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A, B and C

Context dependent behavior: Temperature affects courtship in *Schizocosa bilineata* wolf spiders

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Abstract: The purpose of this project is to study the effect of temperature on courtship and mating behavior in the wolf spider *Schizocosa bilineata* (Emerton), a species common in grasslands in many parts of North America, including Ohio. The breeding season is typically in late spring (May/June), when temperature fluctuation can influence daily activity patterns, including when males are able to court females. Wolf spiders, like all spiders, are ectothermic, meaning that their body temperature is similar to the temperature of the surrounding environment. Colder temperatures should mean correspondingly reduced behavioral activity. To find the ideal courting temperature for male *S. bilineata*, males were exposed to female silk and chemical cues across temperatures ranging from 2.5°C to 40°C during the spring 2009 breeding season. In each trial, the male was acclimated to the treatment temperature for at least 5 minutes before being deposited onto a piece of filter paper containing female cues. His behavior was video recorded for 10 minutes for later analysis. We scored each trial for the presence or absence of key behaviors: Courtship (Slow Jerky Walk, Quick Tap, and Incremental Leg Descend) and Chemoexplore. Chemoexplore was exhibited across the widest temperature range (4°C to 40°C). Courtship elements were exhibited in a narrower range (10°C to 40°C), though only 20% and 40% of males responded with courtship at temperatures of 10°C and 15°C respectively. Results suggest that while males can detect and respond to female cues across a wide range of temperatures, courtship is limited to warmer temperatures. (posted May 29, 2009)

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Multisensory learning in a predatory jumping spider

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Abstract: Multimodal signaling and aposematism are two hot topics in current behavioral research. Multimodal signaling has received a lot of attention in intraspecific communication, but recent studies have shown that multimodal signals are also important in other contexts such as learning (Rowe 2005). VanderSal and Hebets (2007) suggested that aposematically colored animals might utilize multimodal signals to enhance avoidance learning in their predators e.g. some prey vibrate when attacked adding another signal modality. An active, invertebrate predator, jumping spiders have the potential to add vast insights into the world of invertebrate learning and multimodal signaling. The current study investigates the impact of additional signal modalities in avoidance learning in the jumping spider *Phidippus audax*. Here, we investigate the learning rate and extinction time (retention of the effects of learning) of *P. audax* to avoid the Milkweed bug, an aposematic insect possessing visual (color) and chemical (distasteful) cues, in the presence and absence of a vibratory stimulus. By modifying the stimuli available to the jumping spider we are able to determine the effects that additional stimuli have on learning in an ecologically relevant way. We place the spider predators in a vibratory chamber with the milkweed bugs and evaluate presence of attack, latency to attack and prey release following capture, and post release behaviors of the spiders. We specifically test the hypothesis that spider predators exposed to distasteful milkweed bugs in the presence of an additional vibration stimulus will learn to avoid the prey the faster and will retain these effects longer than in the absence of vibration. (posted June 10, 2009)

Arthropod diversity in grazed pastures under different management regimes

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Abstract: Conventional cattle grazing regimes allow unrestricted access to forage resources in pastures. Grasses and forbs face intense grazing pressure, and structural heterogeneity and habitat complexity suffer as a result. Arthropod communities comprised of arachnids and insects respond negatively to such perturbations in grazed ecosystems. However, novel management regimes employ systematic short-term, high-density grazing to encourage regeneration of forage species and robust root structure, maintaining habitat availability for arthropods. Ultra-high stocking rates of approximately 60 to 80 cattle per 0.5 hectare elicit a feeding response where plant tissues are grazed to just above the meristems, permitting rapid re-growth of vegetation. During subsequent occupation by chickens, newly deposited fecal material is dispersed to search for arthropods it has attracted. Using suction and hand sampling, arthropods were collected from the non-conventional pasture before and after cow and chicken occupation and also from conventional pastures. Arthropod communities were less diverse before grazing than immediately after cattle and chicken occupation in the non-conventional pasture, and were least diverse in conventional ones. Ants (Hymenoptera: Formicidae) dominated communities in both conventional systems, and evenness of taxa represented was higher in all non-conventional conditions. These results indicate that systematic pasture management may reduce the effects of disturbance on arthropod communities and preserve biodiversity in grazed ecosystems. (posted May 29, 2009)

Darwin's dilemma: natural selection on orb web performance opposes fecundity selection for extreme female gigantism in spiders

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Abstract: Body size evolution is fundamental to the diversification of life. Sexual size dimorphism (SSD) is pervasive throughout the animal kingdom and results from differences in how sexual and fecundity selection operate on males versus females. Female-biased SSD commonly involves fecundity selection while male-biased SSD is driven in large part by competition for mates. Both mechanisms imply strong directional selection driving the evolution of body size, and are well-supported. However, the mechanisms opposing continued change in body size are largely unknown, even though they play an essential role in shaping SSD. Orb spiders present some of the most extreme examples of female-biased SSD in the animal kingdom. In some species, female spiders are up to nine times longer than males. Female gigantism results largely from increases in fecundity, which in turn demands extremely high prey capture. Here, we demonstrate that the evolution of giant female body size decreases orb web function, such that the increased need for food by these giant spiders is accompanied by decreased ability to gain that food. We use both empirical data and a model to show an allometric relationship in how spider body size scales with the stopping power of orb webs and the kinetic energy of preferred prey such that relative web performance declines as female size increases. This decline in web performance occurs despite overall improvements in silk performance and total investment of silk by spiders. Thus, natural selection ultimately places an upper limit on female gigantism and the evolution of SSD in spiders. (posted June 8, 2009)

Spiders of a rural residential lot in central Ohio

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Abstract: Ever since Frank Lutz, former curator at the American Museum of Natural History, penned; *A Lot of Insects: entomology in a suburban garden* back in 1941, various workers have been inspired to compile lists of the arthropods on small plots of land. Lutz found 1,402 species of insects (he did not enumerate arachnids) on 1/3 of an acre lot in suburban New York. In William Peck conducted a survey of an overgrown 2 acre parcel in west central Missouri that contained a small stream, swampy areas, wooded and prairie patches, as well as a house, driveway and lawns. Peck identified over 200 species of spiders representing 22 families from a sample of 2,596 specimens. The current study compiles the results of haphazard collecting over 18 years on a flat 1.3 acre lot among agricultural fields in central Ohio. During the 18 years of this effort the yard has changed from primarily mowed lawn with 4 mature oak trees in the back of the property and three rows of seedling pines along one edge to a well-vegetated rural yard with a mixture of native shrubs, trees and a patch of native prairie plantings. As these changes occurred, the spider fauna diversified. In this study, fewer than 1000 spiders were collected but they represent nearly 150 species from 20 families of spiders. (posted May 29, 2009)

Leg autotomy leads to decreased survival of the wolf spider *Pardosa valens* in the lab and in the field

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Abstract: Leg autotomy is a common occurrence in many wolf spiders. Although probably of immediate benefit to fitness (due to an increased chance of surviving predation), many studies have suggested that autotomy may reduce fitness in the long term. However, few studies have attempted to compare survival of autotomized and intact individuals in the field. In this study, we examined survival rates of intact and autotomized *Pardosa valens*, a riparian wolf spider from the Chiricahua Mountains of southeastern Arizona. In short-term (one week) mark-recapture studies at two streams, survival was lower for autotomized spiders than for intact spiders; this was found separately for males, females, and females carrying egg sacs. In a related lab study using the larger wolf spider *Rabidosia santrita* as a predator, we found that *Pardosa* missing a leg were more susceptible to predation than were *Pardosa* with all legs intact. These results suggest that leg loss leads to a reduction in survival for both sexes, perhaps due to increased predation by the larger *Rabidosia*. (posted June 10, 2009)

Which was here last, the predator or the prospective mate? Discerning the temporal sequence of chemical cue deposition in the wolf spider *Pardosa milvina*, and its predator, *Hogna helluo*

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Abstract: The wolf spider, *Pardosa milvina*, shows adaptive antipredator responses when encountering silk from the larger co-occurring wolf spider, *Hogna helluo*. Male *Pardosa* also initiate courtship when encountering draglines from adult female *Pardosa*. Given the physical structure of silk, it should be possible for *Pardosa* males to determine whether a conspecific female or a predatory *Hogna* was in the area last. Effective antipredator behavior (freezing) and effective courtship (conspicuous leg waving displays toward females) are mutually exclusive. Therefore, if males can determine the temporal sequence of silk deposition, we predict that males should increase mate searching and courtship as well as increase fighting with other males when conspecific females rather than *Hogna* were in the area last. We tested male *Pardosa* temporal discrimination of silk deposition by female conspecifics and predatory *Hogna* by measuring male courtship and fighting under two treatments ($n = 20/\text{treatment}$): 1) virgin female *Pardosa* silk deposition for 24 h followed by a mature *Hogna* for 24 hours, or the inverse, *Hogna* first, followed by a *Pardosa* female. For 40 minutes we allowed two males matched for size, to interact with an unmated female. Males fought significantly more when females were introduced after a predator, suggesting that males can determine the temporal sequence of silk deposition. However, we found no strong evidence that males differed in their courtship behavior between the two treatments. Males may mitigate predation risk by reducing fighting when predation risk is high however increased fighting may also reduce courtship among males. (posted May 29, 2009)

Aphid consumption and behaviors shown by single and paired harvestmen (Opiliones)

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Abstract: Harvestmen (Opiliones) are generalist predators preying on soft-bodied insects such as aphids (Homoptera: Aphididae). Because *Leiobunum nigripes* is an abundant, active, gregarious harvestman able to breed in captivity, they are candidates for Integrated Pest Management schemes. It is unknown how inter-individual interactions may affect their predatory behaviors or prey consumption rates. This study quantified behaviors and feeding rates of *L. nigripes* on aphids during 24-hour trials in the laboratory. One experiment examined behaviors of a single harvestman and how its presence affected aphid numbers, while a second experiment inspected how interactions within pairs of harvestmen influenced their behaviors and aphid consumption. Aphid numbers were recorded before and after exposure to harvestmen on control and experimental eggplant leaves. Harvestman behaviors were observed directly during the first 45-60 minutes of the experimental period. Subsequent activity levels were assessed from video recordings. Single harvestmen consumed more aphids than harvestmen pairs. However, unlike single harvestmen, increased time-on-leaf for paired harvestmen was related to greater aphid consumption. Single harvestmen spent more time exploring during the initial 8 hours than when paired, whereas the paired harvestmen were most active during hours 9-16. Some single harvestmen continuously explored the arena for hours during the initial 8 hours. However, when paired, many would spend these initial hours resting together with legs touching. Thus, the gregarious habits of harvestmen may exert a significant influence on their circadian activity patterns. Since harvestmen will consume both live and dead aphids they are suitable as agents of biological control in greenhouses. (posted May 29, 2009)

Giant whipscorpions prey on chemically defended Florida scrub millipedes

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Abstract: The rare Florida scrub millipede, *Floridobolus penneri* Causey (Spiribolida, Floridobolidae), is confined to xeric, sandy scrub habitats in the southern part of the narrow Lake Wales Ridge in Polk and Highlands Counties, Florida. *Floridobolus* uses a combination of behavioral, mechanical, and chemical means to ward off most predators. However, on several occasions in August–September 2008 I detected giant whipscorpions, *Mastigoproctus giganteus* (Lucas) (Arachnida, Uropygi) feeding on Florida scrub millipedes in bucket-style pitfall traps in the field. Subsequently, in laboratory feeding trials I determined that *M. giganteus* will readily attack, kill, and consume *F. penneri* even if the prey discharges its irritating defensive secretion. This represents only the second known predator of the Florida scrub millipede. (posted May 8, 2009)

The relationship between diet and eggsac production in the wolf spider, *Pardosa milvina* (Araneae, Lycosidae)

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Abstract: Although it seems obvious that diet differences should affect reproduction, few studies of spiders have explored this issue. Recent research conducted largely in Denmark has revealed that spiders are capable of compensating for their nutritional state when feeding and this research has revived interest in spider diet effects. Since spiders are frequently reared on laboratory cultures of fruit flies and/or crickets, we were interested in determining consumption of these prey, separately or combined, influenced egg production in the wolf spider, *Pardosa milvina* (Araneae, Lycosidae). We collected adult females with eggsacs from the field, removed their eggsac and placed them on a mass controlled diet of either crickets (*Achaeta domesticus*), fruit flies (*Drosophila melanogaster*) or both. We then recorded the time it took to produce the next eggsac and recorded the eggsac weight and number of eggs it contained. Although the mass of the spiders at the beginning of the experiment did not differ by treatment, the impact of the initial weight of the spider on the timing and number of eggs produced differed depending on the diet treatment. When the initial mass of the spider was entered as a covariate, there were treatment effects in the time it took to produce an eggsac but spiders fed crickets alone produced smaller eggsacs with fewer eggs than those fed fruit flies or those fed a mixture of the two prey types. These results verify that diet can have complicated effects on reproduction. (posted May 29, 2009)

Vampire spiders: finding a needle in a haystack

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Abstract: *Evarcha culicivora*, a jumping spider from East Africa, specialises at feeding indirectly on vertebrate blood by choosing blood-carrying mosquitoes as preferred prey. Previous studies have shown that this predator can identify its preferred prey by sight alone and also by odour alone. Here we investigate how vision and olfaction work together. Our findings show that, for *E. culicivora*, cross-modality priming in the context of preying on blood-carrying mosquitoes works in two directions. However, we found no evidence of priming in the context of predation on less preferred prey (midges). When the spider's task was, by sight alone, to find a cryptic lure, it found mosquitoes significantly more often when the odour of mosquitoes was present than when this odour was not present. When the spider's task was to find cryptic odour, it found mosquitoes significantly more often after previously seeing mosquitoes than when it had not previously seen mosquitoes. When the spider's task was to find conspicuous lures or odour, the identity of the priming stimulus appeared to be irrelevant. (posted May 26, 2009)

Early instar development in camel spiders (Arachnida, Solifugae)

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Abstract: Several papers by Muma and others documented early instar development in camel spiders (Solifugae). In our labs, we were able to confirm these early observations. Although egg deposition was not observed, we obtained data on duration of egg stage; hatch success; and behavior of the second, third, and fourth instar nymphs. First instar nymphs are largely immobile. Clustering behavior was evident for first and second instar nymphs. Second instar nymphs are mobile and can hunt. Our observations suggest that cannibalism is high by the third nymphal instar. (received June 3, 2009; posted June 14, 2009)

D, E and F

Spiders of coastal mangrove habitats in Panama: Survey and development of sampling protocol

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Abstract: Coastal mangrove ecosystems are ecologically and economically important yet threatened throughout the world by development and pollution. These tropical ecosystems with low plant diversity and harsh abiotic conditions produce a low-diversity spider assemblage that has been little studied. Using a Rapid Assessment Protocol we developed for obtaining replicable and comparable samples of mangrove arachnids, we sampled three red mangrove sites during wet (September-October) and dry (January) seasons at Bocas del Toro, Panama, and two red mangrove sites at Galeta Field Station near Colón and one white mangrove site further inland at each region, all during wet season.

55.5 person-hours of sampling yielded 256 adult spiders (4.6 specimens/h) belonging to 47 species in 9 families. The most abundantly collected species (*Messua* cf. *dentigera*, *Chryso albomaculata*, and *Eustala* sp.) belonged to Salticidae (16 species, or 34%), Theridiidae (10, or 21%), and Araneidae (8, or 17%), as well as Anyphaenidae (*Anyphaena* sp. and *Wulfilia* sp.) and Tetragnathidae (*Plesiometa* sp.). Over 25% of all adults from the red mangrove samples were *Messua* cf. *dentigera* (Salticidae), which was exclusively collected in red mangrove. 52% of non-singleton species were common to both habitats. Boat and climbing/wading collection methods yielded similar numbers of adult specimens, but the climb-wade method yielded significantly more species per site (6.5 vs. 3.9; paired T-test, $P = 0.019$). However, only 50% of non-singleton species were common to both methods, so incorporating both methods may increase survey thoroughness. (posted Jun 1, 2009; corrected June 23, 2009)

Predatory agrobiont arthropod behavior and interactions as influenced by a glyphosate-based herbicide

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Abstract: In agroecosystems, arthropod predators are exposed to chemical cues from other arthropods and anthropogenic chemicals such as glyphosate-based herbicides (e.g. Round-Up®). These herbicides may have sub-lethal effects on arthropods that respond behaviorally to chemical cues. Our aim was to 1) isolate the effects of a glyphosate-based herbicide on the activity of three intraguild arthropod predators, and 2) assess the effects of this herbicide on the behavioral response of one arthropod predator to the cues of the two other predators within its guild. First, we exposed the wolf spider *Pardosa milvina* (Araneae: Lycosidae) to the herbicide Buccaneer Plus® via two pathways, topical and residual. We exposed another spider, *Hogna helluo* (Araneae: Lycosidae), and a beetle species, *Scarites quadriceps* (Coleoptera: Carabidae), to this herbicide via a compound (topical plus residual) pathway. We used an automated tracking system (Videomex-V) to quantify locomotion and associated behaviors. *Pardosa* spent less time in forward movement and traveled significantly shorter distances under both topical and residual exposure to herbicide. However, both *Hogna* and *Scarites* increased non-forward activity under herbicide exposure. Next, we tested the effects of exposure to herbicide and chemical cues from *Hogna* and *Scarites* on the activity, emigration, and survival of *Pardosa* using full-factorial laboratory experiments. Both predator cues and herbicide led to a decrease in movement by *Pardosa*. However, although *Hogna* cues alone decreased movement, *Scarites* cues only decreased movement when combined with herbicide. Glyphosate-based herbicides may affect arthropod predator interactions, thus altering their effectiveness as biocontrol agents. (posted May 26, 2009)

Hunger state affects female mate choice and aggression in wolf spiders: results of video playback studies

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Abstract: In many animals, elaborate male traits and courtship behaviors play a role in species recognition and female assessment of mate quality. However, in species with potential sexual cannibalism, (e.g., spiders), active courtship may make the male subject to female aggression. Research conducted on the wolf spider *Schizocosa ocreata* examined relationship(s) between female hunger state, courtship behavior and receptivity. Females of varying diet treatments (long- and short-term starvation vs. satiation) were given a choice between video playbacks of males with different behaviors (one male courting; one walking) in simultaneous exposure trails. Results indicate that feeding history and current hunger state may affect female mate choice and levels of female aggression differently, and depend on the behavior of the male. Thus, when confronted with simultaneous choices, female mate choice may be affected by feeding history as well as male quality. (received May 29, 2009)

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G, H and I

Going out for dinner and taking a new way home: videotaping the scorpion's evening walk

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Abstract: Sand scorpions make burrows from which they emerge at night to seek mates and prey. Previous ecological studies have documented scorpion activities on the sand surface. Few studies, however, have videotaped scorpion movements in the context of understanding their sensory neurobiology. Our overall objective is to understand which signals guide scorpions as they emerge from and return to their burrows. Candidate stimuli include chemical trails, footsteps, celestial patterns, geomagnetic cues, humidity and/or temperature gradients, distinctive scents from the burrow, seismic echolocation, memory, or landmark orientation. As an initial step toward answering this question, we videotaped scorpions to learn whether they return to their burrows by the same path they use as they exit, or whether they use a different route. The answer to this question could help eliminate some of the candidate stimuli from consideration. We used pole-mounted infrared surveillance cameras wirelessly connected to a DVD recorder to monitor and record the movements of two female sand scorpions (*Paruroctonus utahensis*) near Monahans, Texas in March 2009. Two-hour recording blocks on two consecutive nights revealed that the animals spent most of their time at the thresholds of their burrows, emerging briefly after an arthropod walked by. In each case, the scorpions took a looping path that did not retrace the route by which they exited their burrows. The videos and other unrecorded observations suggest that these scorpions may not spend much time on the sand surface; instead, they may wait in their burrows and ambush prey that happens to wander nearby. (posted May 24, 2009)

Do southwestern *Agelenopsis* species differ in their vibratory courtship signals?

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Abstract: Courtship often plays an important role in reproductive isolation between closely related, sympatric species. Male *Agelenopsis* funnel-web spiders typically produce a long sequence of vibratory signals on the female's web prior to mating, and many species have overlapping ranges. This study aimed to determine whether or not courtship differed between these species, and thus might be important in species recognition. To answer this question for a group of southwestern *Agelenopsis* species, courtships were observed in the lab, and the behavioral sequences exhibited were recorded. For a subset of courtships, vibratory signals were also recorded from the webs using a Laser Doppler Vibrometer, and the characteristics of the most common vibratory signals were quantified. Three species were found to use the same behavior patterns, while one species' signals were unique. The timing of these behavior patterns as well as the amplitude and frequency characteristics of the resultant web vibrations will be compared and discussed. (posted May 29, 2009, revised June 8, 2009)

Noise influences mating communication of the wolf spider *Schizocosa ocreata*

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Abstract: Communication involves sending and receiving signals that must stand out from background noise of the environment. Under some conditions, the background environment may include noise that interferes with the signals, ultimately jeopardizing the message. The courtship displays of male *Schizocosa ocreata* (Hentz) wolf spiders are multimodal, consisting of visual signals (leg tapping, waving and arching) as well as seismic signals (stridulation, percussion). Airborne noise from various environmental sources (wind, bird calls, cicada choruses, anthropogenic sources) would be translated to substrate noise in leaf litter and likely interfere with seismic courtship signals. The goal of this study was to identify whether environmental noise affects courtship communication of *S. ocreata*, and subsequently influences mating success. To test this, we paired males and females in a 15cm arena with a filter paper bottom and let males court either with no noise, or white noise at 10dB, 20dB, or 30dB above background levels (~60dB). We found that increasing noise levels reduces the number of successful matings by as much as 20%. In addition, raising noise levels increases the latency for mating to occur, although it does not influence when males begin courting females. This is one of very few studies to identify spider responses to background noise. In addition, this study indicates that males able to successfully communicate their message in the presence of noise will reproduce more often than those that cannot, suggesting that noisy environments might impose selection for alternative courtship tactics. (posted May 28, 2009)

Determining the dynamics of the edge relationships in the *Aphonopelma hentzi* complex and its neighbors along the Colorado River Basin

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Abstract: Theraphosids, commonly known as "tarantulas", are a group of large, hirsute spiders that have drawn relatively little interest in ecological, behavioral, or evolutionary research from biologists. The lack of research on theraphosids is problematic because of conservation concerns for this group and the need to compile good life history data, and determine taxonomic and phylogenetic relationships. We examined the phylogenetic relationships among populations of tarantulas of the genus *Aphonopelma* along the Colorado River basin in Texas to construct a framework within which to test ecological, evolutionary, and biogeographical hypotheses in an area of species transition and possible Pleistocene refugium.

We sequenced 890 bp from two mitochondrial genes, *16S* and *ND1*, and their corresponding *tRNA* from 135 individuals, in order to examine relationships among populations of *A. hentzi* tarantulas and populations of neighboring species. Ecological niche modeling was used to determine potential species distributions, both current and 21,000 ypb during the last glacial maximum of the Pleistocene.

Phylogenetic analysis suggests that there may be as many as eight species in the study area, seven south of the Colorado River and one (*A. hentzi*) to the north. The species found in the study include *A. hentzi*, *A. anax*, *A. armada*, *A. moderatum* and four potentially undescribed species (based on genetic distances). Population expansion analysis shows that the northern clade of *A. hentzi* (the Colorado River basin and north) split from the southern clade between 20,000-13,000 ypb, agreeing

with the biogeographical hypothesis that the Colorado River basin was an area Pleistocene refugium. (posted May 27, 2009)

Biodiversity and biological control: are they compatible?

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Abstract: Agricultural diversification, and concurrent increases in acreage planted to low-input and organic farming, has produced a diverse environment that is purported to enhance the ecosystem services provided by the community of natural enemies. This promotion of biodiversity that translates to improved levels of pest suppression is facilitated by the fact that generalist predators, such as spiders, often co-exist through mechanisms of niche partitioning in space and time. Impacting pests at multiple strata within the crop therefore provides levels of regulation above that typically observed by individual species acting alone. However, certain spiders require a diverse diet to maintain normal growth and reproduction. Thus, as planned within-field biodiversity is promoted through habitat manipulation, the glut of alternative prey available to spiders have the potential to disrupt pest suppression through simple substitution or switching, as favored food items become readily available. Non-manipulative molecular techniques, in combination with laboratory experimentation and field surveys, were used in order to reveal pathways of trophic interactions in a complex agricultural food web, delineate trophic connectivity and measure the intensity of specific predator-prey interactions. Although enhanced levels of prey diversity supported increased growth and development of linyphiid spiders, responses to this diversity in the field suggests that despite responses being species-specific, pest consumption was typically reduced in prey-rich habitats. This data indicates that while population growth is enhanced through provision of supplemental food resources, pest suppression by predators may be reduced unless recruitment of natural enemies to the habitat counteracts the per-predator reduction in pest consumption. (posted May 13, 2009, modified June 1, 2009)

The affect of microgravity on hub placement in *Metepeira* (Araneae, Araneidae) spider's web

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Abstract: In November 2008, the space shuttle endeavor was launched with spiders in the payload bay. The purpose of the "Spider in Space experiment" was to determine how well a *Metepeira* spider could spin its web in space. One spider was placed in space while a control spider was placed in our classroom. We noted the differences between 9 total webs made between November 20th and December 5th, 2008. The Earth spider took several days to build a web. Even then this spider did not build a full web until it was removed from the classroom for an extended period of time. I measured the differences in hub placement between the earth webs and the space webs. The average hub placement of the Earth web was 2 cm. above the midpoint. The hub is usually placed in the upper hemisphere, so this was a typical web. During the first two days, the space spider created a matrix of messy silk. It was hard to determine where the hub was located. Then on the twentieth of November, the space spider built a measurable web. The hub on this web was 3 cm. below the midpoint of the web. Most of the hubs of the space spider were in the lower hemisphere and they were closer to the midpoint of the web than the Earth spider's hub was. Microgravity appears to play a role in the positioning of the hub in *Metepeira*. (posted May 26, 2009)

Evaluating the efficacy of continuous quantitative characters for reconstructing the phylogeny of *Antrodiaetus* (Araneae, Mygalomorphae, Antrodiaetidae)

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Abstract: The use of continuous quantitative characters for phylogenetic analyses has long been contentious in the systematics literature. Recent studies argue for and against their use, but there has been no attempt to evaluate whether these characters provide an "accurate" estimate of phylogeny, despite the fact that a number of methods have been developed to analyze these types of data for phylogenetic inference. A tree topology will be produced for a given methodology and set of characters, but little can be concluded with regards to the accuracy of phylogenetic signal without an independent evaluation of those characters. We assess the performance of continuous quantitative characters for the mygalomorph spider genus *Antrodiaetus*, a group that is morphologically homogeneous and one for which few discrete (morphological) characters have been observed. Phylogenetic signal contained in continuous quantitative characters is compared to an independently derived phylogeny inferred on the basis of multiple nuclear and mitochondrial gene loci. Tree topology randomizations, regression techniques, and topological tests all demonstrate that continuous quantitative characters in *Antrodiaetus* conflict with the phylogenetic signal contained in the gene trees. Our results indicate that the use of continuous quantitative characters for phylogenetic reconstruction may be inappropriate for reconstructing *Antrodiaetus* phylogeny and indicate that due caution should be exercised before employing this character type in the absence of other independently derived sources of characters. (posted May 8, 2009)

Spiders as ecological indicators: the effect of forest management practices on spider diversity

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Abstract: Spiders are sensitive to relatively small changes in habitat structure and as such respond to natural and anthropogenic disturbance. Several studies have documented that spider abundance and diversity are strongly influenced by forest management practices. The goal of this study was to use spider species diversity as a measure of the effects of two forest regeneration practices (planted vs. natural regeneration) in northwest Louisiana. We used standard sampling protocols for spider and habitat data collection at Bayou Pierre Wildlife Management Area (Desoto Parish) from October 2007 through February 2009. We used the free software EstimateS to calculate species diversity and species accumulation curves. Combining all four plots we estimate at least 150 species occur at Bayou Pierre WMA. We expected to find similar spider diversity within management practices. Instead, we found higher species diversity indices in one planted and one naturally regenerated plot. These two plots had more complex understory vegetation than the two plots with lower diversity measures. The two high diversity plots are adjacent to one another. Therefore we suggest that the differences in spider diversity may be more related to geographic proximity and habitat structure rather than to management history. (posted May 29, 2009)

Male courtship repeatability and potential indirect genetic benefits in a wolf spider

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Abstract: Indirect benefits derived by females who mate with males exhibiting preferred traits are important to our understanding of "good genes" models of sexual selection. However, few studies have explored male courtship behaviors with potential indirect benefits conferred to females in order to ascertain whether these behaviors serve as honest indicators of male quality. Using a common species of wolf spider, *Pardosa milvina*, we addressed the honesty of male courtship behaviors in two laboratory experiments. In our first experiment, we quantified the repeatability of courtship rate in adult males that were manipulated to be in high or low condition and were sequentially presented with adult, virgin females that similarly differed in body condition. In our second experiment, we explored the effect of male courtship rate on several measures of fitness: number of offspring produced, days until offspring emerged, and offspring viability measured as offspring survival. Our experiments show that male courtship rate is statistically significantly repeatable except when males in high condition have repeated encounters with females in low condition. Our results also reveal that females have the potential to gain indirect genetic benefits by mating with males that naturally court at high rates: females produced more offspring that emerged from egg sacs sooner and survived starvation better compared to females that mated with males that naturally courted at low rates. Our study provides additional support that male courtship rate is an honest indicator of quality, and it makes the novel finding that the repeatability of courtship rate is context-sensitive. (posted May 8, 2009)

J, K and L

A window into perception: Species differences in eye tube movements in salticids (*Phidippus audax* and *Portia fimbriata*)

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Abstract: We present the first results from an eyetracking device designed to view retinal movements in salticid eyes. The salticid principal eye is tube shaped, with a fixed lens on the surface of the cephalothorax and a retina, boomerang-shaped in cross section, at the internal end. The retinas are densely packed with photoreceptors and thus allow impressive spatial acuity, but each retina is small and covers only a narrow angle of view. However, each eye tube can be moved by muscles and thus the retina can be moved over the image projected by the lens even when the spider's body is stationary. Using an eyetracker built by Harland and based on a salticid-specific ophthalmoscope similar to that of Land, we recorded retinal movements of two jumping spider species (*Phidippus audax* and *Portia fimbriata*) as they watched an animation of an 'X'. These species have striking differences in hunting behavior: *Phidippus* attacks moving stimuli very soon after orienting to them, whereas *Portia* readily attacks stationary objects after a much longer period of orientation. In both species, retinas were sometimes far apart but sometimes brought together and directed at the same area of the screen. Both species moved their eye tubes nearly constantly when the 'X' was moving. When the 'X' was stationary, *Portia* eyes moved almost constantly while *Phidippus* eyes were usually still. We will also discuss how well each species tracked the moving 'X', currently under analysis. We suggest how our findings relate to the hunting behavior of these species. (posted May 28, 2009)

Possible frequency-dependent selection on behavioral phenotypes in *Anelosimus studiosus* (Araneae: Theridiidae)

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Abstract: The cooperative spider *Anelosimus studiosus* exhibits two colony types: solitary webs of a single mother and her offspring, and social colonies consisting of multiple adult females and their offspring. Data suggest that there are heritable behavioral phenotypes in these populations (solitary/aggressive or social/tolerant), and that social colonies consist mainly of social individuals. Theory and empirical studies indicate that individuals in smaller social colonies have the highest fitness, and those in large colonies have lower fitness than solitaries. With no evidence to suggest that these spiders adjust colony size, we speculate that colony size is an emergent property of non-dispersing social individuals. We hypothesize that such conditions would lead to negative frequency-dependent selection. When the proportion of social individuals is low, colonies will be relatively small and have higher fitness than solitary colonies, resulting in an increased proportion of social individuals. Conversely, when the proportion of social individuals is high, colonies will grow large and solitary individuals will have higher relative fitness. We developed an agent-based simulation model to explore this hypothesis, and used empirically collected data to inform parameters. Results from simulation runs consistently showed that the proportion of social individuals in the population increased initially, but did not become fixed. Furthermore, there is indication of cycling in mean colony size in the population over generations. These results may explain why in habitats where social colonies have been shown to have an advantage, there is always a mix of social and solitary colonies. (posted May 28, 2009)

Tip-recordings of scorpion pecten chemosensory neurons in response to biological stimulants

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Abstract: All scorpions have pectines, which are ventral appendages that possess thousands of chemosensory peg sensilla on their ground-facing surfaces. The dense fields of sensilla appear uniform; that is, each sensillum has a similar morphology. But do all sensilla respond in the same way to the same stimuli? In this study, we used a new method of electrophysiological recording and stimulation to test the "Information Enhancement Hypothesis". This hypothesis suggests that peg sensilla possess functionally identical sets of chemosensory neurons, and that imprecise information from multiple sensilla is added to provide useful information about stimulant concentration, location, or identity. We flooded the pectines of a live scorpion (*Paruroctonus utahensis*) with mineral oil to create a medium for delivering a variety of water-soluble tastants. We simultaneously recorded and stimulated neurons by touching a sensillar pore with the tip of a glass pipette filled with a salt, sugar, or acid solution; the pipette also contained an electrolyte and a microelectrode to transmit electrical activity. Our study is the first report of successful tip-recordings of neurons in scorpion peg sensilla. Also, this new method allows for faster peg sampling than previous methods because we used the same micropipette for both recording and stimulating. Sampled pegs responded similarly to each stimulus, although each chemical provoked a unique response pattern. For example, sensillar responses to 0.1 M citric acid were different from responses to 0.1 M sucrose. Taken together, our results support the Information Enhancement Hypothesis. (posted May 22, 2009)

M, N and O

The effects of prey availability and scorpion size on the foraging behavior of the scorpion, *Centruroides vittatus*

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Abstract: The scorpion, *Centruroides vittatus*, forages in blackbrush, *Acacia rigidula*, for caterpillars (Lepidoptera). How does the availability of caterpillars on blackbrush affect the foraging behavior of *C. vittatus*? How does the size of the scorpion influence the foraging behavior of *C. vittatus*? The availability of caterpillars on blackbrush was sampled with a beating sheet from May 20, 2004 to May 12, 2005 and from September 12, 2006 to August 20, 2007 on the campus of Texas A&M International University in Laredo, Texas. Data collected on scorpions included scorpion size, microhabitat use, and prey capture (number and taxa). Scorpion size classes were estimated in the field. The classes were class I (< 5 mm), class II (5-10 mm), class III (10-15 mm) and class IV (> 15 mm). The probability of a scorpion feeding on a caterpillar (and in particular size classes III and IV) was significantly higher with an increase in the average number of caterpillars per sample per night. However, the probability of a scorpion on blackbrush did not change significantly with an increase in caterpillar numbers. While all size classes used blackbrush, the proportion of the size class IV was higher when caterpillar availability was higher. The larger scorpions did change foraging behavior in response to caterpillar availability by foraging more in blackbrush, but the smaller size classes did not shift to blackbrush. This suggests that smaller scorpions avoid large scorpions, and this interferes with foraging for caterpillars in blackbrush by smaller scorpions. (posted May 26, 2009)

Cuticular substructure for dragline silk production in the spider *Nephila clavata*

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Abstract: As the liquid feedstock passes through the long duct (exceed 30 mm in length) of the major ampullate gland of the orb-web spider *Nephila clavata*, the polymerized dragline silk fibers are finally produced at the end of its spinning nozzle via the cuticular substructures including the cavities and rifling grooves. Fine structural investigation using the electron microscopy reveals the highly effective cuticular substructures for dragline silk production in detail. We could observe numerous cuticular cavities scattered on the basal surface of the duct along with the middle part of the third limb. The flask-shaped cells of the epithelium extend to the exocuticle of the duct through these cavities. In addition, we could find additional substructure of the cuticular grooves on the apical surface of the third limb cuticle which distributed with the spiral pattern of the rifling. Accordingly, the major procedure for the conversion of the liquid feedstocks into insoluble dragline silk seems to be accomplished at the third limb near the valve, and both of cuticular cavities and rifling grooves seem to contribute to facilitate the rapid conversion of the liquid feedstocks into an insoluble silk strand. (posted May 22, 2009)

Silk Spinning Apparatuses in the Cribellate Spider *Nurscia albofasciata* (Araneae: Titanoecidae)

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Abstract: The fine structural characteristics of the silk spinning apparatus in the titanoecid spiders *Nurscia albofasciata* have been examined by the field emission scanning electron microscopy (FESEM). This titanoecid spiders have a pair of medially divided cribella just in front of the anterior spinnerets, and the surface of the cribellum is covered by hundred of tiny spigots which producing numerous cribellate silk fibrils. The cribellar silks are produced from the spigots of the sieve-like prate, and considered as a quite different sort of catching silk with dry-adhesive properties. The other types of the silk spigots were identified as follows: ampullate, pyriform and aciniform glands. Two pairs of major ampullate glands send secretory ductules to the anterior spinnerets, and another 1-2 pairs of minor ampullate glands supply the middle spinnerets. In addition, the pyriform glands send ductules to the anterior spinnerets, and two kinds of the aciniform spigots feed silk into the middle (A type) and the posterior spinnerets (both of A & B types), respectively. (posted May 22, 2009)

Female condition alters preference for male traits in the wolf spider *Schizocosa ocreata* (Hentz)

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Abstract: Condition dependent mate choice has been observed in a number of animal taxa, and recent research shows that female spiders may alter their selectivity when affected by nutritional stress. Moreover, spider courtship may involve various sensory modalities, and interactions between these modalities and hunger state may influence mate assessment and the decision making process. This research examined the role of male phenotype (male secondary characteristics and body size) on condition dependent mate choice by female *Schizocosa ocreata* (Hentz). We reared females under three different feeding regimes and examined their responses to controlled male visual stimuli (video playback) in a cue isolation study. Spiders were raised from hatchlings reared on one of three controlled diets: well-fed, long-term starvation or short-term starvation. Females were exposed to playback of courting males representing the upper and lower 95% CI for body size and tuft size for their population. Females were scored for receptivity and aggressive behaviors, and results indicate a complex tradeoff between female feeding history and male phenotype. Female feeding treatment significantly affected receptivity, and varied with male phenotype. Larger males with larger tufts received more receptivity in the first week post-maturity, while smaller males received aggressive responses. However, in later stages of female maturity (3 weeks), the pattern changed to reveal a preference shift – higher aggression toward larger males, and increased receptivity toward smaller males with smaller traits. These results demonstrate the complexity of mate choice in wolf spiders, and the role of female feeding history in sexual selection for male traits. (posted May 29, 2009)

Effects of diet quality on aggression and territoriality in the cellar spider, *Pholcus phalangioides*

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Abstract: Resource-holding potential studies have shown that the availability of food influences territorial behaviors; however, little is known about food quality effects on territorial behaviors. Additionally, most studies have focused on competition between males, leaving a void in knowledge about the nature of female contests. Using a cellar spider, *Pholcus phalangioides* (Araneae, Pholcidae), we investigated the influence of diet quality on aggressive interactions in both male-male and female-female contests. Individuals were separated into low-quality and high-quality feeding regimes. Low-quality individuals were fed *Drosophila melanogaster* raised on standard fruit fly medium, while high-quality individuals were fed *D. melanogaster* raised on standard fruit fly medium supplemented with dog food. Spiders of the same sex were arranged such that an "intruder" invaded the web of a "resident" that had been maintained on a similar or contrasting diet. Multivariate analyses revealed a fundamental difference between male and female contests. Specifically females displayed a leg-biting behavior, which was not seen in male contests, and males displayed more grappling behaviors. In female contests, residents were more likely to win overall but intruder success occurred most often when the resident had experienced a low-quality diet. In male contests, there was an interaction between the diet of the resident and the diet of the intruder to determine who won the contest. Intruders were most likely to win when both spiders had been on low quality diets. These diet manipulations clearly caused spiders to perceive their territory differently and did not simply cause a shift in aggressiveness. (posted May 28, 2009)

Are you feeding me a line? Do silk draglines convey honest information about male and female quality in the wolf spider *Pardosa milvina*?

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Abstract: Female *Pardosa milvina* wolf spiders attract prospective mates through silk draglines. Males respond to female silk with conspicuous courtship displays. Males also produce silk draglines yet the role of male silk in courtship remains unclear. If silk is costly for females and males, then it may convey information about the quality or motivational state of a prospective mate. Previously mated females and/or females in poor body condition should produce less silk than virgin females in good condition. Similarly, if male silk serves a courtship function and if males are selective, then they should deposit more silk in the presence of good condition virgin females relative to poor condition mated females. Poor condition males should also produce less silk than good condition males. We measured silk deposition of good and poor conditioned virgin and mated females and also measured silk deposition and courtship intensity of poor or good condition males in response to female cues. Mated females in poor condition deposited the least silk while good condition virgins produced the most. Males courted virgin females in good condition significantly more intensely than mated or poor conditioned females and deposited significantly more silk when encountering silk from a virgin female in good condition. Male body condition had little effect on male courtship intensity but males in poor condition produced significantly less silk than good condition males. Silk deposition is condition dependent for both male and female wolf spiders and could serve as an honest indicator of mate quality for both sexes. (posted May 29, 2009)

The adhesive delivery system of viscous capture threads spun by orb-weaving spiders

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Abstract: The sticky viscous capture threads in araneoid orb-webs are responsible for retaining insects that strike these webs. We used features of 16 species' threads and the stickiness that they expressed on contact plates of four widths to model their adhesive delivery systems. Our results confirm that droplets at the edges of thread contact contribute the greatest adhesion, with each successively interior droplet contributing only 0.70 as much adhesion. Thus, regardless of the size and spacing of a thread's large primary droplets, little adhesion accrues beyond a span of 20 droplets. From this pattern we computed effective droplet numbers (EDN), indices that describe the total droplet equivalents that contribute to the stickiness of thread spans. EDN makes the greatest positive contribution to thread stickiness, followed by an index of the shape and size of primary droplets, and the volume of small secondary droplets. The proportion of water in droplets makes the single greatest negative contribution to thread stickiness, followed by a thread's extensibility, and the area of flattened droplets. Although highly significant, this six-variable model failed to convincingly describe the stickiness of six species, a problem resolved when species are assigned to three groups and a separate model is constructed for each. These models place different weights on the variables and, in some cases, reverse or exclude the contribution of a variable. Differences in threads may adapt them to particular habitats, web architectures, or prey types or they may be shaped by a species' phylogeny or the metabolic capabilities. (posted Jun 1, 2009)

P, Q and R

Pollen interception by linyphiid spiders: effect of anthesis on dietary supplementation and prey availability

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Abstract: Dietary diversification, including consumption of plant tissues such as pollen, can enhance the fecundity of generalist predators, resulting in improved control of pest prey. Supplemental pollen feeding has been observed in many natural enemies, including spiders. Linyphiidae represent a major component of ecological food webs in many agroecosystems. Their horizontal, ground-level webs also have the potential to intercept pollen grains during anthesis of crop plants, providing the opportunity for pollenivory to occur. Furthermore, in transgenic *Bacillus thuringiensis* corn, insecticidal proteins are expressed in the pollen, posing a risk of exposure to non-target arthropods. To measure pollen and prey interception in simulated linyphiid webs, a 20x20m grid of 36 miniature sticky traps was established within and downwind of a corn agroecosystem. Traps were exposed for 24 hours, collected, and replaced with additional traps for 28 consecutive days in July and August 2008, to encompass periods before, during and after anthesis. Over 150,000 corn pollen grains and 5,000 prey items (dominated by Collembola and Hemiptera) were intercepted at simulated web-sites. Dates of peak anthesis resulted in pollen counts as high as 2,000-4,000 grains per web-site in the interior of the cornfield. SADIE (Spatial Analysis by Distance IndicEs) indicated highly significant temporal and spatial variability in pollen interception within and outside the corn field. These results revealed the potential for dietary supplementation with pollen in ground-based sheet-web weaving spiders indicating that pollenivory may be an important component of the feeding biology of linyphiids, as well as risk-assessment of genetically modified crops. (posted May 27, 2009)

Preference for silk cues in male and female *Schizocosa ocreata* (Hentz) wolf spiders

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Abstract: Many ground-dwelling spiders are able to detect and use chemical cues present in the draglines of conspecifics to locate potential mates. Previous studies have shown that chemical cues associated with female silk elicit a courtship response from males of the wolf spider *Schizocosa ocreata* (Hentz). However, there is little information on other chemical signals in males and females of this well-studied species. This study examines preferences of both male and female *S. ocreata* for conspecific silk from members of the same or opposite sex. By using a two-chambered apparatus we examined the number of visits and amount of time spent in a stimulus chamber containing either female silk, male silk, or no silk. We found that both male and female *S. ocreata* spent significantly more time on female silk than a control (stimulus chamber containing no silk). Neither male nor female *S. ocreata* spent significantly more time in chambers containing conspecific male silk than they did in control chambers. We also found that males and females make significantly fewer but longer visits to chambers with preferred silk type, and more frequent but shorter visits to non-preferred silk chambers. Because female silk is known to elicit male courtship and males use female silk to locate potential mates, it is not surprising that the amount of time spent by males in a chamber containing female silk was greater. However, female attraction to female silk has not previously been observed, and merits further research. (posted May 27, 2009)

Measuring the aerobic cost of behaviors in spiders: the pitfalls associated with the use of the rate of carbon dioxide production and other cautionary tales

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Abstract: Recently there has been interest in measuring the metabolic cost of signals that seem to be especially costly energetically in order to test important theories of sexual selection and the evolution of signalling. Systems that measure aerobic metabolism using CO₂ production are popular because they work with small animals such as arachnids and because of the commercial availability of systems that are marketed for their ease of use.

However, it has been known for nearly a century that CO₂ release is the sum of what is being produced by metabolism and its release from (or sequestration to) large capacity stores in body fluids. Release and sequestration are largely governed by changes in pH, which in turn is affected by the production or removal of lactic acid. Spiders and at least one scorpion rely heavily on anaerobic metabolism during intense movement and as a result, any measurement of aerobic metabolism, especially the rate of CO₂ production, may not accurately estimate the metabolic power of intense activity.

We will present data showing that as little as 10s. of intense activity by a lycosid will result in values of CO₂ production that are anomalously high. We will illustrate some of the problems with using CO₂ by making comparisons with insects that engage in costly signalling but that do so entirely through aerobic metabolism. We will also discuss how rates of CO₂ production might be used as rough estimates of the power associated with activity. After the meeting, a detailed resource will be available at the first author's website: <http://www.holycross.edu/departments/biology/website/biofaculty/bear.html> (posted June 10, 2009)

Neurochemical underpinnings of behavior and social structure in the cooperative spider, *Anelosimus studiosus* (Araneae: Theridiidae)

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Abstract: Populations of the cooperative spider *Anelosimus studiosus* in east Tennessee exhibit both social and solitary colonies, and individual spiders can be classified into social/tolerant or solitary/aggressive phenotypes. The striking differences lead to questions regarding the physiological differences which may underlie aggression and social behavior in these spiders. Octopamine is a neurochemical commonly thought of as the invertebrate counterpart of norepinephrine. It acts as a neurotransmitter, neuromodulator, and neurohormone. Previous studies have found that octopamine increases aggression in several invertebrate species. We hypothesize that the behavioral differences in *A. studiosus* are correlated with octopamine levels. Using HPLC-ECD (High Pressure Liquid Chromatography - Electrochemical Detection), we have quantified levels of octopamine in whole-spider extractions. Among spiders collected from social and solitary colonies from two different populations, we detected relatively higher levels of octopamine in the solitary spiders. (posted May 29, 2009)

The cost of being an oversexed wolf spider: Males that court and copulate longer die young

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Abstract: The evolution of life history strategies and mating systems are often influenced by the survival costs of reproductive effort. Males of many species frequently suffer high mortality due to elevated predation risk since mate-seeking and conspicuous courtship displays may attract predators. Courtship and copulation may also be energetically expensive. These metabolic costs may contribute to increased mortality separate from predation risk. We sequentially paired individual adult males of the wolf spider, *Pardosa milvina*, with ten randomly selected virgin females over a sixteen hour period (n = 26). We also retained a second control set of males that were not exposed to females (n = 29). During male-female pairings we measured total courtship and copulatory intensity, courtship and copulation duration, and mating success of males. We then measured the relationship between adult mortality and male reproductive effort and compared mortality among males exposed to females and those that were not. We found no significant mortality effect between control males and those that were paired with ten females. However, among males paired with females, males that mated four or more times survived significantly fewer days after their final molt than males with fewer matings. Males that courted and mated longer also died before males with shorter courtship and copulation durations. Copulation intensity (number of insertions/time spent mating) was unrelated to mortality and courtship duration was not associated with survival among males that failed to mate. Reproductive effort appears to have negative survival consequences on males independent of predation risk. (posted May 29, 2009, revised June 8, 2009)

Courtship and mating behavior of the wolf spider *Schizocosa bilineata*

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Abstract: Of all the wolf spiders (Araneae, Lycosidae), the *Schizocosa* are probably the most widely studied, and have become established models in studies of behavior, sexual selection, and speciation. Despite extensive work on the genus, there remain a few species for which courtship behavior is not well known. This has hindered progress on overall understanding of the correlation between expression of secondary sexual traits and use of visual courtship behavior which is important for fully elucidating phylogenetic relationships in the *Schizocosa*. *Schizocosa bilineata* (Emerton) males possess decorative tufts of bristles on the forelegs which likely play a role in sexual selection, but little is known of male courtship behavior or its role in mate choice. We provide a description of visual and seismic behaviors performed by males in response to female cues, and examine behavioral interactions in live mating trials. Males clearly recognize and respond to female chemical cues by displaying several species-specific visual signaling behaviors accompanied by seismic stridulation signals. As these behaviors rarely occur in the absence of female cues, we suggest they function primarily in a courtship context. In live mating trials, females typically respond to male courtship with visual receptivity behaviors, which are seen prior to mounting and copulation. While male visual and seismic signals are clearly implicated in courtship and mate choice, future work will be necessary to fully understand the interaction between modalities in this species. The description of behavior provided should help resolve the relationship between male ornamentation and courtship behavior in the *Schizocosa*. (posted May 29, 2009)

Diel and seasonal patterns of prey availability to epigeal predators: evidence for food limitation in a linyphiid spider community

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Abstract: Association of web-sites with prey activity is crucial to maximizing foraging success. Spiders are potentially able to restrict pest population growth, but are often food-limited in agroecosystems. They may maximize prey consumption by selectively choosing web-sites in prey rich areas, but how foraging activity relates to diel and seasonal patterns of prey availability is unknown. To quantify the diversity, quantity, and spatial pattern of prey available to spiders over diel and seasonal gradients, we monitored prey availability at web-sites in an alfalfa crop, using mini-sticky traps to mimic linyphiid webs. Although there were no differences in total number of prey available between day and night, significantly more Collembola were captured at web-sites during the night than during the day. Conversely, Diptera and aphids were significantly more abundant during the day and cicadellids constituted an important prey source during both day and night. Overall there was proportionally more prey at web-sites than in the general crop environment, indicating that spiders were selectively constructing webs in areas of high prey density. Prey availability over the seasonal gradient showed high spatial variation further suggesting that spiders should be highly selective for foraging sites. Ultimately, the ability of spiders to forage optimally at sites of high prey density as well as utilize highly nutritional alternative prey can increase growth rates and population density. Understanding mechanisms of foraging in relation to diel cycles of prey activity is essential for predicting the role and impact of spiders as an important part of the community of generalist predators in agroecosystems. (posted May 22, 2009)

Does familiarity breed contempt? Effects of juvenile experience on adult female mating preferences in the wolf spider *Schizocosa rovneri*

Authors

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Abstract: Plasticity in female mate preferences for male courtship and ornamental traits can have important implications for speciation, especially in recently diverged species for which female mate choice is a primary factor in maintaining species isolation. Experience is known to influence female mate choice in a variety of vertebrate animals, although these effects have been less well-studied in invertebrates. A series of studies conducted by Hebets (2003) on the wolf spider *Schizocosa uetzi* Stratton showed that females develop preferences for novel, artificially modified conspecific male phenotypes when exposed to them as juveniles. However, the external validity of these findings is difficult to interpret, as nail polish – a substance known to contain and release a number of volatile compounds well after it is dry – was used to create the novel phenotype modification. As a consequence, it is unknown whether observed effects were in response to visually- or chemically-mediated learning. Here we attempted to replicate the earlier experiment on juvenile experience and adult female mate choice by separately addressing the effects of chemical vs. visual learning in a different wolf spider species [*Schizocosa rovneri*]. Results indicate that juvenile exposure to novel visual/chemical male phenotypes influenced adult female mate preference, but in a manner counter to expectations. Adult female spiders avoided males with the same visual [but not chemical] phenotypes to which they had previously been exposed, and showed greater receptivity to novel phenotypes. We will discuss how in this species, novelty – as well as experience – might sometimes affect female mate choice. (posted May 29, 2009)

The impact of ecological restoration on spider communities of an upland deciduous forest in Northern Mississippi: A pilot study

Authors

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Abstract: Decades of fire suppression have radically altered upland forests of Northern Mississippi. Once covered in grassy open oak woodlands, this region is now experiencing mesophytic tree invasion, canopy closure, reduced oak regeneration, and herbaceous understory loss. In an attempt to restore historical conditions, experimental restoration has been initiated through tree thinning and prescribed burn treatments at Strawberry Plains Audubon Sanctuary in Holly Springs, MS. The goal of our present research is to determine the impact of woodland restoration on spider communities. Spiders are excellent candidates for monitoring efforts due to the relative ease in which they can be sampled, their links to many food chains, and their sensitivity to changes in habitat structure. Our specific objectives are to identify how habitat structure is correlated with spider community composition and guild structure, and to ultimately determine how the restoration treatments have affected the spider community. We hypothesized that the spider community composition of the restored plots would be markedly diverse, and intermediate between that of forest and field ecosystems, reflecting an intermediary habitat structure. To test our hypotheses, habitat structure and spider community was sampled within four habitats located at the restoration site: fire-suppressed forest, intensely treated forest, moderately treated forest, and old field. Data collected in October 2008 (first of four samples) yielded 126 species from 90 genera and 21 families. Examination of the community structure suggests that species composition trends of restored plots appear congruent with our hypotheses. (posted May 29, 2009)

Condition dependent sex ratio adjustment in the cellar spider

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Abstract: Sex ratio manipulation in spiders has been comprehensively explored only in social species where inbreeding and local mate competition lead to female biased clutches. However, female biased sex ratios have been observed in one solitary linyphiid; a species in which the female seems to be able to exert control by shifting her mating position. Theory developed to explain vertebrate sex ratio biases stresses the importance of body condition and the potential for competition among siblings. Both of these factors could be important to the success of cellar spiders, *Pholcus phalangoides* (Araneae, Pholcidae). This species is quasi-social, long lived, and has large sperm-limited males that are choosy. Populations are highly subdivided and the adult sex ratio is variable in natural populations. We experimentally manipulated the body condition of males and females, mated them, and followed the first clutch until we could sex the offspring. Overall the sex ratio was female biased, however clutches produced by well fed females contained more males than the clutches of food limited females. Although male feeding status had no influence on sex ratio when the female was food limited, clutches of well fed females mated with well fed males contained more females than clutches produced by well fed females mated to food limited males. The condition of the parents also influenced in growth rate and adult size of the offspring. These results demonstrate the existence of sex ratio manipulation and suggest that the ability to grow and compete as an adult may be the driving forces. (posted May 26, 2009)

S, T, U and V**LinEpig: An online resource on erigonine epigyna**

Author

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Abstract: *Linyphiidae* is the most speciose spider family in the nearctic region, with the bulk of diversity represented by the *Erigoninae* (about 650 species). But most erigonine genera lack modern revisions; 33 (of about 117) nearctic genera are monotypic, and 15 are ditypic. Female erigonines have often received cursory treatment in descriptions, and lack a key to genus. Our limited ability to identify *Erigoninae* material hampers studies of diversity and distribution, and slows taxonomic progress by preventing synonymies and new species from being discerned. LinEpig seeks to offer a practical remedy, by presenting online images of erigonine epigyna. External genitalia of specimens reliably identified by linyphiid specialists are digitally imaged in an easily attainable view. *Erigoninae* is taken *sensu lato* following Draney & Buckle 2005 and Hormiga 2000, thus encompassing several genera (*Eularia*, *Scironis*, *Sisicus*) which exhibit the erigonine characters of minute size (< 2 mm) and flat epigynal plates without prominent scapes, and all those not in the female key. Habitus images are also taken, and provided to the Nearctic Spider Database. The Google-based LinEpig gallery employs tagging and commenting functionality to annotate recent synonymies and species-placement issues, to complement existing taxonomic e-resources incapable of presenting alternative interpretations. As of May 2009, 120 species had been posted. Completion will require material from a number of collections. I present the work both to make the resource more generally known, and to solicit additional material for inclusion. (posted May 29, 2009)

***Aliatypus thompsoni* (Araneae, Antrodiaetidae) in the Transverse Ranges of southern California: Comparative phylogeography and possible cryptic species**

Authors

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Abstract: The genus *Aliatypus* (Araneae, Antrodiaetidae) includes eleven described species of trapdoor spiders distributed in California and parts of Arizona (Coyle 1975). *Aliatypus thompsoni* occurs from the Los Angeles basin (northern San Bernardino Mountains) north through other LA basin ranges, including two distributional "arms" extending northwest past Santa Barbara, and northeast to Kern County. These spiders are found in a wide variety of habitats at elevations ranging from 900 to 5400 feet (Coyle & Icenogle 1994), but due to microhabitat specificity and low dispersal abilities, are likely susceptible to genetic fragmentation. Such genetic fragmentation makes this species a good candidate for studies of regional biogeography and possible unrecognized species divergence. Preliminary results attained from CO1 (mtDNA) DNA sequence data show the populations spanning the southern Transverse Ranges falling into two monophyletic groups. Northeast of the Transverse Ranges (in Kern County), several genetically isolated, deeply-divergent lineages are recovered. DNA sequencing of the 28S gene (rDNA) reveals three main groupings, with again northeastern specimens very divergent from remaining populations. We are currently in the process of surveying morphological variation in this species, which as noted by Coyle (1975), may be congruent with geography. These data, in addition to comparisons to biogeographical patterns seen in other taxa from the region, will be discussed. (posted May 28, 2009)

Emigration and foraging behavior determined by density dependent interactions between predators and trophic resources

Authors

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Abstract: The ability to maintain high densities of predators in managed systems may depend on the strength of agonistic interactions between individuals. One explanation is that interference between predators decreases predator performance. There are few empirical tests of the interaction between prey and predator density in determining patch use and subsequent impacts on a predator's functional response. Spiders experience fluctuation in prey availability in the field leading to food limitation, which may escalate predator-predator interactions leading to cannibalism and intraguild predation. We used the common wolf spider, *Pardosa milvina*, to explore the tendency to reside in a patch related to both prey and predator density by measuring emigration from field enclosures using a factorial design. To understand the consequences of concurrent variance in prey and predator density on the functional response of these predators, we measured prey consumption using a factorial design crossing three prey densities with four predator densities in the laboratory. In the field, spiders emigrated at a lower rate from enclosures where we added prey, but density of spiders only marginally influenced emigration. The functional response was consistent with ratio-dependent foraging, where interference between predators caused the consumption rate to decline at higher predator density. Together these results indicate that prey density impacts the decision to remain in a patch and possibly the proportional abundance of prey to predators may set an interference threshold, at which point predators search for a new patch. (posted May 29, 2009)

Age as a factor influencing the use of detritus stabilimenta and web decorations by the orb-weaver *Azilia vachoni* (Tetragnathidae)

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Abstract: The presence of silk stabilimenta in orb webs has incurred much debate and controversy with respect to its functionality. However, not much has been done with respect to detritus stabilimenta outside the genera *Cyclosa* and *Allocyclosa*. The orb-weaver *Azilia vachoni* (Tetragnathidae) also constructs detritus stabilimenta and sometimes suspends debris under its web. The habitat preference of this species and dependence of these web features on age were determined. Twenty selected habitats varying in vegetation structure on the island of Trinidad, West Indies were sampled. The presence and location of detritus stabilimenta and suspended debris, spider position and age, web orientation and inclination and canopy cover were noted. A total of 143 webs were observed with *A. vachoni* occupying 13 of the 20 selected habitats. Individuals of all ages showed no significant preference for constructing either detritus stabilimenta or suspending debris with most preferring to use both in their web design. In this species, linear stabilimenta ranged in length from 0.5 to 3 cm towards the top of the sheet and started from the hub above the resting position of the spider. Dried leaves were usually used for suspended debris and positioned in line with the spider. Future studies using this data include testing the three major hypotheses of the functions of stabilimenta usually tested for silk stabilimenta with this species; 1) Warning hypothesis, 2) Prey attraction hypothesis; and 3) Camouflage hypothesis, as well as comparing it with other species exhibiting such behaviour, for example, *Nephila clavipes*. (posted May 14, 2009)

Arthropod relationships revealed by phylogenomic analysis of nuclear protein-coding sequences

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Abstract: The remarkable antiquity, diversity and ecological significance of arthropods has inspired numerous attempts to resolve their deep phylogenetic history, but results from two decades of intensive molecular phylogenetics have been decidedly mixed. The discovery that hexapods are more closely related to crustaceans than to the myriapods was an early, if exceptional, success. More typically, analyses based on limited samples of taxa and genes have generated results that are inconsistent, weakly supported and highly sensitive to analytical conditions. Here we present strongly supported results from a maximum likelihood analysis of over 41 kb of aligned DNA sequence from 62 single-copy nuclear protein-coding genes from 75 arthropod species. These species represent every major arthropod lineage, plus five species of tardigrades and onychophorans as outgroups. Our results strongly support Pancrustacea (Hexapoda + Crustacea) but also strongly favor the traditional morphology-based Mandibulata (Myriapoda + Pancrustacea) over the molecule-based Paradoxopoda (Myriapoda + Chelicerata). In addition to Hexapoda, Pancrustacea includes three major extant lineages of 'crustaceans' – each spanning a significant range of morphological disparity. These are Oligostraca (ostracods, mystacocarids, fishlice, tongueworms), Vericrustacea (malacostracans, barnacles, copepods, branchiopods) and Xenocarida (cephalocarids, remipedes). Within Pancrustacea we identify Xenocarida as the long-sought sister group to the Hexapoda, a result confirming that 'crustaceans' are paraphyletic. The analysis includes at least one representative from every arachnid order and strongly recovers Arachnida and Tetrapulmonata, with Araneae being the sister group to Pedipalpi. The analysis also recovers the controversial group Pulmonata (Tetrapulmonata + Scorpiones) and fails to resolve other relationships within Arachnida. (posted May 24, 2009)

Pardosa milvina (Araneae: Lycosidae) does not use vibratory cues to detect predators or prey

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Abstract: Prey species often face a constant threat from predators and must respond appropriately to minimize the risk of being consumed. Levels of risk can vary with predator species and the degree to which predators are aware of their prey. Predators may be detected via different sensory modalities, which vary in the type of information they convey. Wolf spiders are sensitive to chemical cues from predators and prey, but the role of vibratory cues in these interactions has received little attention. In this study we examined *Pardosa milvina* (Araneae: Lycosidae) behavior in response to vibratory cues from two predators (*Hogna helluo* (Araneae: Lycosidae) and *Scarites quadriceps* (Coleoptera: Carabidae)), prey (*Acheta domesticus* (Orthoptera: Gryllidae)), conspecifics, and controls (silence and white noise). To modify predator awareness of prey, we provided predators with a substrate containing chemical information from *Pardosa*. Vibratory cues were recorded in the laboratory using a laser Doppler vibrometer and played back to *Pardosa* using a speaker. We quantified *Pardosa* activity levels by filming *Pardosa* during vibration playback and analyzing the footage with automated motion digitization techniques. There was no statistically significant effect of treatment (source of vibratory cue) on any aspect of *Pardosa* activity. These results suggest that vibratory cues are not used by *Pardosa* to alter activity levels in response to predators or prey. A sensory bias toward chemotactile and visual cues may be present in *Pardosa*, making vibratory cues less important. Additionally, the habitat in which *Pardosa* occurs may inhibit reliable transmission of vibratory cues. (posted May 28, 2009)

Spider hemocyanin sequences reveal complex evolutionary dynamics of blood proteins and have high phylogenetic utility

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Abstract: Hemocyanins are multimeric copper-containing hemolymph proteins involved in oxygen binding and transport in all major arthropod lineages. Arachnids have seven primary subunits (encoded by paralogous genes *a-g*), which combine to form a 24-mer (4 X 6) quaternary structure. Within some spider lineages, however, hemocyanin evolution has been a dynamic process with extensive paralog duplication and loss. For example, the hunting spider *Cupiennius salei* has lost paralogs *a-f* but undergone many duplications of paralog *g*. A similar pattern of paralog turnover has been hypothesized for the haplogyne spider *Dysdera crocata* as well as some mygalomorphs. We have obtained hemocyanin gene sequences from numerous opisthothele representatives in order to trace the evolution of the hemocyanin gene family and test the phylogenetic utility of these conserved loci. Our hemocyanin gene tree is largely consistent with previous hypotheses of paralog relationships based on immunological studies, but reveals some discrepancies in which paralog types have been lost or duplicated. In addition, phylogenetic analysis of the concatenated hemocyanin sequences recovers a number of clades supported by morphology and recent molecular studies and is used to estimate dates of higher-level spider divergences. The results of this study will be important for understanding respiratory differences among spiders diverse in both size and behavior as well as provide a useful marker for determining spider relationships. (posted May 28, 2009)

Comparative analysis of major life history traits in geographically isolated populations of *Vaejovis* scorpions

Authors

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Abstract: The Sky Islands of the Southwestern United States contains within them a number of isolated populations of *Vaejovis* scorpions. These small scorpions are believed to have been isolated during the Pleistocene glaciation. In the past, scorpions found on all mountain ranges in the area were considered to be *Vaejovis vorhiesi*, however recent research has separated them into three distinct species based upon morphology. Past research has not been conducted to identify differences in life histories among these newly described species. Scorpions were gathered from six different mountain ranges and life history variables were calculated with the dispersal of the offspring. Female size, offspring size, litter size, and total litter mass differed among mountain ranges, though female reproductive investment did not. Path analyses indicated a non-existent size-number trade-off within female's reproductive pathways. Within the Chiricahaus, a trend of increasing size measurements (female and offspring), litter sizes, and total litter masses were found with increasing elevations. Differences among populations and/or elevations may be due to female size constraints or environmental conditions such as temperature or rainfall. (posted May 29, 2009, revised June 8, 2009)

Phylogeography of a cryptic Californian trapdoor spider species complex based on multiple anonymous nuclear loci

Authors

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Abstract: Using a novel approach to species delimitation based on molecular and adaptive divergence as outlined in Bond and Stockman (2008), *Aptostichus atomarius*—a cryptic species complex of Californian trapdoor spiders (Mygalomorphae: Cyrtaucheniidae)—was divided into five species: *A. atomarius*, *A. stephencolberti*, *A. miwok*, *A. stanfordianus*, and *A. angelinajolieae*. The molecular component was based on one nuclear and one mitochondrial loci (ITS and 16S). These species boundaries are further tested here using data from multiple nuclear anonymous loci. At this time, we have seven anonymous loci with an average of 153 variable sites. We are currently in the process of using coalescent methods of reconciling multiple gene trees to estimate the species tree. We will present the congruence of these results with past efforts. (posted May 29, 2009)

Spiders in space: launching orb weaving spiders to the International Space Station

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Abstract: On November 14, 2009, two orb weaving spiders, *Metepeira labyrinthea* (Hentz, 1847) and *Larinioides patagiatus* Clerck, 1757 (Araneidae) were loaded into the payload compartment of the Space Shuttle Endeavor on their way to the International Space Station. A University of Colorado, Boulder affiliate company called BioServe proposed the experiment – a repeat of spider experiments flown to Skylab in the 1970s and on the ill-fated Space Shuttle Columbia in 2003. The goal of this latest arachnological endeavor on Endeavor was to test the effects of microgravity on well fed and well hydrated orb weaving spiders. The two spiders were loaded into a small habitat complete with a fruit fly culture and access to water. Both spiders built complete orb webs within three days of being off-loaded onto the ISS. Approximately 30 K-8 classrooms, primarily in Colorado, monitored their own Earth-bound control spiders to compare the behaviors of the Earth controls with the arachnonauts. Distinct differences in orb-web structure and in orb weaving behavior were apparent in the two arachnonauts. (posted May 28, 2009)

An overall assessment of "Los Aracnidos de Tamaulipas"; a one week mini-course conducted at the Instituto Tecnológico de Cd. Victoria, Tamaulipas, México in August of 2007

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Abstract: This presentation reviews the background, planning and teaching of a one week mini-course on the "Arachnids of Tamaulipas" which was conducted in northeastern Mexico at the Instituto Tecnológico in Cd. Victoria during late August of 2007. Course content, format, ancillaries and amount of time devoted to classroom lecture, laboratory exercises and local field trips will be outlined. The demographic makeup of the institution, its biology majors, and the class of 17 students will also be reviewed. Students were provided with a spiral bound copy of chapters 12 and 13 of Ruppert and Barnes "Zoología de los Invertebrados" (sixth edition) which served as both a lecture text and lab manual. Lecture material included a review of the early evolution of the major arthropod groups and was followed with the origin of the arachnids and a survey of the major morphological characteristics, life cycles, and distributions of the 11 major ordinal groups. Preserved specimens of all ordinal groups were observed in the laboratory. Living specimens of nine ordinal groups (Scorpiones, Palpigradi, Schizomida, Opiliones, Amblypygi, Ricinulei, Pseudoscorpiones, Araneae and Acari) were both observed and collected during the three local field trips with only two groups (urophygids and solifugids) not collected. Due to time constraints, traditional lecture and laboratory examinations were replaced with a pass-fail assessment by the sponsoring faculty member. A post-course assessment and "lessons learned" will be given along with a number of changes planned for future offerings of this course. (posted May 22, 2009)

***Clubiona riparia*: methods and costs of retreat construction**

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Abstract: Female *Clubiona riparia* (Araneae, Clubionidae) build three-sided retreats in which they enclose both themselves and their eggs. A retreat is constructed by bending a single blade of grass or other monocot twice, each time causing a fold that is perpendicular to the long axis of the blade, and joining the edges with silk. The resulting container is roughly triangular in cross section and 3-4 times as long as it is wide. The benefits of such construction (e.g., reduced risks of predation and desiccation) presumably outweigh the costs. To assess the energetic costs involved in assembling a retreat, I first confirmed, using *Iris*, that the work of mechanically bending and then joining monocot leaves could be reliably measured under laboratory conditions. I then measured the work (=energy) that had to be expended in bending and joining the leaf blades of *Stenotaphrum secundatum* (Poaceae), a grass anatomically similar to the grass and cattail leaves normally used by the spiders in retreat construction. The work necessary to make a single bend increased linearly and predictably with distance from the grass blade's tip. Using four actual retreats as models, I calculated the costs of their construction (excluding silk expenditure) at between 1.2 and 1.6 mJ (millijoules). A single egg of *C. riparia* contains about 3.0 J in the form of nutrients and structure, so the cost of retreat construction is very small relative to at least one index of fitness and reproductive effort. (posted May 22, 2009)

The complete mitochondrial genome sequence of the millipede associated mite *Stylochyris rarior*

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Abstract: *Stylochyus ravior* Berlese, 1916 (Acari, Mesostigmata, Ologamasidae) is a mite commonly found in moist, deciduous forests. Juvenile mites are often associated with other animals, such as mammals, birds, and arthropods. Very little is known about this mite or the symbiotic relationships it develops. In an attempt to better understand *S. ravior*, mites found living on Xystodesmid millipedes were collected in the Appalachian Mountains of Virginia, Tennessee, and North Carolina. These mites and millipedes will be included in a future coevolutionary analysis. The complete mitochondrial genome of *S. ravior* associated with the millipede genus *Apheloria* (Polydesmida: Xystodesmidae) was also sequenced using both cloning and primer walking procedures. This genome is 14,899 nucleotides in length and has all the typical genes of an animal mitochondrion. It was discovered that *S. ravior* has a gene arrangement that differs from the ancestral arthropod gene order and is novel among mites and ticks. (posted June 10, 2009)

Mating marathons: courtship and copulatory consequences of consecutive pairings in the wolf spider *Pardosa milvina*

Authors

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Abstract: In species where scramble competition is an important component of intrasexual selection and simultaneous maturation of females is common, selection should favor males that can court and mate repeatedly over short time intervals. Conversely, males should have a long refractory period for courtship and copulation if female maturation phenology is broad. In the wolf spider, *Pardosa milvina*, we examined male courtship and copulatory behaviors over ten sequential pairings with virgin females within a sixteen hour period (N = 26). Males were allowed one hour between pairings and given food and water in excess. We found a significant decrease in several courtship behaviors (leg raises and body shakes) over the course of ten pairings. Males significantly decreased their overall courtship intensity with each subsequent pairing, possibly due to added energetic costs with each new encounter. However, total male courtship intensity across ten pairings was positively correlated with the number of successful matings for each male. The number of successful matings was also positively correlated with male weight, suggesting that weight may be an indicator of a male's ability to court. Among males that mated multiple times there was no significant difference in courtship duration or intensity but there was a significant decrease in copulation duration and number of insertions over subsequent matings. Female egg sac production was not adversely affected by the number of females with which a male had copulated previously. In general high mating frequency negatively impacts copulatory, but not courtship intensity. (posted May 29, 2009)

Life is sweet: How sugars enhance the lives of spiders that feed on nectar and honeydew

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Abstract: Cursorial spiders that wander in vegetation share the likelihood of encountering vegetative structures such as leaves, flowers and nectaries. Nectaries that are extrafloral (EFNs) reside on some plants and are located outside of the flower, almost anywhere on the plant, such as leaf margins, petioles, branch axils, and flower bracts. Thomisids, salticids, and the fast-moving anyphaenids, miturgids, and corinnids all wander in foliage, and some species have been observed feeding at these extrafloral and floral nectaries. Because plant nectar is mostly sucrose and therefore high in energy, I hypothesized that spiders that spend a substantial amount of time in vegetation and/or substantial energy foraging in vegetation should engage in nectar feeding. Field collections bore out this hypothesis: in maintained crops of cotton (which has EFNs) one out of four adult cursorial spiders was positive for fructose, a plant sugar. Laboratory experiments with some of the fastest of these spiders (*Hibana velox*, *Cheiracanthium mildei*, and *C. inclusum*) showed that they lived longer, grew faster, and had more energy for foraging with plant nectar in their diet. Providing *C. inclusum* a lifetime of nectar resulted in more offspring. In particular, *C. inclusum* that could not even mature on a marginal diet of prey could mature and reproduce if they also received nectar. An unexpected greenhouse infestation of long-tailed mealybugs provided opportunity to show that honeydew, the sugary exudate of these and other phloem feeding insects, can also benefit spiders, allowing *C. mildei* spiderlings to survive longer and molt sooner. (posted June 10, 2009)

Can you hear me now? Sensory ecology of a communication network of wolf spiders in forest litter

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Abstract: Animal communication networks occur where the active space of signals overlaps the sensory range of individuals other than the signaler and receiver. Our studies have addressed the role of environmental constraints on signal detection, and the potential for signal interception in a communication network of courting male *Schizocosa ocreata* (Hentz) in forest litter. We used both field observation and laboratory experiments to examine potential for illegitimate receivers (eavesdropping competitors; cue-reading predators) to intercept and exploit male courtship signals. Estimates of active space and encounter rates suggest that multimodal signaling takes place within a relatively large communication network. The forest floor microhabitat varies in substrate continuity, light level and visible spectrum, and both seismic and visual signals from male courtship may be attenuated and/or obscured. However, while horizontal active space of male courtship in leaf litter is highly variable and limited in range from the perspective of conspecific spiders, the potential distance for predator detection (from an oblique or vertical perspective) may be much greater. Studies of the role of signal exploitation by unintended conspecific male receivers suggest that the potential for eavesdropping is high in the field. Lab studies of vertebrate (toads) and invertebrate (spiders) predator responses to audio/video playback of male *S. ocreata* courtship have demonstrated that secondary sexual traits and multi-modal courtship displays likely affect predator detection against complex backgrounds with varied light levels. Results suggest that potential costs of signal exploitation by unintended receivers may influence the evolution of signaling and anti-predator behavior in *S. ocreata*. (posted May 27, 2009)

Arachnids misidentified by physicians and other authorities as brown recluse spiders, *Loxosceles reclusa* (Araneae: Sicariidae)

Author

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Abstract:

Brown spiders, big, small
Spied by doctors and others
Must be recluses Although mistaken
Causing misdiagnoses
Do they really care? Thus, contradiction
Arachnologists say "no"
yet others "know" more Myths proliferate
Misconceptions are entrenched
Errors reinforced

Arachnologists
Put the knowledge in the word
Aracknowledgy

(posted May 3, 2009)

Phylogenetic analysis of populations exhibiting alternative social strategies in *Anelosimus studiosus* (Araneae: Theridiidae)

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Abstract: *Anelosimus studiosus*, in east Tennessee, exhibits two genetically-influenced behavioral strategies: solitary and social. Solitary webs are ubiquitous throughout the range and consist of a mother and her offspring. Social colonies consist of several, to hundreds, of adult females and their offspring. Social colonies are typically clustered in distinct mostly isolated populations in specific habitats. We are testing two mutually exclusive hypotheses to determine if these pockets of social behavior represent multiple independent origins of evolution, or a single (or few) origins that have spread through the population. Analyses of mitochondrial and nuclear markers to date, show variation, but no genetic structure. This could indicate panmixis or a recent range expansion. Microsatellites are currently being used to determine relatedness within, between, and among target populations. (posted May 28, 2009)

W,X, Y and Z**Vertical stratification in a community of web-building spiders**

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Abstract: Web-building spiders are an abundant and important component of natural enemy communities in agroecosystems throughout the world, potentially impacting prey populations and contributing to valuable levels of pest suppression. Integral to their effectiveness as predators and biological control agents are their webs, the primary tool of prey acquisition for many species. The placement and architecture of a web potentially reflects a number of biotic and abiotic variables, including prey availability, competition with neighboring spiders, and vegetational structure. Unraveling the factors that influence web placement can help elucidate the roles of different spider species in community dynamics, including effects on populations of other predators and of economically important pests. In this study, the size and vertical placement of webs in alfalfa were compared to the height of the vegetation and the time of the season to test the hypothesis that the abiotic properties of the environment drive web-height selection. Highly significant vertical stratification among the six most abundant species was evident in this spider community, and the vertical strata occupied by each species did not vary in response to vegetation height or time. Consequently, web-height stratification is interpreted as a species-specific means to partition prey resources, which have previously been shown to vary with height. Understanding these mechanisms of foraging is therefore critical if we are to successfully integrate spiders and other generalist predators into biological control programs. (posted May 22, 2009)

Herbicide may interact with predator cues and foraging success to determine fitness in *Pardosa milvina*

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Abstract: Spiders living in agroecosystems must cope with a range of anthropogenic stressors that affect their foraging behaviors and interactions with predators, which can in turn impact reproductive fitness. Our goal was to determine how a common herbicide (active ingredient glyphosate) interacted with predator cues and prey availability to affect foraging and ultimately reproduction in *Pardosa milvina*. *Pardosa milvina*, common in agricultural systems, frequently encounter herbicide spray and extreme differences in prey availability across the season, while regularly falling prey to the larger wolf spider, *Hogna helluo* or the carabid beetle, *Scarites quadriceps*. We exposed *P. milvina* to all combinations of predator cues (*H. helluo*, *S. quadriceps*, or none), herbicide (or water), and prey availability (high or low). After exposure, we measured foraging success as the number of prey consumed and changes in abdomen width. We then maintained *P. milvina* in the laboratory and recorded several measures of reproductive success (e.g. production of eggsacs). In the low feeding treatments, when exposed to predator cues, fewer spiders produced an eggsac at all, whereas when exposed to herbicide, fewer spiders produced a viable eggsac (one that hatched). In the high feeding treatments these effects were reversed; fewer spiders exposed to herbicide produced an eggsac at all, whereas fewer spiders exposed to predator cues (specifically *S. quadriceps*) produced a viable eggsac. We conclude that exposure to herbicide and predator cues can create complex interactions which might be mediated by the spider's foraging success. (posted May 22, 2009)

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