The Canadian Arachnologist

Number 5 May 2004

Contents

Note From the Editor

I am happy to write that this is the fifth issue in a series that got its start in the bowels of the Earth Sciences building at the University of Alberta. This is still a homegrown hobby, but one worth continuing for years to come.

The CA newsletter has broadened its (some said 'narrow') membership to include folks interested in or working on all arachnids, not just Araneae. With Heather Proctor's prodding (and please note the announcement on p. 8), submitted articles in this issue illustrate the acarological activities in Canada. There are plenty more acarologists in Canada so I encourage you to pass the word and direct future members to the Canadian Arachnologist web address.

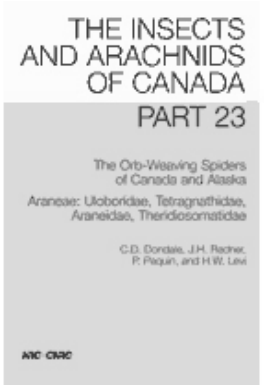
For New Recipients

In order to begin receiving this newsletter and/or to submit your autobiographical material, please visit the Canadian Arachnologist web site at http://davidshorthouse.tripod.com/arachnologist/arachnologist.html.

New Publication

Dondale, C. D., J. H. Redner, P. Paquin, and H. W. Levi. 2003. The Orb-Weaving Spiders of Canada and Alaska (Araneae: Uloboridae, Tetragnathidae, Araneidae, Theridiosomatidae) The Insects and Arachnids of Canada: Part 23. NRC Research Press.

Order your copy today directly from NRC Press at the following address: http://pubs.nrc-cnrc.gc.ca/cgi-bin/rp/rp2_book_e?mlist3_494.



Spiders on the Web

Mailing Lists

The Arachnology Internet Mailing List: This email list can be found at the following web address: http://www.topica.com/lists/arachnida.

Web Resources

The Acarology Homepage: http://www.nhm.ac.uk/hosted_sites/acarology/
The Arachnology Homepage: http://www.arachnology.org
The American Arachnological Society: http://www.americanarachnology.org.

Who Are the Canadian Arachnologists?

Interest in the Canadian Arachnologist has swelled from a few annual recipients to over 50 "Canadian Archnologists" in 8 provinces. Currently in need are members in New Brunswick and Prince Edward Island. For a complete listing of active members, please see the Canadian Arachnologist web site listed on the front page.

New Members

Bolduc, Elise

Elise is currently working on the ground-dwelling spiders in the boreal forest of Abitibi, Quebec and in the past has surveyed the ground-dwelling spider fauna in two vineyards in southern Quebec. She is an undergraduate student in the Buddle lab.

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Brochu, Marc-André

Massothérapeute, récolteur de taxus canadensis, assistant à l'inventaire des araignées de la réserve de faune du cap Tourmente. Inventaire écoforestier, repéreur de sujets fauniques pour les Productions Jean-Louis Frund, animateur et éducateur relatif à l'environnement, assistant de recherche sur sylviculture des érablières du Québec.

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Galloway, Terry D.

My job here in the Faculty of Agricultural and Food Sciences is as a Veterinary and Wildlife Entomologist, so I typically deal with a wide range of interesting problems. Over the years, I have worked on horse flies, horn flies, stable flies, house flies, warble flies, mosquitoes, you name it. At the moment, the main focus of my work is on various ectoparasites, especially fleas and lice. However, I have worked on and off with ticks since about 1979. Since the late 1980's, when Lyme Borreliosis emerged as a concern in Manitoba, I have been involved with the distribution of ticks in Manitoba, and since 1996, I have collaborated with Health Canada scientists to conduct a passive surveillance programme in the province to determine the prevalence of pathogens in the black-legged tick, *Ixodes scapularis*. In recent years, notably associated with a biodiversity study on arthropods on birds, I have become involved with various mites associated with these hosts, and I have been collaborating with colleagues in St. Petersburg to expand out knowledge of the feather mites on birds in Manitoba.

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Kanashiro, Derrick

Derrick is currently working on all sorts of soil fauna, from VAM/AM mycorrhiza fungi, soil bacteria, earthworms and grassland oribatid soil mites.

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Kaufman, W. Reuben

Reuben is currently working on the endocrinology/physiology of ticks.

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Maddison, Wayne

Wayne's research arose from a fascination with the diversity of forms and behaviours of jumping spiders, which led to systematics, which led to phylogenetic theory and computer programming. His work continues to be both empirical, on spiders, and theoretical, on the use of phylogeny in evolutionary inference.

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McDonald, Thomas

Thomas is a retired biologist and as a hobby, is collecting and studying the spiders of Vancouver Island, British Columbia. In the past, he has studied the parasites of North American fish.

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Proctor, Heather

Heather's main research area comprises the ecology, evolution, systematics and behaviour of mites(Arachinda: Acari). She is most interested in aquatic, soil, and feather mites. Her theoretical research areas include the community ecology of freshwater and soil invertebrates, determinants of biodiversity, co-evolution of hosts and symbiotes, and both macro- and microevolutionary aspects of sexual selection.

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Sackett, Tara

Tara is Ph.D. student in the Buddle lab studying the role that apple orchard spider assemblages play in the control of a particular apple orchard pest, the obliquebanded leafroller. She is also evaluating the clay particle spray, kaolin, both for its efficacy in controlling the leafroller and to determine how it affects the spider populations in the orchard. In addition, she is examining the effects of surrounding forest habitat on spider communities within the orchard.

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Varady-Szabo, Hirondelle

Hirondelle is undertaking her M.Sc. examining arthropods and dead wood in the Buddle lab. Her project comprises two experiments: 1) the effect of type (deciduous and conifer) and decomposition level of fallen logs on spider and ant communities found in a Maple dominated forest in Forillon National Park and, 2) the effect of forest type (Maple, Aspen and Conifer) on the spiders and ants associated with fallen logs. Additionally, she is comparing the spider and ant communities found on the fallen logs to those adjacent to and farther away from the logs.

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Wu, King Wan

King is a systematics technician and is currently revising the Ticks of Canada. In the past, he has studied the general systematics of mesostigmatic mites.

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How to Contribute to the Canadian Arachnologist

Contributions to the Canadian Arachnologist annual newsletter may be sent to the editor at any time throughout the year. To be certain that contributions will be published in the May 2005 issue, please send your articles or news items no later than April 16, 2005. There are no page fees and copies are freely distributed to Canadian recipients. Additional copies may be ordered at the recipient's expense. Back-issues are deposited and permanently stored in the Cameron Library at the University of Alberta.

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Mitey Goings-on at the University of Alberta

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I have been working on the ecology and behaviour of mites (yes, they are arachnids, too!) since my undergraduate days at the University of Alberta. In 2002 I was lucky enough to be awarded a professorial position at my old alma mater after 5 years of wandering in the wilderness of Australian academia. In Australia I continued to work on my old favourites, water mites (Acari: Parasitengona; Hydracarina), but also began to explore the biology of mites that lived in soil and on birds. This switch was inspired by the fact that water is rather scarce in Australia, while dirt and dead parrots are abundant! Together with my husband David Walter, now an adjunct at the U of A, and a growing team of graduate and undergraduate students, I am continuing all three themes with Canadian mites. The purpose of this article is to provide a brief report of the mitey goings-on in the Proctor-Walter lab.

(1) Bird-associated mites: As noted by Galloway & Danks (1990), there is surprisingly little known about the arthropods associated with birds and mammals in Canada. One of my personal goals over the next three years is to survey the feather mites and haematophagous mites associated with birds from Alberta. My freezers are packed full of avian corpses graciously donated by Fish & Wildlife Forensic lab, the Provincial Museum of Alberta, and others. Over the summer and subsequent teaching year, NSERC summer students and honors students will have their hands full with sudsy birds that they will wash to remove the mites (and lice). I am also working with several colleagues in the U.S. and overseas to describe new species of mites from parrots, kites, and other exotic birds (Figure 1).

Galloway, T.D. & H.V. Danks (1990). Arthropod ectoparasites of vertebrates in Canada. Biological Survey of Canada brief.

(Continued on page 8)

Upcoming Meetings

June 23-27, 2004: The 28th annual meeting of the American Arachnological Society at the University of Oklahoma in Norman, Oklahoma hosted by Douglas Gaffin. Deadline for registration May 15, 2004. Visit http://www.americanarachnology.org/AAS_Meetings/AAS_2004.html for more information.

August 2-7, 2004: 16th International Congress of Arachnology in Gent, Belgium hosted by Léon Baert Royal Belgian Institute for Natural Sciences. Visit http://allserv.rug.ac.be/~jpmaelfa/index.htm for more information.

October 15-18, 2004: Joint meeting of the Entomological Society of Canada and the Acadian Entomological Society in Charlottetown, PEI hosted by Donna Giberson. Visit the meeting website at http://www.acadianes.org/aesesc04.html for updates.

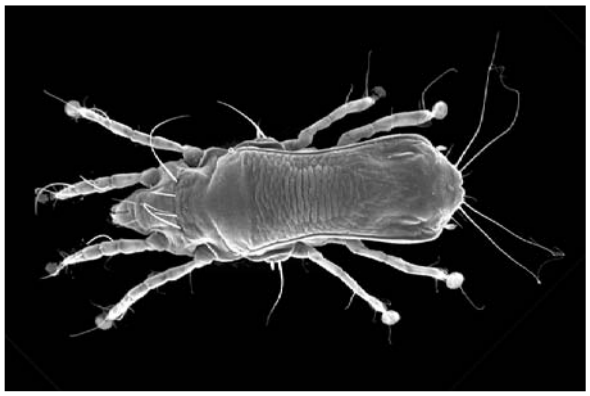

Figure 1. A new species of feather mite (Gabuciniidae: Aetacarus) from the swallow-tailed kite *Elanoides forficatus*.

(2) Host-plant specificity of soil invertebrates: Host-plant-specificity among phytophagous arthropods is well documented (e.g. Lepidoptera selecting certain food plants). But does this also occur among the denizens of the rhizosphere, the area around plant roots? Danica Belter, my M.Sc. student, will be studying boreal forest plants to determine whether there is evidence of host-specificity among below-ground mites, springtails, and nematodes.

(2) Habitat change and mite assemblages in the Yukon: Canada's north will be faced with major changes in climate (global warming) and habitat alteration (e.g. increased nutrient input) as human influence expands in intensity. Dr. David Hik from the U of A has been studying the effects of greenhouse warming and nutrient addition on Yukon plants for the past several years. Our honors student, Andrea Moore, is examining how warming and nutrients affect the assemblages of mites that live in the litter beneath these plants. One of the most exciting findings from Dave Walter's point of view was large numbers of mites from the family Arctacaridae, a cold-restricted group of Mesostigmata. It will be interesting to see whether this family is more negatively affected by the greenhouse treatments than other mites (Figure 2).

Figure 2. A face-on view of a menacing male *Arctacarus* sp. from the Yukon.

(Continued on page 9)

Upcoming Gathering

Lovers of spiders, mites, harvestmen, pseudoscorpions and their relatives, mark your calendar for the first inaugural Chelicerate Club of Canada get-together at the Entomological Society of Canada meeting in PEI (15-18 Oct, Charlottetown). Even pycnogonid fanciers are welcome! We will be assembling in an informal fashion for lunch or dinner (location and time TBA) to chat about our favourite animals, and to plan for a more formal symposium at the 2005 joint meeting of the Entomological Societies of Canada and Alberta in Canmore. Please let Heather Proctor know if you are interested in joining the arachno-fun in Charlottetown (hproctor@ualberta.ca).

(3) Effects of earthworms on microarthropod assemblages: Alberta, like much of northern North America, was rendered almost earthworm-free during the last glaciation. Most worms in the province have been brought here by human activity, including deliberate release. There has been much recent hype about the potential disastrous effects of earthworm invasion on native fauna. Mike Goad, an honors student supervised by me and Dr. Cindy Paszkowski, is running lab experiments to determine whether addition of earthworms does indeed affect soil microarthropods. Oribatid mites are a particular focus, because of previous documentation of ill effects of worms on these animals.

(4) Mites of pyrophilous carabid beetles: Dr. John Spence has been a long-time afficianado of both arachnids (*Dolomedes* spiders) and carabid beetles. When he set his honors student Andrea Dechene to work on the habitat preferences of *Sericoda* spp. carabids, little did he know that arachnids would rear their little heads (ok, gnathosomas). These beetles are pyrophilous, meaning they prefer to inhabit recently burned woodlands. In counting pitfall-trapped beetles, Andrea noticed that some of them had rather large mites underneath their elytra. Her honors project quickly changed course and became a survey of mites associated with two species of *Sericoda*. So far half a dozen genera from several families have been found. What are they doing on the beetles? Some species are probably parasitic, but as for the others, that we have to wait for Andrea's NSERC work this summer (Figure 3).

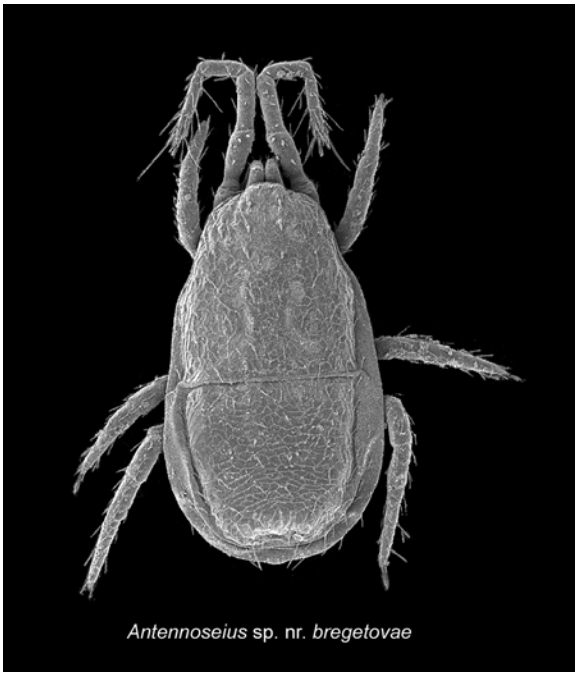

Figure 3. A new species of *Antennoseius* nr. *bregetovae* from carabid beetles in Alberta.

(5) Cross-border trade in potted plants and inadvertent importation of arthropods: In Australia, quarantine inspectors are particularly paranoid about movement of soil into the continent from elsewhere. Justifiably, because that is how the ferocious fire ant arrived in Queensland a few years ago. Canada is more lax in its requirements for phytosanitation, but even our inspection agency requires “root washing” and repotting of garden and house plants that cross the border. But how effective is this process in removing mites and other soil arthropods from the root mass? This is the honours project of Sean Bromilow, jointly supervised by me and Dave Walter. He has extracted the soil from a wide taxonomic range of imported plants purchased from local greenhouses, and has experimented with the efficacy of root-washing. The short answer is: root-washing gets rid of some creatures, but there are many tenacious ones left behind.

Mini article on big fat ticks!

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Ticks of the family Ixodidae remain attached to a host for up to several weeks, the specific duration depending on many factors. The extended feeding period is divided into three phases. (1) The 'preparatory phase' (1 or 2 days), (2) the 'slow feeding phase' (4-9 days), during which the female mates (in almost all species, mating takes place only on the host), and increases her weight ~10-fold, and (3) the 'rapid feeding phase' (up to 1 day), during which the female increases her weight a further 10-fold and detaches from the host. Ten days following feeding, egg laying begins. Virgin females rarely enter the rapid feeding phase, even after 40 days on the host (Kaufman & Lomas, 1996). Pappas & Oliver (1972) proposed that the trigger for female engorgement is a protein ('engorgement factor'; EF), contained in the spermatophore and transferred to the female during copulation.

Amblyomma hebraeum is a cattle tick from sub-Saharan Africa. To identify EF in *A. hebraeum*, we extracted a cDNA library from the testis, and isolated 35 feeding-induced transcripts (Weiss et al. (2002). We produced recombinant (*rec*) proteins from these transcripts, and found that two (recAhEFα and recAhEFβ) were necessary and sufficient for EF-activity (Weiss & Kaufman, 2004). recAhEF causes a full engorgement response at an effective haemolymph concentration of 10 nM or less (Figure 1). We have now given EF a more colourful name: 'voraxin' (from the Latin, *vorax*, for 'gluttonous', or 'voracious').

Ticks have long been recognized as important vectors of paralytic toxins and numerous pathogens (viruses, rickettsiae, spirochaetes and protozoa; Sonenshine, 1993). *A. hebraeum*, for example, is the vector for *Ehrlichia* (formerly *Cowdria*) *ruminantium*, the rickettsia which causes 'heartwater'. It has been estimated that 80% of the world's cattle population is at risk from ticks and tick-borne diseases, and global losses due to ticks (including the cost of control measures) were estimated at $US 8 billion in 1984 (Tellam et al., 1992); although I'm unaware if there are more recent estimates, the amount today is undoubtedly much larger.

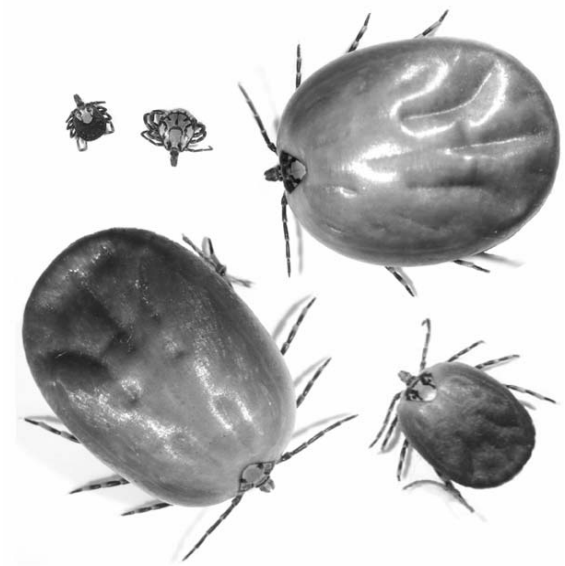

Figure 1. Virgin female *Amblyomma hebraeum* will not feed beyond a 'critical weight' (CW) of approximately 10x their unfed weight. Two feeding-induced transcripts from the male gonad encode proteins that induce virgin females to engorge. Clockwise from upper left: unfed female and male; normally engorged female; virgin female at the CW; engorged virgin female injected with recombinant *A. hebraeum* engorgement factor (recAhEF).

Ticks have negative effects on their hosts beyond what their relatively small size would suggest. To give just two examples: (1) the African tick, *A. variegatum*, achieves an engorged weight of 1-3 g, but causes a live-weight gain loss of 45-60 g in host cattle; (2) another African tick, *Rhipicephalus appendiculatus*, achieves an engorged weight of 0.3-0.6 g, but causes a live weight gain loss of 4 g in the host, and a milk loss of 7 g (Pegram et al., 1993).

Throughout the world, insecticides (redubbed "acaricides" when used for controlling ticks and mites) still represent the major control strategy for ticks. For well-known reasons, there is a significant incentive to minimize the use of chemicals for the control of ectoparasites. Fortunately, there seems to be a promising alternative for controlling ticks. Unlike most blood-sucking insects (eg mosquitoes), ixodid ticks remain attached to the host for up to several weeks. During this

time they secrete numerous antigenic salivary proteins into the host. In response, many hosts develop antibodies against these antigens which substantially inhibit the degree of tick-feeding (and pathogen transmission) during subsequent tick infestations (reviewed by Wikel & Bergman, 1997). The idea that one might be able to vaccinate livestock against tick feeding is attractive, because vaccines have no negative impact on the meat or the environment, are highly specific against the target pest, and immunity endures.

The early approaches to immunological control focused on the potential of using salivary gland antigens, because these are the ones that are normally injected into the host. The tick proteins proving to provide the greatest protection to hosts, however, are so-called 'concealed antigens' - those that are not normally injected into the host by feeding ticks - and there are now basically two commercially-available vaccines on the market (TickGARD™ and Gavac™), both based on the same Bm86 antigen (reviewed by Willadsen et al. 1995). Adult female *Boophilus microplus* (a tick prevalent in Australia, the Caribbean and South America), feeding on cattle immunized against Bm86, suffer a 5-27% reduction in engorged weight.

It is because voraxin is a 'concealed antigen' and is required for an essential physiological process, that we considered its potential for a superior anti-tick vaccine. To test this, we immunized a rabbit against the two recombinant peptides comprising *rec*voraxin and then exposed the rabbit to normal female *A. hebraeum* (with males) for up to 14 days. The results were unambiguous: almost 75% of females feeding on the immunized rabbit failed to enter the rapid feeding phase, and none of them produced eggs; 100% of controls engorged and oviposited normally (Weiss & Kaufman, 2004).

There is still much to learn about voraxin and its potential to serve as the basis for an effective anti-tick vaccine. For example:

- Where is voraxin produced in the testis?
- Where in the female is its site of action? Does it act within the seminal receptacle which then secretes a signaling molecule into the haemolymph or (perhaps more likely) is it transported into the haemocoel where it acts directly on the synganglion, perhaps stimulating the neural pathways associated with feeding?
- Except for rare instances of parthenogenesis, virgin females in all ixodid species do not fully engorge. Hence, are there homologous voraxins throughout the family Ixodidae?
- If the answer to the latter is "yes", are the homologues similar enough that a vaccine based on one *rec*voraxin can protect hosts against a large range of ixodid tick species?
- Tick-borne pathogens are transmitted to the host via the saliva. Female ixodid ticks utilize their salivary glands to excrete the excess fluid of the blood meal, and thus normally secrete very large volumes of saliva compared to other blood-sucking organisms (Kaufman, 1989). When feeding is inhibited, so should salivation be inhibited. If all this is true, would a vaccine based on voraxin not only inhibit tick feeding and subsequent egg production, but would the attenuated salivation also afford the host some protection against tick-borne pathogens?

We are now designing experiments to address these questions and, if the editor doesn't mind allowing me a short plug (!), we are looking for at least an extra graduate student and postdoctoral fellow. If you are interested, please e-mail me (reuben.kaufman@ualberta.ca).

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Canadian Arachnologists - Then and Now

(Photos Supplied by R. Holmberg)

The Canadian contingent at the American Arachnological Society meeting in Ottawa (July, 1990)

Select Canadian members enjoying a meal overlooking the Rideau Canal in Ottawa (August 2003)

Clockwise from left:
Robert Holmberg, Charles Dondale, Christopher Buddle, Nadine Dupérré, Robb Bennett, Pierre Paquin, and Catherine Holmberg

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