also appear to mimic waveforms made by falling debris such as twigs and leaves when striking a web. Meanwhile, the prey spiders ignore the advance of *Portia* in the web, enabling *Portia* to capture them. We analyzed the similarities and differences between the waveforms of smokescreen signals and environmental noise, using single-factor fourier transform (FFT) and high-resolution multifactor wavelet analysis. The FFT approach was not able to differentiate between the two types of waveforms, but the wavelet approach was able to detect subtle differences, in excess of 40-50% probability of positive discrimination. The wavelet approach is thus a significant improvement in analyzing biological signals of this type. The differences between *Portia*'s signals and environmental noise imply that prey spider species could evolve the ability to discriminate between the two types of waveform, through selection in an evolutionary arms race. (posted June 8, 2006)

The relative efficacy of pre- and postcopulatory sexual cannibalism in *Hogna helluo* (Araneae, Lycosidae)

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Abstract: Sexual cannibalism, the consumption of a male by a female in the context of mating, occurs in a wide range of spiders. The timing of this behavior, either before or after mating, can have important implications for male and female fitness. The purpose of this study was to test if precopulatory sexual cannibalism occurs more quickly and requires fewer female attacks than postcopulatory sexual cannibalism in the wolf spider *Hogna helluo*. We tested this by randomly pairing males and females in arenas in the laboratory. Using data from all trials in which sexual cannibalism occurred, postcopulatory sexual cannibalism occurred more quickly, required fewer lunges by females and tended to require fewer interactions between males and females. But in some trials, the latency to sexual cannibalism was unrealistically long. Sequentially removing long latencies to cannibalism revealed that differences between the treatments depended on the maximum latency included. To create a more realistic data set, we only analyzed latencies that were less than 180 s (the shortest time for which we had reasonable sample sizes). The more realistic data set revealed the opposite results: precopulatory sexual cannibalism occurred more quickly, required fewer interactions between male and female and tended to require fewer chases by the female than postcopulatory sexual cannibalism. The more realistic results suggest that food-limited, virgin females must decide between not mating and having a better chance of cannibalizing a male or mating and having a poorer chance of cannibalizing a male. (posted May 16, 2006)

The effects of regeneration and food limitation on growth and development time in wolf spiders

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Abstract: Autotomy (self amputation) of appendages in order to avoid predation is common to many spiders. Several species that can autotomize appendages can also later regenerate. However, autotomy and regeneration may lead to functional and energetic costs (i.e. reduced foraging and growth). Because autotomy has the potential to reduce foraging, a spider that is regenerating an appendage may be dealing with increased energetic costs while receiving reduced nutritional input. This may be particularly critical for spiders that are food limited in the field. In this study, the lycosid species *Schizocosa ocreata* was used to address the costs of food limitation and regeneration separately, as well as the interactions between the two factors. Individuals were placed in four treatment groups based on autotomy of a leg and feeding regime: 1) intact/ high feeding, 2) autotomy/high feeding, 3) intact/low feeding, and 4) autotomy/low feeding. Spiders were weighed and their cephalothorax widths were measured post-molt (after regeneration) to determine growth. Additionally the molt intervals in days were noted to determine development time. Regeneration had no effect on mass, but well fed spiders weighed more than deprived spiders. Leg regeneration reduced molt interval, while low feeding conditions prolonged it. Cephalothorax width was largest in the well fed, intact group with no difference between the other three groups. These results demonstrate that impacts of regeneration on growth and development time in this species may be partially determined by level of nutrition. (posted May 10, 2006)

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

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Abstract: Spider silk fulfills many functions including mate attraction. The aim of this study was to determine how male *H. helluo* use silk in their search for a female. In laboratory experiments, well-fed or food-limited females were forced to lay down silk draglines along a track. An adult male was placed in the center of the track. The direction of the male's movement (same or opposite of the female) and the duration of each trial were recorded. In field experiments, two pitfall traps were placed inside a circular metal enclosure. One pitfall was left unmanipulated. The other trap either had a trail of silk draglines leading to it or a female hidden inside or both. Males were released inside the enclosures and left overnight. The presence of a male in either trap was recorded. The laboratory experiments revealed that male *H. helluo* followed the direction in which silk draglines were laid by well-fed females, but not by food-limited females. Field studies showed that males also followed silk draglines and cues into the pitfall traps when no female was present but avoided traps with females. We conclude that male *H. helluo* can detect the direction in which the silk draglines are laid and will follow well fed females. The field experiments verify that males use silk to find females. However since they avoided traps with females and *H. helluo* are known to produce kairomones, airborne cues may lead to avoidance because of the possibility of cannibalism. (posted May 19, 2006)

Sodium channel peptide toxin genomics in the striped scorpion

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Abstract: Scorpion toxin analysis has taken on marked improvements with the advent of the genomics revolution. Venom constituent characterization is rapidly improving with insights into the components that produce toxicity to humans. Among the best characterized are peptide components, and a better grasp of venom peptide evolution and genomics is beginning to emerge as investigations develop better tools for genomic characterization of nucleotides and peptides in scorpion venom. Most of the effort that investigates scorpion venoms involves those species that are toxic to humans. We investigated sodium toxin coding regions in the non-lethal striped scorpion (*Centruroides vittatus*) to determine if any nucleotide changes in these coding regions may correspond to the scorpion's reduced toxicity. This scorpion is a sister species and morphologically similar to the more toxic *Centruroides sculpturatus*. We amplified regions corresponding to the sodium channel toxin peptide with PCR primers developed for *C. sculpturatus*. Our preliminary analysis indicates that homology exists between both scorpion species but several areas in the coding region show variation. We plan to determine if these nucleotide alterations are associated with peptide structural changes that differentially affect sodium channel physiology. (posted May 25, 2006)

Aliens among us: colony identity in a social huntsman spider, *Delena cancerides*

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Abstract: Unlike other social spider species, the social sparassid, *Delena cancerides*, appears to have a colony identity and shows extreme aggression toward non-colony members. Rowell & Avilés (1997) reported juveniles killing alien juveniles and adult females killing alien males. However, Rayor subsequently found that younger juveniles and males were usually accepted into the colony, while penultimate and mature females were killed. To resolve this discrepancy, we systematically introduced a wide age range of juvenile spiders and adults of both sexes into foreign colonies. Colonies were of two types: third generation lab-raised and recently captured. Where colonies had spiders of similar age as the introduced alien, a colony member was removed and reintroduced as a control. We compared contact rates, aggression rates, and nearest neighbor distances between controls and aliens. The roles of colony demographics, colony origin (lab or field), age, and sex of the alien spider on the probability of aggression were investigated. Although colonies reacted differently toward aliens than controls, and aliens experienced more aggression than controls, we nevertheless found aggression, especially killing, to be rare. Aggressive interactions were most likely between adult females, wild females and juveniles, and wild females and males. We discuss possible reasons why wild animals may be more aggressive than lab animals and why we found aggressive behavior against aliens to be less common than originally reported. Our evidence suggests that *D. cancerides* is capable of recognizing non-colony members but may regulate aggression depending on the situational context. (posted May 25, 2006)

Establishing hemolymph biochemistry reference ranges for wild-caught goliath birdeater spiders (*Theraphosa blondi*) and Chilean rose spiders (*Grammostola rosea*)

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Abstract: Giant spiders are increasingly popular species for both private and public captive display. Despite the large numbers of individuals out in captivity, very little is known of or done for their medical care when compared to vertebrate species. We evaluated hemolymph biochemistry analytes of sub-adult, wild-caught goliath birdeater (*Theraphosa blondi*) (n=11) and Chilean rose spiders (*Grammostola rosea*) (n=12) after import and again after two months of captivity. Hemolymph gas analysis was also performed on the second *T. blondi* samples. Our goals were to establish reference ranges for both species for various analytes and assess the clinical health of the study subjects using common in-clinic technology. All of the spiders in the study survived the process of anesthesia and intra-cardiac hemolymph sampling. Significant differences in analyte levels between sampling times for both species were found for weight, osmolality, potassium, and sodium. Significant differences for *T. blondi* were also found for total protein, blood urea nitrogen, creatine kinase, and calcium. Measurement of biochemical analytes allows for an evaluation of the health status of an animal. Poor nutritional state and dehydration were considered a problem in these spiders at presentation, and subsequent correction of these conditions in captivity probably accounts for the differences seen in weight, osmolality, total protein, blood urea nitrogen, and sodium. Further studies are needed to elucidate additional details of clinical spider physiology, as well as species by species differences. (posted May 23, 2006)

Does plasticity in the web building behavior of the western black widow spider, *Latrodectus hesperus*, affect foraging and defense?

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Abstract: Orb-weaving spiders alter their web building behaviors in response to variation in their needs for foraging and defense. However, little is known about spiders that construct three-dimensional (3D) webs, even though these spiders are more abundant and diverse than their two-dimensional orb-weaving ancestors. The black widow spider, *Latrodectus hesperus*, constructs a 3D cobweb that contains a tangled sheet held in place by supporting silk threads and uses sticky gumfooted threads instead of sticky spirals to adhere to prey. Both the size of the sheet and the number of gumfoots may affect foraging success, while the supporting silk threads may enhance defense by surrounding the spider with a barrier of silk. In preliminary experiments, we found that fed *L. hesperus* constructed webs with a greater ratio of support to capture components than did fasted spiders. We hypothesize that webs spun by fasted *L. hesperus* function better at prey capture while those spun by fed spiders function better at defense, due to differences in web architectures. To test the foraging efficacy of the two types of webs, we allowed spiders to forage on crickets for three hours, videotaping them to record both successful and unsuccessful attempts to capture prey. To eliminate spider motivation as a confounding factor, half of the spiders were placed on the webs of the opposite groups. Preliminary results suggest that spiders foraging on webs spun by unfed spiders have increased prey capture success compared to spiders on webs spun by fed spiders, regardless of the past foraging history of the spiders themselves. (posted May 15, 2006)