

Chapter 8

The Dragonflies and Damselflies (Odonata) of Canadian Grasslands

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Abstract. The Odonata are energetic aerial predators of other insects; the aquatic larvae are voracious predators of invertebrates and small vertebrates. As of 2010, 5,952 species of the order were described worldwide; 211 species are known from Canada. Grasslands across the country support about 59% of the national fauna. A checklist and systematic overview of 124 species in nine families are presented. Species totals in these families are as follows: Calopterygidae, 2; Lestidae, 7; Coenagrionidae, 31; Aeshnidae, 16; Gomphidae, 15; Cordulegastridae, 1; Macromiidae, 2; Corduliidae, 13; and Libellulidae, 37. The geographical ranges of the species are defined and summarized; according to the definitions herein, 20 species have boreal ranges, 17 are transition species, 12 are Cordilleran, 1 is Pacific coastal, 10 are western, 4 are more or less restricted to the Great Plains, 16 have southern ranges, 38 are considered eastern, and 6 are widespread species. A summary of studies on grassland Odonata and recommendations for inventory and taxonomic research are provided. The geographical scope of the Canadian grassland fauna is described briefly with respect to lotic and lentic habitats in grasslands of the Cordillera, the Great Plains, and southern Ontario.

Résumé. Les odonates sont de féroces prédateurs aériens d'autres insectes ; leurs larves aquatiques sont aussi des prédateurs voraces d'autres invertébrés et petits vertébrés. En 2010, 5 952 espèces d'odonates avaient été décrites dans le monde. De ce nombre, 211 sont connues au Canada. Environ 59 % des odonates de la faune canadienne s'observent dans les prairies. Ce chapitre présente une liste et un aperçu de la systématique de 124 espèces, réparties en neuf familles comme suit: caloptérygidés, 2 ; lestidés, 7 ; coenagrionidés, 31 ; aeshnidés, 16 ; gomphidés, 15 ; cordulégastridés, 1 ; macromiidés, 2 ; corduliidés, 13 ; libellulidés, 37. Les aires de répartition de ces espèces sont par ailleurs définies, ce qui permet de conclure que 20 espèces ont une aire de répartition boréale, 17 sont des espèces de transition, 12 vivent dans la Cordillère, 1 vit sur la côte du Pacifique, 10 sont occidentales, 4 sont plus ou moins limitées aux Grandes Plaines, 16 ont une aire de répartition méridionale, 38 sont considérées orientales, et 6 sont des espèces largement répandues. Le chapitre présente un résumé des études réalisées sur les odonates des prairies ainsi que des recommandations concernant les travaux d'inventaire et les études taxonomiques à réaliser. La portée géographique de la faune de la prairie canadienne est brièvement décrite en ce qui a trait aux habitats lotiques et lenticques des prairies qui se trouvent dans la Cordillère, dans les Grandes Plaines et dans le sud de l'Ontario.

Introduction

The Odonata (dragonflies and damselflies) is a small order of insects of 5,952 named species (as of 2010) in 30 families worldwide (Dijkstra *et al.* 2013). It is predominantly tropical in distribution and is not as diverse at higher latitudes. Canada records 211 species (Catling *et al.* 2005; RAC and P. Catling, unpublished data).

The Odonata and their ancestors are some of the most ancient of insects; there is a considerable fossil record containing many extinct groups. Dragonflies and damselflies have many primitive features, but also possess specializations that reflect their aerial

and predatory life. Odonata are usually divided into three suborders: the Zygoptera (damselflies), the Anisoptera (dragonflies), and the Anisozygoptera (a small group of four species from Asia that is intermediate in appearance between the other two suborders). The Zygoptera is normally considered the sister group to the Anisoptera plus Anisozygoptera. A brief summary of the issues and relevant literature in Odonata phylogenetics is found in Trueman and Rowe (2009), and the most recent and widely accepted classification is given in Dijkstra *et al.* (2013). The Canadian fauna is treated here in two suborders, Zygoptera and Anisoptera.

The two suborders differ in structure and behaviour. Damselflies are slimmer and often smaller, and they usually fly more slowly than dragonflies. At rest, their equal-sized wings are usually held together above the body (Zygoptera means “joined wings”). The compound eyes are spaced widely apart on the head. Dragonflies are robust and often fast flying, with the hind wings broader at the base than the fore wings (Anisoptera means “unequal wings”); when perched, they hold their wings out and away from the body. The eyes usually touch on the midline, although in some families they are separated, but not to the extent seen in the Zygoptera. There are significant differences between damselflies and dragonflies in wing venation and sexual structures.

Biology

Corbet (1999) provides comprehensive detail on the biology of Odonata in a global context; more general summaries related to North America and Canada are found in Walker (1953), Cannings (2002), Acorn (2004), Paulson (2009, 2011), and Hutchings and Halstead (2011). Most of the following short summary is taken from Cannings (2002).

Members of the Odonata are large and abundant predatory aquatic invertebrates; because of this, the order forms one of the predominant groups in freshwater communities. Some species prefer lakeshores, whereas others are found only along streams and rivers and in springs. Ponds and marshes rich in aquatic vegetation support the greatest diversity. The aquatic larvae are armed with an enormously enlarged, hinged labium, which is used as an extendible grasping organ for capturing prey. Larvae are voracious, eating aquatic insects, small crustaceans, and even fish and tadpoles. Larvae can be placed in three categories according to their feeding behaviour (Corbet 1999). Claspers (Zygoptera, Aeshnidae) are streamlined stalkers that live in submerged vegetation and use their clasping legs to hold on to vegetation. Sprawlers (Macromiidae, Corduliidae, and most Libellulidae) lie spread-eagled on the bottom mud, debris, or vegetation, waiting in ambush; they often hide under a coating of mud and algae. Burrowers (Gomphidae, Cordulegastridae) dig into sand and mud and await their prey. Metamorphosis in odonates is striking. Larvae go through 8 to 17 (usually 10 to 14) moults before emerging as terrestrial flying adults.

Adults are often colourfully patterned and exhibit a wide variety of readily observed behaviour. They are aerial, visually oriented predators and are large, strong-flying insects with big eyes, strong mandibles, and spiny legs. Their prey includes a wide range of flying insects that are normally captured in flight, although some groups, such as the coenagrionids (except for *Argia*), usually take their prey from the substrate (Paulson 2009). Mature males often patrol the breeding habitats, aggressively searching for mates and may, like birds, defend a territory against other males of the species. These territories limit aggression and prevent undue disturbance of egg-laying females. Sometimes in crowded situations group territories with dominance hierarchies are established.

Developmental timing varies depending on the group and geographical location. In the damselflies and many dragonflies, development from egg to mature adult may be rapid, requiring only a year, even in the north and at higher elevations. *Lestes* and some *Sympetrum* species overwinter as diapausing eggs, hatch in the spring, and emerge as adults in the summer. Others overwinter as larvae and emerge the following spring or summer, although probably in some species and conditions, the larvae overwinter two years. However, in many larger dragonflies, such as *Aeshna* or *Somatochlora*, the short summers of high altitudes and northern regions often mean that four or five years are spent in the larval stage. In Canada, most adults live for one to two months.

Summary of Taxonomic and Biodiversity Studies in the Region

General Faunal Treatments and Annotated Lists

The major early works on Odonata of the Canadian fauna, including grassland species, are Walker (1912a, 1912b, 1925, 1927, 1933, 1940, 1941a, 1941b, 1943), Buckell (1938), and Whitehouse (1917, 1918a, 1918b, 1941). Walker (1953, 1958) and Walker and Corbet (1975) used data from some of these baseline publications in their work on the Odonata of Canada and Alaska, including records of dragonflies in grassland habitats, and added considerable ecological information.

Several subsequent regional treatments also covered grassland areas across Canada. In the West, Scudder *et al.* (1976) and Cannings and Stuart (1977) updated and summarized the distributional information known for British Columbia. Since then, inventories and general collecting have improved knowledge considerably. Cannings *et al.* (1991) and Cannings and Cannings (1997) documented extensive surveys in Yukon and, in British Columbia, Cannings *et al.* (1998, 2000, 2008) undertook detailed inventories, from 1996 to 2005, jointly sponsored by the Royal BC Museum and the British Columbia Conservation Data Centre (British Columbia Ministry of Environment). Many of these dealt with grassland habitats in the Yukon and the Okanagan, Kootenays, Peace River, and Chilcotin/Cariboo regions of British Columbia. Other surveys were made for more specific reasons, such as investigations on the possible impact of the Site C Dam proposal along the Peace River (Cannings 2012). Data and distribution maps for British Columbia species are available at the Royal BC Museum, British Columbia Conservation Data Centre (2013), and E-Fauna BC (2013).

In the Prairie Provinces, inventories and annotated provincial lists have been undertaken by various institutions and have resulted in provincial databases, websites, and publications for Alberta (Acorn 2004; Strickland Museum 2013), Saskatchewan (Lehmkuhl 1975; Hutchings and Halstead 2011; Parker 2013), and Manitoba (Hughes and Duncan 2003; Manitoba Dragonfly Survey 2004). The Manitoba Dragonfly Survey, a volunteer project organized by NatureNorth and the Manitoba Wildlife and Ecosystem Protection Branch, has provided data to the Manitoba Conservation Data Centre. Acorn's (2004) publication (noted above) on the damselflies of Alberta is a superb example of a regional treatment, useful both in scientific terms and as a popular stimulus for student and naturalist involvement in the study of Odonata. Systematic research into other groups has sometimes resulted in useful information on Odonata. For example, Conroy and Kuhn (1977) improved the Manitoba Odonata list during their study of water mites that parasitized aquatic insects; such mites are frequently found on adult Odonata.

Ontario has been a leader in Odonata study ever since E.M. Walker's superb work started the trend. Catling and Brownell (2000) published a summary of species and

distribution that complements the volumes of *Ontario Odonata* (Catling *et al.* 2000, 2001, 2002, 2004a, 2004b, 2005, 2007), an annual summary of Odonata records published by the Toronto Entomologists' Association. This publication also supplies notes on observations, range extensions, and regional lists. All these data are summarized in the Ontario Odonata Atlas (2005), an outgrowth of the extensive database of the Natural Heritage Information Centre, Ontario Ministry of Natural Resources. Websites such as that for Ojibway Prairie (Pratt 2010) and for regional Ontario lists (Pratt 2012) are ongoing resources for Odonata study in the grassland pockets in southern Ontario. A field guide to species of southwestern Ontario (Carmichael *et al.* 2002) covers most of the species considered grassland inhabitants in the region.

Studies of Particular Areas or Sites

Several studies have examined the odonate fauna of particular areas, including grassland sites. Not all of these studies were made for faunistic or systematic reasons; the purpose of the work was often ecological. For example, in British Columbia's Chilcotin region, Cannings and Cannings (1987) documented 22 species in 18 saline lakes at Riske Creek. The distribution of the genus *Lestes* was studied in detail across these water bodies, whose chemistry varied widely (Cannings *et al.* 1980). Conference-related field trips can also contribute to regional faunal information. In 1983, the Seventh International Symposium of Odonatology held in Calgary resulted in field trips to grasslands around Calgary and the southern Rocky Mountain Trench in British Columbia (Invermere/Radium Hot Springs area) that produced new and important records and range extensions (Cannings 1983, 1984). Intensive life history studies on *Argia vivida* in non-grassland habitats in hot springs in Banff, Alberta, and similar montane localities in British Columbia (Pritchard 1989; Conrad 1992) should be mentioned here, as they give significant insight into the biology of this rare species in British Columbia grasslands.

Insect surveys that include Odonata have been published from several localities in Alberta, mostly in the Aspen Parkland near Edmonton: Clifford E. Lee Nature Sanctuary (G.C.D. Griffiths and D. Griffiths 1980, unpublished report), Devonian Botanic Garden (Stoyke 1987), Wagner Natural Area (Page 1998), and Beaverhill Lake (Rice 1999). As the wetlands in these sites often lie in a mosaic of parkland, forest, and peatland, many of the species listed are not typical grassland species. The same is true for the species of Cypress Hills in Alberta (Hilton 1985) and Saskatchewan (Catling and Kostiuk 2004b), although some of the localities are predominantly fescue grasslands. Rice (2003) studied 16 wetlands near Brooks, Alberta, as part of a larger ecological study of dragonflies and damselflies in Prairie marshes. This study primarily dealt with the effects of cattle grazing on odonates and wetland quality (Hornung and Rice 2003) and on the use of odonates as biological indicators of grazed and ungrazed sites (Foote and Rice 2005). The study is summarized by Wrubleski and Ross (2011: 104). The collections produced 25 species of Odonata typical of marshes in the dry mixed grassland of southeastern Alberta, and one, *Ischnura verticalis*, was the first Alberta record of this primarily eastern damselfly.

Other ecological and faunistic studies emphasize the rudimentary nature of our knowledge of the Great Plains odonate fauna. Catling and Kostiuk (2004a) published abbreviated lists of the more notable results of odonate collecting along a few streams in southern Saskatchewan, resulting in significant numbers of unusual records from sites along Frenchman Creek, Lodge Creek, and Souris River. Unusual records and distributional data also often result from studies that have their origins in fields far from Odonata systematics, such as the pollution work of Dosdall and Lehmkuhl (1989). They found that the larvae of

the rare *Stylurus intricatus* in the North Saskatchewan River were affected in a catastrophic kill of aquatic insects, 21 and 38 km downstream from an application site of methoxychlor to control black fly larvae. In Manitoba, Ackerman and Galloway (2003) collected Odonata larvae of 22 species in 10 stormwater retention ponds in Winnipeg. This highly modified urban habitat within the tallgrass prairie ecosystem produced almost one quarter of the species known in Manitoba.

Inventories in Ontario have also contributed to the knowledge of grassland Odonata. For example, the fauna of Ojibway Prairie in Windsor, Ontario, is well-known (Pratt 2010). Paiero *et al.* (2010) discusses the locality in the context of insects and remnant grassland localities in the province. Skevington *et al.* (2000) inventoried the insects of north Lambton County, including a number of grassland and oak savanna sites, and produced a list of Odonata.

Conservation Studies

Most conservation studies involve general surveys searching for particular target species to improve knowledge of the species' status. A major goal of the surveys in British Columbia noted earlier was the clarification of the conservation status of all provincial species; in the process, many grassland species were studied. This improved understanding has allowed more accurate estimates for conservation ranking of British Columbia Odonata, which has, since 2005, become an important part of provincial and national research and conservation efforts (Ramsay and Cannings 2005; Cannings *et al.* 2007). The distribution, status, and ecological requirements of the fauna are relatively well-known for the Thompson-Okanagan and Columbia-Kootenays and moderately known for the remaining southern valleys. The grassland populations in the Cariboo-Chilcotin Plateaus and the Peace River region are probably less accurately assessed. The British Columbia Conservation Data Centre, the Ontario Natural Heritage Information Centre, and the equivalent agencies for each province give conservation ranks to all odonate species. Many of the most vulnerable, because of habitat destruction and disturbance, are grassland species.

Nationally, all species are given a general conservation rank (Wild Species 2005, 2010). In addition, the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) has commissioned status reports on a few odonates of national rarity and concern that have grassland populations: *Argia vivida* (British Columbia), *Stylurus olivaceus* (British Columbia), and *Stylurus amnicola* (Manitoba). Provincial jurisdictions have sometimes produced status reports on species of provincial concern; for example, in British Columbia, Cannings (2003) studied *Macromia magnifica*. Hall *et al.* (2011) summarized some conservation issues on the grasslands of the Great Plains. They list some odonate species that may be at risk based on national general status rankings: *Somatochlora ensigera* (Saskatchewan 5, Manitoba 2), *Gomphus externus* (Saskatchewan 5, Manitoba 2), and *Stylurus intricatus* (Alberta 3, Saskatchewan 5) where 2 = may be at risk, 3 = sensitive, and 5 = undetermined (based on low search effort).

Other Studies

Other specific studies dealing with taxonomy, morphological variation, distribution, life histories, and other aspects of Odonata biology in Canadian grasslands are cited under the relevant genus or species in the systematic treatment below.

Research Priorities

The taxonomy of the Nearctic Odonata is relatively well-known compared with that of

many other insect groups; there are only a few problematic taxa. Certain closely related pairs of taxa such as *Erythemis collocata* (West) and *E. simplicicollis* (East), and especially *Amphiagrion abbreviatum* (West) and *A. saucium* (East), require more study to ascertain whether they should remain separate species. Phylogenetic examination lumped together the widespread grassland taxa *Sympetrum occidentale* Bartenev (West) and *S. semicinctum* (East) (Pilgrim and von Dohlen 2007), but further work on these and other such variable taxa is desirable. *Aeshna interrupta* is another good example of a species with widespread geographical variation (Catling *et al.* 2005). Genetic work may also help determine the relationships among Palaearctic and Nearctic taxa, as was done with the separation of the Nearctic *Enallagma annexum* Hagen from the Palaearctic *E. cyathigerum* (Charpentier) (Turgeon *et al.* 2005).

Despite the excellent inventories and data compilations described earlier, more studies are required to better define occurrence and abundance for almost all species of odonates in grasslands. This is especially true in the Prairies Ecozone where some areas (southern Saskatchewan, in particular) have not been well collected. Detailed, annotated site lists developed over several years would be extremely valuable in all regions, as would autoecological research on species to determine habitat requirements. With potential habitat changes because of climate change, baseline data on distribution and habitat (with detailed vegetational and water characteristics) are of the utmost value, and continuous monitoring of sites, especially in areas of transition between grassland and forest, would be most useful. Studies that examine the effects of disturbance and habitat change on species are needed. Several species new to particular regions will likely be recorded in southern grasslands if monitoring is increased. For example, *Hetaerina americana* (Calopterygidae), which ranges into northern Montana, will probably be recorded in Alberta and Saskatchewan before long.

Ongoing monitoring of conservation status is also a priority as habitats and climate fluctuate in character. Even when species have already been assessed, COSEWIC and provincial agencies require regular updates, and so more status reports will likely be required as drying wetlands and reduced stream flows affect populations of rare species.

Overview of the Odonata of Canadian Grasslands

Odonata Habitats

The correlation of Odonata distribution and habitat requirements with detailed schemes of wetland classification are largely lacking in Canada. Cannings *et al.* (2008) and Cannings and Cannings (2011) matched odonate species presence with site associations in the classification of British Columbia wetlands by MacKenzie and Moran (2004). Habitats for odonates in grasslands are diverse; a few generalized habitats are summarized here with some typical odonate species given for each. Many species live in more than one of these general habitat types. Various kinds of peatlands that harbour northern, eastern, or montane forest species in grassland transition areas are omitted.

Alkaline water bodies typically occur in areas of low precipitation and high evaporation. Some odonate species are able to live in these sites despite the often high salinity, and their life histories enable them to take advantage of the ephemeral nature of the shallower lakes and ponds; these species include *Enallagma boreale*, *E. clausum*, *Lestes congener*, *L. unguiculatus*, *Aeshna interrupta*, *Sympetrum internum*, *S. corruptum*, and *S. costiferum*. They are not restricted to this habitat. In addition to some saline ponds that may disappear during hot weather, fresher ephemeral waters may support species such as *Lestes dryas*,

L. unguiculatus, *Sympetrum internum*, *S. madidum*, and *S. pallipes*. In some years, large numbers of *Anax junius* (and probably other species) emerge in August from seasonally flooded fields in southern Manitoba (M. Hughes, pers. comm.).

Marshes are permanently to seasonally flooded mineral wetlands dominated by emergent grass-like vegetation. Tall stands of cattails (*Typha*) and bulrushes (*Shoenoplectus*) are most common in nutrient-rich warm waters and often form rather uniform beds in basins or margins around otherwise open ponds and lakes. Odonata are diverse here; some species associated with these habitats include *Lestes congener*, *L. disjunctus*, *L. dryas*, *L. unguiculatus*, *Coenagrion angulatum*, *Enallagma annexum*, *E. carunculatum*, *E. civile*, *E. ebrium*, *Ischnura cervula*, *I. perparva*, *I. verticalis*, *Aeshna canadensis*, *A. constricta*, *A. interrupta*, *A. palmata*, *Anax junius*, *Rhionaeschna californica*, *R. multicolor*, *Epitheca cynosura*, *E. princeps*, *E. spinigera*, *Erythemis collocata*, *E. simplicicollis*, *Leucorrhinia intacta*, *Libellula forensis*, *L. luctuosa*, *L. pulchella*, *L. quadrimaculata*, *Pachydiplax longipennis*, *Pantala hymenaea*, *Perithemis tenera*, *Plathemis lydia*, *Sympetrum costiferum*, *S. danae*, *S. internum*, *S. obtrusum*, *S. rubicundulum*, *S. semicinctum*, *S. pallipes*, and *Tramea lacerata*.

Sedge marshes are widespread, especially in the regions of grassland–forest transition in the Cordillera or northern Prairies. Sedge marshes grow in places such as flooded beaver ponds, lake margins, and flood plains. Some typical species are *Lestes congener*, *L. disjunctus*, *L. dryas*, *Coenagrion resolutum*, *Enallagma annexum*, *E. boreale*, *Nehalennia irene*, *Aeshna canadensis*, *A. interrupta*, *A. juncea*, *A. palmata*, *Epitheca canis*, *Somatochlora hudsonica*, *S. semicircularis*, *Libellula quadrimaculata*, *Leucorrhinia borealis*, *L. hudsonica*, *Sympetrum internum*, and *S. obtrusum*.

Lakes, both those that are ringed by emergent vegetation and those that lack the abundant vegetation typical of marshes, have considerable open water. Typical species include *Enallagma carunculatum*, *E. clausum*, *Aeshna eremita*, *Gomphus graslinellus*, *Macromia magnifica*, *Epitheca cynosura*, *E. spinigera*, *Libellula forensis*, and *L. quadrimaculata*.

Odonata of running waters are most diverse east of the Cordillera, probably owing to the mainly cold waters of the mountains. In southern British Columbia, the following species, when living in running water, are generally restricted to lowland streams or warm montane streams that drain lake basins, beaver ponds, or peatlands: *Argia emma*, *Ophiogomphus occidentis*, *Stylurus olivaceus*, and *Macromia magnifica*. Damselflies found in Prairie streams include *Argia fumipennis*, *Enallagma anna*, *E. antennatum*, and *Ischnura damula*, while *E. antennatum* and *E. exulans* occur in streams in southwestern Ontario tallgrass prairie. *Calopteryx aequabilis* lives in western grassland streams; *C. maculata* is common in eastern streams. The stream-dwelling *Archilestes grandis* is rare in Ontario Ojibway Prairie grasslands. *Ophiogomphus severus* is widespread in the West and is one of the more common lotic species across the Cordillera and Great Plains, in the latter region sharing the rivers with other gomphids such as *Gomphus externus*, *G. fraternus*, *Ophiogomphus rupinsulensis*, *Stylurus amnicola*, *S. intricatus*, and *S. notatus*.

Some of the more uncommon species of Odonata are associated with small springs and shallow seeps, although most of these species are not restricted to these places. *Amphiagrion abbreviatum* and *A. saucium* are widespread in such habitats in the West and East, respectively. *Argia vivida* is most often found in outlets of hot springs in the mountains, although it occurs in some tiny spring-fed cool streams in the grasslands of British Columbia's southern valleys. In the same region, *Cordulegaster dorsalis* is a rare inhabitant of small streams usually arising from springs.

Odonata Faunas of Regional Grasslands *Cordillera*

Yukon

The most familiar Yukon grasslands are those on south-facing slopes in xeric parts of the Yukon, dominated by *Artemisia frigida* Willd., as well as grasses such as *Poa glauca* Vahl and *Festuca brachyphylla* Schult. ex Schult. and Schult. (Scudder 1997; Shorthouse 2010b). These grasslands have little relevance to the Odonata, however, except as hunting areas above wetlands lying below. Grasslands with wetlands supporting Odonata are few; those treated here lie in the main valleys of the southern Yukon, especially northwest of Lake Laberge and in the Takhini River Valley. Prominent species include those common across western grasslands to the south, but there is a strong boreal flavour to the list. Salt flats occur along the Klondike Highway about 25 km northwest of Upper Laberge in one of the driest parts of the Yukon; these are found in *Pinus* and *Populus* parkland, with scattered vegetation consisting of grasses, rushes, *Chenopodium*, and *Salicornia*. Ponds in these areas support species such as *Lestes dryas*, *L. disjunctus*, *Enallagma annexum*, *E. boreale*, *Aeshna eremita*, *A. juncea*, *A. septentrionalis*, *Sympetrum danae*, and *S. internum*. Among the aspen groves of the Takhini River Valley along the Alaska Highway, a series of small, rich, prairie kettlehole ponds bordered with emergent sedges provide habitat for *Lestes disjunctus*, *L. dryas*, *Coenagrion resolutum*, *Enallagma annexum*, *E. boreale*, *Aeshna eremita*, *A. interrupta*, *A. juncea*, *A. septentrionalis*, *Somatochlora hudsonica*, *Leucorrhinia borealis*, *L. hudsonica*, *Libellula quadrimaculata*, *Sympetrum danae*, and *S. internum*. *Aeshna palmata* is restricted to small warm marl-bottomed lakes in parkland in the southern Yukon.

British Columbia

Shorthouse (2010b) discusses the wide distribution and complexity of grasslands in British Columbia. About 50 of the province's 87 known Odonata species are recorded in grasslands (Cannings 2008). Odonata diversity is greatest in intermontane grasslands in the Montane Cordillera Ecozone east of the Coast Mountains (Cannings and Cannings 2011), especially in the warm valleys south of 51°N. Two biogeoclimatic zones, the Bunchgrass and Ponderosa Pine zones in the Thompson-Okanagan, Cariboo-Chilcotin, and East Kootenay regions, are the main focus. Big sagebrush (*Artemisia tridentata* Nutt.) and bluebunch wheatgrass (*Pseudoroegneria spicata* (Pursh) A. Löve) grow in the bottomlands of the Thompson and Okanagan Valleys, usually below 500 m. At higher elevations and in more northern plateaus in the Cariboo-Chilcotin, other grass ecosystems develop. East Kootenay grasslands lie in the Ponderosa Pine Zone at low elevations in the Rocky Mountain Trench, immediately west of the Rockies. Although these grasslands are similar to those in the Bunchgrass Zone to the west, in some areas they support species typical of the Great Plains east of the Rockies, such as blue grama (*Bouteloua gracilis* (Willd. ex Kunth) Lag. ex Griffiths). Damselfly and dragonfly species found in British Columbia grasslands that are absent or rare elsewhere in Canadian grasslands include *Argia emma*, *A. vividula*, *Stylurus olivaceus*, and *Macromia magnifica*. Other characteristic species are *Enallagma clausum*, *Aeshna constricta*, *Rhionaeschna californica*, *R. multicolor*, *Gomphus graslinellus*, *Ophiogomphus occidentalis*, *Libellula pulchella*, *Sympetrum costiferum*, and *S. vicinum*.

In the Boreal White and Black Spruce Biogeoclimatic Zone east of the Rockies (Boreal Plains Ecozone), special grasslands occur on the south-facing slopes of the Peace River Valley. These river valley "breaks" are related to the mixed grasslands of the Prairies Ecozone. Other grasslands on the level plains have mostly been converted to agriculture.

The odonate fauna in this region is similar to that of the Aspen Parkland of Alberta; species such as *Coenagrion angulatum* and *Leucorrhinia borealis* are typical.

The Garry oak meadows of southeastern Vancouver Island and the Gulf Islands are coastal grassland and savanna, the driest part of the Coastal Douglas-fir Biogeoclimatic Zone (Pacific Maritime Ecozone). Summer drought produces meadows and open parkland characterized by two broad-leaved trees, Arbutus (*Arbutus menziesii* Pursh) and Garry oak (*Quercus garryana* Douglas ex Hook.). Characteristic odonate species include *Ischnura cervula*, *Rhionaeschna californica*, *R. multicolor*, *Libellula forensis*, *Pachydiplax longipennis*, and *Erythemis collocata* (all shared with the intermontane grasslands); *Ischnura erratica* and *Sympetrum illotum* are found in no other Canadian grasslands.

Great Plains

Shorthouse (2010a) gives an overview of the grasslands of the Central Plains of western Canada. The Prairies Ecozone has a diverse Odonate fauna with several notable, but not surprising, patterns. Cordilleran species such as *Ischnura cervula*, *Aeshna palmata*, and *Somatochlora semicircularis* range into the western Prairies Ecozone and the Cypress Upland Ecoregion, and some, such as *Argia emma*, apparently have spread from the south into the Mixed Grassland Ecoregion. In southeastern Manitoba, eastern forest species (e.g., *Lestes rectangularis*, *Chromagrion conditum*, *Ischnura posita*, *Arigomphus cornutus*, *Stylurus amnicola*) have penetrated tallgrass prairie around Winnipeg or grasslands in the Lake Manitoba Plain Ecoregion. Boreal and transition species common in the Boreal Plains Ecozone to the north appear in grassland–forest interface areas, especially in the Aspen Parkland, but also sometimes in isolated forested uplands such as Cypress Hills: *Coenagrion interrogatum*, *Nehalennia irene*, *Aeshna eremita*, *A. juncea*, *Cordulia shurtleffi*, *Ladona julia*, *Leucorrhinia hudsonica*, *L. proxima*, *Sympetrum obtrusum*, and others. Species more or less restricted to the Prairies Ecozone in Canada are *Enallagma anna*, *Gomphus externus*, *Stylurus intricatus*, and *Somatochlora ensigera*. Several others, such as *Ischnura damula* and *Coenagrion angulatum*, have most of their Canadian population in this region.

Southern Ontario

Small remnant patches of tallgrass prairie are scattered in southern Ontario, part of a transition zone between the Great Plains and the eastern forests. In the warm Hypsithermal period, about 6,000 to 8,000 years ago, extensive prairies reached into what is now southern Ontario; these grasslands were maintained by dry microclimates, well-drained soils, and seasonal fires. When cooler modern temperature regimes were established, these prairies were severely fragmented by increased forest development and, later, by human activity (Paiero *et al.* 2010; Shorthouse 2010b).

Ojibway Prairie

The Ojibway Prairie Complex in Windsor is an important protected remnant of tallgrass prairie in extreme southwestern Ontario. Its relevance to studies of insects in this unusual eastern ecosystem is documented by Paiero *et al.* (2010). The site consists of five separate areas of tallgrass prairie, oak savanna, and open oak woodland totalling 320 ha, second only to nearby Walpole Island (650 ha) (Paiero *et al.* 2010; Shorthouse 2010b).

Ojibway Prairie was chosen to represent the tallgrass prairies of Ontario because a list of Odonata has been developed and maintained there for many years. Sixty-one species have been recorded (2013). Although the list contains a mixture of species typical of both open and forest habitats, it gives an excellent picture of the odonate fauna of this

transitional ecosystem in Ontario. Typical eastern species recorded, among many, are *Archilestes grandis*, *Lestes rectangularis*, *Enallagma geminatum*, *Enallagma signatum*, *Ischnura posita*, *Anax longipes*, *Epiaschna heros*, *Gomphus vastus*, *Macromia taeniolata*, *Epitheca princeps*, *Celithemis elisa*, *Erythemis simplicicollis*, *Leucorrhinia frigida*, *Libellula incesta*, *Perithemis tenera*, and *Tramea carolina*. A comparable list from Pinery Provincial Park and dunes at Port Franks on Lake Huron (localities containing mostly oak savanna and other transitional grassland habitats in north Lambton County) includes 62 species of Odonata (Skevington *et al.* 2000). Other localities in southern Ontario containing grassland remnants or similar environments include the Rice Lake Plains (Catling 2008) and various alvars (areas of flat limestone with shallow soils) (Shorthouse 2010b).

Defining Grassland Odonata

There is no specialized Odonata fauna in Canadian grasslands; the species that live in grasslands also mostly occur in marshes, at pond edges, and in streams in other nearby ecosystems (Euliss *et al.* 1999; Scudder *et al.* 2010; Wrubleski and Ross 2011). The distribution patterns of these grassland Odonata might appear less defined than in many other grassland insect groups, at least terrestrial groups. This may be partially due to the strong flying abilities of most dragonflies and damselflies, but the important factor is that aquatic environments spread throughout a diverse landscape may possess similar habitats. To individuals of *Aeshna interrupta*, a *Typha* marsh in a dry prairie grassland might be equivalent to a similar pond in a spruce fen in the Aspen Parkland or boreal forest. To *Libellula forensis*, a pond on a hot sagebrush steppe in the Interior of British Columbia might be no different from a similar pond in a wet coastal hemlock forest, yet few terrestrial organisms would live in both places (Paulson 1970; Cannings and Stuart 1977). In British Columbia, for example, the close proximity of forest and grassland areas promotes the mixing of montane or northern species such as *Somatochlora semicircularis*, *Aeshna juncea*, and even *A. subarctica* with more typical grassland inhabitants in waters in, or at the margins of, grasslands. This also happens at the interface of grassland and forest in the Prairie Provinces, where northern species, such as *Coenagrion interrogatum*, *Aeshna eremita*, and *Cordulia shurtleffi*, encroach on the grasslands. This occurs primarily in the Aspen Parkland but also in more discrete areas such as the forest “islands” of southern Manitoba and the Cypress Hills of Alberta and Saskatchewan. In extreme southeastern Manitoba, a similar phenomenon occurs where the eastern forest fauna meets that of the Prairies. Some eastern species that are at home in open habitats have spread into grasslands (or urban or agricultural areas that once were grassland), but many eastern forest species remain tied to the forests near the Ontario-Manitoba border. Nevertheless, some species are more often found in grassland waters than are their close relatives, and some can develop in a wide range of habitat types. A few, such as *Lestes congener*, *Enallagma boreale*, and *Sympetrum costiferum*, are able to withstand the high salinities of alkaline ponds that are typical of many grassland environments. Others, such as *Lestes dryas* and *S. internum*, have life histories that allow them to live in water bodies that dry up in summer, another characteristic of many grassland waters. These species overwinter as eggs, and larval development is unusually rapid (Sawchyn and Gillott 1974a, 1974b). A core list of typical grassland species can thus be established, but constructing a complete and accurate list is complicated by the difficulty in defining a grassland species because of this encroachment of predominantly forest taxa. In this examination of the fauna, I have arbitrarily included all species recorded within the ecological regions and localities that I use to represent the grassland environments of Canada. Except for a few lists from specific

grassland sites, I do not know of any other compilations of Odonata species living in Canadian grasslands. However, Wrubleski and Ross (2011) indicate that 49 species from seven families were recorded in North American Prairie wetlands by Eulis and Mushet (1999).

The Odonata species shared by all the various types of Canadian grasslands discussed here, from Yukon to southern Ontario, are few: *Lestes congener*, *L. dryas*, *Coenagrion resolutum*, *Enallagma boreale*, and *Libellula quadrimaculata*. If the southern Ontario grasslands are omitted, the number of species rises dramatically because the Ojibway Prairie fauna is dominated by eastern species and lacks many of the northern transcontinental species common to the other regions. The small Yukon list results in the omission of many common, more southerly species. Thus, typical grassland species that are widespread in most Canadian grasslands (British Columbia and the Prairie Provinces) include *Lestes congener*, *L. disjunctus*, *L. unguiculatus*, *Coenagrion angulatum*, *C. resolutum*, *Enallagma annexum*, *E. boreale*, *E. carunculatum*, *E. clausum*, *E. ebrium*, *E. hageni*, *Ischnura perparva*, *Aeshna constricta*, *A. interrupta*, *Anax junius*, *Ophiogomphus severus*, *Leucorrhinia borealis*, *L. intacta*, *Libellula quadrimaculata*, *Sympetrum corruptum*, *S. costiferum*, *S. danae*, *S. internum*, *S. madidum*, and *S. semicinctum*. Species more or less restricted to the various grassland regions of Canada were indicated earlier in the Odonata Faunas of Regional Grasslands section.

Some grassland populations are distinctive in that there is a trend toward a lighter colour in adults within species and within species groups (Catling and Hughes 2008). *Gomphus externus* and *Stylurus intricatus*, both of the Great Plains, are among the palest species in their genera. In *Gomphus fraternus*, *Macromia magnifica*, and *Ophiogomphus severus*, pale subspecies occupy grassland regions. Paleness in grassland Odonata may serve to reduce body temperature and avoid predation. The grassland environment is often hot and dry during the flight period and the vegetation is often yellow or pale brown.

Systematic Review of the Grassland Odonata

An annotated systematic checklist of the 124 species, including the biogeographical faunal elements that they represent, is included in Table 1. English names of the species are included in this list. The nomenclature follows that of the Dragonfly Society of the Americas (2013). A brief review of the taxa of Canadian grasslands with biological and distributional information is presented in the following sections. Localities listed, unless otherwise noted, are sites selected as examples only. These localities are often reduced to the name of the closest town or city.

Order ODONATA (Dragonflies and Damselflies)

Suborder ZYGOPTERA (Damselflies)

Family CALOPTERYGIDAE (Broad-winged Damsels)

North America: 8 species; Canada: 5 species; Canadian grasslands: 2 species

The Calopterygidae, a family of large, elegant, and colourful damselflies, is represented by two species in Canadian grasslands, although typically species in the family live in woodlands. They fly with a beautiful dancing flight along clear streams, where the larvae cling to submerged vegetation.

Calopteryx species are large and spectacular with metallic green or blue bodies and with wings or wingtips that are often black; they are the showiest damselflies in North America. Males and females perform fascinating courtship displays. *Calopteryx aequabilis* is the more widespread species in Canada, occurring across much of the transition and

southern boreal regions and south to varying degrees all across the country. Only three localities are known in British Columbia and two of these are at the edge of grasslands: one at 100 Mile House in the Cariboo region and the other immediately north of the United States boundary at Christina Creek near Grand Forks. The species occurs in central Alberta and Saskatchewan, mostly north of grasslands, and south to southern Manitoba. Although it is common in Ontario it has not been recorded from Ojibway Prairie. The strictly eastern *C. maculata* (Fig. 1) is recorded at Ojibway but, although it lives in extreme southeastern Manitoba, it is not known from prairie sites there.

Family LESTIDAE (Spreadwings)

North America: 18 species; Canada: 10 species; Canadian grasslands: 7 species

The Lestidae is a cosmopolitan zyopteran family. Although it is a small group in Canadian grasslands, several of its members are abundant and widely distributed. Two genera are represented: *Lestes*, with six species and *Archilestes*, with one. Adults are metallic green or bronze, but parts of the body become pruinose-gray with age. They characteristically perch with wings half-spread. Females oviposit in tandem with males, and eggs are usually placed in plants above the surface of the water. Larvae have unusually elongate labia. Some species

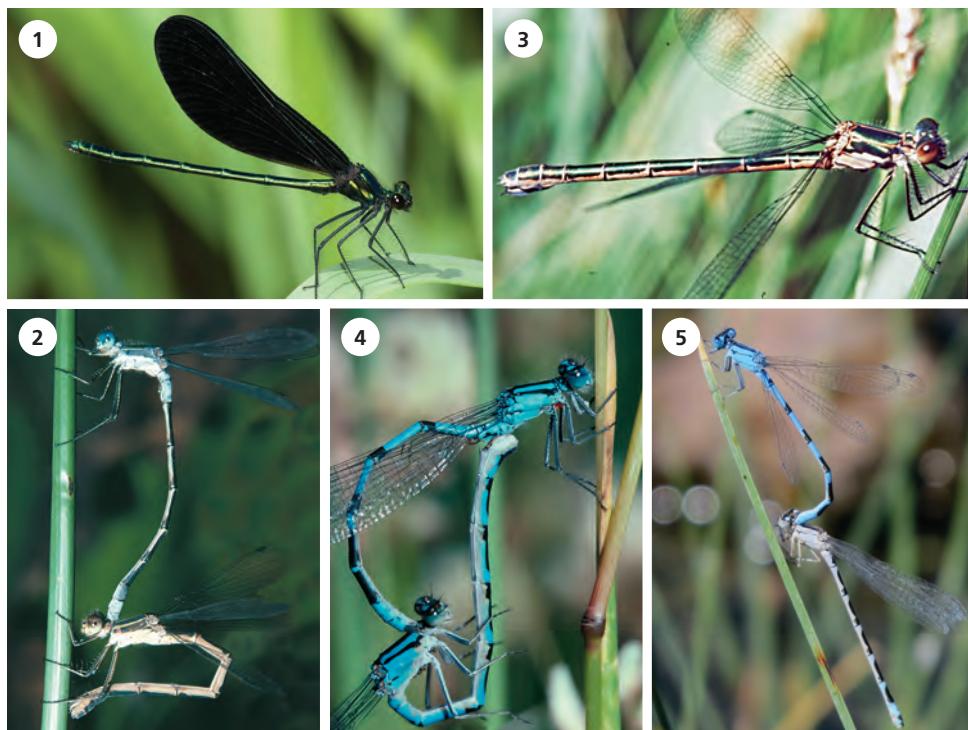


Fig. 1. *Calopteryx maculata* (Ebony Jewelwing), male. Photo: Dennis Paulson. **Fig. 2.** *Lestes disjunctus* (Northern Spreadwing), male guarding ovipositing female. Photo: George Doerksen, Royal British Columbia Museum. **Fig. 3.** *Lestes dryas* (Emerald Spreadwing), female. Photo: George Doerksen, Royal British Columbia Museum. **Fig. 4.** *Enallagma boreale* (Boreal Bluet), male and female mating. Photo: George Doerksen, Royal British Columbia Museum. **Fig. 5.** *Enallagma clausum* (Alkali Bluet), male and female mating. Photo: Dennis Paulson.

are adapted to temporary ponds; in these situations, larvae grow rapidly after overwintering as eggs. *Archilestes grandis* is known in Canada only from Ojibway Prairie, where it was first discovered in 2002 (Pratt and Paiero 2004). It normally lives along slow streams with wooded banks. Most of the recorded species of *Lestes* are typical of various types of grasslands from British Columbia to Ontario. Four species, *L. congener*, *L. disjunctus* (Fig. 2), *L. dryas* (Fig. 3), and *L. unguiculatus*, are particularly common and widespread. *Lestes disjunctus* is the most frequently observed grassland species from Yukon to Manitoba, but is not yet recorded from Ojibway Prairie, although it is known from Essex County. *Lestes dryas* is the only Holarctic member of the family. These *Lestes* species possess ecological traits and life history adaptations that allow them to inhabit prairie ponds that may vary in water chemistry and hydrology. In prairie ponds near Saskatoon, Saskatchewan, all four oviposit above the water surface and overwinter as eggs (Sawchyn and Gillott 1974a, 1974b). With the exception of those of *L. congener*, eggs are laid in green *Shoenoplectus* (*Scirpus*) stems and enter diapause after embryonic development is complete. Eggs of *L. congener* are placed in dead, dried stems and start diapause at an earlier stage. Wetting of the eggs at snowmelt in spring stimulates post-diapause development and helps synchronize larval development and adult emergence. *Lestes dryas* emerges earlier than the other species in both British Columbia and Saskatchewan (Sawchyn and Gillott 1974a, 1974b; Cannings *et al.* 1980), which may allow it to colonize temporary ponds, a strategy for which it is well-known. In British Columbia, *L. dryas* emerged about 10 days before *L. disjunctus*, which preceded *L. congener* by nine days. The main emergence of *L. disjunctus* occurred 20 days before the peak of the *L. congener* emergence (Cannings *et al.* 1980). The last species to emerge in both areas is *L. congener*, which has more egg development to undergo in the spring (Sawchyn and Gillott 1974a, 1974b). The lakes and ponds where these species were studied on British Columbia's Chilcotin Plateau range greatly in salinity (Cannings *et al.* 1980). *Lestes dryas* colonized only the freshest ponds, *L. disjunctus* occurred in lakes up to medium salinities, and *L. congener* lived in the complete range of salinities and occurred in very large numbers even at the highest concentrations (conductivity of 15,524 microSiemens, or about 1 ppt salinity).

Two other *Lestes* species should be noted here. *Lestes forcipatus* is primarily an eastern species, but was discovered in British Columbia in 1998 (Cannings *et al.* 2000, 2005) and is now known from many localities there (Cannings and Simaika 2005). Although largely restricted to forest fens north of grasslands in the West (and still unknown from Alberta), it is found at some sites adjacent to grassland in British Columbia. In Nebraska, it is common at grassland ponds (D. Paulson, pers. comm.). In western Canada, the species is more common than records indicate; it has certainly been overlooked over much of its range west of Ontario because of its similarity to the common *L. disjunctus* (Simaika and Cannings 2004). *Lestes rectangularis* is an eastern species recorded from Ojibway Prairie and southeastern Manitoba as far west as Winnipeg.

Family COENAGRIONIDAE (Pond Damsels)

North America: 105 species; Canada: 42 species; Canadian grasslands: 31 species

Seven genera and about 31 species of coenagrionids occur in Canadian grasslands (as defined here). They are usually the most common damselflies in ponds and marshes anywhere. Adult males are frequently blue marked with black, but the ground colour may be green, yellow, orange, red, or purple. Females may be similar to males (andromorphs) or coloured differently. Eggs are laid in the tissues of water plants, and females may

completely submerge for considerable periods during oviposition. The larvae are less elongate and have shorter labia than those of the Lestidae.

Enallagma is the most diverse and abundant genus of damselflies in Canada; 14 species live in grasslands. Most males are blue and black, while females are similarly coloured or have the blue replaced by brown or green. Most live in ponds and the marshy edges of lakes and streams, while a few are at home in saline lakes, and others are restricted to flowing water. *Enallagma boreale* (Fig. 4) and *E. annexum*, with widespread boreal distributions, are perhaps the most common species of the genus in Canada, and both extend into grasslands from Yukon to Ontario. *Enallagma boreale* swarms around the grassland kettle lakes and ponds from British Columbia's central plateau east across the Great Plains. *Enallagma annexum* is not recorded yet from Ojibway Prairie, but occurs nearby. It once was considered the only Holarctic member of the genus and family (as *E. cyathigerum*), but it has recently been split into two: the original Old World species (*E. cyathigerum*) and a New World species (*E. annexum*) (Turgeon *et al.* 2005). *Enallagma clausum* (Fig. 5) is a western species characteristic of alkaline ponds and lakes in dry grasslands in British Columbia and the Prairies, where it can be extremely abundant, even at sites so salty that other odonates are absent. *Enallagma ebrium* and *E. hageni* are common species across much of Canada. In British Columbia, *E. hageni* is restricted to the central plateau and does not enter the southern valley grasslands as *E. ebrium* does, but both species are common across the Prairies; in Ontario, *E. hageni* is less abundant at Ojibway than is *E. ebrium*. *Enallagma civile* occupies a wide range of marshy habitats, including newly created wetlands, and although it can be abundant in some sites, it is often only locally distributed. Apparently, it is an early successional species and may disappear from some wetlands as they age (Paulson 2011). Its range is expanding in Ontario (Catling and Brownell 2000), and it is common in southern Manitoba grasslands, uncommon in Saskatchewan, and unknown in Alberta. In British Columbia, *E. civile* is recorded only from Bridge Lake on the Cariboo Plateau, where it has been collected only once, in 1934 (Scudder *et al.* 1976). Two close relatives of *E. civile* are found in grassland habitats: *E. carunculatum* is widespread throughout much of southern Canada, and *E. anna* (Fig. 6) is predominantly western in Great Plains streams. *Enallagma carunculatum* can develop in moderately saline waters and is often the sole *Enallagma* species of *Shoenoplectus* beds and rocky or gravelly shorelines in the large lakes of southern British Columbia valleys (some, like the Okanagan, once largely clothed in grasslands). It is less common on the Great Plains, where it is considered a grassland species. It is listed as uncommon at Ojibway Prairie. Most of the few records of *E. anna* are from Alberta, where it was first discovered in Canada at Ross Creek, Medicine Hat, in 1980 (Acorn 2004), and has been collected from Fish Creek, Calgary (Cannings 1984; Beukeboom and Wasscher 1986). It is also known from several Saskatchewan localities, for example, Highway 630 SW Swift Current (Cannings 1984) and on the Souris River at Highway 39 (Catling and Kostiuk 2004a). *Enallagma anna* probably occurs in southern Manitoba streams, but it is not recorded there. Although it is known in Ontario only from several localities in Essex County, it is not listed from Ojibway Prairie. Four of the common *Enallagma* species (*E. carunculatum*, *E. clausum*, *E. ebrium*, and *E. hageni*) may be relatively recent migrants to the western Great Plains, because Whitehouse (1918a, 1918b) failed to find them. Acorn (2004) believes they have colonized Alberta (and perhaps other parts of the Prairies) over the last 100 years because of the proliferation of man-made wetlands, irrigation schemes, and water storage areas. Six *Enallagma* species recorded in grasslands are eastern in distribution and are known from Ojibway Prairie, although one, *E. antennatum*, is a stream species that occurs rarely on the Great Plains (e.g., Saskatchewan in Frenchman Creek at Highway 21, Souris River at Highway 39; Catling and Kostiuk



Fig. 6. *Enallagma anna* (River Bluet), male. Photo: Dennis Paulson. **Fig. 7.** *Ischnura damula* (Plains Forktail), male and female mating. Photo: George Doerksen, Royal British Columbia Museum. **Fig. 8.** *Ischnura verticalis* (Eastern Forktail), male. Photo: Dennis Paulson. **Fig. 9.** *Coenagrion angulatum* (Prairie Bluet), female. Photo: John Acorn.

2004a). *Enallagma basidens* has dramatically expanded its range in the last century all the way to New England from the American Southwest (Paulson 2011). Cannings (1989) first reported *E. basidens* in Canada in 1985 and attributed the rapid range expansion, at least in part, to its ability to colonize man-made habitats. The other eastern species are *E. aspersum*, *E. exsulans*, *E. geminatum*, and *E. signatum*.

Ischnura is a cosmopolitan genus whose distribution in North America is decidedly southern in character. In Canada, seven species are recorded in grasslands: *I. cervula*, *I. erratica*, *I. perparva*, and *I. damula* (Fig. 7) are western, and *I. verticalis* (Fig. 8), *I. posita*, and *I. hastata* are mostly eastern in distribution. *Ischnura cervula* is common in ponds and lakes with *Typha* and *Schoenoplectus* margins in both coastal Garry oak meadows and interior grasslands in southern British Columbia. In Alberta, it is mainly a montane species at Banff, a Cordilleran relict in the Cypress Hills (Acorn 2004), and recorded rarely in Saskatchewan grasslands (e.g., Frenchman Creek at Highway 21, where it flies with *I. verticalis*; Catling and Kostiuk 2004a). *Ischnura erratica* is restricted to the Pacific Coast from southern British Columbia south to northern California. It is a large forktail, commonly perching on the leaves of water lilies. *Ischnura perparva* is also common and widespread in southern British Columbia grasslands but is rarer east of the Rockies. For example, it is recorded at Medicine Hat, Alberta (Acorn 2004); in Lodge Creek, Saskatchewan (Catling and Kostiuk 2004a); and at Fort Whyte Centre and Winnipeg Beach in the southern Manitoba prairies (Hughes and Duncan 2003). *Ischnura damula* is predominantly a species of the Great Plains and the American Southwest and, in Canada, is more widespread in grasslands east of the Rockies than the other western species. It is rare in northern British Columbia and Yukon, where it is not associated with grasslands but inhabits warm springs in forests (it is considered a relict of a more widespread distribution during warmer climatic periods). In Alberta, it ranges from the Edmonton area to Medicine Hat (Acorn 2004) and in Saskatchewan from

Prince Albert National Park (Walker 1953) to Lodge Creek at Highway 13 and Souris River at Highway 39 (Catling and Kostiuk 2004a). It is rare in southeastern Manitoba. The three eastern species recorded at Ojibway Prairie make up the rest of the *Ischnura* grassland complement. *Ischnura hastata* prefers shallow temporary pools at Ojibway (P. Pratt, pers. comm.) and at some other southern Ontario grassland sites such as the Rice Lake Plains (P. Catling, pers. comm.). *Ischnura posita* and *I. verticalis*, the common eastern members of the genus, are abundant at Ojibway and also range west onto the Great Plains. *Ischnura verticalis* is fairly common in the Winnipeg area, in some southern Saskatchewan localities, and in several sites in southeastern Alberta. It was first reported in Alberta near Rolling Hills in 1999 (Hornung and Rice 1999). *Ischnura posita* is recorded from the Fort Whyte Centre, Winnipeg (Conroy and Kuhn 1977; Hughes and Duncan 2003).

Coenagrion is a predominantly Palearctic genus with three Nearctic species, two of which, *C. interrogatum* and *C. resolutum*, range across most of boreal North America. The third, *C. angulatum* (Fig. 9), is a Great Plains species. *Coenagrion interrogatum* typically develops in water bodies with aquatic moss in northern forest peatlands; it is the most boreal of Nearctic damselflies (Cannings and Cannings 1997). It is included here because it encroaches on grassland habitats in the southern Yukon and is recorded in a few ponds and marshes in the Aspen Parkland in central Alberta (e.g., Wagner Natural Area; Page 1998) and the prairies of Saskatchewan (e.g., Saskatoon; Sawchyn and Gillott 1975). *Coenagrion resolutum* is one of the most widespread odonates in Canada and mainly a northern forest species, but is a common early-season flyer in many grassland habitats from Yukon to southern British Columbia and across the Great Plains. It reaches the grassland pockets of southern Ontario, but is rare at Ojibway, not being found there until 2001 (Pratt 2010). *Coenagrion angulatum* is one of the most frequently seen damselflies on grasslands of the Great Plains and is widespread in ponds and marshes of the prairies, Aspen Parkland, and southern boreal forest from the Peace River region of British Columbia to southern Manitoba. It is known in a few northwestern Ontario sites, but not in grassland habitats. Sawchyn and Gillott (1975) studied the life histories of *C. resolutum* and *C. angulatum* in a pond near Saskatoon. Both species overwinter in late larval stages and emerge synchronously over about 10 days beginning in the last week of May.

Argia is the largest genus of Odonata in the New World, with over 110 species. It is primarily a stream-dwelling group, although many species do show up along lakeshores. The two western Canadian species, *A. emma* and *A. vivida* (Fig. 10), are both found in grasslands. The Canadian range of both is mostly in British Columbia, where most grassland populations are in the Okanagan Valley. There, *A. emma* is most common in the Okanagan River but also develops along lakeshores. In Alberta, there is a single photographic record of *A. emma* from Milk River at Writing-on-Stone Provincial Park in 2010 (K. Allen, pers. comm.). *Argia vivida* lives mostly in warm springs in southern British Columbia mountains and in Alberta at Banff, but also lives in Okanagan grasslands in cool, constant-temperature seeps and spring-fed streamlets (Cannings *et al.* 1998). Both species are considered threatened or vulnerable in British Columbia. Pritchard (1989) and various students published many papers documenting the development and behaviour of *A. vivida* in hot springs, and their findings are probably relevant to grassland situations. *Argia fumipennis* is mainly an eastern species that ranges into the Great Plains, especially in the United States. In Canada, *A. fumipennis* populations consist of the subspecies *A. f. violacea* Hagen. In 2004, it was found in Saskatchewan on the Souris River at Highway 39 (Catling and Kostiuk 2004a), the first Canadian record west of southern Ontario. It is not recorded at Ojibway Prairie, although it occurs nearby. At the Souris River, it flew with *Calopteryx aequabilis*, *Enallagma anna*, *E. antennatum*, *E. civile*, and *E. ebrium*.

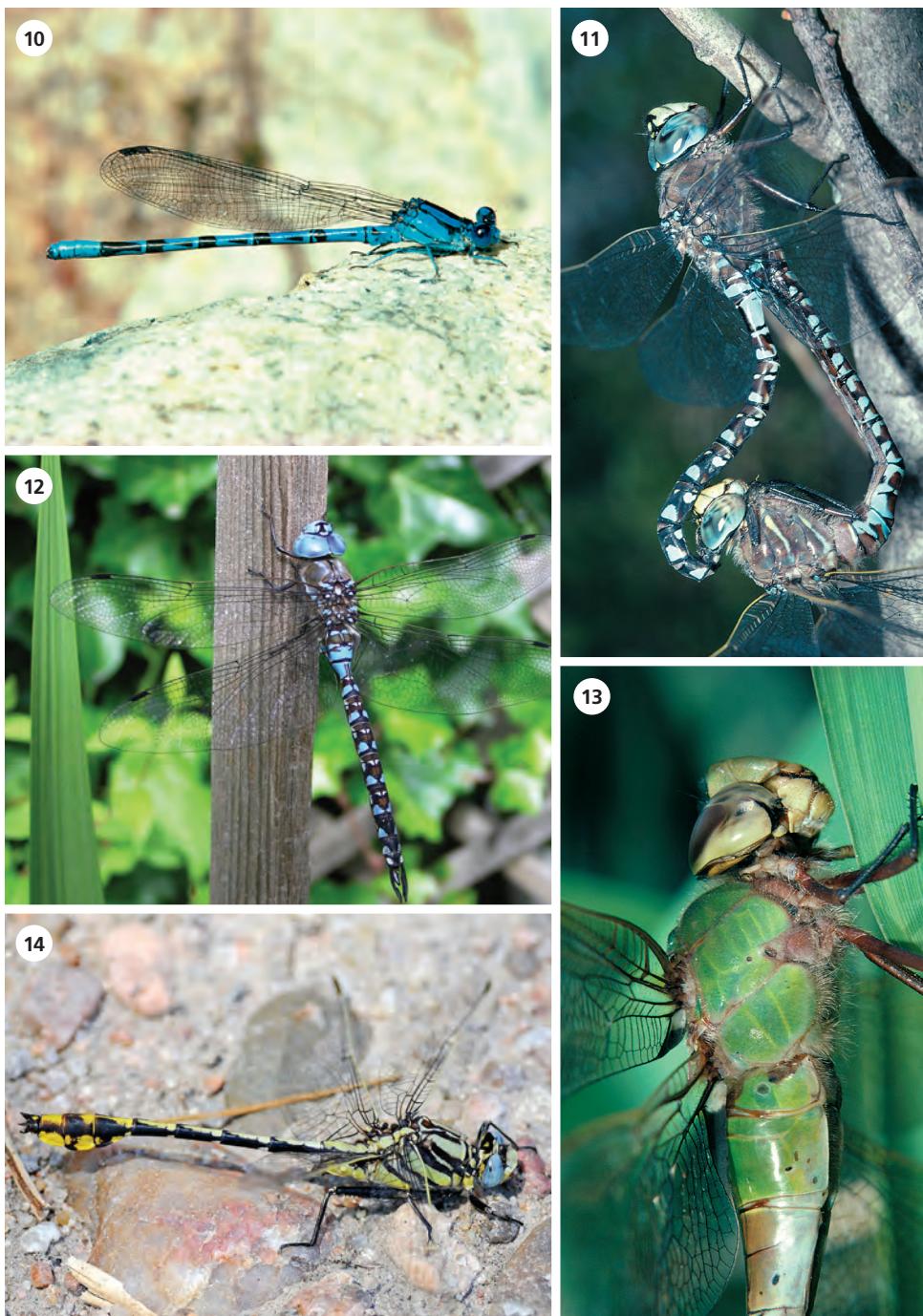


Fig. 10. *Argia vivida* (Vivid Dancer), male. Photo: George Doerksen, Royal British Columbia Museum. **Fig. 11.** *Aeshna interrupta* (Variable Darner), male and female mating. Photo: George Doerksen, Royal British Columbia Museum. **Fig. 12.** *Rhionaeschna multicolor* (Blue-eyed Darner), male. Photo: Derrick Ditchburn. **Fig. 13.** *Anax junius* (Common Green Darner), female. Photo: George Doerksen, Royal British Columbia Museum. **Fig. 14.** *Gomphus externus* (Plains Clubtail), male. Photo: Steve Mlodinow.

Three other coenagrionid genera have members in Canadian grasslands. The two species of *Amphiagrion*, *A. abbreviatum* and *A. saucium*, are possibly one and the same, and more research in the Great Lakes region is required to clarify their status (Paulson 2011). They are red and black species inhabiting seeps and marshy areas that are often spring-fed in both grassland and forest habitats. Manitoba specimens, which are scarce (e.g., Treesbank), are considered to be *A. saucium* by Hughes and Duncan (2003), although recent evidence suggests that in Canada the species does not range west of Ontario (D. Paulson, pers. comm.). Thus, populations from Manitoba need more study, but those from Saskatchewan west to British Columbia are *A. abbreviatum*. This species is more common in British Columbia than it is farther east. The delicate, metallic green *Nehalennia irene* is widespread across much of Canada, mainly in marshes and fens with dense stands of sedges. In the West, it is generally absent from the hottest and driest grasslands of extreme southern British Columbia and the western Prairies Ecozone. *Chromagrion conditum* is an eastern damselfly not recorded at Ojibway Prairie, which is well within its range, but known from an extralimital record at Fort Whyte grasslands, Winnipeg, Manitoba (Hughes and Duncan 2003).

Suborder ANISOPTERA (Dragonflies)

Family AESHNIDAE (Darners)

North America: 42 species; Canada: 24 species; Canadian Grasslands: 16 species

Members of the Aeshnidae are large dragonflies with big eyes and long abdomens; they are usually marked with blue, green, or yellow. In *Aeshna* and *Rhionaeschna*, females have several colour forms; the typical male colour form with a blue-marked abdomen is usually less common in females than yellow or green forms. Adults tirelessly hunt for insects over ponds, lakes, and streams and wander widely in search of prey. They fly swiftly, hover here and there, and perch vertically. *Rhionaeschna* males tend not to hover. Females have well-developed ovipositors at the tip of the abdomen, and oviposit in water plants or floating wood above or below the waterline. The larvae are slender and sleek, with flattened labia lacking setae. They are rapacious hunters among water plants. Darners are represented in Canadian grasslands mainly by three genera, *Aeshna*, *Rhionaeschna*, and *Anax*; a fourth, *Epiaeschna*, normally an eastern forest species, is included because of its presence at Ojibway Prairie. Cannings (1996) provides pictorial identification keys and outlines the biology and distribution of *Aeshna* and *Rhionaeschna* species in British Columbia, a fauna that includes all Canadian grassland species. Peters (1998) discusses the ecology of some of these darners and gives a key to adults based on wings only. This allows the identification of specimens that have been eaten by birds, a situation often encountered in the field, especially at grassland marshes.

Eleven of the 13 Canadian *Aeshna* species are grassland inhabitants, although some are more typical of grasslands than others. The most characteristic grassland species is *Aeshna interrupta* (Fig. 11); this is one of the most widespread dragonflies in Canada, living in many habitats from northern peatlands to alkaline lakes and temporary ponds. It is the most abundant species of grassland ponds and marshes from Yukon to Manitoba and can occur in impressive numbers. Catling and Brownell (2002) counted about 2,000 flying over the largely agricultural landscape near Grenfell, Saskatchewan, in 2001, and Catling and Kostiuk (2008) estimated (from roadkill counts) that about 10 million individuals crossed 4 km of the Trans-Canada Highway east of Brandon, Manitoba, over a few days in July 2007. In some years, massive aggregations move up the eastern slopes of the Rockies in midsummer (Paulson 2009; J. Acorn, pers. comm.). Three subspecies (*A. i. interrupta*, *A. i. interna*, and *A. i. lineata*) have been described for Canadian *A. interrupta* populations (Walker 1912a,

1958); the common one in Canadian grasslands (except for southern Ontario and coastal British Columbia grasslands) is *A. i. lineata* Walker. However, the subspecies are problematic (Cannings and Stuart 1977; Catling *et al.* 2005), as they do not form clear, geographically separate populations. *Aeshna constricta* lives across much of southern Canada, where it prefers small, rich marshy habitats. It is rare in British Columbia's southern Interior valleys and is of management concern because its habitat is often threatened by human development; some of the few sites are in grasslands (Cannings *et al.* 1998). It becomes more common eastward across the Great Plains to Ontario and is abundant in southern Manitoba and at Ojibway Prairie in southwestern Ontario. The primarily forest-dwelling *A. palmata* and *A. umbrosa* are close relatives that venture into grasslands. *Aeshna palmata* is a Cordilleran dragonfly and is perhaps the most widespread and common dragonfly in British Columbia. It is much less common northward and, in Yukon, it is restricted to shallow, marl-bottomed lakes in southern parkland (Cannings and Cannings 1997). It spills out onto the foothills and plains from the Rockies in southern Alberta, at least as far east as Calgary. It is also one of the many montane animals that live in the forested enclave of the Cypress Hills, straddling the Alberta–Saskatchewan boundary (Hilton 1985; Catling and Kostiuk 2004b) and also occurs in the Maple Creek area in Saskatchewan (Cannings 1984). Cordilleran and boreal flora and fauna in the Cypress Hills are considered isolated relicts of a cooler postglacial period when coniferous forest linked the Cypress Hills and the Rocky Mountain foothills (Hilton 1985). *Aeshna umbrosa*, on the other hand, is a common transcontinental darner that also occurs in grasslands from British Columbia to Ontario. The specimens collected in the Alberta Cypress Hills (Hilton 1985) are the blue Cordilleran form rather than the green transcontinental form (Cannings and Stuart 1977; Catling *et al.* 2005). *Aeshna verticalis* is an eastern species that ranges from southern Ontario to Nova Scotia but extends to the prairies of southern Manitoba. The other darners recorded in grassland habitats are mainly northern forest species that are sometimes recorded along the northern (or montane) borders of grassland regions. *Aeshna canadensis* is the most southerly of these species, found in numerous sites in warm British Columbia valleys (e.g., Athalmer in the East Kootenay and Cossens Bay near Vernon) and on the Prairies, especially northward (e.g., Stoyke 1987). *Aeshna eremita* is a widespread and common boreal darner; in British Columbia it is one of the most widespread forest dragonflies that also inhabits grassland wetlands. It is common in the Cypress Hills and occurs in many sites along the northern borders of grasslands on the Great Plains (e.g., G.C.D. Griffiths and D. Griffiths, 1980, unpublished report; Stoyke 1987; Page 1998; Rice 1999), but is absent from Ojibway Prairie, which is too far south in Ontario to support it. The Holarctic *Aeshna juncea*, common in northern sedge marshes, has a similar distribution to *A. eremita* but with less movement into grasslands, especially in the Prairies Ecozone. *Aeshna subarctica* is closely related to *A. juncea*, but prefers peatland ponds and lakes with submerged mosses, which are rare in and near grasslands. However, the species breeds at several grassland ponds on the Chilcotin Plateau in central British Columbia (Riske Creek; Cannings and Cannings 1987) and in East Kootenay (Athalmer; Cannings 1984). The northern boreal *A. septentrionalis* is a peatland obligate in northern British Columbia and farther east, but lives in a wide range of wetland types from roadside ditches to marl lakes and from sedge marshes to deep mossy fens in the Yukon, where it is the most widespread large dragonfly (Cannings *et al.* 1991; Cannings and Cannings 1997). Such wide habitat tolerance results in its presence at grassland ponds in southern Yukon (e.g., salt flats northwest of Upper Laberge). The related *A. sitchensis*, however, is a peatland obligate wherever it occurs; it gains a place on this grassland list only as a species in forest–grassland interface sites such as Devon and Red Deer in Alberta and Tolstoi in Manitoba.

Rhionaeschna is characteristic of South and Central America, with a few species reaching the United States and Canada, mostly in the West. Both species of *Rhionaeschna* treated here, *R. californica* and *R. multicolor* (Fig. 12), occur in British Columbia grasslands but are not normally found eastward in Canada, although there is a record of *R. multicolor* in the Alberta Cypress Hills (Hilton 1985). Either species, especially *R. multicolor*, which is found in Montana, may expand northward into the Canadian Prairies, given trends in climate warming. *Rhionaeschna multicolor* is one of the most common dragonflies of southern British Columbia grassland ponds and marshes in midsummer. In contrast, *R. californica* is remarkable for its springtime flight season, emerging with the earliest dragonflies. In the southern valleys of British Columbia, and especially in the Garry oak grassland habitats around southern Vancouver Island, it usually appears by mid-April. It normally disappears by early August, just when many darner species are reaching their peak abundance. The only other Neotropical darner in Canada is the eastern *R. mutata*, which is strikingly similar to *R. multicolor*. It is a rare species of extreme southern Ontario and has not yet been reported in grassland habitats, although it is known from Essex County near Ojibway Prairie.

Anax species are among the largest dragonflies. *Anax junius* (Fig. 13) has a southern transcontinental distribution and is found in grasslands from Vancouver Island to southern Ontario. At least some populations migrate, with spring migrants moving north in the spring before any emerge locally. These migrants breed; their offspring emerge in late summer and fly south in August and September. Other populations are resident, with adults emerging in spring from larvae that have overwintered locally. This species swarms over Ojibway Prairie in August and September (P. Pratt, pers. comm.). The eastern *Anax longipes* has a spectacular male with a green thorax and red abdomen. It is rare in southern Ontario but has been recorded at Ojibway Prairie (Pratt 2010).

Epiaeschna heros is a forest species; the majority of Canadian records are from southern Ontario. Although it is atypical of grasslands, it is included because it is recorded at Ojibway Prairie, where it commonly hunts over the open grassland (P. Pratt, pers. comm.).

Family GOMPHIDAE (Clubtails)

North America: 101 species; Canada: 42 species; Canadian grasslands: 15 species

The Gomphidae is a large family of mostly stream dwellers that, in Canada, is largely eastern in distribution. Six genera (14 species) are listed here as grassland inhabitants. Gomphids are not observed as frequently as some other odonate families because many species are rare and their short flight seasons, cryptic coloration, and tendency to rest often makes them a challenge to find. When they are encountered, they are readily recognized by their relatively small, widely separated eyes and their green or yellow bodies striped in brown and black. The tip of the abdomen in males is usually swollen into a club. The female lacks an ovipositor and drops the eggs directly into streams or along the sandy shores of larger lakes. The larvae burrow in the bottom sediments of streams and lakeshores.

Three gomphid genera have only one or two species in grassland habitats. *Progomphus obscurus* is a clubtail of sandy sites, where the larva is a highly adapted burrower; the species is restricted in Canada to southern Ontario. It is rare at Ojibway Prairie (Pratt 2010). The genus *Arigomphus* is mainly distributed in central and eastern North America, but in contrast to other related gomphids, species are likely to live in lakes and ponds. Two species are recorded in grasslands in Canada. In southern Manitoba, *Arigomphus cornutus* has been collected in diverse habitats around Winnipeg, for example, in urban stormwater retention ponds (Ackerman and Galloway 2003), in the Red and La Salle rivers (Walker

1958), and in the oxbows of the Assiniboine River (M. Hughes, pers. comm.). In 2013, *Arigomphus villosipes* appeared at Ojibway Prairie for the first time (P. Pratt, pers. comm.). *Dromogomphus spinosus* is a widespread eastern forest gomphid that, at the extreme northwestern edge of its range in southern Manitoba, has been recorded in grassland near Oak Hammock Marsh north of Winnipeg and at the edge of prairie near Marchand (Hughes and Duncan 2003).

Gomphus is the most diverse genus of odonates in North America, with 38 species; there are 51 worldwide (Paulson 2011). Four are considered here. *Gomphus graslinellus* lives along valley bottom lakeshores in the Okanagan, Shuswap, and Boundary regions of British Columbia, where grasslands were once common but are now scarce. It is rare on the Great Plains, where there is one record for the Cypress Hills in Alberta, several near Armit, Saskatchewan (almost 53°N; Halstead 2013), and a few in southern Manitoba. It is restricted to the south in Ontario; it is uncommon at Ojibway Prairie (Pratt 2010). One of the few odonates that is more or less restricted to the Great Plains is *Gomphus externus* (Fig. 14). The larvae develop in sandy or muddy streams or rivers with moderate current. In Canada, *G. externus* is recorded only in southern Manitoba, where it can be common locally along the Red River north to Winnipeg Beach and on the Assiniboine River west to Treesbank (Hughes and Duncan 2003). The two other *Gomphus* species are mainly eastern in distribution. *Gomphus fraternus fraternus* is fairly common in Manitoba along the Winnipeg River and southeastern Lake Winnipeg in largely forested habitat, immediately east of the grasslands. It ranges eastward through southern Ontario to Québec, although it is not recorded at Ojibway Prairie. Prairie populations along the Red and Assiniboine rivers in Manitoba are smaller and paler than others and are designated as subspecies *G. f. manitobanus* Walker (Walker 1933; Walker 1958; Catling and Hughes 2008). Although not known outside Manitoba, this subspecies could occur in other Great Plains localities in the United States (Catling and Hughes 2008). *Gomphus vastus* has a wide range in the eastern United States and a few small areas of southern Canada, but like so many other eastern forest plant and animal species, it barely enters the southeastern Manitoba woodlands. It is included in the grassland Odonata list because it is recorded at Ojibway Prairie (Pratt 2010).

Stylurus also has four species on the Canadian grassland Odonata list. When perched, individuals often hang down from the leaf or twig, or sit tail down on large leaves. *Stylurus olivaceus* lives strictly west of the Rockies and, in British Columbia, it mainly inhabits warm rivers such as the Okanagan and Thompson that flow through grasslands. It ranges east to Christina Creek in the Boundary region. Most of its habitats are strongly affected by humans (Cannings 2011) and it is assessed as “Endangered” by COSEWIC (2011). *Stylurus intricatus* (Fig. 15) is a small, mostly yellow clubtail living in scattered populations across the arid West, typically developing in warm, muddy, slowly moving rivers (Paulson 2009) such as the Milk (e.g., Lost River Ranch, Milk River; Acorn 1983) and Saskatchewan (e.g., Maidstone, Catling and Kostiuk 2004a; Saskatoon, Prince Albert, Walker 1958). *Stylurus annicola* is an eastern clubtail that was recently (2004) recorded on the southern Manitoba prairies along the Assiniboine and Red rivers (Hughes and Catling 2005) and is now also known from a few other locations in the region. The Great Plains population is believed to be at some risk from agricultural impacts, but more data are needed to determine its status; a recent COSEWIC assessment resulted in an assessment of “data deficient” (COSEWIC 2013). Another eastern *Stylurus*, *S. notatus*, is recorded in grasslands from Saskatchewan east, although the northern parts of its range are in the boreal forest. For example, the only record for Alberta is at Fort McMurray (J. Gatten, pers. comm.), and two of the Saskatchewan records (Frenchman Butte, Hutchings 2004; Prince Albert, Halstead 2013) are at the interface of the boreal forest.

Records from Saskatchewan grasslands also include Maidstone (Catling and Kostiuk 2004a). *Stylurus notatus* is called the Elusive Clubtail; in most places, it is seen much less often than its true abundance warrants. Experienced observers in Manitoba seldom see a mature adult, but sometimes lucky people have come across a mass emergence or thousands of exuviae on a river bank (M. Hughes, pers. comm.). The species is uncommon at Ojibway Prairie, where it spends considerable time hunting and resting out on the prairie (P. Pratt, pers. comm.). *Stylurus notatus* is the sole odonate species living in grasslands that is considered of global conservation concern; it is designated G3 (vulnerable) (Hall *et al.* 2011).

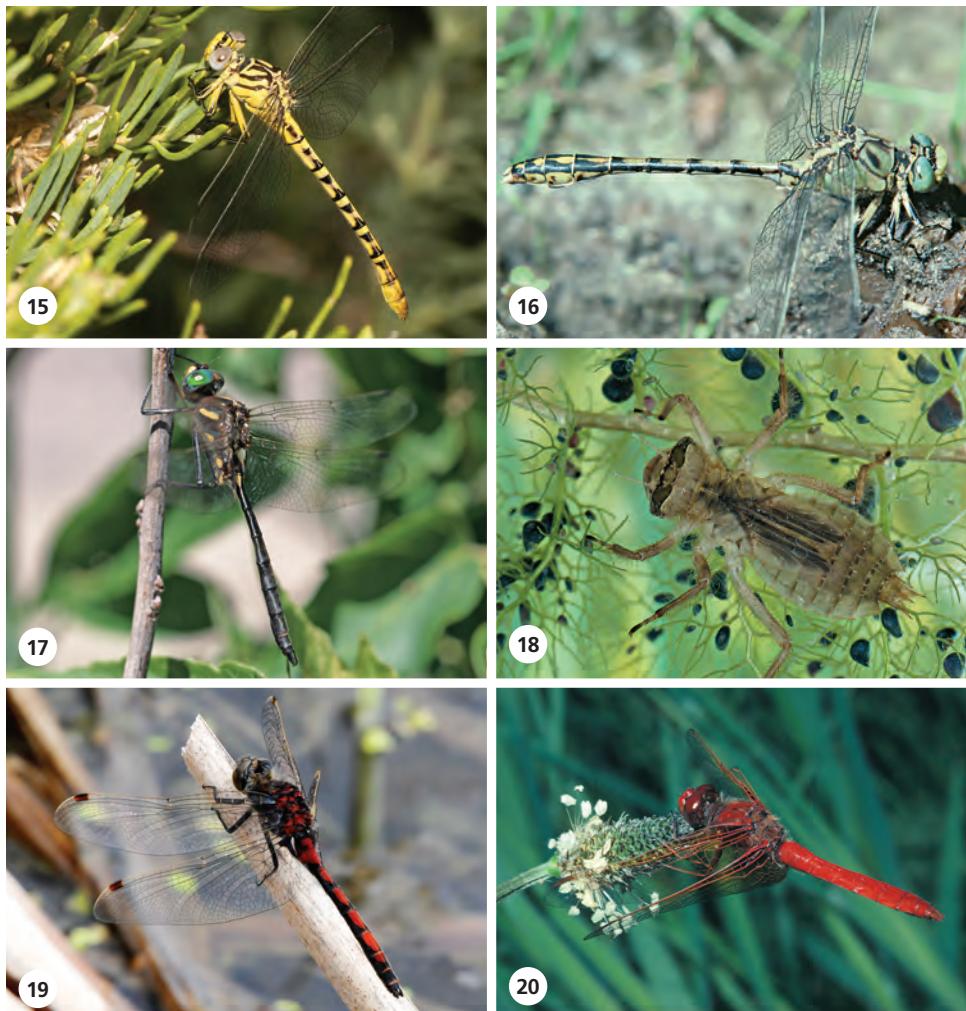


Fig. 15. *Stylurus intricatus* (Brimstone Clubtail), female. Photo: Dennis Paulson. **Fig. 16.** *Ophiogomphus severus* (Pale Snaketail), male. Photo: George Doerksen, Royal British Columbia Museum. **Fig. 17.** *Somatochlora ensigera* (Plains Emerald), male. Photo: Sid Dunkle. **Fig. 18.** *Libellula quadrimaculata* (Four-spotted Skimmer), larva. Photo: Robert A. Cannings, Royal British Columbia Museum. **Fig. 19.** *Leucorrhinia borealis* (Boreal Whiteface), male. Photo: Dennis Paulson. **Fig. 20.** *Sympetrum illotum* (Cardinal Meadowhawk), male. Photo: George Doerksen, Royal British Columbia Museum.

Species in the beautiful genus *Ophiogomphus* have green thoraxes and yellow abdomens marked in black. Two western and one eastern species are regularly found in grassland habitats. In Canada, *O. occidentis* is known only from British Columbia, where it ranges from southern Vancouver Island east to the Shuswap and Boundary regions, all south of 51°N. It is most common in the Okanagan Valley, where it breeds in rivers and along sandy lakeshores. *Ophiogomphus severus* (Fig. 16) is the most frequently recorded gomphid west of Manitoba. It develops in small streams, rivers, and lakes in both grasslands and forests from British Columbia east to Saskatchewan and north into the boreal forest. The montane populations in British Columbia and Alberta are part of the subspecies *O. s. montanus* (Selys) and are more heavily marked than the pale populations of the nominate subspecies on the Great Plains. This snaketail is common in the Saskatchewan River system (Miyazaki and Lehmkuhl 2011) and other streams such as the Milk River. The eastern *O. rupinsulensis* is recorded in Canadian grasslands only in Saskatchewan and Manitoba. Typically, it inhabits streams and rivers that are more sluggish and muddy than those used by most other *Ophiogomphus* species. It is uncommon in extreme southern Manitoba (prairie records along the Assiniboine River include Treesbank, Griswold, and Virden) and it is rare in central Saskatchewan (Saskatoon, Prince Albert).

Family CORDULEGASTRIDAE (Spiketails)

North America: 9 species; Canada: 5 species; Canadian grasslands: 1 species

Spiketails are large black and yellow dragonflies with relatively small blue or green eyes that usually touch at a single point. The dragonflies live along creeks and streams, sometimes even small trickles, usually in woodland. Adults patrol these streams, and the female, hovering vertically, shoves eggs in the sand and silt of the stream bed using her spade-like ovipositor. The large, squat, hairy larvae bury themselves in the sediment to await their prey. The labium of the larva, with its palps deeply and irregularly toothed, is distinctive.

One genus, *Cordulegaster*, lives in North America. *Cordulegaster dorsalis* is the most widespread *Cordulegaster* west of the Rockies and is the only representative of the Cordulegastridae in western Canadian grasslands. It is common on some coastal British Columbia streams, but it is also a rare inhabitant of running water, especially spring-fed streams, in the mountains of the Interior south of 51°N. The only grassland habitat currently known is Little Sand Creek near Jaffray (East Kootenay), which runs through dry, open coniferous forest and associated grassland patches (Cannings *et al.* 2000), although other occupied sites probably exist. Before Garry oak savannas on southern Vancouver Island were highly modified by humans, *C. dorsalis* likely flourished along some of the grassland streams there (e.g., Bowker Creek, Oak Bay) but, today, it is recorded only in nearby woodland. The eastern *Cordulegaster maculata* is rare at the western edge of its range in extreme southeastern Manitoba (e.g., Sandilands Provincial Forest) and has not been recorded on adjacent prairie, although presumably individuals could appear on small wooded streams there.

Family MACROMIIDAE (Cruisers)

North America: 9 species; Canada: 4 species; Canadian Grasslands: 2 species

The Macromiidae are large yellow and black dragonflies with the thorax encircled below the wings by a distinctive, oblique yellow band. They inhabit rivers and wave-washed shores of lakes, where the adults fly rapidly out over the water, but they also hunt along roads and railways, sometimes far from water. The larvae sprawl on the bottom silt

and sand. Their long spider-like legs and the horn-like projection between the eyes are characteristic. There are two North American genera, *Macromia* and *Didymops*, but only the former is recorded in Canadian grasslands. However, *Didymops transversa*, a common and widespread eastern forest species, occurs in extreme southeastern Manitoba and may venture out onto the prairies just to the west.

Three *Macromia* species may be found in or near Canadian grassland habitats, although only two are so far recorded. *Macromia magnifica* lives in a few of the southwestern valleys of mainland British Columbia. In the Okanagan Valley, most of the records at breeding sites are from Vaseux Lake, but it is often seen hunting along roads and abandoned railways in the hills above Okanagan Lake, 500 or 600 m above any potential breeding sites along the lakeshore below (Cannings *et al.* 1998). The nominate subspecies *M. m. magnifica* is the grassland form (Cannings *et al.* 2006). *Macromia taeniolata*, a large cruiser of the eastern United States, reaches Canada only along the rivers of extreme southwestern Ontario in Lambton and Essex counties (Catling and Brownell 2000) and was first recorded at Ojibway Prairie in 2004 (Pratt 2010). The most common and widespread eastern *Macromia*, *M. illinoiensis*, is known from the forests of southeastern Manitoba, but has yet to be recorded at adjacent grassland sites. It is not known at Ojibway, although it ranges across southern Ontario and east to Nova Scotia.

Family CORDULIIDAE (Emeralds)

North America: 50 species; Canada: 33 species; Canadian grasslands: 13 species

In most of Canada, the Corduliidae is a family best seen around lakes, boggy streams, and peatlands in the mountains or in northern forests. Many species are boreal in distribution. The adults are medium-sized dragonflies, usually with metallic blackish green or brassy green bodies; this and the bright green eyes of many species give the group its English name. The family is mainly found in forested habitats and only four genera are on the Canadian grassland list: *Cordulia*, *Dorocordulia*, *Epitheca*, and *Somatochlora*.

Cordulia shurtleffi and *Dorocordulia libera* are generally forest species, but both occur in grassland habitats. *Cordulia shurtleffi* is a widespread boreal dragonfly, the most common species of the Corduliidae in Canada, typically inhabiting boggy lakes, fens, and beaver ponds. It enters grassland habitats all over British Columbia, but much less so in prairie habitats of the Great Plains, where it is mostly a species of the foothills (Bragg Creek) and northern fringes (Edmonton, Prince Albert). It is recorded from the Cypress Hills in both Alberta and Saskatchewan and is common in southern Manitoba (e.g., Treesbank; Walker and Corbet 1975), but is absent from Ojibway Prairie. *Dorocordulia libera* is normally a denizen of northeastern North American forest marshes and boggy habitats. It is uncommon in southeastern Manitoba, which is at the western edge of its range, but there are records for Winnipeg and Hansen Creek, both within grassland zones. It is rare and local in southwestern Ontario and has not been observed at Ojibway Prairie.

Somatochlora is the predominant genus of the Corduliidae in North America with 26 species, 20 of which are recorded in Canada. Most of these are not typical grassland species, but seven are known from grasslands. None are recorded at Ojibway Prairie in Ontario. *Somatochlora ensigera* (Fig. 17) develops in streams, often small ones, in scattered areas across the Prairies Ecozone (e.g., Maple Creek, Saskatchewan; Red, La Salle, Assiniboine, and Whitemud rivers in Manitoba) and in woodlands east to southern Ontario (single record) and Ohio. *Somatochlora semicircularis* is a western Cordilleran species that lives in sedge marshes. It is widespread in British Columbia and in and near the mountains of

Alberta (e.g., Sibbald Flats southwest of Calgary; Cypress Hills). In British Columbia, it is the most likely *Somatochlora* to appear in or at the edge of grasslands (e.g., Madeline Lake, Penticton; Cosens Bay, Vernon). A few others are marginal grassland species at best, but five more or less transcontinental boreal species are recorded from grassland zones (e.g., Aspen Parkland), usually in “forest islands” or at the grassland–woodland interface: *Somatochlora franklini* (e.g., Alberta: Red Deer, Wagner Natural Area near Edmonton; Saskatchewan: Saskatoon; Manitoba: Treesbank, Winnipeg, Victoria Beach), *Somatochlora hudsonica* (e.g., Alberta: Red Deer, Cypress Hills in fescue prairie), *Somatochlora kennedyi* (e.g., Manitoba: Winnipeg), *Somatochlora minor* (e.g., Alberta: Bragg Creek, Cypress Hills in fescue prairie); Manitoba: Treesbank, Onah), and *Somatochlora walshii* (e.g., Manitoba: Winnipeg).

Epitheca species are dull emeralds, with mostly black and pale brown/yellow bodies and brown marks at the hind-wing bases. They fly in late spring and early summer. Females gather a cluster of eggs at the tip of the abdomen, supported by the long bifid subgenital plate (thus the English name, “baskettail”). Long strands of eggs are laid, sometimes communally, along lakeshores. *Epitheca* species often feed in swarms. Two species on the grassland list are strictly eastern in distribution, ranging mostly from Ontario to Nova Scotia; they are both recorded at Ojibway Prairie but nowhere in grasslands to the west. *Epitheca cynosura* is distributed westward to extreme eastern Manitoba but remains in the forests there, not extending west much from the Ontario border. *Epitheca princeps* is an unusual baskettail in that it is large and darner-like, with strongly spotted wings. It has a distribution similar to that of *E. cynosura*; the only Manitoba records are recent (2004, 2009) from forest habitats in the extreme southeast (De Marsh and Taylor 2011). *Epitheca canis* and *E. spinigera* are more or less transcontinental in the southern half of Canada. *Epitheca canis* is weakly associated with the margins of the Prairies Ecozone in Saskatchewan (Cypress Hills, northern edge of Aspen Parkland) and Manitoba (Dauphin, Riding Mountain, Sandilands), while *E. spinigera* is more common and more likely to be seen in a variety of habitats, including grassland edges. It is common around lakes associated with Garry oak meadows on southern Vancouver Island, but uncommon at grassland sites in the dry Interior (e.g., Vaseux Lake, Penticton, Vernon). In the Prairie Provinces, it is common across southern Manitoba (e.g., Treesbank, Winnipeg) and in the boreal forests of Saskatchewan and Alberta, south to the Aspen Parkland (e.g., Edmonton).

Family LIBELLULIDAE (Skimmers)

North America: 112 species; Canada: 45 species; Canadian grasslands: 37 species

The Libellulidae is the largest family of Odonata but is only slightly more diverse than the Gomphidae. The species are most common around ponds, marshy lakeshores, and sluggish streams where the adults, often colourful, dart about and spend much time perched horizontally in the sun. Females oviposit alone or in the company of guarding males by dipping the abdomen in the water, releasing the eggs. Many larvae, like those of the Corduliidae, move sluggishly or squat on the bottom mud; others are more active in vegetation.

The genus *Libellula* contains seven large, striking species in Canadian grasslands. Some have banded or spotted wings, and most mature males, especially, have extensive pale pruinosity (a white, gray, or pale blue powdery bloom that exudes from the cuticle) on the abdomen or entire body. *Libellula quadrimaculata* (Fig. 18), a widespread Holarctic species and one of the most common dragonflies worldwide, is nearly everywhere in

Canada, from northern bogs to alkaline grassland ponds. It lives in all areas covered by this study, from the Yukon to Ontario. *Libellula forensis* is strictly Cordilleran. It is most common on British Columbia's southern coast, where it is characteristic and abundant in ponds and marshes in Garry oak meadows, and in the Okanagan Valley, where it is common in grassland waters. It is rare in the Kootenays. *Libellula pulchella* is a large southern transcontinental species, often associated with grassland ponds, although it is rare in the Prairies Ecozone in Alberta and Saskatchewan. It ranges across the southern British Columbia Interior, with most records in the Okanagan Valley, where most of its habitat has been drained and filled in the past century. It is reported from Prairie grasslands in only the Cypress Hills (Hilton 1985), Medicine Hat (J. Acorn, pers. comm.) and Onefour (G. Hilchie and M. Buck, pers. comm.) in Alberta and from near Prince Albert in Saskatchewan (G. Hutchings, pers. comm.). However, it is common in southern Manitoba and at Ojibway Prairie. *Libellula luctuosa* is a southern transcontinental dragonfly that has shown up once in southern Manitoba at Winnipeg (Hughes and Duncan 2003), whereas it is common in Ontario and Québec. At Ojibway Prairie, it is the most common *Libellula* species (P. Pratt, pers. comm.). It has moved north in recent decades on the Pacific Coast (Paulson 2009) and may appear in British Columbia grasslands before long; this is perhaps a northward shift in distribution resulting from climate warming. Three eastern *Libellula* species recorded at Ojibway Prairie are *L. incesta*, *L. semifasciata*, and *L. vibrans*. In Canada, the latter is known from only extreme southwestern Ontario, while the other two range through southern Ontario and, to a limited extent, into the southern Maritimes.

The genera *Ladona* and *Plathemis*, which are closely related to *Libellula*, each contain one transcontinental species in Canadian grasslands. *Ladona julia* is decidedly more northern in distribution and is much less a grassland inhabitant than *Plathemis lydia*. *Ladona julia* is partial to montane, southern boreal, or Aspen Parkland lakes with peaty shores; it is absent from the prairie grasslands of Alberta and Saskatchewan but is common in southern Manitoba. It breeds uncommonly around northern grassland ponds in the Chilcotin region of central British Columbia (Cannings and Cannings 1987). In British Columbia, *Plathemis lydia* is recorded in southern British Columbia and from Manitoba eastward to Nova Scotia. In British Columbia, it likes muddy ponds in the warm lowlands of eastern Vancouver Island (Garry oak meadow remnants), the grasslands of the Okanagan, and (more rarely) the Kootenays in the Interior. Eastward, the northern limit of its range runs through central Montana and North Dakota in the United States (Paulson 2009), and so it is absent from the Canadian Great Plains except for the Winnipeg region, where it is rare, but apparently increasing in numbers (Hughes and Duncan 2003). It is common at Ojibway Prairie.

Two other genera, *Perithemis* and *Celithemis*, are mainly eastern. *Perithemis tenera* is a tiny, orange-winged dragonfly (clear with large brown marks in females), assumed to be a wasp mimic, at least away from water. It is widespread in the East, including much of the American Great Plains, but in Canada is mostly confined to southern Ontario. It is common at Ojibway Prairie. The eight species of *Celithemis* develop in marshy lakes and ponds and are more or less restricted to the eastern United States and Canada (four species). Two are recorded at Ojibway, *C. elisa* and *C. eponina*; both species have strongly coloured, patterned wings.

Leucorrhinia species (whitefaces) are small, black, white-faced dragonflies marked with red or yellow that are found around the marshy shores of lakes and ponds, often in peatlands, in the late spring or early summer. Whitefaces are most common in mountain or northern areas; they are largely absent from the dry grasslands of Alberta and Saskatchewan

but are more widespread in southern Manitoba. *Leucorrhinia intacta* is the anomaly in the genus, preferring ponds with water lilies in warm lowlands; it is the common species in the grassland valleys of southern British Columbia and over much of southern Ontario, including Ojibway Prairie, where it is abundant. Although it is absent from the driest parts of the Prairies, it lives in central Alberta and Saskatchewan and southern Manitoba. Despite its southern affinities, it is also recorded from northern Alberta and along the Mackenzie River in the Northwest Territories. *Leucorrhinia hudsonica* is one of the most wide-ranging dragonflies in Canada, from Yukon to Newfoundland. In grasslands, it is recorded in Yukon, British Columbia (e.g., Chilcotin region), the Aspen Parkland of Alberta and Saskatchewan, and throughout most of southern Manitoba. It is found in the Cypress Hills in both Alberta (where one of the sites is in a fescue prairie; Hilton 1985) and Saskatchewan. A close relative, *L. borealis* (Fig. 19), is a dragonfly of the western boreal forest and Cordillera, not ranging east of Hudson Bay. It is common over much of Yukon, Interior British Columbia, and the central forested areas of Saskatchewan and Alberta (also Cypress Hills at the same grassland locality as *L. hudsonica*), as well as over much of central and southern Manitoba. At some localities, especially in the Aspen Parkland and southern boreal forest, it can be strikingly abundant. On the other hand, *L. frigida* is eastern in distribution, ranging from the grassland interface of the southern interlake area of Manitoba to Nova Scotia. It is considered rare at Ojibway Prairie. *Leucorrhinia glacialis* and *L. proxima* are transcontinental but, at least in western Canada, *L. glacialis* ranges much less into the north than does *L. proxima*. In grasslands, neither is common in British Columbia, but *L. proxima*, especially, is widespread there (e.g., Penticton, Oyama). Both species are found in grassland-edge habitats across Alberta and Saskatchewan. They mainly occur in the Aspen Parkland in Alberta (e.g., Red Deer), although *L. glacialis* is rare in Saskatchewan. *Leucorrhinia proxima* lives in the Alberta and Saskatchewan Cypress Hills and, at least in Alberta, occurs at grassland sites there (Hilton 1985). Both species live across southern Manitoba, but only *L. proxima* is reported at Ojibway, where it is uncommon.

Although seven species of *Erythemis* live in North America north of Mexico, only two are found in Canada; these are the similar *E. collocata* and *E. simplicicollis*. Females and young males are green, and mature males are blue pruinose. In Canada, *E. collocata* lives in southwestern British Columbia, predominantly on the coast, where it is typical of ponds in Garry oak grasslands on Vancouver Island and the Gulf Islands. It is rare in South Okanagan grasslands at Osoyoos Lake. *Erythemis simplicicollis* in Canada ranges through southern Ontario and Québec; it is common at Ojibway Prairie. There is some evidence that *E. collocata* and *E. simplicicollis* may be conspecific (Paulson 2009).

Sympetrum (meadowhawks) is an important genus in Canadian grasslands, with 11 species recorded; both the diversity of species and the abundance of individuals in these habitats are notable. These are mostly small red dragonflies, which are usually abundant as adults in the late summer and fall. Females and young males are usually brown or yellow, although some females, at least those that are old, are red like the males. One species, *S. danae*, is black with yellow markings. Meadowhawks usually lay their eggs while male and female are in tandem or with a guarding male hovering near the female. Some species (e.g., *S. madidum*, *S. pallipes*, *S. internum*) breed in temporary ponds, and eggs are often laid in dry basins where they hatch in spring when the snow melts. Larval growth is rapid after the ponds fill with water. North America has 13 species, and all but one are recorded in Canada. They are especially common in marshy lowland habitats.

Three *Sympetrum* species on the grassland list are restricted to western North America. *Sympetrum illotum* (Fig. 20) ranges from the southern British Columbia coast south to

Panama. It is common and is an unusually early flyer for a *Sympetrum*, often appearing in April. With its relatively large size and broad scarlet abdomen, it is one of the most conspicuous dragonflies of ponds in the Garry oak meadows of southeastern Vancouver Island and the Gulf Islands. A closely related western species, *S. madidum*, ranges much more extensively in Canada, from southern British Columbia north to southeastern Yukon and Northwest Territories and east to Manitoba. The species is fairly common in southern British Columbia, including grassland sites (e.g., Aspen Grove, Osoyoos, Hat Creek, Athalmer) and ranges across the grasslands of Alberta (Lethbridge, Calgary) and Saskatchewan (Maple Creek, Battleford, Regina) to southwestern Manitoba (Aweme, Portage la Prairie). Cannings (1980, 1981) described the larva and presented ecological information on the species from studies in fescue grasslands of the eastern Chilcotin and Garry oak meadows near Victoria, British Columbia. *Sympetrum pallipes* is another western species but one that barely ranges east of the Rockies. It is common in the remnant savannas of southern Vancouver Island and the grasslands of the British Columbia Interior (Osoyoos, Oliver, Wasa, Douglas Lake) and is recorded from both the Alberta and Saskatchewan Cypress Hills (the single Alberta record there is from fescue prairie) but is rare in the Mixed Grassland Ecoregion in southern Alberta (e.g., Suffield).

Seven of the eight other meadowhawks recorded in grassland sites are transcontinental in distribution, with the lone species restricted to the East. The eastern species, *S. rubicundulum*, is the most common meadowhawk in open areas of Ojibway Prairie and almost reaches southern Manitoba at the extreme northwest extent of its range in the United States. A larval record in stormwater retention ponds in Winnipeg (Ackerman and Galloway 2003) needs to be confirmed, as there are no adult records, and Hughes and Duncan (2003) did not include the species on the Manitoba list. The related *S. internum* (Fig. 21) is characteristic of grassland marshes, ponds, and pools (especially those whose margins dry up) across the West from Yukon through British Columbia and east to Manitoba, but although it ranges east to Newfoundland, it is not known from Ojibway Prairie. Wing length in both sexes decreases northward (Cannings and Cannings 1997; Catling 2007) and colour patterns (the extent of amber on the hind-wing base) can vary between sexes and with latitude (Catling 2007). *Sympetrum obtrusum* does not range as far north as *S. internum* but, in the dry West, at least, it is more associated with woodland and is less common on the Prairies than *S. internum*. *Sympetrum obtrusum* is typical of sedge meadows and is often common in peatlands where *S. internum* is absent. In grasslands, it often inhabits temporary waters, for example, in British Columbia (Osoyoos, Vernon), Alberta (Claresholm, Devon), Saskatchewan (Manitou Lake), Manitoba (Westbourne, Swan River), and Ontario (uncommon at Ojibway). *Sympetrum costiferum* is common in many Canadian grasslands, at least from British Columbia to Manitoba. It occurs in many wetland types, but can be abundant at alkaline lakes in the British Columbia Interior and on the Great Plains. In Ontario, it is recorded from grassland-like ponds along Great Lakes beaches, although it is not reported from Ojibway Prairie. *Sympetrum danae* (Fig. 22) ranges around the northern parts of the globe and has wide ecological tolerances, being equally at home in mountain and northern peatlands, lowland marshes, and warm, shallow lake margins. It is a common grassland species from Yukon to Manitoba, but may be absent from the driest parts of the southern Prairies. *Sympetrum semicinctum* is a striking meadowhawk, with orange-brown coloration on the basal halves of the wings, which varies in intensity across its range (British Columbia to Nova Scotia). The western populations were considered separate (*S. occidentale* Bartenev) (Walker 1951) until recently (Catling *et al.* 2005). It is fairly common in southern British Columbia but less so

in Alberta, rare in Saskatchewan and Manitoba, and rare at Ojibway Prairie. Individuals or pairs often wander across grasslands well away from water, and although they are not restricted to grasslands, they can be common there. In Canada, *Sympetrum vicinum* ranges from the Atlantic to southeastern Manitoba. A disjunct western population lives from extreme southern British Columbia to northern California. Grassland populations occur at Ojibway Prairie (where it is common), in the Winnipeg area, and in British Columbia in the southern Okanagan grasslands at Vaseux Lake and on southern Vancouver Island. It flies late, well into November in mild autumns in British Columbia. *Sympetrum corruptum* is a transcontinental species, but is much more abundant in the West than east of the Mississippi River. Probably many of the individuals seen in eastern North America are migrants or wanderers (Paulson 2011). Breeding occurs in both spring and late summer in southern Canada. Spring breeding individuals apparently are migrants from the south, and their offspring, emerging in late summer and fall, often undertake impressive southward movements. The species is fairly common in grasslands of southern British Columbia east to Manitoba; it develops in shallow marshy lakes, saline ponds, and temporary pools.

Pachydiplex longipennis (Fig. 23) is a common southern transcontinental species that enters Canada only in southernmost areas of British Columbia, Manitoba, Ontario, Québec, and New Brunswick. There is a single Manitoba record at the forest–grassland interface at Lac du Bonnet, north of Winnipeg (Hughes and Duncan 2003). In Ontario it is common



Fig. 21. *Sympetrum internum* (Cherry-faced Meadowhawk), male. Photo: George Doerksen, Royal British Columbia Museum. **Fig. 22.** *Sympetrum danae* (Black Meadowhawk), male and female mating. Photo: George Doerksen, Royal British Columbia Museum. **Fig. 23.** *Pachydiplex longipennis* (Blue Dasher), male. Photo: Robert A. Cannings, Royal British Columbia Museum. **Fig. 24.** *Pantala hymenaea* (Spot-winged Glider), male. Photo: Dennis Paulson.

at Ojibway Prairie. In British Columbia, its distribution includes grassland habitats; it has a distribution almost exactly the same as that of *Erythemis collocata* (southwest coast, southern Okanagan) and the two are often found together.

Tramea species are called “saddlebags” because of the large dark marks at the base of the broad hind wings. It is a worldwide, but primarily tropical, genus, mainly found in southern Ontario in Canada. The two most common species, *Tramea lacerata* and *T. onusta*, range transcontinentally in the United States. These species and *T. carolina*, which is restricted to the East in North America, are all recorded at Ojibway Prairie. *Tramea lacerata* is common in southern Ontario and, since 1996, has been seen in British Columbia at Victoria in Garry oak grasslands (Cannings 1997), where it is known to mate, if not complete a life cycle. It also occurs at Parksville to the north.

The two species of *Pantala* are mainly tropical and subtropical in their worldwide distribution but wander widely, entering temperate regions. The hind wings are unusually broad, much like those of *Tramea*, which is likely closely related (Paulson 2011). Both are recorded in southern Canada, especially in Ontario, where both species breed, usually in lagoons and pools along Great Lakes beaches. There is a single record of *Pantala flavescens* in Alberta grasslands; it is rare in southern Manitoba and uncommon at Ojibway Prairie. *Pantala hymenaea* (Fig. 24) has wandered to coastal British Columbia at Victoria several times (Cannings 1988) and to southern Manitoba (e.g., Victoria Beach). It is common at Ojibway Prairie. Both *Pantala* species, *Tramea lacerata*, *Epitheca princeps*, and *Anax junius* are conspicuous aerial hunters over Ojibway grasslands (P. Pratt, pers. comm.). Reports of northward wandering and migration of several species may increase in Canada as the climate warms.

Biogeography and Faunal Elements

Species can be grouped with others that share similar distributions to form what can be termed faunal elements. The majority of the 124 species reported here from the Canadian grasslands are restricted to the Nearctic region, although five species, *Lestes dryas*, *Aeshna juncea*, *A. subarctica*, *Libellula quadrimaculata*, and *Sympetrum danae*, are Holarctic (defined here as species with transcontinental ranges in both North America and Eurasia). Two species (*Anax junius* and *Sympetrum corruptum*) are known from eastern Asia, but do not have Holarctic distributions. This section describes the Nearctic faunal elements (species with Holarctic distributions are also assigned to a North American faunal element). Those relevant to Canadian grassland Odonata are as follows:

1. Boreal (20 species). Species occurring in the northern spruce (*Picea*) forests, across the boreal zone from treeline to the southern margin. In general, these species range from the Atlantic Provinces across the northern New England states, Quebec, northern Ontario, parts of the northern tier of midwestern states, the Prairie Provinces north of the Great Plains, and northern British Columbia, often ranging considerably southward in the higher mountains and plateaus of the western Cordillera. These species can be further subdivided into the following:
 - i. Widespread Boreal (11 species). With ranges as described above.
Coenagrion resolutum, *Enallagma annexum* E. boreale, *Aeshna eremita*, *A. juncea* (also Holarctic), *A. sitchensis*, *A. subarctica* (also Holarctic), *Cordulia shurtleffii*, *Somatochlora franklini*, *Leucorrhinia hudsonica*, *Sympetrum danae* (also Holarctic).
 - ii. Northern Boreal (2 species). Species that are common near the northern treeline, but that are virtually absent from the northern contiguous United States and from

- the southeastern Atlantic Provinces and do not extend far south into the Cordillera. *Coenagrion interrogatum*, *Aeshna septentrionalis*.
- iii. Southern Boreal (5 species). Species that are uncommon north of 60 °N in the West and absent near the arctic treeline in the East, but range far down the Cordillera and/or into the southeastern Atlantic Provinces and New England states. Some (e.g., *Aeshna interrupta*) are common on the Great Plains. *Aeshna interrupta*, *Somatochlora kennedyi*, *S. minor*, *S. walshii*, *Leucorrhinia proxima*.
- iv. Western Boreal (2 species). Boreal species not found east of Hudson Bay. *Somatochlora hudsonica*, *Leucorrhinia borealis*.
2. Transition (17 species). Species generally most common in the southern boreal forests and adjacent montane forests in the West and mixed and deciduous forests in the East. *Calopteryx aequabilis*, *Enallagma ebrium*, *E. hageni*, *Nehalennia irene*, *Aeshna canadensis*, *A. constricta*, *A. umbrosa*, *Gomphus graslinellus*, *Epitheca canis*, *E. spinigera*, *Ladona julia*, *Leucorrhinia glacialis*, *L. intacta*, *Sympetrum costiferum*, *S. internum*, *S. obtrusum*, *S. semicinctum*.
3. Cordilleran (12 species). Species mostly confined to the western mountains and their intervening valleys and plateaus but extending to various degrees into the Great Plains. *Argia emma*, *A. vividula*, *Ischnura cervula*, *Aeshna palmata*, *Rhionaeschna californica*, *Ophiogomphus occidentis*, *Stylurus olivaceus*, *Cordulegaster dorsalis*, *Macromia magnifica*, *Somatochlora semicircularis*, *Libellula forensis*, *Sympetrum illotum*.
4. Pacific Coastal (1 species). Coastal species restricted to the lowlands and lower slopes of the mountains west of the Coast Mountains. *Ischnura erratica*.
5. Western (10 species). Species confined to west of the 100th meridian, but otherwise ranging widely in North America. *Amphiagrion abbreviatum*, *Enallagma anna*, *E. clausum*, *Ischnura damula*, *I. perparva*, *Rhionaeschna multicolor*, *Ophiogomphus severus*, *Erythemis collocata*, *Sympetrum madidum*, *S. pallipes*.
6. Great Plains (4 species). Species more or less confined to the Great Plains. *Coenagrion angulatum*, *Gomphus externus*, *Stylurus intricatus*, *Somatochlora ensigera*.
7. Southern (16 species). Species ranging across the continent south of the boreal forests, often extending into transition areas, but with most of the range in the United States. *Archilestes grandis*, *Lestes forcipatus*, *Enallagma basidens*, *E. carunculatum*, *E. civile*, *Ischnura hastata*, *Anax junius*, *Libellula luctuosa*, *L. pulchella*, *Pachydiplax longipennis*, *Pantala flavescens*, *P. hymenaea*, *Plathemis lydia*, *Sympetrum vicinum*, *Tramea lacerata*, *T. onusta*.
8. Eastern (38 species). Species ranging widely but mostly east of the 100th meridian. *Calopteryx maculata*, *Lestes rectangularis*, *Amphiagrion saucium*, *Argia fumipennis*, *Chromagrion conditum*, *Enallagma antennatum*, *E. aspersum*, *E. exsulans*, *E. geminatum*, *E. signatum*, *Ischnura posita*, *I. verticalis*, *Aeshna verticalis*, *Anax longipes*, *Epiaschna heros*, *Arigomphus cornutus*, *A. villosipes*, *Dromogomphus spinosus*, *Gomphus fraternus*, *G. vastus*, *Ophiogomphus rupinsulensis*, *Progomphus obscurus*, *Stylurus amnicola*, *S. notatus*, *Macromia taeniolata*, *Dorocordulia libera*, *Epitheca cynosura*, *E. princeps*, *Celithemis elisa*, *C. eponina*, *Erythemis simplicicollis*, *Leucorrhinia frigida*, *Libellula incesta*, *L. semifasciata*, *L. vibrans*, *Perithemis tenera*, *Sympetrum rubicundulum*, *Tramea carolina*.
9. Widespread (6 species). Species with broad distributions in North America, from north to south and east to west, overlapping several of the other elements listed. These species range into boreal regions to varying degrees. *Lestes congregatus*, *L. disjunctus*, *L. dryas* (also Holarctic), *L. unguiculatus*, *Libellula quadrimaculata* (also Holarctic), *Sympetrum corruptum*.

Table 1. Annotated list of the Odonata species of Canadian grasslands. The term following the English name of each species is the faunal element (range type as defined above). An "H" indicates a Holarctic species. Notes on distribution are necessarily general; provincial abbreviations indicate grassland occurrence (species may also occur widely in other habitats in other provinces and territories) and an additional "(int)" indicates the species more or less occurs at the forest interface of the grassland biome (or at higher elevations above grassland, including Cypress Hills) and is primarily a forest species. Yukon inclusion is restricted to occurrences at two grassland sites in the Takhini Valley and northwest of Lake Laberge as noted in the text. Ontario representation is from Ojibway Prairie only. Many eastern species recorded in the forests of extreme eastern Manitoba but not at grassland sites are excluded, although they occur close by. Other notes are given where necessary. See text for more clarification.

SUBORDER ZYGOPTERA (DAMSELFLIES)

FAMILY CALOPTERYGIDAE (JEWELWINGS)

Calopteryx aequabilis Say (River Jewelwing). Transition. BC (int), AB (int), SK, MB.
Calopteryx maculata Beauvois (Ebony Jewelwing). Eastern. ON.

FAMILY LESTIDAE (SPREADWINGS)

Archilestes grandis (Rambur) (Great Spreadwing). Southern. ON.
Lestes congener Hagen (Spotted Spreadwing). Widespread. BC, AB, SK, MB, ON.
Lestes disjunctus Selys (Northern Spreadwing). Widespread. YT, AB, SK, MB.
Lestes dryas Kirby (Emerald Spreadwing). Widespread (H). YT, BC, AB, SK, MB, ON.
Lestes forcipatus Rambur (Sweetflag Spreadwing). Southern. BC (int), SK (int), MB, ON.
Lestes rectangularis Say (Slender Spreadwing). Eastern. MB, ON.
Lestes unguiculatus Hagen (Lyre-tipped Spreadwing). Widespread. BC, AB, SK, MB, ON).

FAMILY COENAGRIONIDAE POND DAMSELS

Amphiagrion abbreviatum (Selys) (Western Red Damsel). Western. BC, AB, SK, MB?
Amphiagrion saucium (Burmeister) (Eastern Red Damsel). Eastern. MB?
Argia emma Kennedy (Emma's Dancer). Cordilleran. BC, AB.
Argia fumipennis Burmeister (Variable Dancer). Eastern. SK.
Argia vivida Hagen (Vivid Dancer). Cordilleran. BC
Coenagrion angulatum Walker (Prairie Bluet). Great Plains. BC, AB, SK, MB.
Coenagrion resolutum (Hagen) (Taiga Bluet). Widespread Boreal. YT, BC, AB, SK, MB, ON.
Coenagrion interrogatum (Hagen) (Subarctic Bluet). Northern Boreal. AB (int), SK (int)
Chromagrion conditum (Selys) (Aurora Damsel). Eastern. MB.
Enallagma anna Williamson (River Bluet). Western. AB, SK.
Enallagma annexum (Hagen) (Northern Bluet). Widespread Boreal. YT, BC, AB, SK, MB.
Enallagma antennatum (Say) (Rainbow Bluet). Eastern. SK.
Enallagma aspersum (Hagen) (Azure Bluet). Eastern. ON.
Enallagma basidens Calvert (Double-striped Bluet). Southern. ON.
Enallagma boreale Selys (Boreal Bluet). Widespread Boreal. YT, BC, AB, SK, MB, ON.
Enallagma carunculatum Morse (Tule Bluet). Southern. BC, AB, SK, MB, ON.
Enallagma civile (Hagen) (Familiar Bluet). Southern. AB, SK, MB, ON.
Enallagma clausum Morse (Alkali Bluet). Western. BC, AB, SK, MB.
Enallagma ebrium (Hagen) (Marsh Bluet). Transition. BC, AB, SK, MB, ON.
Enallagma exsulans (Hagen) (Stream Bluet). Eastern. ON.
Enallagma geminatum Kellicott (Skimming Bluet). Eastern. ON.
Enallagma hageni (Walsh) (Hagen's Bluet). Transition. BC (int), AB, SK, MB, ON.
Enallagma signatum (Hagen) (Orange Bluet). Eastern. ON.
Ischnura cervula Selys (Pacific Forktail). Cordilleran. BC, AB, SK.
Ischnura erratica Calvert (Swift Forktail). Pacific Coastal. BC.
Ischnura damula Calvert (Plains Forktail). Western. AB, SK, MB.
Ischnura hastata (Say) (Citrine Forktail). Southern. ON.
Ischnura perparva Selys (Western Forktail). Western. BC, AB, SK, MB.
Ischnura posita (Hagen) (Fragile Forktail). Eastern. MB, ON.
Ischnura verticalis (Say) (Eastern Forktail). Eastern. AB, SK, MB, ON.
Nehalennia irene (Hagen) (Sedge Sprite). Transition. BC, AB (int), SK (int), MB, ON.

SUBORDER ANISOPTERA (DRAGONFLIES)**FAMILY AESHNIDAE (DARNERS)**

- Aeshna canadensis* Walker (Canada Darner). Transition. BC, AB (int), SK (int), MB.
- Aeshna constricta* Say (Lance-tipped Darner). Transition. BC, AB, SK, MB, ON.
- Aeshna eremita* Scudder (Lake Darner). Widespread Boreal. YT, BC, AB (int), SK (int), MB
- Aeshna interrupta* Walker (Variable Darner). Southern Boreal. YT, BC, AB, SK, MB.
- Aeshna juncea* (Linnaeus) (Sedge Darner). Widespread Boreal (H). YT, BC, AB (int), SK (int), MB (int).
- Aeshna palmata* Hagen (Paddle-tailed Darner). Cordilleran BC, AB, SK (int).
- Aeshna septentrionalis* Walker (Azure Darner). Northern Boreal. YT.
- Aeshna sitchensis* Hagen (Zigzag Darner) Widespread Boreal. AB (int), SK (int), MB (int).
- Aeshna subarctica* Walker (Subarctic Darner). Widespread Boreal (H). BC (int).
- Aeshna verticalis* Hagen (Green-striped Darner). Eastern. MB.
- Aeshna umbrosa* Walker (Shadow Darner). Transition. BC, AB (int), SK (int), MB, ON.
- Anax junius* (Drury) (Common Green Darner). Southern. BC, AB, SK, MB, ON.
- Anax longipes* Hagen (Comet Darner). Eastern. ON.
- Epiaschna heros* (Fabricius) (Swamp Darner). Eastern. ON.
- Rhionaeschna californica* (Calvert) (California Darner). Cordilleran. BC.
- Rhionaeschna multicolor* (Hagen) (Blue-eyed Darner). Western. BC, AB (int).

FAMILY GOMPHIDAE (CLUBTAILS)

- Arigomphus cornutus* (Tough) (Horned Clubtail). Eastern. MB.
- Arigomphus villosipes* (Selys) (Unicorn Clubtail). Eastern. ON.
- Dromogomphus spinosus* Selys (Black-shouldered Spinyleg). Eastern. MB (int).
- Gomphus externus* Hagen (Plains Clubtail). Great Plains. MB.
- Gomphus graslinellus* Walsh (Pronghorn Clubtail). Transition. BC, AB (int), SK (int), MB, ON.
- Gomphus fraternus* (Say) (Midland Clubtail). Eastern. MB.
- Gomphus vastus* (Walsh) (Cobra Clubtail). Eastern. ON.
- Ophiogomphus occidentis* Hagen (Sinuous Snaketail). Cordilleran. BC.
- Ophiogomphus rupinsulensis* (Walsh) (Rusty Snaketail) Eastern. SK, MB.
- Ophiogomphus severus* Hagen (Pale Snaketail) Western. BC, AB, SK.
- Progomphus obscurus* (Rambur) (Common Sanddragon) Eastern. ON.
- Stylurus amnicola* (Walsh) (Riverine Clubtail) Eastern. MB.
- Stylurus intricatus* (Hagen) (Brimstone Clubtail) Great Plains. AB, SK.
- Stylurus notatus* (Rambur) (Elusive Clubtail) Eastern. SK, MB, ON.
- Stylurus olivaceus* (Selys) (Olive Clubtail) Cordilleran. BC.

FAMILY CORDULEGASTRIDAE (SPIKETAILS)

- Cordulegaster dorsalis* Hagen (Pacific Spiketail). Cordilleran. BC.

FAMILY MACROMIIDAE (CRUISERS)

- Macromia magnifica* McLachlan (Western River Cruiser) Cordilleran. BC.
- Macromia taeniolata* Rambur (Royal River Cruiser) Eastern. ON.

FAMILY CORDULIIDAE (EMERALDS)

- Cordulia shurtleffi* Scudder (American Emerald) Widespread Boreal. BC, AB (int), SK(int), MB.
- Dorocordulia libera* (Selys) (Racket-tailed Emerald). Eastern. MB.
- Epitheca canis* (McLachlan) (Beaverpond Baskettail). Transition. SK (int), MB (int).
- Epitheca cynosura* (Say) (Common Baskettail). Eastern. ON.
- Epitheca princeps* Hagen (Prince Baskettail). Eastern. ON.
- Epitheca spinigera* (Selys) (Spiny Baskettail). Transition. BC, AB (int), SK (int), MB.
- Somatochlora ensigera* Martin (Plains Emerald). Great Plains. SK, MB.
- Somatochlora franklini* (Selys) (Delicate Emerald). Widespread Boreal. AB (int), SK(int), MB(N).
- Somatochlora hudsonica* (Hagen) (Hudsonian Emerald). Western Boreal. YT, BC (int), AB(int).
- Somatochlora kennedyi* Walker (Kennedy's Emerald). Southern Boreal. MB.
- Somatochlora minor* Calvert (Ocellated Emerald). Southern Boreal. AB (int), MB.
- Somatochlora semicircularis* (Selys) (Mountain Emerald). Cordilleran. BC, AB (int).
- Somatochlora walshii* (Scudder) (Brush-tipped Emerald). Southern Boreal. MB.

FAMILY LIBELLULIDAE (SKIMMERS)

Celithemis elisa (Hagen) (Calico Pennant). Eastern. ON.

Celithemis eponina (Drury) (Halloween Pennant). Eastern. ON.

Erythemis collocata (Hagen) (Western Pondhawk). Western. BC.

Erythemis simplicicollis (Say) (Eastern Pondhawk). Eastern. ON.

Ladona julia (Uhler) (Chalk-fronted Corporal). Transition. MB (int).

Leucorrhinia borealis Hagen (Boreal Whiteface). Western Boreal. YT, BC, AB (int), SK (int), MB.

Leucorrhinia frigida Hagen (Frosted Whiteface). Eastern. MB (int), ON.

Leucorrhinia glacialis Hagen (Crimson-ringed Whiteface). Transition. BC (int), AB (int), MB (int).

Leucorrhinia hudsonica (Selys) (Hudsonian Whiteface). Widespread Boreal. BC, AB (int), SK (int), MB.

Leucorrhinia intacta (Hagen) (Dot-tailed Whiteface). Transition. BC, AB (int), SK, MB, ON.

Leucorrhinia proxima Calvert (Belted Whiteface). Southern Boreal. BC, AB (int), SK (int), MB, ON.

Libellula forensis Hagen (Eight-spotted Skimmer). Cordilleran. BC.

Libellula incesta Hagen (Slaty Skimmer). Eastern. ON.

Libellula luctuosa Burmeister (Widow Skimmer). Southern. MB, ON.

Libellula pulchella Drury (Twelve-spotted Skimmer). Southern. BC, AB, MB, ON.

Libellula quadrimaculata Linnaeus (Four-spotted Skimmer). Widespread (H). YT, BC, AB, SK, MB, ON.

Libellula semifasciata Burmeister (Painted Skimmer). Eastern. ON.

Libellula vibrans Fabricius (Great Blue Skimmer). Eastern. ON.

Pachydiplos longipennis (Burmeister) (Blue Dasher). Southern. BC, ON.

Pantala flavescens (Fabricius) (Wandering Glider). Southern. AB (wanderer), MB (wanderer), ON.

Pantala hymenaea (Say) (Spot-winged Glider). Southern. BC (wanderer), MB (wanderer), ON.

Perithemis tenera (Say) (Eastern Amberwing). Eastern. ON.

Plathemis lydia (Drury) (Common Whitetail). Southern. BC, MB, ON.

Sympetrum corruptum (Hagen) (Variegated Meadowhawk). Widespread. BC, AB, SK, MB.

Sympetrum costiferum (Hagen) (Saffron-winged Meadowhawk). Transition. BC, AB, SK, MB.

Sympetrum danae (Sulzer) (Black Meadowhawk). Widespread Boreal (H). YT, BC, AB, SK, MB.

Sympetrum illotum (Hagen) (Cardinal Meadowhawk). Cordilleran. BC.

Sympetrum internum Montgomery (Cherry-faced Meadowhawk). Transition. YT, BC, AB, SK, MB.

Sympetrum madidum (Hagen) (Red-veined Meadowhawk). Western. BC, AB, SK, MB.

Sympetrum obtrusum (Hagen) (White-faced Meadowhawk). Transition. BC, AB (int), SK (int), MB, ON.

Sympetrum pallipes (Hagen) (Striped Meadowhawk). Western. BC, AB, SK (int).

Sympetrum rubicundulum (Say) (Ruby Meadowhawk). Eastern. ON.

Sympetrum semicinctum (Say) (Band-winged Meadowhawk). Transition. BC, AB, SK, MB, ON.

Sympetrum vicinum (Hagen) (Autumn Meadowhawk). Southern. BC, ON.

Tramea carolina (Linnaeus) (Carolina Saddlebags). Eastern. ON.

Tramea lacerata Hagen (Black Saddlebags). Southern. BC, ON.

Tramea onusta Hagen (Red Saddlebags). Southern. ON.

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