Canadian Spider Diversity and Systematics

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Introduction

It can be stated accurately that spiders are to be found everywhere (with apologies to William Morton Wheeler who originally made this claim for ants). Spiders, unique among all organisms in their modes of silk production and usage and of reproduction, are common (if often inconspicuous) predatory arthropods in all terrestrial and many aquatic ecosystems throughout Canada. From marine intertidal zones to tundra and rocky peaks, and all points between, the ardent araneologist is always close to a wealth of species and numerous specimens of great intrinsic and biological interest. Among all organisms, spiders form the seventh largest order. Furthermore, spiders are ruthless storm troops in the matriarchal anarchy that is the arthropod world: theirs is the most diverse, female-dominated, entirely predatory order on the face of the earth. As such, spiders are key components of all ecosystems in which they live.

Twenty years ago, Dondale (1979) listed 33 spider families with 1256 known Canadian species. He estimated another 144 unrecorded or undescribed species were likely part of the Canadian fauna. Araneology is blessed with some of the very best systematists in the world and in the intervening years spider taxonomy and systematics have been highly active fields (e.g. see the Introduction in Platnick 1997). Canada's spider record now stands at 38 families: two families have dropped out of the list (one does not occur in Canada and the other is generally considered a subfamily), five families have been added through the apparent resolution of polyphyletic and paraphyletic groups, one family was apparently missed or perhaps included in Theridiidae, and one family (Bennett and Brumwell 1996) has been newly collected. Recent revisions have added considerable numbers of species to some groups, particularly those with predominantly cryptic, ground-dwelling members (e.g. Gnaphosidae – 63 species (Dondale 1979) *versus* 100 species (Platnick and Dondale 1992)). Such groups have historically been passed over in favour of those with larger, showier, or otherwise more obvious members (Alderweireldt and Jocqué 1993). Many genera within some cryptic spider groups with considerable numbers of Nearctic species such as Linyphiidae, Dictynoidea, and Amaurobioidea still await serious revision and within these groups may lie numbers of unknown species with Canadian representatives. Still, the number of spider species known or estimated to be awaiting discovery in Canada is relatively unchanged from Dondale's estimate – there are probably at most 1,500 spider species in Canada. This is about 35% and 4% of the world total numbers of spider families (108) and described species (nearly 40,000) respectively, not a bad representation for a land mass repeatedly bulldozed in the Pleistocene. Coddington and Levi (1991) have estimated a world total of 170,000 spider species and that 20% and 80% respectively of the world and Nearctic spider fauna have been described.

Although Canada's araneofauna is reasonably well known, precious little is known of the behaviour, ecology, habitat associations and other aspects of the biology of the majority of species. Furthermore, in spite of a rapidly growing interest world-wide in many aspects of spider biology (e.g. ecology, sexual selection, behaviour, taxonomy, and systematics) as well as in habitat-based spider inventories (see Introduction in Platnick 1997), there is currently not one professional araneologist in Canada and the vast majority of Canadian habitats have yet to

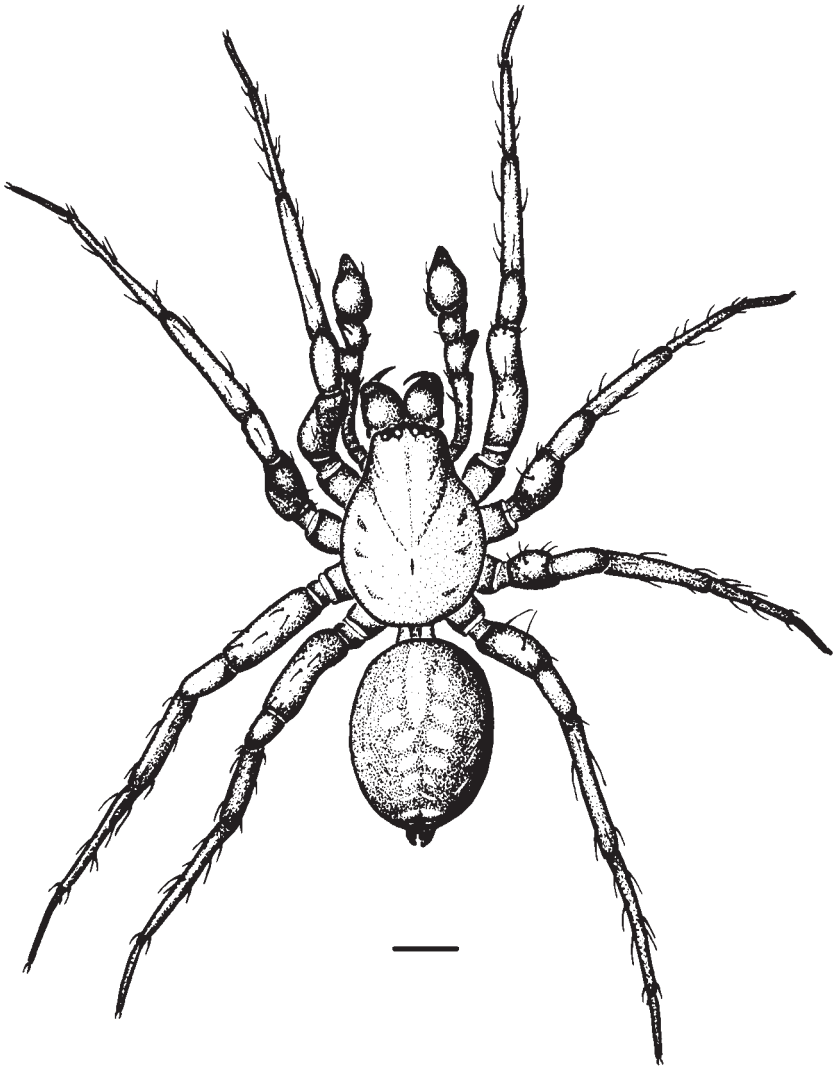


Fig. 1. Male *Cybaeus multnoma* Chamberlin and Ivie (RTA Clade, Dictynoidea, Cybaeidae). Scale bar = 2 mm.

Individuals of about two dozen species of this Holarctic genus are dominant but poorly known generalist predators in the forest floor arthropod community of the Pacific Northwest, especially in coastal regions. In Canada, six species are known to occur in British Columbia (with one species apparently endemic to the Rocky Mountains of BC and Alberta), one species may occur in southeastern Canadian forests. Many species of *Cybaeus* (most notably in Japan and unglaciated regions of the Pacific Northwest) have extremely restricted ranges and are known from only a few specimens.

be seriously sampled for spiders. Biologists seeking reliable identifications of Canadian spiders are forced to use the services of a small handful of amateur specialists located in Ontario, Saskatchewan, Alberta, and British Columbia or seek help outside the country. Under the auspices of Agriculture and Agri-Food Canada, the Canadian National Collection of Insects and Arachnids houses a large, world-class spider collection and taxonomic library. The federal government has effectively declared spider studies to be irrelevant to the agricultural needs of the nation (C. D. Dondale pers. comm.) and little use is now made of this resource.

Table: Classification of spider families with Canadian representatives (modified from Dondale 1979 and following Coddington and Levi 1990 and Platnick 1997) and estimated numbers of species in Canada. With greater knowledge of forest litter and canopy spiders, the number of species found in Canada should approach 1,500.

	Species*
ORDER ARANEAE	
Suborder Opisthothelae	
Infraorder Mygalomorphae	
Fornicephalae	
Atypidae	1
Antrodiaetidae	2
Tuberculotae	
Mecicobothriidae	1
Dipluridae	1
Infraorder Araneomorphae	
Neocribellatae	
Araneoclada	
Haplogynae	
"Scytodoidea"	
Scytodidae	1
Telemidae	1
Pholcidae	3
Dysderoidea	
Segestriidae	1
Dysderidae	1
Entelegynae	
Palpimanoidea	
Mimetidae	6
Eresoidea	
Oecobiidae	1
"RTA Clade"	
Lycosoidea	
Lycosidae	110
Pisauridae	7
Oxyopidae	2
Dictynoidea	
Dictynidae	75-80
Cybaeidae	11
Hahniidae	16
"RTA Clade" (cont'd)	
Dionycha	
Anyphaenidae	7
Liocranidae	18
Clubionidae	35
Corinnidae	11
Gnaphosidae	100
Zoridae	1
Philodromidae	47
Thomisidae	68
Salticidae	110
Amaurobioidea	
Amaurobiidae	30
Titanoecidae	4
Agelenidae	11
Orbiculariae	
Deinopoidea	
Uloboridae	3
Araneoidea	
Nesticidae	2
Theridiidae	100
Theridiosomatidae	1
Mysmenidae	1
Pimoidae	1
Linyphiidae	>500
Tetragnathidae	23
Araneidae	74
TOTAL	~1400

*Approximate number of species in Canada (1999 estimate)

All spiders produce and use silk and can be divided roughly into two behavioural groupings based on this usage: those that use their silk to snare prey and those that don't. Orbicularians, especially the araneoids (primarily sheet-web, orb-web, and cob-web weavers) dominate the former grouping. The latter is a diverse assemblage dominated by the "RTA clade" with major families including the salticids (jumping spiders), lycosids (wolf spiders), thomisids (one family of crab spiders), and gnaphosids (ground spiders). However, us-

age of silk for prey capture is not phylogenetically constrained and numerous groups span the gap. For instance many amaurobioid and dictynoid species (common and widespread in Canada) utilize greatly reduced webs (e.g. see Bennett 1985) and rely upon sit, wait, and pounce strategies. Other species within these groups build large and characteristic capture webs. Among the fascinating but mostly uncommon Canadian tarantula kin (Mygalomorphae) atypids (purse-web spiders), diplurids (funnel-web tarantulas), and mecicobothriids (no common name) use silk in prey capture. Antrodiaetid mygalomorphs (folding-trapdoor spiders) sit in the entrance of excavated burrows and wait for hapless creatures to come near enough to be grabbed and dragged deep into the dim recesses of their retreats and repeatedly stabbed to death (big-city downtown terror is far exceeded by the nightly mayhem on a seemingly peaceful suburban British Columbia lawn). Linyphiidae (including Erigonidae of various authors) and Salticidae, the major family in each behavioural grouping on a world-wide basis, are very difficult taxonomically and have many genera in need of revision and large numbers of undescribed species. Following is a summary of the diversity, abundance, and systematics of Canada's araneofauna.

Araneoidea

The superfamily Araneoidea includes many of the spiders most familiar to the layperson including the orb-weaving garden spiders (Araneidae) and the cob-web weaving widow spiders and house spiders (Theridiidae). However, the vast majority of araneoids, and the most numerous, are linyphiids (sheet-web weavers), only a few of which are encountered or collected regularly by the uninitiated generalist. On the world scale, Araneoidea is the most diverse and phylogenetically best understood superfamily of spiders (Griswold *et al.* 1998).

Linyphiidae

Linyphiidae accounts for over one third of all Canadian spider species (445 known Canadian species with probably over 70 unknown – Dondale 1979). Linyphiids are the largest spider family in Canada in terms of numbers of species and often are extremely abundant. On the world stage, they are second in diversity only to salticids. Many years ago, Bristowe (1938) made a well reasoned estimate of over 2.25 million spiders (mostly linyphiids) per acre of grassy meadow in late summer in England. He also cited a study which produced 159,000 spiders per acre from the soil alone of a similar habitat. (These figures should be kept from the poor arachnophobes who recoil from the small handful of spiders they encounter annually.) The bulk of linyphiid diversity is made up of erigonine species. Dondale (1979) listed over 300 erigonine linyphiids in Canada with an estimate of 50 remaining to be recorded or described. These species are characterized by their undistinguished appearance and small to minute size: not only are a majority of erigonines tiny, most of them look alike. Usable taxonomic keys are virtually non-existent and most genera and species are very difficult to determine even for the specialist. Identification is based largely upon microscopic characters of the very complex male genitalia; in contrast, females usually are unremarkable morphologically and often are unidentifiable if not collected with male conspecifics.

Few comprehensive spider lists have been published for any habitat in Canada except some peatlands (but note that only pitfall trapping was used in most of those studies and therefore the resultant lists likely are incomplete) but a casual glance at the generated species lists shows a preponderance of linyphiids (especially erigonines): 51 of 106 species collected (Aitchison-Benell 1994); 28 of 49, 37 of 108, 27 of 59, 32 of 97, 26 of 76, and 22 of 77 (Dondale and Redner 1994; Blades and Marshall 1994); and 95 of 169 (Koponen 1994). No other family comes close in diversity. This pattern is common throughout the Holarctic region and erigonines increasingly dominate the spider fauna the farther north one travels: Dondale *et al.* (1997) recorded 154 known or expected linyphiid species (34+3 linyphiines, 102+5 erigonines) in the Yukon fauna of 336 spider species. Fully 56% of all Yukon arctic spider species are erigonine. The world is bottom

heavy in terms of plant and animal diversity: most species are found in the tropics and south temperate areas (Platnick 1991). However, among spiders, linyphiids are most diverse in the north and predominate in the Holarctic fauna (Coddington and Levi 1991).

Theridiidae

Theridiidae is the second most diverse araneoid family in Canada with about 100 species (Dondale 1979). Overall, theridiids are as diverse as gnaphosids; both share fourth place in Canada after the hunting salticids and lycosids. Theridiids also are a dominant group on the world scale although, as in most spider families other than Linyphiidae, theridiid diversity primarily occurs south of the Holarctic region. Taxonomically, the Nearctic theridiids are well known and most genera have been revised recently by Levi and co-authors (references in Roth 1993). A field guide to Canadian theridiids is in preparation but is on hold because of shifting government funding priorities (C. D. Dondale pers. comm.).

Theridiids are common and abundant spiders throughout southern Canada in most habitats but are relatively minor components of the fauna of the northern Nearctic region. They are rather more conspicuous than linyphiids as most build their webs above ground level and therefore are more often collected by the generalist. However, a number of genera are - like erigonines - tiny, inconspicuous members of the soil and deep-litter fauna (Dondale 1990). Several genera are regularly and easily misidentified by inexperienced workers and often are found in collections labelled as unidentified clubionids and agelenids. Two theridiid genera, *Steatoda* and *Achaearanea*, are very common in Canadian homes where they kill most other arthropods unfortunate enough to become entangled in their cob-webs and thus are particularly efficient, if not particularly welcome, house-cleaners. These synanthropic species are routinely misidentified as black widows (*Latrodectus* spp., which are closely related theridiids) or the infamous (and completely non-Canadian) brown recluse (*Loxosceles* sp., Sicariidae).

Araneidae and Tetragnathidae

Araneids are probably the most familiar spiders to the average Canadian. Almost all the araneids as well as the closely related tetragnathids (long-jawed orb-weavers) build characteristic, radially symmetric orb webs and together these two families have about 100 species with Canadian representatives. As with the theridiids, the Nearctic tetragnathid and araneid genera have been well revised by Levi and others (references in Roth 1993). A field guide to Canadian species is being readied for publication by volunteers on a part-time basis (C. D. Dondale pers. comm.). In Canada, Araneidae is about as diverse as Dictynidae with which it shares honours for sixth and seventh largest families after Linyphiidae, Salticidae and Lycosidae (equally diverse), and Theridiidae and Gnaphosidae (equally diverse). In the world, Araneidae is the third largest family (Griswold *et al*. 1998), a reflection of its great diversity in the tropics.

Araneids and tetragnathids usually are abundant in fields, open woodlands, and other similar habitats (but note that a significant number of araneids are litter inhabitants). Tetragnathids often are especially common around water or in wet areas. Several species are abundant around homes and outbuildings and in gardens. The classic araneid orb web was for many years considered to be a highly derived structure but now is generally accepted to be a relatively primitive structure, and theridiid cob-webs and linyphiid sheet-webs are derived from it (see papers in Shear 1986).

RTA clade

Sister to Orbiculariae (Araneoidea plus Deinopoidea, a superfamily poorly represented in Canada) is the large and diverse "RTA clade" (Coddington and Levi 1991). (The name is derived from the probable synapomorphy of a distinctively placed apophysis on the male palpal tibia.) Resolving the familial and superfamilial relationships within the RTA clade is the last major hurdle for spider systematics. RTA clade families with Canadian representatives are placed in Dionycha, Lycosoidea, Dictynoidea, and Amaurobioidea. Species in the former two

groupings, Dionycha and Lycosoidea, are common and familiar components of the Canadian araneofauna. Dictynoidea and Amaurobioidea are also common components but mostly unfamiliar to the majority of Canadian biologists. Dionycha encompasses families of two-tarsal-clawed, primarily sedentary (ambushing) or active hunters. Dominant Canadian groups are Salticidae, Clubionidae (sac spiders), Gnaphosidae (ground spiders), Thomisidae, and Philodromidae (philodromid crab spiders). Lycosoidea is represented in Canada primarily by the diverse and extremely abundant lycosids. In Canada, Dictynoidea and Amaurobioidea are dominated by their family namesakes. The Nearctic lycosoid and dionychan genera are taxonomically well known (except for the salticids) and excellent keys exist for the Canadian genera and species (Dondale and Redner 1978, 1982, 1990; Platnick and Dondale 1992). Some Nearctic amaurobioid and dictynoid genera have been revised (e.g. Bennett 1987, 1991; Chamberlin and Gertsch 1958; Leech 1972) but many others are poorly known and no comprehensive guides to the Canadian fauna exist.

Lycosidae

In Canada, Lycosidae has just one fifth as many species as Linyphiidae but shares with Salticidae the honour of being the second most diverse spider family here. Dondale (1979) estimated a Canadian wolf spider fauna of 110 species with roughly 10% of these undescribed or unrecorded. On the world scale, lycosids make up the fifth largest family (Coddington and Levi 1991). Although lycosid diversity is much greater elsewhere, the abundance of individual species often is astounding in Canada. Pitfall traps in any sort of open habitat are regularly swamped with wolf spiders (see abundance tables in Blades and Marshall 1994, Dondale and Redner 1994, and Koponen 1994). Fields, tundra, shorelines, and open wooded areas may literally be alive with wolf spiders (often a single *Pardosa* species) particularly in the spring. Lycosids are diverse and abundant in the far north of the Holarctic and account for 18% of the known Canadian arctic araneofauna (Dondale *et al.* 1997). Lycosids are unique in the transportation by mature females of egg sacs on their spinnerets (giving rise to apocryphal tales of spiders with three body sections) and of young spiderlings dorsally on their abdomens (giving rise, among arachnophobes who have bravely dispatched a large, fuzzy spider only to watch countless small spiders magically appear and scatter in all directions, to nightmares and apocryphal tales of spontaneous generation).

Two other lycosoid families are common but have few species in Canada. Pisaurids (nursery-web spiders) often are encountered along the edges of freshwater systems where they hunt actively above and below the water surface. Two pisaurid species are the largest native spiders in Canada and probably have struck fear into countless cottagers in Ontario and Quebec. Some oxyopids (lynx spiders) may occur in large numbers in agricultural fields and have been the subject of studies on natural pest control (see references in Young and Lockley 1985).

Salticidae

Salticids are the charismatic "cute/fuzzies" of the spider world: many are highly photogenic and, deservedly, they feature regularly on the pages of glossy natural history magazines. Jumping spiders are renowned for their often fantastic degree of sexual dimorphism and colouration and wild and interesting range of behaviours. Much of this is due to the highly developed visual sense in salticids: the huge main eyes are complex, high-resolution structures capable of focusing on objects by retinal movement. Throughout the twentieth century salticids have been the focus of many optical studies (see references in Foelix 1982, 1996). Jumping spiders are agile, visually orienting, day-active predators commonly found among foliage in sunny locations. Some are synanthropic.

World-wide, Salticidae is the largest family of spiders: well over 10% (about 5,000) of all described spider species are jumping spiders. Salticid taxonomy and systematics are very active fields of study (see current review by D. B. Richman at:

http://dns.ufsia.ac.be/Arachnology/Pages/Documents/Salticid.html) but primarily with tropical groups. Some excellent revisions of Nearctic groups have been published recently (e.g. Maddison 1996 and references in Roth 1993) but the bulk of the genera found in Canada are badly in need of revision. Taxonomically they are a trying group with identifications difficult even for specialists. In Canada, Salticidae is about as diverse as Lycosidae with about 110 species including close to 20% of this number yet to be described or recorded (Dondale 1979). As with most spiders except lycosids and linyphiids, salticids are more diverse and abundant in Canada's southern latitudes than in the far north.

Gnaphosidae

Gnaphosidae is the sixth largest spider family in the world (Coddington and Levi 1991) and a major player in spider diversity in the tropics. In Canada, Gnaphosidae, with about 100 species known or expected to live here (Platnick and Dondale 1992), is about as diverse as Theridiidae and slightly less so than Salticidae and Lycosidae. In general, gnaphosids are common ground-dwelling hunters and are important in the natural control of forest and agricultural insects (Platnick and Dondale 1992). However, few are encountered by general collectors because most are inconspicuously coloured and nocturnal hunters. Members of one genus (*Herpyllus*) are found regularly in buildings.

Over the last quarter of this century, Platnick and others (references in Roth 1993) have revised many of the world's gnaphosoid genera including all of those with Canadian representatives. As a direct consequence, an excellent taxonomic guide to the Canadian gnaphosids (Platnick and Dondale 1992) has been published and few new Nearctic species probably await discovery. However, the biology of the majority of gnaphosid species is not well known, a reflection of our relatively poor grasp of ground-dwelling spiders in general. For instance, in a 1998 study of arthropods of cranberry bogs in an area with a high concentration of Canadian entomologists (southwestern BC), J. Troubridge and S. Fitzpatrick (unpublished data) collected hundreds of specimens of *Gnaphosa snohomish* Platnick and Shadab, a large species previously known only from a pair of specimens taken in central Washington. After lycosids, one or a couple of species of gnaphosids may be among the numerically dominant and visually conspicuous spiders pitfall-trapped in bogs (see Table 2 in Aitchison-Benell 1994; Table 1 in Dondale and Redner 1994). Typical of groups with a preponderance of tropical species, Canadian gnaphosids become increasingly scarce with increasing latitude. However, Gnaphosidae is still a dominant group in subarctic and alpine regions in Canada although few species occur in the far north (Dondale *et al*. 1997).

Clubionidae

The "old" Clubionidae was paraphyletic (Coddington and Levi 1991) and the family was relimited after Dondale's (1979) estimate of a Canadian fauna of about 64 species was made. At least 29 of these species have been transferred to Corinnidae and Liocranidae which together may be sister to Gnaphosidae and its relatives (Coddington and Levi 1991). The remaining species are likely most closely related to Salticidae and Anyphaenidae. Although a field guide to Canada's (paraphyletic) clubionids (and our few species of anyphaenids) has been prepared (Dondale and Redner 1982), the ground-dwelling genera placed now in Liocranidae are poorly known. In Canada, the relimited Clubionidae is comprised primarily of nocturnal species actively hunting on herbs, shrubs, trees, and other plants. A very few species occur in litter or under stones. The majority of Canadian clubionids are found in southern regions with a few species ranging into the subarctic.

Thomisidae and Philodromidae

The two crab spider families with Canadian representatives, Thomisidae and Philodromidae, are dionychans of uncertain affinities (Coddington and Levi 1991). Thomisidae is seventh in terms of world spider diversity with a majority of its species occurring in the tropics. Together, about 115 species in the two families occur in Canada. Thomisids,

with their two anterior pairs of long legs and habitual sideways gait, are distinctly more crab-like than philodromids. Both are dorso-ventrally flattened spiders; thomisids tend to be sparsely bristled and slow moving, philodromids hairy and quick. Crab spiders are primarily diurnal ambush hunters. Thomisids are more common on the ground, philodromids on foliage. Some thomisids are famous for waiting in flowers to grab visiting nectar and pollen feeding insects. Both families are well represented in Canada's boreal north and some species range into the Arctic (Dondale *et al*. 1997) but the bulk of thomisid and philodromid diversity is encountered in the south.

Dictynoidea and Amaurobioidea

Although generally accepted as valid superfamilies, Dictynoidea and Amaurobioidea remain poorly defined and their family level systematics is in disarray (Coddington and Levi 1991). Classically, all members of both groups were considered to be cribellate (the cribellum is a distinctive silk production organ found in some spiders and derived from the ancestral anterior median spinnerets). Lehtinen's (1967) exposure of "Cribellatae" as paraphyletic and defined by a plesiomorphic character (the cribellum) marked the beginning of the current era of spider systematics which has resulted in massive restructuring of the classification of Araneae from family to subordinal levels. Dictynidae and Amaurobiidae are now seen to contain both cribellate and ecribellate genera, many of the latter transferred there after the sundering of the old, paraphyletic Agelenidae (e.g. *Blabomma* and *Cicurina* are ecribellate dictynids; *Coelotes*, *Coras*, and *Wadotes* are ecribellate amaurobiids). The two superfamilies have Canadian representatives in Dictynidae, Cybaeidae, and Hahniidae (Dictynoidea) and Amaurobiidae, Agelenidae, and Titanoecidae (Amaurobioidea). The taxonomy and systematics of amaurobioids and dictynoids has been studied actively in recent years (e.g. Bennett 1987, 1988, 1991, 1992; Griswold 1990) but little has been well resolved above the genus level, various genera are placed only tentatively or uncertainly within one or the other superfamily, and most of the families lack clear diagnosis (except for Amaurobiidae – Griswold 1990). No doubt, if this area remains active, major changes are yet to come.

Dictynidae

With the addition of two genera from the agelenids, the Canadian dictynid araneofauna has grown from about 65 (Dondale 1979) to perhaps 75-80 species, making the regional diversity of this family on a par with Araneidae. The cribellate dictynids were revised by Chamberlin and Gertsch (1958) but they remain exceedingly difficult to identify without comparison to voucher specimens. Most species are quite small and cryptic. The ecribellate taxa need revision and there are no usable species level keys for the family. Both cribellate and ecribellate dictynids weave tangled, relatively shapeless webs although some species build specialized tube-like structures (Bennett 1985). The ecribellate species are found primarily under objects on the ground in wooded areas. Rotting logs may harbour considerable numbers of individual webs. Many of the cribellate species are distinctly arboreal, building their small webs on branch tips. The current growing interest in canopy arthropod surveys may boost the number of dictynid species recorded from Canada. Several dictynids are widespread in Canada's Boreal zone forests and a very few are found in Arctic and Subarctic regions (Dondale *et al.* 1997). The majority of Canada's dictynids have southern distributions.

Other Dictynoidea

Hahniidae and Cybaeidae together have about 30 species with Canadian representatives. Both groups are very common but infrequently collected litter inhabitants. Cybaeids are forest floor spiders; hahniids may be found in a variety of litter habitats. Hahniidae has been considerably augmented by genera transferred from Agelenidae. Cybaeidae is comprised entirely of taxa formerly placed in that family. The Nearctic cybaeids have been revised in recent years (references in Roth 1993) but much of this work remains unpublished and the family is not clearly defined. Most of the Nearctic hahniid taxa have also been revised (references

in Roth 1993) but all the genera transferred from Agelenidae need major work. A few hahniids are found in the far north (Dondale *et al*. 1997) but most Canadian species in both families have southern distributions. Some hahniids are very abundant in peatlands (see Table 1 in Dondale and Redner 1994; Koponen 1994). Cybaeids and coelotine amaurobiids are similar morphologically and ecologically but have different areas of endemism in North America. Coelotines are abundant in eastern forests and none is found in the west. Cybaeids are diverse in the west but are nearly absent from eastern North America.

Amaurobiidae

The cribellate amaurobiids were revised by Leech (1972) and had 25 species with Canadian representatives (Dondale 1979). Since then, the Canadian fauna has lost three species to Titanoecidae but has gained eight ecribellate species from Agelenidae for a total of about 30. Two of the three ecribellate genera in Canada need revision. Most Canadian amaurobiids are forest floor dwellers and build rather amorphous, tangled webs under various objects in woodlands, especially the loose bark of trees and logs. Spiders of this family often are abundant but only the larger species are found commonly in general collections. Most species have southern distributions in Canada but a few are widespread in the Boreal zone and into alpine and subarctic areas (Dondale *et al*. 1997).

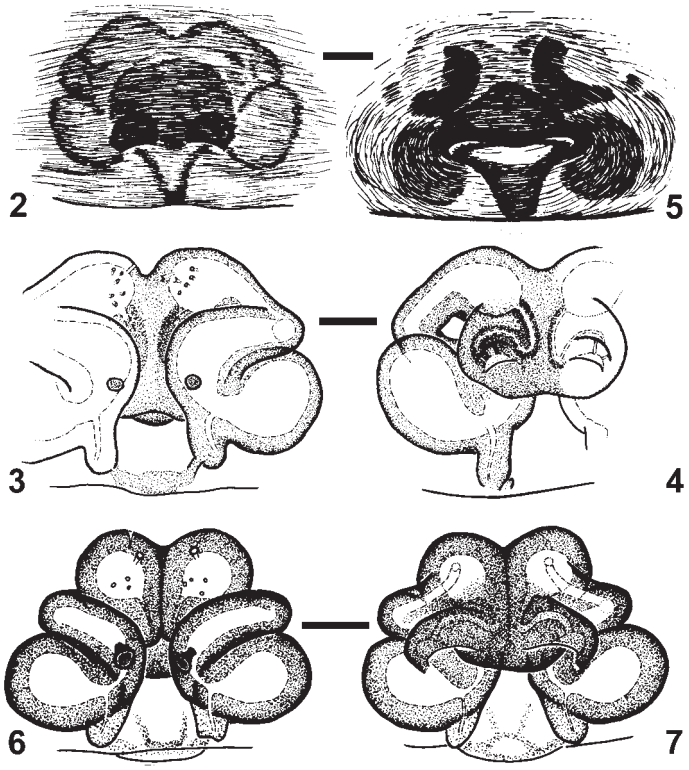
Other Amaurobioidea

In Canada, Dondale (1979) estimated there to be some 65 agelenid species. Agelenidae has long been an acknowledged dump heap for amaurobioid and dictynoid genera of uncertain affinities and the family has undergone major relimitation in recent years (see above). Today in Canada, Agelenidae is a mere shadow of its former self with perhaps 11 species in two common and one rare genus. Several of these species are very well known because of their abundance and/or synanthropic habits. True agelenids all spin distinctive large, non-sticky sheet webs narrowing to a funnel at one edge wherein the builder is usually found waiting for prey to become entangled. Virtually all true agelenid genera need revision. Titanoecidae, a cribellate group extracted from Amaurobiidae, is represented in Canada by only four forest floor inhabiting species.

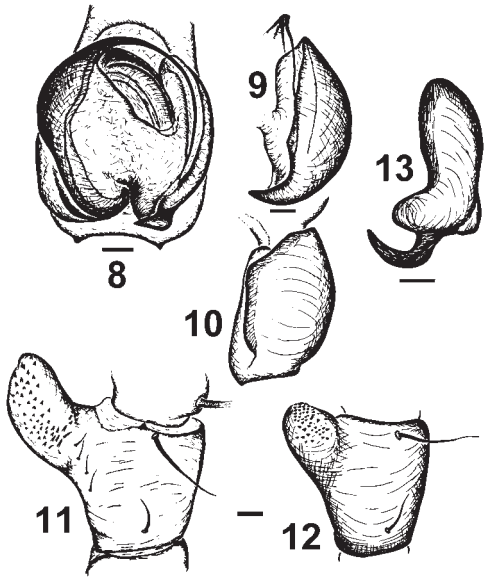
Mygalomorphs and other spider groups

All other spider families with Canadian species are much more diverse elsewhere and, for the most part, rarely encountered here. Pimoidae (previously considered part of Linyphiidae) has one species in Canada which is abundant on the west coast. Mysmenids, nesticids, and theridiosomatids are small araneoids with a single rare species each in the southernmost reaches of Canada. Three species of uloborids (small and interesting cribellate, deinopoid orb-web weavers) are widespread but not abundant across southern Canada. One zorid (small, lycosid-like dionychans) was recently discovered in disturbed areas on southern Vancouver Island. A small handful of mimetid pirate-spider species are the only Canadian representatives of Palpimanoidea (an interesting group, probably sister to Orbiculariae + RTA clade, containing many specialized araneophagous species). One ecribellate oecobiid is an uncommon synanthrope across southern Canada. Haplogynae, originally believed to be paraphyletic, is probably sister to all the "higher" spiders (Entelegynae) including all those discussed above. In Canada, Haplogynae is represented by one synanthropic species each of Scytodidae (spitting spiders) and Dysderidae, a single tiny and very rare species of Telemidae found deep in forest leaf litter in British Columbia, a single segestriid species each in the southern reaches of eastern and western Canada and three or four pholcids (two of which are common in cellars) in various southern localities. Centres of diversity for all these groups are austral or elsewhere other than north temperate.

Four mygalomorph families (Mygalomorphae is sister to Araneomorphae) each have one or two species found in Canada, mostly in the west. One atypid purse-web spider used to be found on the Niagara Peninsula but this species has not been collected recently



Figs. 2-4 *Cybaeus constrictus* Chamberlin and Ivie, Figs. 5-7 *C. conservans* Chamberlin and Ivie; female genitalia. 2, 5 epigynum (external), ventral views; 3, 6 vulva (internal), dorsal views; 4, 7 same, ventral views. Scale bars = 0.1 mm.



Figs. 8-11 *C. angustiarum* L. Koch, Figs. 12-13 *C. tetricus* (C. L. Koch); characters of male left pedipalp. 8 genital bulb, ventral view; 9, 13 apical apophysis, retrolateral views; 10 carinate retrolateral tibial apophysis, retrolateral view; 11, 12 patellae, dorsal views. Scale bars = 0.1 mm.

Figures: In spiders, species within genera are normally very similar in general morphology and usually only can be distinguished by careful comparison of sexual characters with published drawings or expertly identified voucher specimens.

and may have disappeared from Canada. One tiny funnel-web weaving diplurid is found at a single montane locality in southern British Columbia. A disjunct population of one mecicobothriid sheet-web weaver is found on southwestern Vancouver Island. One antrodiaetid trapdoor spider species is common and abundant in reasonably undisturbed habitats along the entire British Columbia coast. Another antrodiaetid is occasionally collected in the dry southern interior valleys of that province. The vast bulk of mygalomorph diversity is found in the tropics and subtropics.

Conclusion

"This is an exciting time in the study of spiders" (C. E. Griswold *in* Dippenaar-Schoeman and Jocqué 1997). Major advances are being made in the taxonomy and systematics of spiders at all classification levels. Publication of taxonomic papers has been very high over the last several decades and shows no sign of levelling off (see Platnick 1997). The Smithsonian Institution and the American Museum of Natural History support active graduate programs that are training new arachnid systematists. These programs have taken up the slack from Harvard University as its highly regarded program winds down (Coddington *et al*. 1990). And there is much work available for spider systematists in North America: ecological interest in spiders is at an all-time high and many families are in urgent need of revision, particularly Linyphiidae and Salticidae but also most families with cryptic, ground-dwelling genera.

Yet there is little in the way of funding or support for systematists beyond the graduate level. Trained arachnid systematists are finding it increasingly difficult to find paid work and often when work is found, research is not a component of it (Coddington *et al.* 1990). Many of the North American arachnid systematists are retired or aging and there is little incentive for younger researchers to enter the field: nearly three-quarters of all active workers receive nothing or less than $1,000 annually in support of their research (Coddington *et al*. 1990). Here in Canada, Agriculture and Agri-Food Canada has shut the doors on its arachnid research program, effectively mothballing its collection of close to 150,000 specimens and the only complete research library in the country.

Basic taxonomic and systematic research provides the foundation for all other aspects of biological research and will continue to do so long into the future. The alpha-level taxonomy (i.e. basic descriptive work, comparative morphology) of the vast majority of arthropod groups including most spiders is in relatively poor shape. Research dollars tend to be directed at the macroflora and macrofauna at the tips of terrestrial ecosystem icebergs. The organisms, primarily arthropods and fungi, comprising the huge and invisible foundations of these icebergs (vital to the existence of the tips) are too often ignored except for those taxa aspiring to "pest" status. Can we expect to understand the functioning of any ecosystem without basic knowledge of the hidden organic and inorganic network supporting the visible component? "Can't see the forest for the trees" is an apt expression: trees obscure our vision of the real machinery of the system. Within ecosystem machinery, spiders are diverse and important cogs. With luck, in the new millenium, Canada will rediscover the inherent value of its declining cadre of systematic araneologists (to say nothing of entomologists) and ecosystem research biologists will no longer have to rely upon the volunteer services of accomplished amateurs to provide names for their data points.

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