The Canadian Arachnologist

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For New Recipients

In order to begin receiving this newsletter and/or to submit your autobiographical material, please visit the Canadian Arachnologist web site.

Newsletter Funding

The Montréal Insectarium has graciously funded the reproduction and postage for this issue of the newsletter. Here's hoping this becomes an extended collaboration!

New Web Home

The Canadian Arachnologist website now has a new, permanent home at: **http://canadianarachnology.webhop.net**. Feature articles and entire back-issues are posted, members are featured, and have an opportunity to create and maintain profiles, publication listings, and post announcements. Species lists for many arachnid groups in Canada are posted by members. I encourage you to periodically visit and contribute to its growth.

New Publication

This is close to your last chance to order **Spiders of North America: An Identification Manual** edited by Darrell Ubick, Pierre Paquin, Paula E. Cushing, & Vince Roth with original drawings by Nadine Dupérré at pre-publication pricing. The deadline for reduced pricing is June 2005 and orders may be made on-line at the following address:
http://www.americanarachnology.org/AAS_SGNA/SGNA_OnLinePayment.html.
Congrats to Pierre and Nadine for work on what will be a fantastic manual for all of us!

Arachnids on the Web

Valerie Behan-Pelletier and Barbara Eamer have recently completed an excellent on-line compendium of the diversity of Oribatida, organized by Province and also provisioned with an image gallery. Visit **http://www.cbif.gc.ca/spp_pages/mites/phps/index_e.php**.

Wayne Knee has created a dichotomous key to the genera of blood- and tissue-feeding feather mites associated with birds found in Alberta. The key is accessible on the Canadian Arachnologist website, **http://canadianarachnology.webhop.net**, under "Arachnid Data".

Who Are the Canadian Arachnologists?

For a complete listing of active members, please see the Canadian Arachnologist web site listed on the front page.

New Members

Frost, Carol M.



Carol is an undergraduate student at the University of Alberta under the tutelage of John Spence who has become interested in ballooning motivation of *Dolomedes triton*. This summer, she aims to unravel whether food availability alters this motivation to balloon and whether this can be linked to the permanence of ponds.

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Marczak, Laurie B.



Laurie is a Ph.D. candidate in John Richardson's lab interested in the intersection of landscape and food web ecology. Presently, she is studying the effects of emerging aquatic insects on the spatial distribution, abundance and fitness of riparian spiders. She is also doing some behavioural work with *Tetragnatha versicolor* and aims to evaluate the fitness consequences of variable aquatic insect subsidies.

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Wayne is starting his M.Sc. program under Dr. Heather Proctor and aims to study the endoparasitic nasal mites of birds in Alberta and Manitoba.

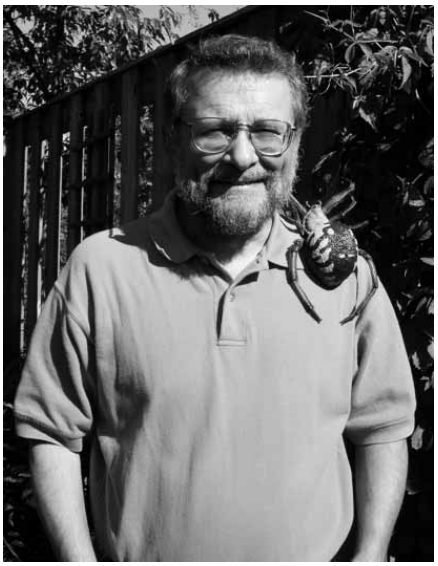
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Stott, Greg

Greg is a field geologist and is currently mapping and engaged in research of the Precambrian geology of Northwestern Ontario. As a hobby, he collects and studies spiders around Sudbury, ON.



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Work, Timothy T.

Tim works with generalist arthropods associated with leaf litter and coarse woody debris in boreal forests. He is interested in detrital-based food webs and the relationships between biodiversity and ecological processes like decomposition. Tim also helps coordinate the arthropod biodiversity project at the EMEND project in western Alberta.



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The Itsy-Bitsy Spider: Reflections on Immature Spiders in Orchard Foliage

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Two of the most important areas of investigation in Integrated Pest Management are to understand the roles of resident natural enemies (including spiders!) in the agroecosystem, and to find "curative" (i.e. immediate) pest control methods that do not disrupt these natural enemy populations. For my doctoral work I am investigating the compatibility of two such strategies, a non-chemical particle spray, kaolin clay, and assemblages of canopy spiders, in the management of a caterpillar pest (Tortricidae: *Choristoneura rosaceana* Harris) in apple orchards. I am doing this work as a student in Dr. Chris Buddle's Arthropod Ecology Lab in the Natural Resource Sciences Department at McGill University, and with my co-supervisor Dr. Charles Vincent, at Agriculture and Agri-Food Canada in Saint-Jean-sur-Richilieu. My field sites are located in the eastern townships of Quebec, conveniently near several vineyards for post-field work sustenance.

I am approaching the spider studies from a few different angles, but one of the interesting patterns in my work is its increasing focus on immature spiders and spiderlings; in this contribution I will return to this theme of young spiders.

One part of my project is to determine whether or not canopy spiders feed upon (or affect via other trait-mediated interactions) the caterpillars at any point in their life cycle. The timing of potential interactions is important - a characteristic behaviour of these caterpillars is to make leaf shelters - most of their larval development is spent hidden away in leaf rolls, munching away on leaves (or fruit) and protected from threats such as wandering spiders. Although I have seen larvae occasionally caught in webs, and although if given caterpillars most spiders will happily gobble them up (Figure 1), I suspect that predation by spiders of late instar caterpillars isn't a major population control. The caterpillars, however, are more vulnerable to predation as neonates; eggs are laid in masses of a few hundred, and upon hatching, the larvae are not gregarious, but disperse away from the egg mass to find a place to settle. The successful establishment of neonate herbivores is a crucial factor in determining subsequent population dynamics (Cornell and Hawkins 1995). These neonates are very small, so probably the average mature hunting spider wouldn't give them a second look, but it may be different for a very small spider, or many small spiders. The canopy of the orchard is at this time a nursery for a lot of newly hatched arthropods, including spiders. From surveys and experiments I did with the spider fauna in the orchard in summer



Figure 1. Female *Araneus diadematus* Clerck enjoying an OBLR larva.

2004, from mid-July to early August about half the individuals collected from the canopy of the orchard were spiderlings - not just immature spiders, but brand-spanking new ones. We know little of what effect this population boom of tiny arachnids has on the orchard community in the few weeks they are there before they themselves get eaten, move on to other places, or grow up into handsome older spiders. In experiments this summer I will study in more detail the interactions between these spiderlings and the neonate caterpillars, both via direct consumption of neonates, but also through trait-mediated interactions. I will also test whether the spider assemblages have any effect on populations of the caterpillar in the orchard.

Although we know little of the effects of all these spiderlings in the orchard at the same time, it is clear that the spiderlings themselves are sensitive to what we spray in this environment. For example, a promising pest control method in fruit orchards is kaolin clay, a non-toxic compound that when sprayed on trees and fruit, reduces damage by a variety of fruit pests, probably through physical deterrence. What about its physical effects on spiders? A previous study indicated that extended kaolin applications throughout the summer would reduce spider populations (Knight *et al.* 2001), but we don't have any more specific information than that. Last summer I looked at the effect of kaolin on spider populations in the orchard when I was testing kaolin in mid-July to reduce leafroller damage. At this time there are peak populations of neonate leafrollers, and also peak populations of spiders and spiderlings. Plots sprayed with kaolin had reduced abundances of hunting spiders (but not web-spinners) and there was also a large effect on the spiderling populations (of which most were hunters). Both spiderling and larger hunting spider populations were significantly lower in plots treated with kaolin as compared to control plots - thus the populations of spiders may be affected in both current and subsequent years. I will look in more detail at the mechanisms of these effects this summer, and how kaolin affects spider-OBLR interactions.

Immature spiders interest me from a sampling perspective as well. Anyone who has sampled for canopy spiders by beating will have noticed that a large proportion of the spiders collected are immature, and therefore not identifiable to species (with some exceptions). When I was planning the collecting of spiders this past summer for a study of habitat use around orchards, it irked me that I would collect a large number of immatures and not be able to identify them - what if there was a particularly interesting species there? More importantly, how were my data changing, and how were my conclusions biased because of this "lost" information? The exclusion of spiderlings was reasonable, but what about all the sub-adults and larger immatures? I decided to try and rear all the immature spiders I collected until they were mature, and see how the inclusion of these data changed my results.

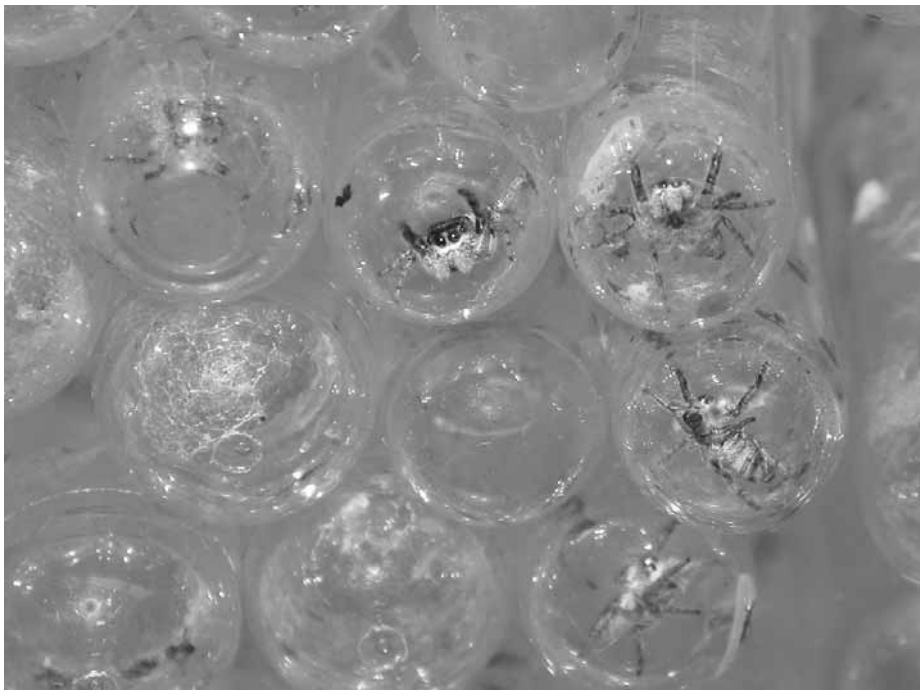


Figure 2. Salticids in their deluxe test tube accommodations.

The spider nursery: To avoid the hazards of my spiders eating each other, immature spiders were individually housed in deluxe accommodations of test-tubes of varying sizes (Figure 2), humidity was controlled by a damp cotton plug in the tube, and regular meals were provided of assorted insects caught with a sweep net on the front lawn of the university, or fruit flies made extra nutritious by adding dog food to the *Drosophila* diet (Figure 3). For several species, mainly *Philodromus* spp., after rearing many specimens to maturity



Figure 3. An adult male *Pelegrina proterva* (Walckenaer) having a last nutritious meal.



Figure 4. An immature male *Philodromus praelustris* Keyserling.

the immatures could be reliably identified to species as well. In total, I reared to maturity and/or identified more spiders initially collected as immatures than I collected as mature individuals. This extra information was interesting - for example, eight species in my survey were only found as immature individuals, and not all of these were rare species. The most striking example was that of *Philodromus praelustris* Keyserling (Figure 4), which was one of the most common species I found, but none of them were mature upon collection! This species would have been excluded from community data without rearing and subsequent identification. Another benefit from rearing the immatures was the extra species data. When I was comparing spider communities found in different habitats around the orchard agroecosystem, the extra numbers were crucial - for example, there wasn't enough data to do multivariate analysis if only spiders collected as mature were considered, whereas when all identified spiders were used in the data set, multivariate analysis did yield patterns. Rearing spiders is time consuming, but in cases when massive sampling still doesn't yield enough specimens for analysis, and when an accurate portrayal of all species present in the habitat is needed, rearing of some captured individuals could be considered.

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Upcoming Meetings

June 26-30, 2005: The 29th annual meeting of the American Arachnological Society at the University of Akron in Akron, Ohio hosted by Todd Blackledge, Maggie Hodge, and Sam Marshall. Registration deadline is May 16. Visit the following address for more information: http://www.americanarachnology.org/AAS_Meetings/ . This year's symposium is "Spider silk: Form and function across biological levels".

November 2-5, 2005: Joint Annual Meeting of the Entomological Societies of Canada and Alberta at the Radisson Hotel and Conference Centre in Canmore, Alberta chaired by John Acorn. Registration deadline for reduced fees is August 1, 2005 and for regular fees September 15, 2005. The conference theme is "Entomology: A Celebration of Life's Little Wonders" and for the first time (as far as I know!) there will be a symposium on The Biology and Diversity of Arachnids hosted by Heather Proctor, Derrick Kanashiro, and Robb Bennett. Symposium papers are by invitation but there may also be a contributed papers session.Visit http://www.esc-canmore.org/ for updates.

Ballooning in Dolomedes triton (Pisauridae)

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A few days after hatch, juveniles of the fishing spider *Dolomedes triton* Walkenaer (Pisauridae) may stand on "tiptoe", point their abdomens skyward and release several strands of silk, with which they catch the breeze and are carried away from the nursery web (Figure 1). These so-called ballooning individuals may descend elsewhere on the same pond or may be carried by the wind high into the sky, marking the start of a much longer dispersal event. Ballooning individuals do not control their direction of travel, but are at the mercy of the wind. *D. triton* is semi-aquatic and, unlike generalist ballooners such as salticids and linyphiids, individuals must land on or very near another body of fresh water if they are to survive and reproduce. Suter (1992) suggested that ballooning spiders may be able to control when they land by changing their posture or by reeling in their silk to reduce drag. However, I find it difficult to imagine how a minute aeronaut can perceive a pond below and react quickly enough to drop out of the sky. Ballooning must therefore be a very risky means of dispersal for *D. triton*, and I am interested to know what makes a juvenile decide to balloon.

Richter (1970) found that lycosid juveniles ballooned most often in warm, dry air and at low wind speeds between 0.35-1.70 m/s. Alice Graham (2002), found similar results for *Dolomedes triton*: elevated temperatures (30°C), low wind speeds (0.35-1.70 m/s), and low humidity result in the most frequent juvenile ballooning attempts.

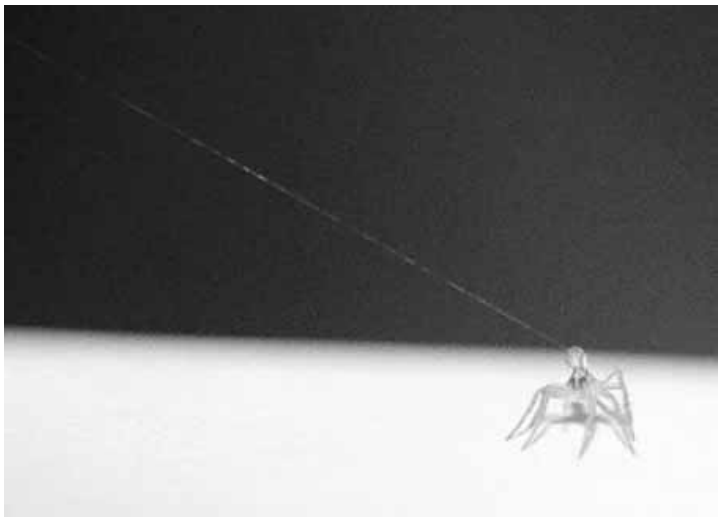


Figure 1. Tiptoeing *Dolomedes triton* spiderling. Note strand of silk emerging from the spinnerets. Photo: Tyler Cobb.

In the summer of 2004 with the help of Laura DeHaas, I did an NSERC project under Dr. John Spence's tutelage on *D. triton* ballooning behaviour and motivation. I continued the work Alice Graham started. I collected females carrying egg sacs (Figure 2) from ponds near George Lake, AB and when the eggs hatched, I tested the effects of wind speed and temperature on the frequency of ballooning attempts made by variously aged spiderlings. I placed these juveniles on a constructed platform next to an adjustable wind source and recorded the behaviour and the number of ballooning attempts. My results agreed with those obtained by Alice; more spiderlings ballooned at the highest temperature (30-32°C) followed by far fewer successful ballooning attempts at the next lowest temperature, a mere 3-5°C cooler. The most frequent "tiptoe" behaviour occurred at the lowest wind speed tested (0.1-1 m/s). I also found that ballooning behaviour peaks 5 days after hatch, which is just under halfway through the duration of the first instar. At 5 days, these individuals are very small (Figure 3). Males typically require 13 days to complete their first instar while females require 16 days (Zimmermann and Spence, 1998). Contrary to my observations, Alice's data suggested that ballooning occurs most frequently 3 to 4 days after hatching. To my frustration, I unknowingly pseudoreplicated my experimental design. Consequently, I may describe trends in the frequency of ballooning attempts but the significance of these trends is questionable.



Figure 2. Adult female *Dolomedes triton* carrying egg sac. Photo: Tyler Cobb.

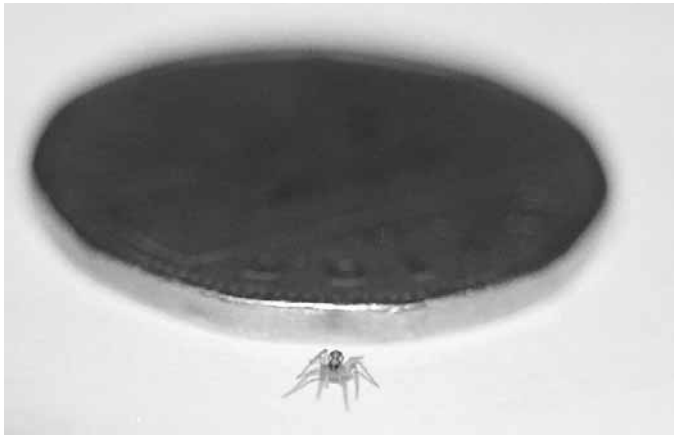


Figure 3. Minuscule first instar *Dolomedes triton* (foreground) with loonie (background) providing a reference for size. Photo: Tyler Cobb.

Regardless of my experimental design flaw, I observed something that to my knowledge has never been recorded for *D. triton*. Spiderlings do not just balloon after exhibiting the pre-ballooning "tiptoe" behaviour observed by Graham (2002) but, especially at higher wind speeds, individuals may use the ancestral, suspended ballooning method. The phylogenetics of this method was described by Bell *et al.* (2005) and the mechanics were described by Coyle (1983). Briefly, this method involves descending on a silk line, catching the wind and then blowing out horizontally until the line breaks at its point of attachment. A few spiderlings also performed a surprising behaviour that I describe as "kiting". These spiderlings would tiptoe, take off with the wind, but then hover in the breeze about 30 cm above the platform to which the dragline remained firmly attached. (Perhaps they did not have time to sever their draglines before being whisked away by the wind.) Occasionally, spiderlings tiptoed as if to balloon then released long strands of silk that became affixed some distance away on a barrier such as a wall in the area where I conducted my experiments. These trapeze artists then walked along their extended, aerial strands. Clearly, *D. triton* has many and varied short and long term dispersal methods.

This summer I will re-examine ballooning in *D. triton*. With proper replication this time, I will determine if food availability affects late instar female and spiderling propensities to balloon. Weyman *et al.* (1994) addressed a similar question and used the linyphiid, *Erigone* spp., but the effect of starvation on the ballooning behaviour of other species has not been tested. I will also assess whether the frequency of ballooning juveniles differs dependent on whether they originated from egg sacs collected on permanent versus temporary ponds. Dispersal polymorphisms are common for freshwater insects in the sorts of habitats I will sample but are unknown for spiders. Thus, I hypothesize that *D. triton* females collected from large, permanent ponds should have egg sacs containing juveniles that won't balloon as frequently as those collected from small, temporary ponds. The answer to these and other questions will just have to wait until the end of this summer.

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Canopy arthropods in hardwood forests of southern Québec

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Ever since the day Raymond Hutchinson mentioned to me that Dr. Herb Levi once told him he was convinced at least five new species of Theridiidae lived up in the tree tops of eastern North America, I wondered what spider species reside in our Canadian treetops. To date, only Neville Winchester (University of Victoria) and his colleagues in British Columbia sampling the treetops of Sitka Spruces (*Picea sitchensis*, (Bong) Carr.) and some work by Sandy Smith (University of Toronto) in Ontario's hardwood forests have provided any data on canopy arthropods in Canada. Winchester's work in particular has provided indications that potential new spider species reside in our Canadian tree canopies. Still, we know precious little about canopy arthropods across Canada and nor has systematic and rigorous ecological work been conducted in the treetops. Will we find new species or perhaps merely subpopulations of species already known to live at ground level? From a conservation standpoint, assessing the unknown fauna in canopies is critical to our evaluation of ecosystem biodiversity. This is simply because the ecological signals we detect at the ground level may not reflect those in the canopy.

Some of these and other questions will be addressed within the next few years (at least for the hardwood forests of southern Québec) as Dr. Chris Buddle's arthropod ecology laboratory at McGill University assesses the contribution of canopy arthropod diversity to the arthropod species pool of various ecosystems. In this report, I summarize some of the ecological hypotheses I will test while investigating the canopy arthropod fauna of the southern hardwood forests of Québec and briefly describe the methodology I will employ to test these hypotheses.

For my doctoral research, I propose to describe and compare the diversity of select arthropod groups, including spiders, found within and between two dominant tree species of mature hardwood forests of southern Québec: Sugar Maple (*Acer saccarrhum* Marsh) and American Beech (*Fagus grandifolia* Ehrh.) Using a hierarchically nested design, the canopy and the understory around individual trees of each tree species (smallest scale in the hierarchy) will be sampled in hardwood stands (2nd scale), replicated in hardwood sites (3rd scale), and lastly replicated within the greater Montréal area (4th scale). Sampling will be conducted in two of McGill's research forests (UNESCO biosphere reserve of Mont St-Hilaire and the Morgan Arboretum), and at two of Québec's provincial parks (Mont St-Bruno and Oka). All of these sites

are within 80 km of each other and are on or near the Island of Montréal. Arthropods will be collected using 3 methods (branch clipping, Lindgren funnel traps, and sticky traps on trunks) to cover most exploitable niches available in the treetops and in the understory. Sampling in the canopies will be done with the help of the DINO 260xt (Figure 1), a mobile aerial lift platform that can reach heights of 26 m and be transported from site to site. Sampling procedures will be conducted during the summers of 2005 and 2006.



Figure 1. Aerial platform (DINO 260xt) that will be used for collecting canopy arthropods.

In order to test ecological hypotheses about the importance of canopy arthropod diversity in hardwood forests of southern Québec, the first essential step will be to characterize the diversity (richness and composition) of the arthropods found in the canopy and the understory (up to 2 m above ground) of both Sugar Maple and American Beech trees. This will allow me to determine if canopy arthropod diversity is distinct from that of the understory. Once this characterization is complete and I have an idea of the richness and composition of species living in the canopy of both tree species, I will tackle a classic problem when dealing with large arthropod samples: the problem of "apparent" rarity. Apparent refers to species collected with low abundance for reasons such as inadequate or insufficient sampling, transient or tourist species in the study area, species at extremes of their geographic range, or species at extremes of their niche in a habitat. I will determine if apparent rarity varies from one sampling method to another and also whether it is scale-dependent.

The contribution of each spatial scale (vertical and horizontal) to the regional species pool (γ diversity) will be assessed by adding the contributions made by α diversity (mean within-sample diversity) and β diversity (mean between-sample diversity), an approach defined by Lande (1996). The significance of the diversity patterns observed at each scale will be tested against the null model hypothesis (H_0), that of the random distribution of species in space.

I will also investigate how α diversity and β diversity change across spatial scales as a function of life history traits, *e.g.* dispersal (good vs. bad) or habitat affinity (specialists vs. generalists). These traits will be determined through information contained in the literature and by using the maximal indicator value of habitat specificity rendered by the IndVal software package (Dufrêne and Legendre 1997). Dispersal ability will further be assessed in a controlled laboratory environment (as per methods described by Bonte *et al*. 2004).

This study will provide novel information about arthropod diversity within two dominant stand types in our hardwood forests. It will also illustrate a new direction to canopy research in north-temperate forests, one that is not limited to inventories but also tests ecological hypotheses. Sampling devices and the methodologies have greatly improved over the last two decades, and with the use of the mobile lift platform, this new dimension to canopy arthropod research in Canada will be successful. In addition, I hope to collaborate and solicit wider interest in the material we collect in Québec's forest canopies. If you have a particular interest in some of the material, please contact me for more information. Although Québec's spider fauna has been well described (Paquin & Duperré 2003), I do hope I can prove Herb Levi correct. Perhaps there are new Theridiids and other undescribed species in our canopies.

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Working on the Genus From Hell

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I came to California with the intention of working on a rapid evolution scenario involving a few spider species that are 'specialist' on a desert bush (creosote bush, *Larrea* spp.). The idea was quite simple: it was thought that this bush had been present in North America for no more than 10 000 years, which seemed incredibly short to harbor any specialized species. Could an environment such as the deserts of the southwest USA exert such pressure to promote rapid evolution? The question was interesting enough to devote it some time. But shortly after my first field trip in the SW deserts, a publication showed that the time estimation of the presence of *Larrea* in North America was wrong, and instead, the occurrence of the bush had to be measured in millions of years. That spider project went down the drain.

Meanwhile, my post-doc advisor Marshal Hedin, received a modest grant from Fish and Wildlife to test a molecular approach to solve a problem related to the distribution of an endangered spider found in Texas caves. He offered me the project and I remember saying 'yes', thinking that it would be done quickly and that I could hit something interesting. Oops… that was a mistake. Basically, we were interested in delimiting the distribution of *Cicurina madla*, an eyeless cave species that, until recently, was thought to be restricted to Madla's Cave (Bexar County, Texas). The problem is that collections of cave *Cicurina* rarely yield adult specimens, and morphology does not allow species level identification of immatures. On the premise that juvenile spiders harbor a similar molecular signature of adults, the use of standard phylogenetic molecular analysis should allow us to 'identify' a juvenile that clustered within a clade 'anchored' by an identified adult. I communicated the news to Don Buckle about this new project and his reaction was: ha ha, you will be working on the genus from hell! Only now can I tell how prophetic that comment was.

Ironically, the first species I ever tried to identify when I started to be interested in spiders in 1998 was *Cicurina brevis*. At the time, Jim Redner had generously provided me with names for a few spiders I'd collected with a winter pitfall of my design for my work in the boreal forest of Québec. He also suggested that I start learning how to identify spiders… and I tried! I made copies of a few taxonomic papers, including Chamberlin & Ivie (1940), and hit the microscope with the first specimens. All *Cicurina* that Jim identified for me from these winter samples were determined as *Cicurina pallida*. I studied the specimens I had under the scope and determined them as *C. brevis*. Then I compared them with the specimens Jim identified and I could not figure out how he'd distinguished *C. brevis* from *C. pallida*. All these specimens simply appeared identical to me. Even after several hours and the most 'splitting mind' possible, I still could not tell them apart. I thought that arachnology was too subtle for me and I waited until my subsequent visit

to the CNC to ask Jim for some help with the problem. He looked at all the specimens (the one I determined as *C. brevis* and those that he determined as *C. pallida*) for about 20 minutes without saying a word (Jim likes to be sure about what he says) and then looked serious and said: do you know the term *lapsus calami*? Of course I'd never heard the term before, my Latin classes were restricted to short stories about a master, table and a dog. He added with a large smile: these all are *Cicurina brevis*. Of course, this early support by such an eminent arachnologist had a major effect on my enthusiasm for spiders! A bit later, I went to the world famous spider class given by Fred Coyle and Bill Shear in North Carolina. About the same time, I met Charlie Dondale and was shocked at how nice all these people were. I thought: it must have something to do with the spiders! So I then decided to become an arachnologist too, and become nice (for the sake of my social life). So here I am, in California, still trying to become nice.

My actual project relates to the entire *Cicurina* genus: I am trying to establish the phylogenetic relationships of the numerous species (~130). This task is intimately linked to the species limits that are problematic in the genus for several good reasons. Therefore, I am accumulating morphological and molecular data to propose a comprehensive scenario (taxonomy and evolution) for this 'difficult' genus. The difficulties are on several levels - just like hell, which apparently is also pretty complex… and the road to it is paved with good intentions, just as my *Cicurina* interests.

A few facts,

To understand the project better, we first must know that most species of *Cicurina* are found in North America about 10 species in South-East Asia, and one in Europe. A fascinating portion of the genus includes 70 eyeless species found only in caves, mainly in Texas. This is one of the most impressive (and mysterious) radiations of troglobites. Other surface *Cicurina* are found all over North America, except in the coldest parts of the continent, and southward to northern Mexico.

The initial seed of the actual project - the use of a molecular approach to solve the distribution of *C. madla*- turned out successfully (see Paquin & Hedin 2004), but the data showed more than the distribution of a particular species: 1) it provided a method of identifying any juveniles for which we have adults, 2) we can use the method to detect undescribed species, 3) the radiation of troglobites seemed monophyletic 4) the distribution of a species can range from a single cave to all the caves found within a radius of 20 km, and 5) we can use the molecular approach to test species boundaries independent of morphology. In Paquin & Hedin (2004) we included data on *C. varians*, a troglophilic species, and the analysis suggested that the amount of morphological variation of the female spermatheca is extraordinary. This was the belief of many arachnologists who dared to look at the genus, although it has never been demonstrated or tested. Rich with knowledge, it seemed that the best thing to do was to collect fresh *Cicurina*, both for morphology and molecules to test this 'incredible variability', if we wanted to have the relevant data to reconstruct the phylogeny and evolutionary history of the genus.

… and many problems!

Many species of *Cicurina* are known only from females, as males are apparently rare. This is especially true for cave species. Interestingly, in the cases where the males are known, they are of little taxonomic value, as the male of closely related species are incredibly similar. As a consequence, most of the taxonomy and classification is based only on female genitalic morphology. But this is only the start of a long list of unusual things that happen in *Cicurina.* Here are a few examples.

1) Variability

Two arachnologists worked on the genus and left us with many unresolved questions and problems. A major revision of the group was published by Chamberlin and Ivie (1940). They described many species based on tiny variations in the female genitalia but did not provide any justification for the cases where they reported larger variation. For instance, it seems difficult to justify any other species illustrated on the same plate from the variation shown for *Cicurina intermedia* (Brignoli 1979). A few of the names of Chamberlin

& Ivie (1940) have been synonymized, however several doubtful species are still valid (Bennett 2005). In the Chamberlin and Ivie (1940) paper, many of the 'species' described are only known from a single specimen (a bit doubtful) and in the case where males were known, they only provided an uninformative lateral view of the palp (a bit useless).

The second most important player is W.J. Gertsch. He published a paper in 1992 (he was about 80 years old then) in which he described ~60 species that belong to the subgenus *Cicurella*, which included all the eyeless *Cicurina* species found in Texas. He described everything he could from museum specimens that were collected over the years by spelunkers. He did a remarkable job considering the amount of material available (only a few specimens in most cases), which should be considered as extremely bold and something only an experienced arachnologist could do. His work is even more remarkable, in that he had, apparently, no idea where the caves were located (useful information for knowing which caves may harbor the same species). He was a bit reluctant to publish the work because he felt that not enough information was available (number of adults in particular) to make solid decisions. He had a hard time making up his mind about species limits: boundaries were constantly changing between the several versions of the manuscript (J. Reddell, *pers. comm.*). However, he 'decided' to publish the taxonomic work for the necessity to have described species for the sake of cave conservation. Thank you for that, Willis!

But Gertsch -as Chamberlin- did not suspect that *Cicurina* could be so extraordinarily variable. Both arachnologists recognized very little variation in that genus and therefore we've inherited a situation where most of the previous work has to be re-examined in detail. Recently, Cokendolpher (2004a, b) described a few additional eyeless *Cicurina* species from Texas caves, following the traditional line of little (or no) variation. In the light of the present work and molecular evidence, the limits of these species will also need re-assessment.

The illustrations given for the variability of *C. varians* in Paquin & Hedin (2004), shows what is actually considered to be 2 or 3 distinct species. Could this be unique in the genus? Let's take a look at the spermatheca of a specimen (Figure 1) that I've collected near Flagstaff (AZ), near the type locality of *Cicurina arizona*. In the spider world, we are used to a perfectly symmetrical structure. This asymmetry is a bit unusual. Interestingly, the left side of the structure is very similar to *C. varians* as illustrated by Chamberlin & Ivie (1940) while the right side looks like *C. cavealis*. Not even looking like *C. arizona*, the species that apparently 'lives' there. Is that asymmetry highly exceptional? Not really. I took a look at the *Cicurina* specimens curated at the California Academy of Sciences and found several similar cases. The really troublesome fact about my collection near Flagstaff is that none of the 11 females I found on that day look alike, and the size of the spiders ranges from 10 - 20 mm despite the fact that they were only collected a few meters from each other. The molecular data for these spiders however suggests that they all belong to the same species, with a rather weak population structure! Therefore, what should we think of the subtle variation used to distinguish similar species such as *C. robusta* and *C. arcuata*? That is one case among many that remains, so far, unsolved.



Figure 1. Spermatheca of a female collected near Flagstaff (AZ), close to the type locality of *Cicurina arizona*. The left portion of the spermatheca is similar to *C. varians* and the right part to *C. cavealis*.

A lot of the present work is in assessing if the long-established species delimitations are mistaken. For instance, *C. reyesi* is an eyeless species known only from Airman's Cave (Travis County, Texas) described by Gertsch (Fig. 2a). Gertsch established this species based on a single specimen and his

illustrations are rather weak. It turns out that it is quite difficult to separate *C. reyesi* from *C. cueva* (Figure 2b) and *C. bandida* (Figure 2c), two species also known only from a few specimens each. In fact, the caves that harbor these three species are found within a 20km area. Recently, I collected a mature female in Airman's Cave that Nadine Dupérré (one of the best female arachnologists in this solar system) illustrated for me (Figure 3). It seems difficult to match this specimen with certainty with any of the three species illustrated by Gertsch from the same region. In fact, the new illustrations match *C. bandida* better (Figure 2c) than the illustration of the other known specimen from the same cave (Figure 2a). Further work is needed to delimit species boundaries and intra-specific variation. Species determination relies on genitalic

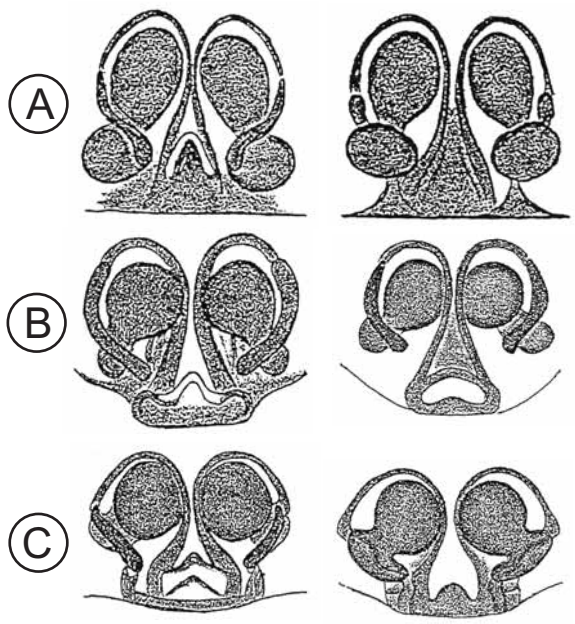


Figure 2. Spermathecae reproduced from Gertsch (1992). A) *Cicurina reyesi*, B) *Cicurina cueva* C) *Cicurina bandida*.

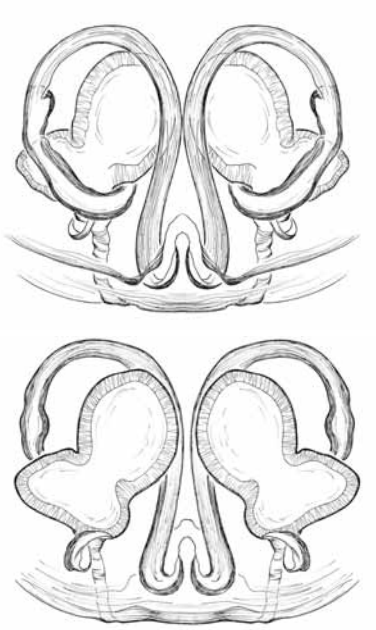


Figure 3. Spermatheca of a specimen recently collected in Airman's Cave, the type-locality (and only known locality) of *Cicurina reyesi*.

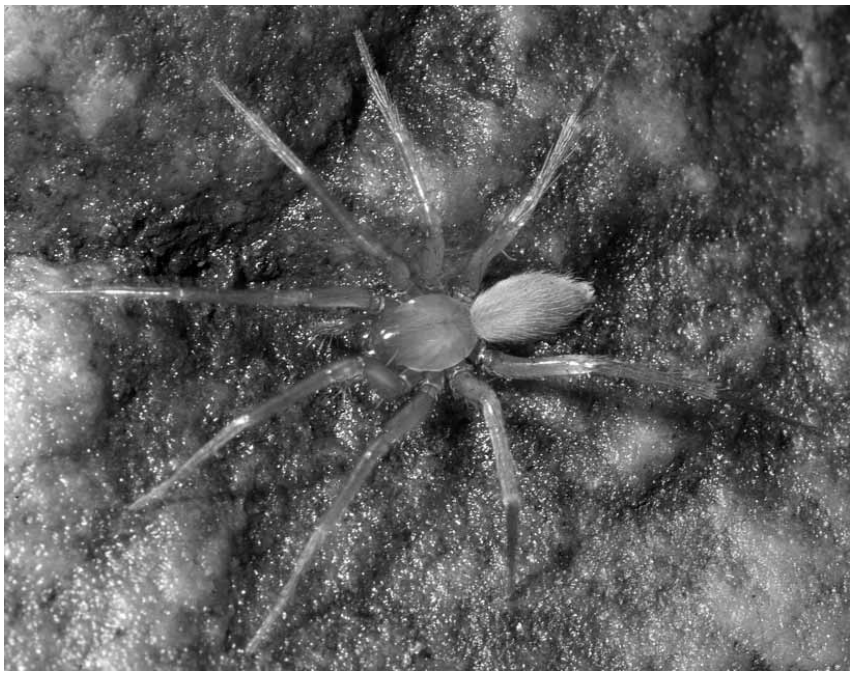


Figure 4. *Cicurina cueva*, an eyeless species found in a few caves of Travis County, Texas. Photo: Jean Krejca (*aka* Dr. Creature).

structures of the females but at least, eyeless species of *Cicurina* are easy to recognize at the genus level (Figure 4).

2) Collecting *Cicurina*

Except for a few common surface species such as *C. brevis* and *C. arcuata* in the East, *C. simplex* and *C. intermedia* in the West, and *C. varians* somewhere in the middle, the collection of most species is difficult and enigmatic. Why are so many species known from only a few specimens - not only for cave species but also for surface species? That is an excellent question for which I can now begin to answer. Let's get back to the days when I was working in the boreal forest of Québec with the same samples from which I identified my first spider: *Cicurina brevis*. Figure 5 is showing a simple histogram of abundance of that particular species according to the time of year, including the winter months thanks to my modified pitfall (Paquin 2004). Although adults are present all year round, astonishingly, the most important collections are done when snow cover is present. This confirmed my suspicion I had following a few unsuccessful collecting trips: maybe *Cicurina* is a highly cryophilic species, and therefore mainly found in the coldest months of the year? Of course, the coldest months would vary throughout North America and altitude, but I re-oriented my collecting trip towards December and January for the warmest zone of North America and towards the latest possible period before snow cover for more northern or high altitude habitat… and bingo!, there they were. I found many species directly under rocks that were partially covered with snow, and mostly adults! That was an important step in the development of the work.

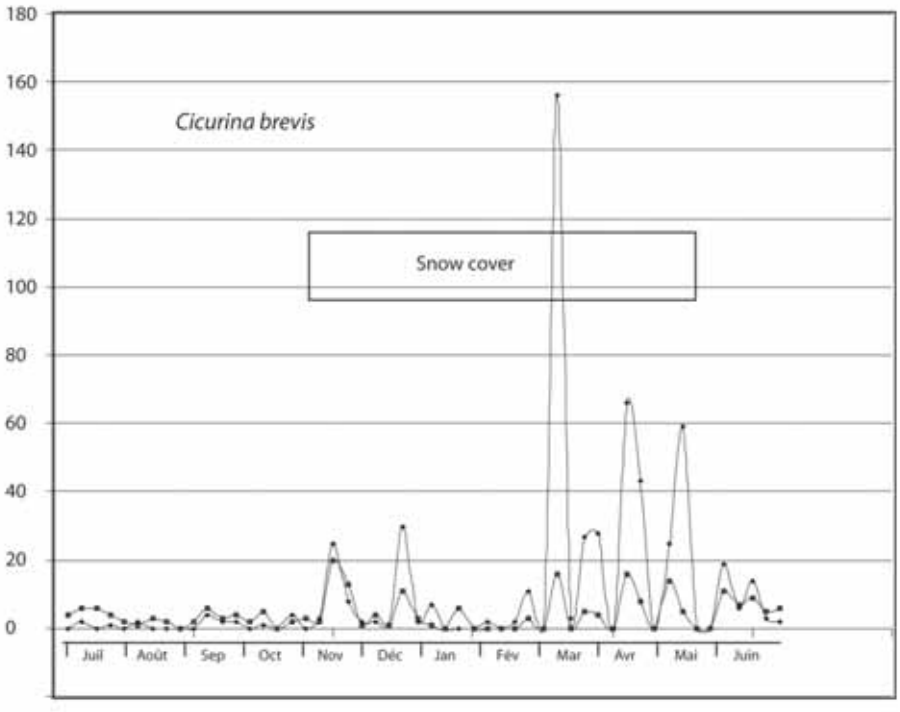


Figure 5. Abundance of *Cicurina brevis* collected by pitfall throughout the year. Note that the most important collection was done when a snow cover was present. The two lines represent male and female, females, as usual, are more abundant.

The apparent cryophilic affinities of the genus also provides an interesting basis to explain the wonderful radiation of troglobites in Texas; if *Cicurina* indeed prefer cold weather and a slight climate warming happens, they are facing two 'choices': they could either climb to higher elevations (which in Texas isn't far, but seems to have worked fine for AZ, CA, UT where *Cicurina* is only present at elevations) or, go deeper in the ground, where the temperature is cooler and stable. This idea of cryophilic affinities and multiple variations in climate over a short period of time is actually the basis of a cave evolution model that we call *progressive environment availability* on which I am working with Kemble White, a friend and geologist who guided me through my first Texas caves. I am also working on a way to test the presumed cryophilic affinities of *Cicurina* based on museum records; this is a rather challenging aspect of my research, especially on the applied statistics side.

How about collecting in caves? This is also a serious challenge. I remember having a 'sampling' chat with the eminent biospeleologist Stewart Peck (Carleton University) when I was working in the boreal forest.

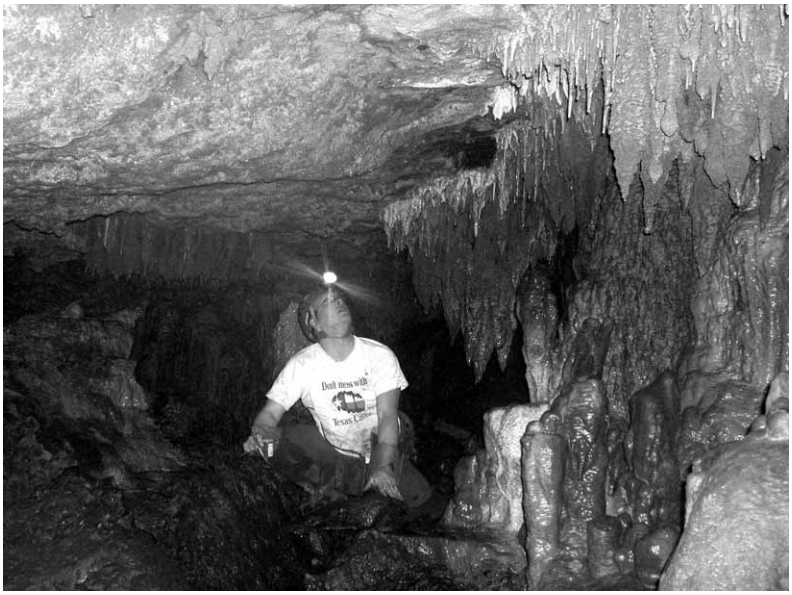


Figure 6. Sampling in Brown's Cave (March 2005). Photo: Mark Sanders, City of Austin, Balcones Canyonlands Preserve.

After he told me of a few of his caving adventures in Alabama, I recall my thoughts: *at least I don't have to do that kind of fieldwork!* And look today… that is probably fate having a good laugh at me. Indeed, I never thought I'd be into caving one day. However, the situation is a bit different now as I am doing the cave sampling myself and I have accumulated about 100 cave entries in the last year (Figure 6) in CA, TX and in 5 different states of the Appalachians.

Interestingly, the sampling period may also have an influence on the collecting success of adult *Cicurina* in caves. This could be reminiscent of the synchronicity that may have characterized the ancestral surface species. This is difficult to test because of the low number of known adults, but for instance, here is a summary of the last 2 field trips in Texas: 1) beginning of January: 31 caves, 142 immatures, 33 females and 3 males, 2) March: 42 caves, 133 immatures, 11 females, and 1 male. Despite a higher number of visited caves in the last trip, the number of collected adults is 3 times less.

The collecting efforts carried out so far and the observations made both in caves and on the surface allows us to better organize the sampling strategy. However, there is still a lot of sampling to undertake before reconstructing the evolution and phylogeny of the genus.

3) Political considerations

An important aspect of the *Cicurina* work relates to the political aspect of sampling in caves. Cave conservation is now a very delicate matter in Texas (and everywhere); most owners and societies are not particularly warm to the idea of having the caves under their protection sampled, for any reasons. While there is a positive side to such an attitude for the protection and conservation of caves, there are also some important aspects involved in the progress of scientific knowledge and data gathering that I stand for. Knowledge is often a major key in conservation issues. So far, I have been successful in convincing the interested parties that my objectives are strictly scientific, and that I have no other goals than the understanding of the biology, evolution, taxonomy as well as the promotion of scientific knowledge of spiders and cave fauna. After a slow start, I have to say that things are going very well and the number of spelunkers, biologists and interested people that are providing help for this project is becoming very impressive. Everyone has been very cooperative in providing contacts, allowing cave access or simply lending a hand. Sampling in Texas caves would not be possible without the concerted efforts of all these people. I'll take a second here to salute them all!

Another political consideration when working with eyeless *Cicurina* is the fact that four species are on the US federally endangered species list. While there is little reason to have only these four *Cicurina* listed -they all meet the criteria to be a species of concern- this particular conservation status makes their collecting a complex thing. Although, the collecting of listed species and/or species of concern requires a special permit and only given under particular circumstances, I must say that the response to the work I am doing on *Cicurina* is generally well received and is not seen as a threat of any kind.

Work in progress

So far, the work on *Cicurina* has been a constant challenge, but the understanding I have gathered is

very satisfying. The collecting has been successful; I have crossed the continent 4 times, visiting most known localities (and added several new ones) in order to collect specimens both for morphology and DNA study. Several caving trips have been successful, but several others will be needed to collect all the known species. In that regard, I have had the opportunity to meet key people in the caving community to explain my project and scientific goals, and the responses have been very positive. Let's hope that it will allow me to visit all type localities in the near future, and explore many more caves that are still harboring species unknown to science. I have so far accumulated about 1500 'fresh' *Cicurina* specimens from all over North America, and collected *Cicurina cicur* in a few localities in Europe. Several colleagues sent me specimens of the European species, and I hope to be able to cover its enigmatic distribution. Recently, I have also developed some contacts in China and will hopefully be able to gather some data for that portion of the genus in the near future. Another important part of this work involves the re-examination of the material curated in several North American museums. So far, in addition to my own personal collecting, I have processed the material of the CNC, and about half of the material of the CAS… This is good warm up session before I hit the MCZ and AMNH, which should be undertaken this fall, just before the next field season

I am carrying out this work with Nadine, and together we often have the pleasure of scratching our heads together when interpreting the morphological variations. I am fortunate enough to benefit from her help in discussing these extraordinarily variable genitalic structures, which she generously illustrates in her spare time (yeah right). It is very interesting to pose fascinating questions that the arachnological community has been pondering for many years. For instance, the recent collecting effort in the Texas caves allowed me to collect some eyeless males that are probably among the rarest and most difficult spiders to find. The work of

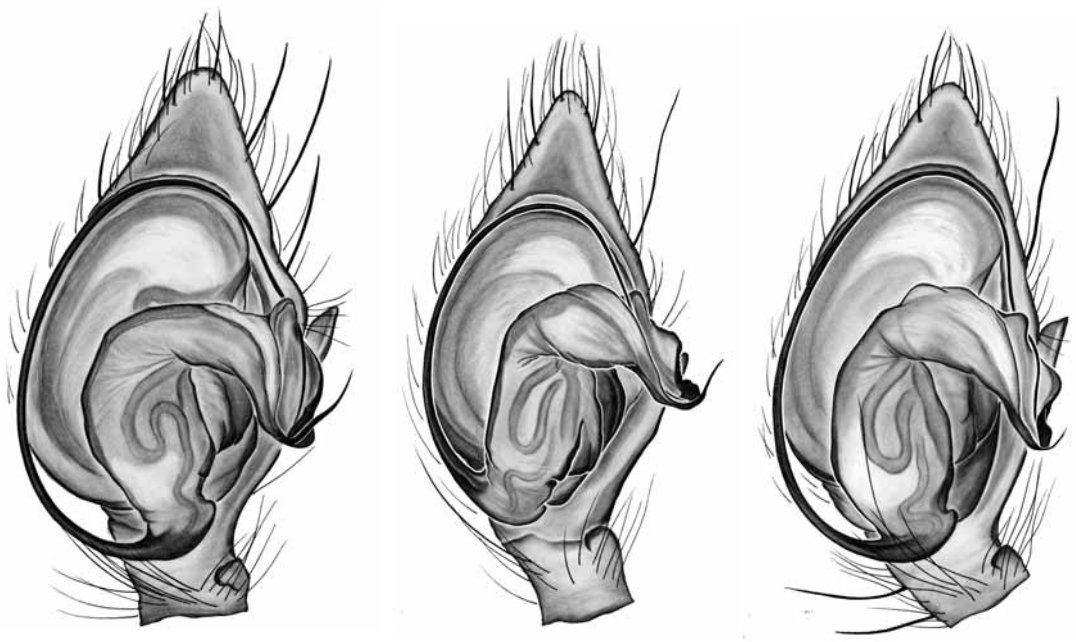


Figure 7. Underscibed males of eyeless *Cicurina*. Note the subtle variation between the palpal structures. These males are not only incredibly rare, they seem to display less diagnostic features than females do, which is also unusual.

Nadine allows us to finally address the question 'what about the males?' when dealing with cave *Cicurina*. Figure 7 shows the male pedipalp (still undescribed) for three species, which differ by only slight variations. Solving scientific questions that no one has been able to answer before is a wonderfully satisfying… which is just enough to help me forget my bruises, scratches, and contusions (even a broken rib) that such field work involves… but I simply adore it! Nadine, of course, smiles and waits outside the cave. The molecular data gathered so far, with the wonderful contribution of Nadine's illustrations and the recent collaboration of

friends, cavers and colleagues, will hopefully allow a taxonomic revision proposal for the whole genus, as well as a phylogeny in which I hope will include the Asian taxa. In addition, the ability to determine which eyeless species occur in a particular cave (based on juveniles), is a very interesting conservation aspect that minimizes the collecting pressure on the cave fauna, while allowing an investigation into the intriguing mechanisms of speciation and cave evolution. This project will also allow us to propose a comprehensive evolutionary scenario of the genus that will include two independent radiations of troglobites (one in North America and one in Asia) as well as the faunal split between North America and Asia. Almost too good to be true, but many hours of work ahead.

If you collect *Cicurina* in your backyard, on your field trip or on your next European excursion, think of me: I am known to be pretty generous, especially with wonderful Québec beer! Also, if you find yourself getting angry with someone and you tell them: *ah well, you can go to hell!*… make sure you provide them with a jar and some 100% ethanol, just in case.

Drop an email
ppaquin@sciences.sdsu.edu

or visit my web site
http://www.bio.sdsu.edu/pub/Cicurina/paquin.html

Acknowledgements

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The second annual gathering of arachnid-types at the joint Entomological Society of Canada and Acadia meeting in Charlottetown, PE 15-18 October, 2004. The group has been inaugurated as the CCCP, "Chelicerate Club of Canada..." The "P" has yet to be determined, but "Pro-pedipalps!" is one option. Photo care of H. Proctor.

New 2006 Canadian Arachnologist Calendar

The Canadian Arachnologist website has received considerable growth since its new-found home but to ensure its utility and longevity, I encourage you to contact me with suggestions for improvement. The background web log catalogs at least 25 unique visits a day from all over the world and many visitors who performed searches from well-known search engines seek images. Approximately three to four times a week during the summer months, I receive emails from visitors seeking information about arachnids found in or on their homes. Invariably, these people ask to be guided to web sites or materials containing images of typical Canadian arachnids. So, if you have a penchant for snapping shots, please consider having digital images posted on the Canadian Arachnologist website. Photo credits will be noted and all images will be watermarked. As incentive, I propose a new 2006 Canadian Arachnologist calendar that will feature 13 of the best donated shots as judged by you. The best image will appear on the cover. If we can complete this in time for the joint Entomological Society of Canada and Alberta meeting in October 2005, copies can be made available for purchase by conference participants.

Happy hunting,

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