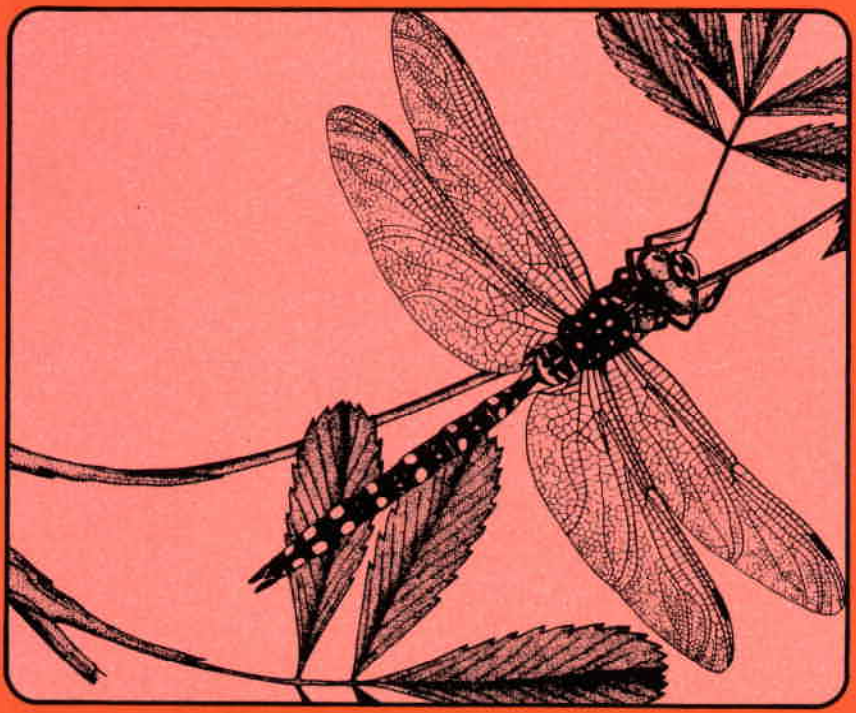
The Dragonflies of British Columbia

35

by Robert A. Cannings
and Kathleen M. Stuart



British Columbia Provincial Museum
Victoria Canada

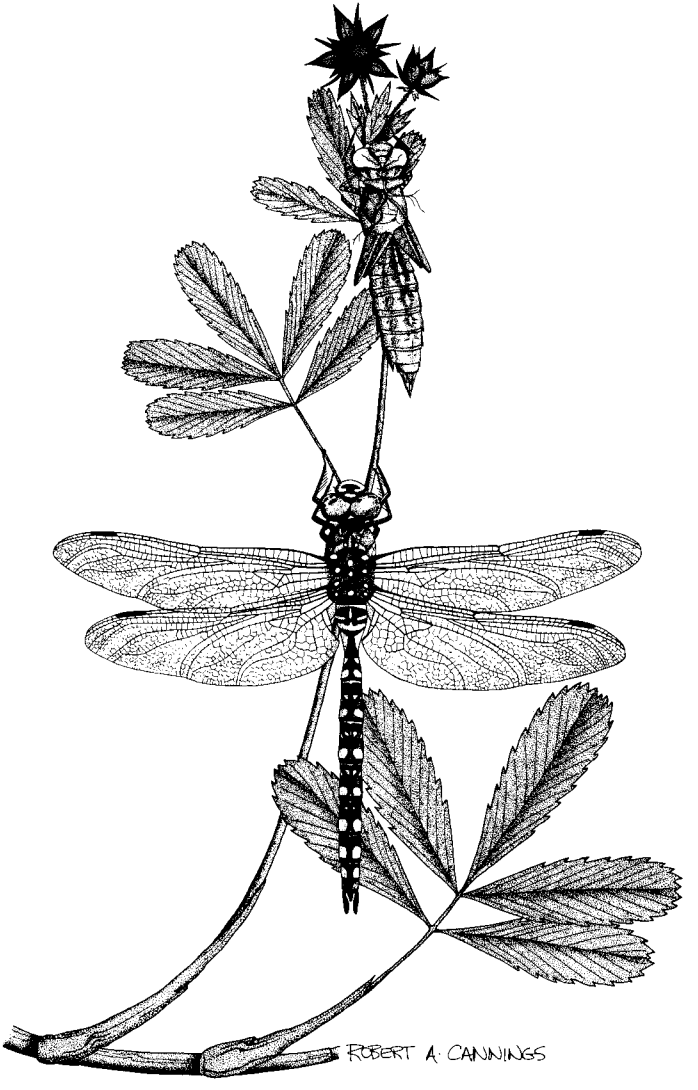
DRAGONFLIES OF BRITISH COLUMBIA

"Thus the Dragon-fly enters upon a more noble life than it had hitherto led in the water, for in the latter it was obliged to live in misery, creeping and swimming slowly, but now it wings the air."

—Jan Swammerdam (1669)

Frontispiece: *Æshna interrupta lineata* male, resting after emergence on marsh cinquefoil (*Potentilla palustris*); the larval exuvia remains clinging to the leaves above.

by Robert A. Cannings


ROBERT A. CANNINGS

BRITISH COLUMBIA PROVINCIAL MUSEUM

HANDBOOK No. 35

The Dragonflies
of British Columbia

by

ROBERT A. CANNINGS
and
KATHLEEN M. STUART

Line Drawings by Robert A. Cannings
Half-tones by Kathleen M. Stuart

PROVINCE OF BRITISH COLUMBIA
MINISTRY OF THE PROVINCIAL SECRETARY
AND TRAVEL INDUSTRY

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1977

FOREWORD

Some of the happiest people I know are enthusiastic watchers. It doesn't matter what they watch, be it steam trains or wildflowers, fences or butterflies, old churches or birds, the result is a joyful extra dimension to living that offers adventuresome hunting, exciting discovery, and the satisfaction of becoming expert at something new.

This handbook will add many dragonfly watchers to the British Columbia landscape. It will not only add zest to the lives of the watchers, it will also add to our deeper understanding of those quiet places in British Columbia where other creatures live out their wild lives.

Watchers who use this book will be indebted to the authors (who are also the illustrators) for donating their knowledge of dragonflies to the public. The time spent in assembling and organizing the manuscript for a book such as this is enormous, and in addition can take place only after years of conquering the subject. On behalf of all users of this book, this Museum extends grateful thanks to Robert Cannings and Kathleen Stuart for their generosity in making their knowledge available to us all.

Now summer days punctuated by the metallic dashes of dragonflies can be days of learning new names for old friends. The authors offer Latin names only because there are none in English that will do. There is nothing wrong with Latin names. They work quite well, as you prove yourself every time you say "hippopotamus".

This book has no magic directions to the instant identification of all dragonflies. But if you work at it, if you puzzle out some details of how dragonflies are put together, and learn some names for dragonfly parts, this small volume will become a familiar companion as you explore this group of unusual living creatures.

R. YORKE EDWARDS
Director

PREFACE

The purpose of this book is to acquaint those interested in natural history with the Odonata, or dragonflies, of British Columbia. There is an obvious lack of information for the general reader pertaining to the insects of this Province. We hope that this work will stimulate more interest in these animals and in the dragonflies in particular. While the book is mainly intended as a means of identifying dragonflies, learning the names of the species is only the first step toward an understanding of them. The Odonata are a fascinating group to study. The beauty of their colours, their remarkable flight, and their interesting ecology and behaviour (in both adult and larval forms) cannot fail to impress the observer. With this in mind, field observations have been included in the handbook.

The task of preparing an identification guide that will be useful to professional biologists as well as appealing to beginners, young and old, is not easy. We feel, however, that this handbook should attempt to fulfil these goals since it is the first of its kind written on the dragonflies of the Province. We have tried to use simple language while still retaining accuracy and precision. In many cases, however, the inclusion of technical terms is unavoidable; these are explained in the introduction, illustrations, and glossary.

This book contains keys and descriptions identifying the adults and larvæ of the 80 species of dragonflies known to occur in British Columbia. The keys for the identification of larvæ should be especially useful to workers engaged in stream and lake surveys.

Our knowledge of the Odonata of British Columbia is far from complete. The larval stages of two species have yet to be discovered; more ecological information is needed. Distribution patterns are not well known, especially in the northern part of the Province. It is possible that in some areas there are a few species that are not yet on our list. This book is essentially an updating and reorganization of pioneering studies. We hope that this contribution will induce others to take up this interesting research.

The work is necessarily, to a large degree, based upon existing publications. To these works the authors are indebted for much

of the information used. Particularly valuable sources of descriptive and natural history data were Walker (1953, 1958), Walker and Corbet (1975), and Whitehouse (1941). The discussion on dragonfly structure and biology owes much to Walker (1953), Corbet *et al.* (1960), and Corbet (1962).

The authors wish to express their thanks to Dr. G. G. E. Scudder, Head, Department of Zoology, University of British Columbia, for his encouragement and assistance throughout this study. The material for this work comes chiefly from the collection of the Spencer Entomological Museum, under the care of Dr. Scudder at The University of British Columbia. We also are indebted to the following for loan of material or permission to examine specimens: Dr. R. H. Carcasson (British Columbia Provincial Museum, Victoria), J. E. H. Martin (Canadian National Collection, Ottawa), Dr. D. R. Paulson (University of Washington), Dr. R. Ring (University of Victoria), and Dr. G. B. Wiggins (Royal Ontario Museum, Toronto). We would also like to thank our many friends and colleagues for collecting specimens for us in recent years.

Dr. D. A. Campbell (University of Victoria) and Dr. J. B. Corston (Annapolis Royal) provided information on the derivation of Latin names.

Dr. Nancy Turner and Barbara Moon supplied information concerning the place of dragonflies in Native culture.

The authors extend their thanks to Faith Fisher and Chris Brown for typing the manuscript.

The editorial criticism of Dr. R. H. Carcasson and Harold Hosford of the British Columbia Provincial Museum is gratefully acknowledged. The support of Dr. A. F. Szczawinski, past Curator of Botany in the Provincial Museum, and R. Yorke Edwards, Director of the Museum, are greatly appreciated. Sincere thanks are extended to Wayne Campbell, Richard and Sydney Cannings, George Doerksen, Jennifer Fisher, and Dennis Paulson for their help and interest.

ROBERT A. CANNINGS
KATHLEEN M. STUART

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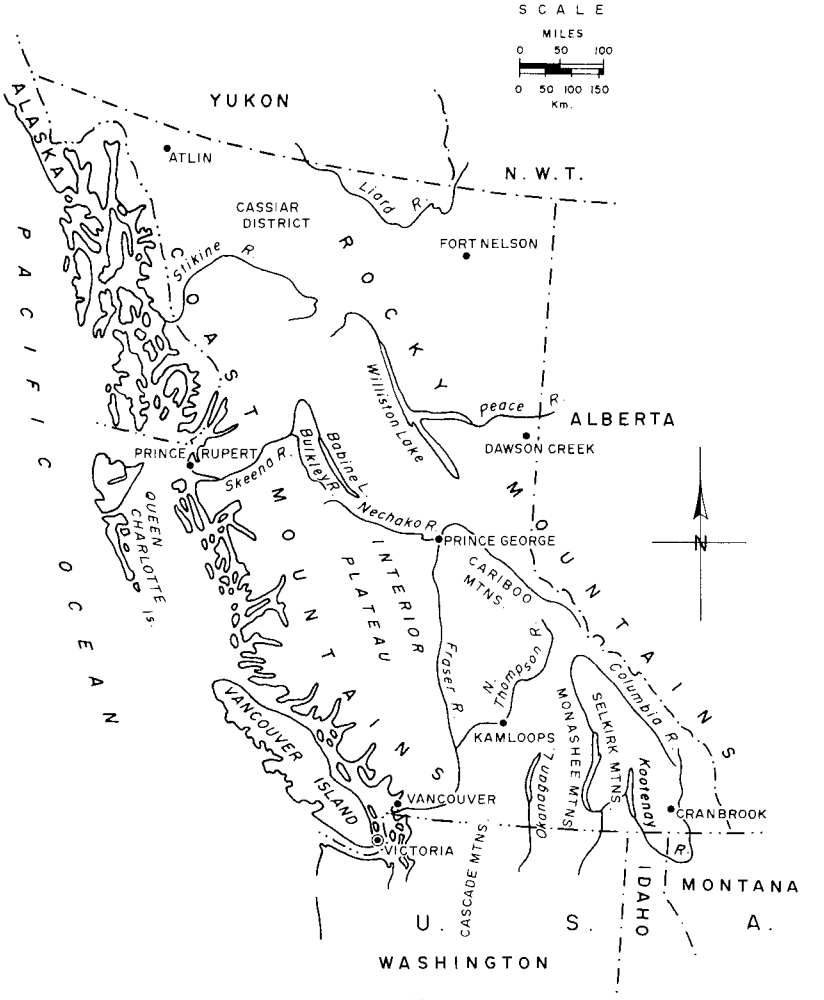
PROVINCE OF
BRITISH COLUMBIA



INTRODUCTION—THE ODONATA

Dragonflies are ideal organisms for naturalists to study. The adults, as striking and colourful as the birds with whom they share the air, have complex and interesting territorial, mating and egg-laying behaviour. Compared to many other insects, they are large and easily observed. Study of the larvæ, among the more important of the smaller aquatic carnivores, introduces the observer to the fascination of fresh-water ecology.

Among the most ancient of insects, dragonflies are far older than flowering plants and as old as the first reptiles. Fossilized, 300-million-year-old dragonfly wings are found in the Carboniferous Period and are known from every geological period since. Because the pattern of wing veins is used extensively to classify dragonflies, this fossil story has given us a better understanding of their family tree than we have for many other groups whose fossil history is less complete. Dragonflies have evolved without much alteration during this enormous period of time—a triumph of evolutionary conservatism in a world where change is usually synonymous with survival.

Just as woodpeckers are an order in the Class Aves (birds) and rodents an order in the Class Mammalia (mammals), dragonflies comprise an order in the Class Insecta (insects). They share with the mayflies the ancient inability to fold their wings down flat over their bodies. Dragonflies can be separated from all other insects by the combination of the following characteristics: The adults have biting mouthparts and two equal or almost equal pairs of elongate, membranous, net-veined wings; the eyes are very large; the antennæ very short and thread-like; and the abdomen is elongate and in the male has accessory genitalia present on the venter of the second segment. The larvæ are aquatic and develop without a pupal stage; their labium is modified into an extendible, grasping organ, and respiration is by rectal or caudal gills.

There are more than a million known species of insects; of these only about 5,000 are dragonflies—the Order Odonata. The word Odonata is derived from two Greek words meaning *toothed jaws,* a description that well suits these predators. There are two

distinct suborders, the Zygoptera and the Anisoptera. The Zygoptera, sometimes called damselflies, are slim and fly slowly. Zygoptera means *joined wings;* their equal-sized wings are held together above the body when at rest. The Anisoptera are robust and fly rapidly. The hindwings are broader at the base than the forewings, thus the name meaning *unequal wings.*

While dragonflies do not sting or bite, these bold and striking insects have instilled superstitious fear in people. It is tempting to suggest that the "fearsome" adult bears some resemblance to the mythical dragon; thus the name dragonfly. They are, however, real dragons to other insects of the air—flying dragons, magnificent predators.

The Dragonfly in Indian Culture

The dragonfly is frequently depicted in the art of the Indians of the British Columbia coast, especially on totem poles and spoon handles of the Haida and Tsimshian (Boas, 1927). The image of the insect usually appears as a large head attached to two pairs of wings and an elongate, segmented abdomen. Some have a mouth of human shape and others are shown with a beak or curled proboscis. The identification of the latter as a dragonfly is no doubt an error on the part of ethnographers since only butterflies and moths have such mouthparts. Similarly, the status of the dragonfly in Indian myth is unclear; early ethnographers appear to have confused it with the mosquito and other aquatic flies. There are widespread myths dealing with the origin of these biting insect pests (Barbeau, 1929).

In the Nootka language, *dragonfly* is equivalent to *clacking stick,* the name given to the cedar tongs used to remove coals from the fire. These tongs make a sharp clacking sound when they snap shut; presumably the rattling noise of dragonfly wings suggests this sound (Peter Webster, Ahousat, B.C.—personal communication).

Vanishing Marshland

The rapidly increasing human pressure on land in southern Canada is of great concern to those interested in the well-being of

natural biotic communities with all their diversity and beauty. Perhaps more than any other type of habitat the marshes and ponds that are vital to many dragonfly species have succumbed to expanding cities, roads, and farms. Every year many acres of marshland are filled and the shores of ponds and lakes are "cleaned up". A significant reduction in the Province's dragonfly fauna is a future possibility. The elimination of marshland is particularly noticeable in the more populated areas of southern British Columbia, areas that possess the richest dragonfly fauna—the Okanagan Valley, the Lower Mainland, and southern Vancouver Island. For example, the destruction of rich aquatic habitats in the Okanagan Valley has been phenomenal in the past three or four decades. To most naturalists, this is evidenced by the considerable reduction of marsh-breeding birds in the valley, but the student of aquatic insects will note that the sizes of dragonfly populations that impressed collectors around Penticton in the 1930's no longer exist. Hopefully much of the remaining fresh-water habitat will be preserved, enabling it to support a varied dragonfly fauna—"a reliable, and delightful, indicator of a healthy environment" (Walker and Corbet, 1975).

Structure

The following is a brief account of a few of the more important structural features of the Odonata; others are discussed in the section on biology. The glossary and the accompanying diagrams give details of additional structures important in dragonfly identification.

Dragonfly mouthparts are segmental. In feeding, the adult dragonfly holds the prey in the labium with the maxillæ and front legs and chews with the mandibles.

The unique slanting of the thoracic segments has pushed the legs forward and the wings backward. This helps stabilize the flying insect when it captures prey in the basket formed by its spiny legs. In addition, the whole head is a delicate organ of balance. Differences in its position relative to the body are compensated for by wing movements.

The flight of dragonflies is perhaps their most notable feature. In most insects, the wings are moved not by muscles connected to them but by muscles attached to the inside of the thorax. The contraction of these muscles changes the shape of the thorax, and the wings, being attached, are levered up and down. In dragonflies, however, the wings are worked by muscles joined directly to them. Thus all four wings can move independently, resulting in amazingly agile flight.

Larval mouthparts, except for the labium, are similar to those of the adult. The labium is enormously enlarged, hinged, and armed with hooks to form an extendible grasping organ. When not in use it is folded beneath the head. The larva seizes its prey by a sudden extension of the labium, the palps acting like a pair of pincers, closing as the victim is drawn back to the mouth. The labium takes many forms and is important in larval classification.

Anisopteran larvæ pump water in and out of the rectum and oxygen and carbon dioxide are exchanged through gills lining its walls. This pumping may also be used as a method of escape—water is squirted out backward and the larva disappears, jet-propelled. The actual method of respiration in Zygoptera has still not been satisfactorily established. Some rectal respiration may occur, but it is also believed that gases are exchanged through the tracheæ in the three leaf-like caudal lamellæ at the end of the abdomen. These lamellæ are also used as swimming fins.

Biology

This section deals in general with the biology of the Odonata. More specific details can be found in the family, genus, and species discussions.

Dragonflies occur in most fresh-water habitats, except very cold glacial waters. Small, shallow lakes or ponds with aquatic vegetation are the most productive localities. Aquatic vegetation provides abundant dissolved oxygen, shelter, and food for the organisms that are the prey of dragonfly larvæ.

Different types of habitats support different species. The acid ponds of sphagnum bogs have a special fauna characterized by *Sympetrum danæ,* whereas the closely related *S. costiferum* is most

abundant in the temporary alkaline ponds of the dry Interior. Species of *Somatochlora* and *Æshna* are typical inhabitants of mountain and northern lakes.

Except in sheltered places where wave action is reduced, larger lakes have a poor dragonfly fauna. In British Columbia the most distinctive inhabitants of lakeshores are *Gomphus* and *Macromia*. Rivers often support dragonflies similar to those that develop along the shores of large lakes. Smaller streams produce characteristic types, especially species of *Argia* and *Ophiogomphus*. Along coastal streams *Cordulegaster dorsalis* is typical.

The newly emerged adult, or teneral, is soft, and a weak flier. Full development of adult colour often takes several days. After surviving this period, during which they are highly vulnerable to predation, young dragonflies scatter widely to feed. Dragonfly food consists mainly of small, flying insects.

Although some species fly late into evening, most Odonata are active only in sunshine. Many may disappear from the air when a cloud passes over the sun. During cloudy periods or inclement weather Zygoptera may rest in grasses or sedges while Anisoptera usually settle in the trees.

A week or two after emergence dragonflies become sexually mature and return to habitats near water to breed. Here males begin patrolling, aggressively searching for mates. Females seldom appear near water except to pair or oviposit.

At this time, differences in the habits of various groups reduce aggressive encounters between dragonflies. At a summer pond it is usual to find the Cœnagriidæ flying and perching very low over the water among emergent or floating plants, the Corduliidæ slightly higher around the margin or out over open water, and the Æshnidæ patrolling widely up to a height of several metres. Perchers such as the Lestidæ, Gomphidæ, and Libellulidæ usually rest on or near the shore.

Within such a localized area, males of the same species may defend territories. This behaviour is probably important in preventing the disturbance of courtship and egg-laying and also may serve to disperse the species. Mortality may be high from aerial battles. As in birds, the occupant of a territory usually is the victor

over any intruder. Threat displays have also evolved. For example, the male of *Libellula lydia* chases off other males by displaying his white, pruinose abdomen, but keeps the abdomen lowered when seeking females (Corbet *et al.* 1960).

The method of dragonfly mating is unique among insects. The genital opening of the male is in the usual insect position near the end of the abdomen, but before mating the male transfers the sperm to the accessory genitalia on the venter of the abdomen base. The male then pursues a female, and grasps her head (Anisoptera) or thorax (Zygoptera) with the anal appendages. The "tandem position" results. The female then curls the tip of her abdomen around below and contacts the accessory genitalia; the sperm is transferred. Everyone has seen paired dragonflies flying like this, the female on her back. Interspecific pairing is often attempted but is seldom successful.

The female lays her eggs either still held by the male in the tandem position (some Zygoptera and Libellulidæ) or may lay them while she is unattended (Æshnidæ, Corduliidæ, some Zygoptera and Libellulidæ). In certain genera, for example *Libellula,* the male hovers near the ovipositing female, chasing away interested males.

Those species with ovipositors (Zygoptera, Æshnidæ) lay their eggs in plants and floating debris. Many Zygoptera descend beneath the water to lay their eggs and may remain submerged for over an hour. Air trapped between their closed wings and among body hairs may be utilized under water. Odonata lacking ovipositors usually release their eggs into the water (Corduliidæ, Libellulidæ). In swift streams, *Cordulegaster* shoves her eggs into the mud, and the eggs of some Gomphidæ are known to develop filaments that tangle the eggs safely among stones.

The development of the egg and larval stages is variable. Eggs usually hatch in under a month, but in some groups (Lestidæ, Æshnidæ) they may overwinter. There may be 10 to 15 larval stages (instars) before the adult emerges. This may require from a few weeks, in some species of *Lestes* adapted to temporary pools, to five years in cold-water forms such as *Cordulegaster* and *Tanypteryx.* Most species of Zygoptera and Libellulidæ produce

one generation per year, whereas species of *Æshna* and most of our Gomphidæ and Corduliidæ probably take from two to four years to develop. The larval stage represents by far the greatest part of the total life history of most Odonata. While the maximum life span of adult Odonata may be about 10 weeks, at least, most probably live less than five weeks (Corbet *et al.* 1960).

Larvæ may be divided into three general categories: climbers (Zygoptera, Æshnidæ)—streamlined, stalking predators with highly developed eyesight that live in submerged vegetation; sprawlers (Cordulegastridæ, Macromiidæ, Corduliidæ, and most Libellulidæ)—which live a slothful life mainly among mud and bottom trash where, concealed by the mud and algæ usually coating their bodies, they lie in wait for approaching prey; and burrowers—chiefly the Gomphidæ, which bury themselves in the bottom sand and mud, sometimes leaving only the tip of the abdomen extended for breathing. The primitive *Tanypteryx* tunnels in the moss of mountain bogs, coming out at night to stalk its prey on the surface.

Most larvæ ascend aquatic plants to a point a few inches above the water and transform into adults in a vertical position. Species of *Argia, Macromia,* and most Gomphidæ emerge, either horizontally or vertically, on objects along the shore. Emergence usually occurs at night or in early morning when predators presumably are less active. The larval cuticle splits dorsally, the adult slowly extricates itself from the exuvia, expands and dries.

Zoogeography

Despite the diversity of its topography and climate, British Columbia supports fewer genera and species of dragonflies than comparative areas to the south and east. The reasons for this are varied. Dragonflies are aquatic insects and diversity in terrestrial systems is not usually expressed fully in associated aquatic systems. The mountains doubtless have impeded the spread of southern and eastern species into our area. Most importantly, a large proportion of streams and lakes are cold, having their sources in the mountains, and for this reason sustain a less varied dragonfly fauna.

The Odonata of British Columbia consists of nine families, 23 genera, and 80 species. As Walker (1927) notes, this fauna is remarkable for the absence of Calopterygidæ (Agriidæ), the scarcity of Gomphidæ and Corduliidæ, and the relative abundance of the genera *Ischnura, Æshna,* and *Sympetrum.*

The distribution of dragonflies in British Columbia appears less distinct than in many other animal groups. To some extent this may be due to their powers of flight, but the important factor is that aquatic habitats spread throughout a diverse landscape may possess very similar ecologies. To individuals of *Æshna californica* or *Libellula forensis* a cat-tail marsh on a sagebrush flat may be equivalent to a similar pond in a coastal hemlock forest, yet few terrestrial organisms would live in both places (Paulson, 1970).

It is convenient to introduce a discussion of dragonfly distribution using the Life Zone concept. Life Zones are arranged mainly according to altitude and latitude. British Columbia includes a small area of the Upper Sonoran (Austral) Zone in the extreme southern Okanagan Valley. Large areas of Transition Zone occur in the Interior, characterized by bunchgrass (*Agropyron spicatum*), ponderosa pine (*Pinus ponderosa*), and Douglas-fir (*Pseudotsuga menziesii*). A more humid Transition Zone type is found in the Lower Fraser Valley and the Garry Oak-Arbutus area of southeastern Vancouver Island and the Gulf Islands.

Canadian Zone forests blanket the coastal region and the middle altitudes of the Interior mountains, and above this, and extending into the northern valleys, occurs the Hudsonian Zone with its thinning subalpine forests. The Alpine-Arctic Zone occupies the mountain tops throughout the Province and extends, altitudinally lower, towards the north.

Using this system, Walker (1927) describes the Province's dragonfly fauna by dividing it into four groups:

(1) The General Boreal Fauna—consists of species widely distributed in the Hudsonian and Canadian Zones and stragglers to the Alpine-Arctic Zone, most of them transcontinental and some circumpolar. It includes about 43 per cent of the British Columbia fauna. Many of these species are generally distributed in the

Province and include *Lestes disjunctus, L. dryas, Enallagma boreale, E. cyathigerum, Cœnagrion resolutum, Æshna eremita, A. interrupta, A. juncea, A. septentrionalis, A. sitchensis, A. subarctica, Cordulia shurtleffi,* all species of *Somatochlora* except *S. semicircularis,* all species of *Leucorrhinia* but *L. intacta,* and *Sympetrum danæ* and *Libellula quadrimaculata.*

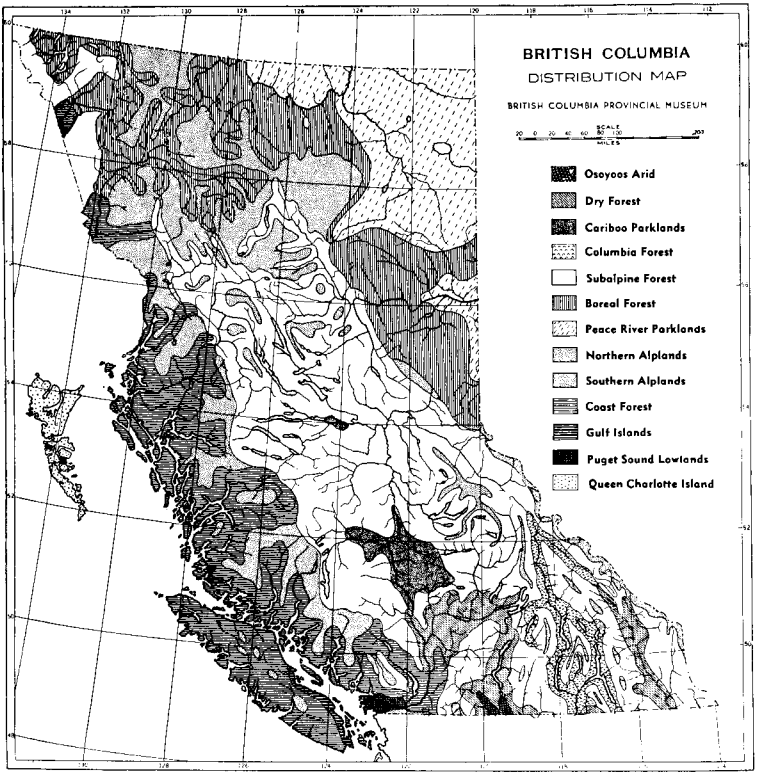
(2) The Western Boreal Fauna—a small group of northern species restricted to the Cordillera and forming about 5 per cent of our fauna. Characteristic species are *Æshna palmata, Cordulegaster dorsalis, Somatochlora semicircularis,* and *Tanypteryx hageni.*

(3) General Austral Fauna—not distinctly separable from Group 1, but made up of transcontinental species that are mainly found in the Transition and Upper Austral Zones. The group is thus often absent from Canada between southern Ontario and western British Columbia; it is best developed in the southwest part of the Province and contains about 24 per cent of the fauna. Examples are *Lestes unguiculatus, Enallagma ebrium, E. carunculatum, Anax junius, Æshna tuberculifera, A. constricta, Gomphus graslinellus, Leucorrhinia intacta, Libellula lydia, L. pulchella, Pachydiplax longipennis,* and *Sympetrum vicinum.*

(4) Western Austral or Sonora Fauna—about 28 per cent of our species represent northward extensions of this group and are most abundant in the Upper Sonoran and Transition Zones. A few of the species have spread beyond these zones but are rather rare or local. Species include *Argia emma, Enallagma clausum, Gomphus olivaceus, Octogomphus specularis, Ophiogomphus occidentis, Æshna californica, A. multicolor, Macromia magnifica, Libellula forensis, Erythemis collocata, Sympetrum corruptum, S. illotum,* and *S. madidum.*

An examination of these distribution patterns on a finer scale shows that the biogeoclimatic zones of Krajina (1965) are too

detailed to have much meaning in this context. The biotic areas of Munro and Cowan (1947) are constructed on a broader scale and are useful when a few of the high altitude and northern areas are lumped together, as is demonstrated below. The accompanying map shows the extent of these biotic zones British Columbia; further details on their characteristics are found in Munro and Cowan (1947) and Cowan and Guiget (1956).



Approximate boundaries of terrestrial biotic areas of British Columbia (from Munro and Cowan, 1947).

Osoyoos Arid Biotic Area

The dragonflies of this small area, equivalent to the Upper Sonoran Life Zone, are similar to those of the larger, surrounding Dry Forest Biotic Area. There are no species restricted to this area.

Dry Forest Biotic Area

This area is comparatively rich in Odonata, containing 70 per cent of the species known to occur in British Columbia. It supports 14 species not known from the related coastal part of the Transition Life Zone (*see* Puget Sound Lowland and Gulf Islands Biotic Areas). Species restricted to, or having their centre of abundance here, are *Enallagma clausum, Æshna constricta, Gomphus graslinellus, G. olivaceus,* and *Libellula pulchella.*

Cariboo Parklands Biotic Area

The Odonata of this area are a mixture of forms from the Subalpine Forest and Boreal Forest Biotic Areas to the north and from the Dry Forest Biotic Area to the south. Two species are particularly characteristic, *Enallagma hageni* and *Leucorrhinia borealis.* The only record of *Enallagma civile* in the Province is from this area.

Columbia Forest Biotic Area

The dragonfly fauna of this area is not distinctive; it contains about 50 per cent of our species. Certain southern species such as *Argia emma, Ischnura cervula, I. perparva, Æshna californica, A. constricta, Libellula forensis, Sympetrum corruptum,* and *S. madidum* are common to the Dry Forest and Columbia Forest Biotic Areas. Many species, however, are derived from the boreal fauna.

Subalpine Forest and Boreal Forest Biotic Areas

These large areas of northern and mountain forest, covering much of British Columbia, have a dragonfly fauna derived to a large extent from the transcontinental boreal fauna. Such species

as *Lestes disjunctus, Cœnagrion resolutum, Enallagma boreale, E. cyathigerum, Æshna eremita, A. juncea, Cordulia shurtleffi, Somatochlora hudsonica, Libellula quadrimaculata, Leucorrhinia hudsonica,* and *Sympetrum danæ* are common here. *Cœnagrion interrogatum, Æshna septentrionalis, Ophiogomphus colubrinus, Somatochlora franklini, S. septentrionalis,* and *S. whitehousei* are more or less confined to this area. The only records of *Somatochlora cingulata* are from a subalpine lake near the Okanagan Valley. *Tanypteryx hageni* inhabits the subalpine of the western Cascade Mountains and the southern Coast Range. In the mountains of the south and the valleys of the Interior Plateau some mainly lowland species locally enter these biotic areas.

Peace River Parklands Biotic Area

This area has been little explored, but in general is inhabited by a fauna similar to the Subalpine and Boreal Forest Biotic Areas. Two species are restricted to this area in British Columbia—*Cœnagrion angulatum* and *Ischnura damula.*

Coast Forest Biotic Area

This is an area mixing elements from both the boreal and mountain faunas and the coastal Transition fauna of the southern Georgia Strait region. Some notable species are *Æshna canadensis, A. tuberculifera, Octogomphus specularis,* and *Cordulegaster dorsalis.*

Gulf Islands Biotic Area

The Transition Life Zone, represented by the Dry Forest and Osoyoos Arid Biotic Areas in the Interior and by the Gulf Island and Puget Sound Lowlands Biotic Areas on the coast, is inhabited by both boreal and austral species and possesses the richest fauna in the Province, about 80 per cent of our species occurring there.

This coastal region is especially notable in its wide overlap of boreal and austral faunas, much more marked here than in any other part of Canada. Cool summers permit a southward range extension of boreal species, whereas mild winters allow austral species to live in the same locality. Walker (1927) illustrates this

with the examples of *Somatochlora albicincta,* a truly boreal species, and *Pachydiplax longipennis,* an austral form. On southern Vancouver Island both species may be found flying at the same pond, but in Ontario the northern limit of *P. longipennis* is separated from the southern limit of *S. albicincta* by at least 200 miles.

The Gulf Islands Biotic Area is the only place in the Province where *Pachydiplax longipennis* is found, and *Sympetrum illotum* is virtually confined to this area. In British Columbia, *Æshna tuberculifera* occurs only here and in the adjacent Coast Forest Biotic Area of Vancouver Island.

Puget Sound Lowland Biotic Area

The dragonfly fauna of this area has much in common with that of the Gulf Islands Biotic Area. *Erythemis collocata, Sympetrum illotum,* and *S. vicinum* are found only in these two areas and *Ischnura erratica* is virtually confined to them. The Fraser Valley and the Dry Forest also have characteristic species in common, notably *Argia emma, Ophiogomphus occidentis, Macromia rickeri,* and *Libellula lydia. Octogomphus specularis* appears to be restricted to the Puget Sound Lowlands Biotic Area and the adjacent Coast Forest.

Queen Charlotte Islands Biotic Area

The fauna of these islands is essentially similar to that of the Coast Forest Biotic Area, but with a much reduced fauna consisting of only 13 known species: *Lestes disjunctus, Enallagma boreale, E. cyathigerum, Æshna eremita, A. juncea, A. palmata, A. sitchensis, A. umbrosa, Cordulia shurtleffi, Somatochlora albicincta, Libellula quadrimaculata, Sympetrum costiferum,* and *S. danæ.* Most are associated with the bogs of Graham Island. Here *Somatochlora albicincta* reaches a very large size and is considered to be a distinct race, *S.a. massettensis.*

Species to Watch for

There exist a few species not yet recorded in British Columbia but which may appear within our borders. *Calopteryx æquabilis* Say (*Agrion æquabile*) may breed locally along the United States

border in the Columbia River drainage, and *Somatochlora forcipata* (Scudder) is almost certainly to be found in the Rocky Mountains of British Columbia. *Somatochlora kennedyi* Walker, *S. sahlbergi* Trybom, and *Leucorrhinia patricia* Walker may occur in the extreme northern part of the Province. They have been collected north of the 60th parallel in the west. *Tramea lacerata* Hagen and *Pantala flavescens* (Fabricius) of the Libellulidæ, two strongly wandering species, may appear sporadically from the south.

Observing and Collecting

Observation—Since dragonflies overproduce to make up for heavy losses, their populations are seldom damaged by collecting. Collecting for scientific purposes, especially in areas where the fauna is little known, is important. Indeed, much of our knowledge is dependent on collecting. But collecting for collecting's sake is retrogressive in this time of awakening ecological awareness. Fortunately there is much even the noncollector can contribute once he is familiar with the fauna; living organisms supply information that dead ones can never yield.

This book will help the beginner learn the best times and places to look for dragonflies. Little is known of the ecology of dragonflies in British Columbia, and anyone interested can swell our scant knowledge by studying the species of his or her particular area. Naturalists can gather invaluable data on emergence, feeding, mating and oviposition behaviour, territoriality, and habitat preferences. By raising larvæ in aquaria, significant life-history information can be gathered. It is vital to keep detailed notes on all observations.

Photography—In conjunction with observational studies, dragonfly photography can be an absorbing pursuit. Excellent results can be obtained with a little practice and a great deal of patience. Thirty-five millimetre, single-lens reflex equipment is the most suitable for field photography. A macro lens which permits close focusing is invaluable for photographing dragonflies that can be easily approached, especially those in the process of emerg-

ing. Most adults are wary, and must be photographed from several feet away using a telephoto lens and extension tubes. The sunny weather in which dragonflies are active usually provides enough light for this type of photography; electronic flash is not essential. A fast colour film, such as High Speed Ektachrome, is most useful. Detailed notes of the pictures should be kept.

Collecting for study—Collecting should be left to those seriously interested in studying dragonfly distribution patterns and classification. To such students it is an indispensable way to learn about these insects.

Dragonflies should be observed as much as possible before their capture. Data referring to behaviour and habitat make such specimens much more valuable than those taken without such ecological information.

The insect should be captured by a quick sweep of a net from behind; a head-on swing is much less successful. Many species have regular habits of flight and their movements can be anticipated. Some collectors use a poison jar to kill specimens. A few drops of ethyl acetate should be poured on some cotton wool and the cotton placed in a wide-mouthed jar and covered with a bit of tissue to prevent the insects from coming in contact with the cotton. The jar should always be kept clean and dry and in the dark; it should be charged with ethyl acetate every hour or so during collecting periods. Once dead, the insect, with wings folded above the thorax, is placed in a paper or cellophane envelope along with information regarding the date, place of capture, and collector's name. The envelopes are placed vertically in a noncrushable box, transported to the home or laboratory, then the specimen is mounted on a proper insect pin on a grooved board, the wings positioned flat and held in place with pinned strips of paper. The insects will dry in about a week and some colours will fade. Dried, unmounted dragonflies may be mounted after being placed for several days in an airtight "relaxing" container of wet sand or other dampened absorbent material. Larval exuviæ (the cast larval skins of emerged adults) should be secured to a narrow strip of card by a drop of glue on the venter of the obdomen. The mounting pin is then passed through the card.

Adult dragonflies may also be killed and preserved in vials containing 80 per cent alcohol; this method should always be used for larvæ. Larvæ are collected from bottom sediments and aquatic weeds with a long-handled dip net.

Sometimes many dragonflies emerge together and the shore vegetation teems with them. These easily captured tenerals are not fully hardened and make poor, shrivelled specimens. Collecting at this time is important but should be done carefully, for it is now that both the larval and adult stages can be associated. Each exuvia should be removed carefully from its support and placed in a paper bag with the adult that emerged from it. The adult should be kept in the bag about a day until it has hardened and the colour pattern is well developed. Always keep the adult specimen and its exuvia together. The delicate wings of teneral adults should not be handled.

Specimen boxes should be kept away from moisture and should be treated periodically with paradichlorobenzene to prevent damage by dermestid beetles. All private collections should eventually be placed in a university or museum collection where the information can be put to further use.

Nomenclature

With few exceptions, the dragonflies of our area have no common names. Most people are unfamiliar with dragonfly species and such names have not evolved. Thus students of these insects, unlike botanists, have escaped the confusion associated with an overabundance of common names. To invent English names is unnecessary; scientific names reveal relationships, are recognized throughout the world, and are easy to learn. People who speak freely of irises, primulas, and petunias will have no trouble with æshnas, libellulas, and sympetrums. Scientific names are always written in Latin form, whether they are actually derived from Latin or not. Through international agreement, the same name can never be correctly applied to more than one kind of animal.

Scientific names are quite simple; they are based on the classification of organisms. The unit of classification is the species. For the purpose of this book a species is a *kind* of dragonfly made up

of similar individuals capable of breeding with one another and interbreeding rarely, if ever, with other kinds of dragonflies. These species possess certain more or less stable characteristics that make them recognizable as separate entities. Closely related species may also have different habits and different habitat and food requirements. Related species having certain main characteristics in common are brought together to form a genus (plural, genera). Each genus has a name formed of a single capitalized, latinized word. The name of the species is made up of two words, the first being the name of the genus to which it belongs, the second a qualifying word referring to the species itself. The names may be constructed to describe the organism or to honour a person. *Leucorrhinia borealis,* for example, states that the face is white and that the species has northerly distribution; *Tanypteryx hageni* notes that the wings are long and that the name honours the famous 19th-century entomologist, Hermann Hagen.

Entomologists often distinguish groups separated by less evident differences than those that delineate species. These forms which usually show slight differences in colour or shape and which may interbreed where their ranges meet, are called races, or if they occupy separate parts of the species' range, are termed subspecies. Their subspecific name is placed after the specific name, thus, *Æshna interrupta lineata* (*lineata* designating the subspecies).

Related genera are arranged in even larger groups called families. Each family is named by a single word ending in "idæ". This name is usually taken from the name of the genus first designated part of the family.

The name of the person (the author) who first described the insect is also part of the scientific name and is placed after the specific name. If a later worker studies the relationships of the species and decides it properly belongs in another genus, the name of the first author is placed in parentheses. For example, *Enallagma cyathigerum* (Charpentier) was first described in 1840 by Charpentier who placed it in the genus *Agrion.* Selys, in 1876, transferred this species to the genus *Enallagma.*

This example shows that biological groups, especially those above the species level such as genera and families, are subjective classifications. As such they are apt to be reorganized by biologists as our knowledge of animals expands. Sometimes two or more scientists, in ignorance of one another's work, may give the same newly discovered species different names. In such a situation, the first name published is the valid one and the other name becomes a synonym.

This book follows the authority of Walker (1953, 1958) and Walker and Corbet (1975) for the nomenclature pertaining to the dragonflies of our region, except in the case of *Erythemis* (*see* discussion under *Erythemis*).

How to Use This Book

Format—The dragonflies described in this book are grouped in the conventional manner, beginning with those usually considered to be most primitive, the Zygoptera, which have similarly formed fore and hindwings and a prominent ovipositor. Within this framework the insects are grouped by family and in each family the genera are alphabetically arranged. Species also are arranged alphabetically within their genera.

Keys—To enable the reader to identify dragonfly specimens, keys to the families, genera, and species of the adults and larvæ of British Columbia dragonflies are provided. The use of the keys is facilitated by drawings that indicate many of the characteristics under consideration. Whenever possible, these drawings were produced from British Columbia specimens. It is important to note that the keys in this book are designed for use in British Columbia only. They may lead one astray even in nearby areas such as Alberta or the northwest United States where the dragonfly fauna is somewhat different from ours. The keys to the larvæ are meant to be used on final instar larvæ or larval exuviæ. The correct identification of younger stages is not guaranteed since measurements and proportions may change with age.

In this book, each species account begins with a brief synonymy, to indicate name changes and to enable readers to pursue

their interest in other literature. Distributional records plotted on the accompanying maps are documented in Scudder, Cannings, and Stuart (1976).

Many of the keys are based on those of Walker (1953, 1958) and Walker and Corbet (1975), but greatly simplified, modified, and in many cases completely changed to agree with our experience of the British Columbia dragonfly fauna. Evolutionary relationships are not implied in the order the insects are arranged in the keys. Technical terms have been kept to a minimum, but they are unavoidable. The diagrams of dragonfly structure (*see* Figs. 1–6) and the glossary (*see* page 244) should be examined carefully before any identifications are attempted.

Because the characteristics in the keys often refer to structures too small to be observed by the unaided eye, the use of a 10-power hand lens in good light is necessary. In some cases a dissecting microscope with magnification up to 30 times is very useful, especially when equipped with an eyepiece grid for making measurements. With practice one can readily recognize most genera and species without the keys.

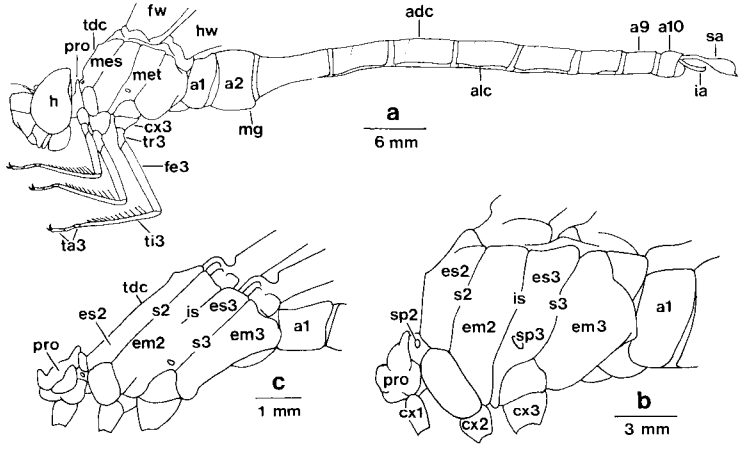


Fig. 1. **a**, Typical Anisoptera (*Æshna palmata* ♂); **b**, lateral view of thorax (*A. palmata* ♂); **c**, typical Zygoptera, lateral view of thorax (*Ischnura perparva* ♂) (*see* p. 243 for explanation of letters).

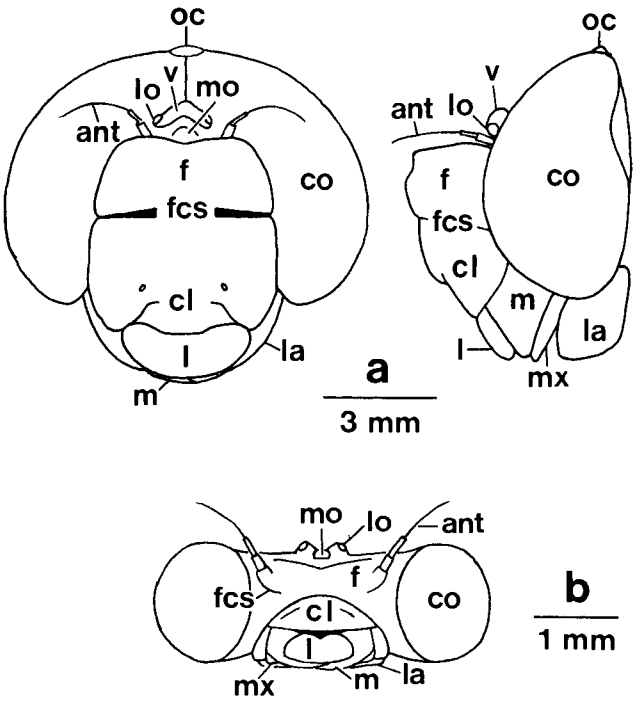


Fig. 2. Heads of Odonata: **a**, front and lateral views of a typical Anisoptera (*Æshna palmata* ♂); **b**, front view of a typical Zygoptera (*Ischnura perparva* ♂) (*see* p. 243 for explanation of letters).

Keys are a short-cut to the identification of organisms. They are constructed using paired statements containing contrasting characteristics. If the specimen's characteristics do not agree with statement "a" then they will fit statement "b"; one then proceeds to the next pair of statements indicated by the number after the correct alternative. This process is followed until a name is reached.

To identify a dragonfly, the description of the Order in the introduction should be read carefully to ensure the insect belongs

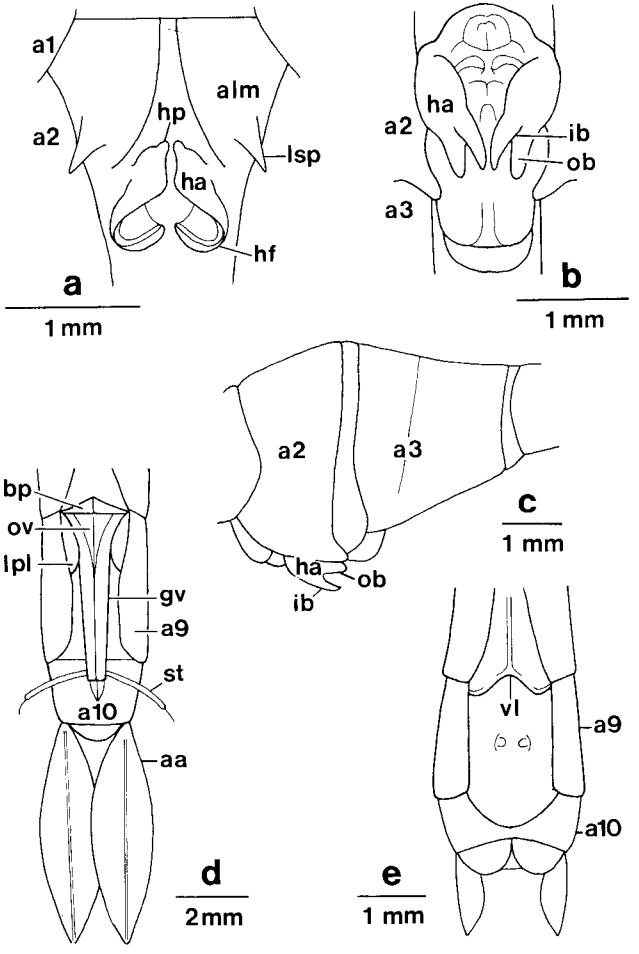


Fig. 3. External genitalia in the Families Æshnidæ and Libellulidæ: **a**, ventral view of abdominal segment 2, *Æshna eremita* ♂; **b**, ventral view of abdominal segment 2, *Sympetrum internum* ♂; **c**, lateral view of base of abdomen, *Sympetrum internum* ♂; **d**, ventral view of end of abdomen, *Æshna constricta* ♀; **e**, ventral view of end of abdomen, *Sympetrum occidentale* ♀ (*see* page 243 for explanation of letters).

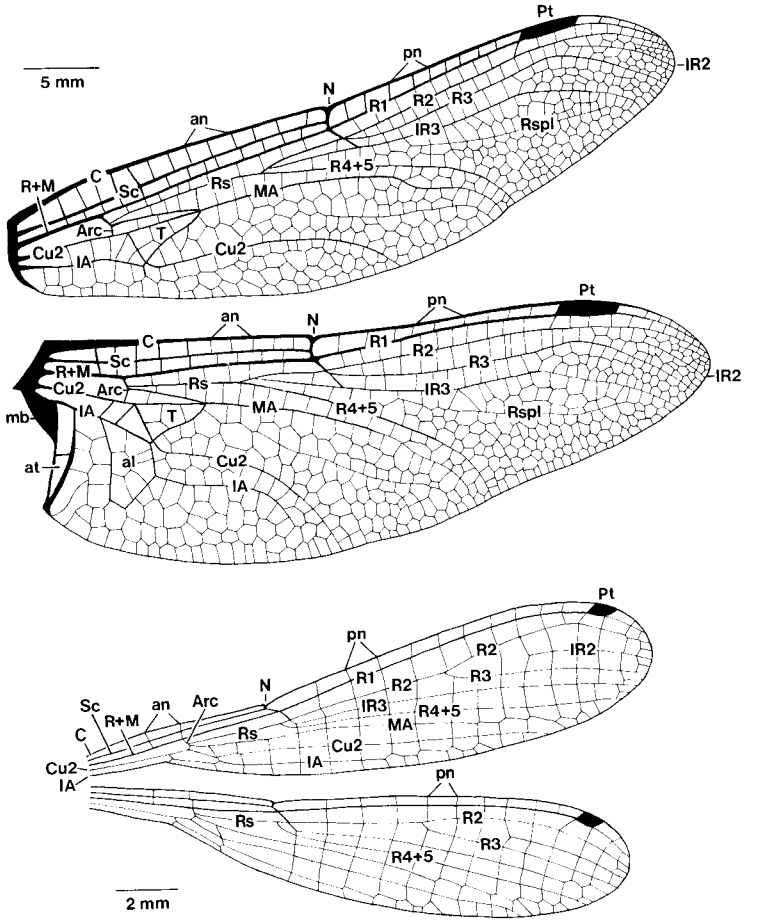


Fig. 4. Wings of Odonata illustrating the Tillyard-Fraser venational system: Top pair, Anisoptera (*Æshna juncea* ♂); bottom pair, Zygoptera (*Nehalennia irene* ♂) (*see* p. 243 for explanation of letters).

to the Odonata. Next, the keys to the suborders and families should be consulted. When the family is decided upon, check the specimen with the family description and then proceed to the generic key for that family. After the generic name is found, check the generic description and key out the specimen in the species key. The final identification should be verified by carefully comparing the dragonfly with the species characteristics and any relevant drawings in the text. If the description obviously does not fit, a mistake has been made in working the key and the process of identification must be repeated. If the specimen remains perplexing, it should be carefully labelled and packaged and sent for identification to the Entomology Division, British Columbia Provincial Museum, Victoria.

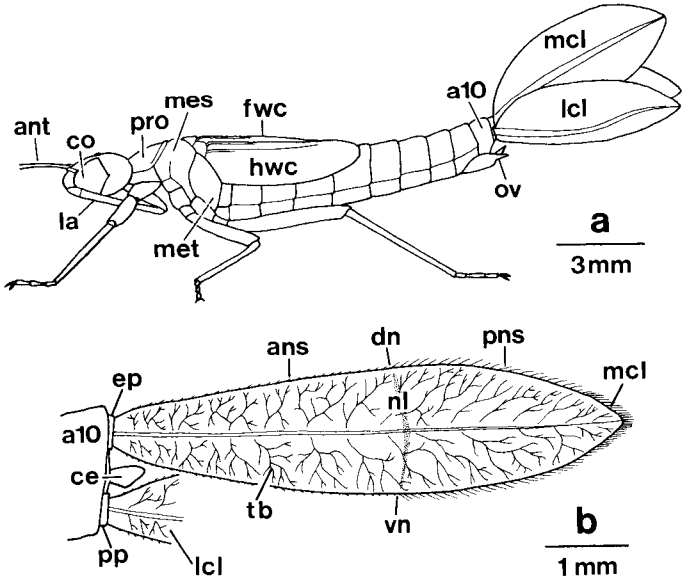


Fig. 5. Larval structures of the Zygoptera: **a**, larva of *Argia emma* ♀ (after Kennedy, 1915); **b**, median caudal lamella and associated structures of *Enallagma boreale* ♂ (*see* p. 243 for explanation of letters).

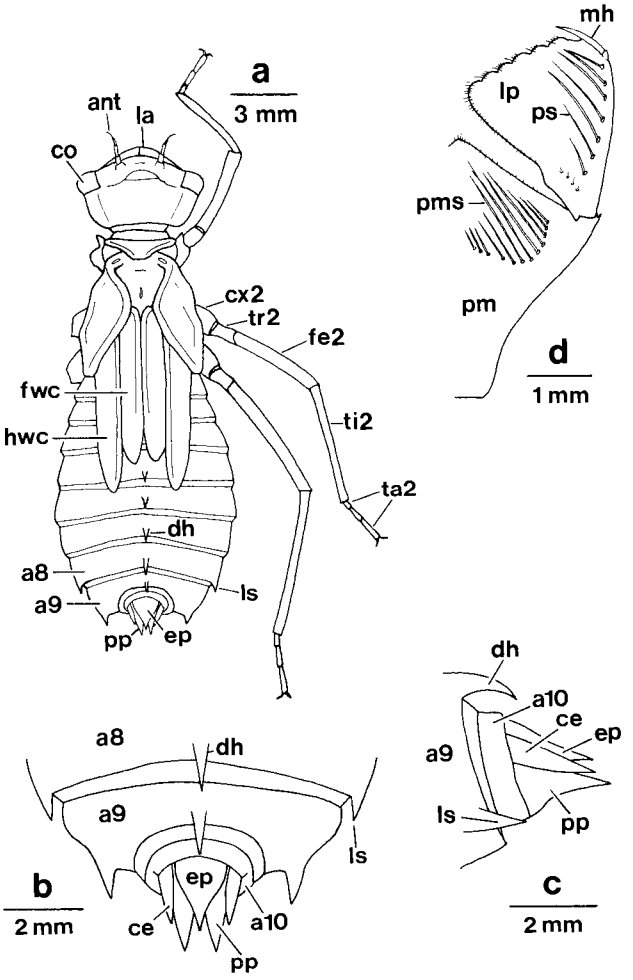


Fig. 6. Larval structures, Anisoptera: **a**, dorsal view, larva of *Somatochlora minor;* **b**, dorsal view, end of abdomen of *S. minor;* **c**, lateral view of same segments; **d**, dorsal view, right half of labium, *Epitheca spinigera* (*see* p. 243 for explanation of letters).

Key to the Suborders and Sexes of Dragonfly Adults

1a. Forewings and hindwings similar in form (Fig. 7a), Suborder Zygoptera 2

1b. Hindwings much broader near base than forewings (Fig. 7c), Suborder Anisoptera 3

2a. Accessory genitalia present on venter of abdominal segment 2; 2 superior and 2 inferior anal appendages ..... male

2b. No accessory genitalia on abdominal segment 2; ovipositor present on venter of abdominal segment 9 ..... female

3a. Accessory genitalia present on venter of abdominal segment 2; 2 superior and 1 inferior anal appendage ..... male

3b. No accessory genitalia on abdominal segment 2; ovipositor present on venter of abdominal segment 9, or absent ..... female

Key to the Suborders of Dragonfly Larvæ

1a. Abdomen not widening from the base; end of abdomen with 3 caudal lamellæ (Fig. 7b) ..... Zygoptera

1b. Abdomen widening from the base; end of abdomen without caudal lamellæ but with 5 stiff, pointed appendages (Fig. 7d) ..... Anisoptera

Key to the Families of British Columbia Dragonflies

ADULTS

1a. Zygoptera 2

1b. Anisoptera 3

2a. Wings with R4+5 arising from Rs nearer to the arculus than to the nodus (Fig. 8a) ..... Lestidæ (p. 42)

2b. Wings with R4+5 arising from Rs nearer to the nodus than to the arculus (Fig. 8b) ..... Cœnagriidæ (p. 52)

3a. Triangle of forewing more distant from the arculus than in the hindwing (Fig. 8c) 4

3b. Triangle of forewing and hindwing about the same distance from the arculus (Fig. 8d) 6

4a. Anal loop short and wide, without a mid-vein; triangle of hindwing distant from the arculus (Fig. 8e) ..... Macromiidæ (p. 151)

4b. Anal loop long with 2 rows of cells separated by a mid-vein, usually widened near the posterior end; triangle of hindwing touching the arculus (Fig. 8f) 5

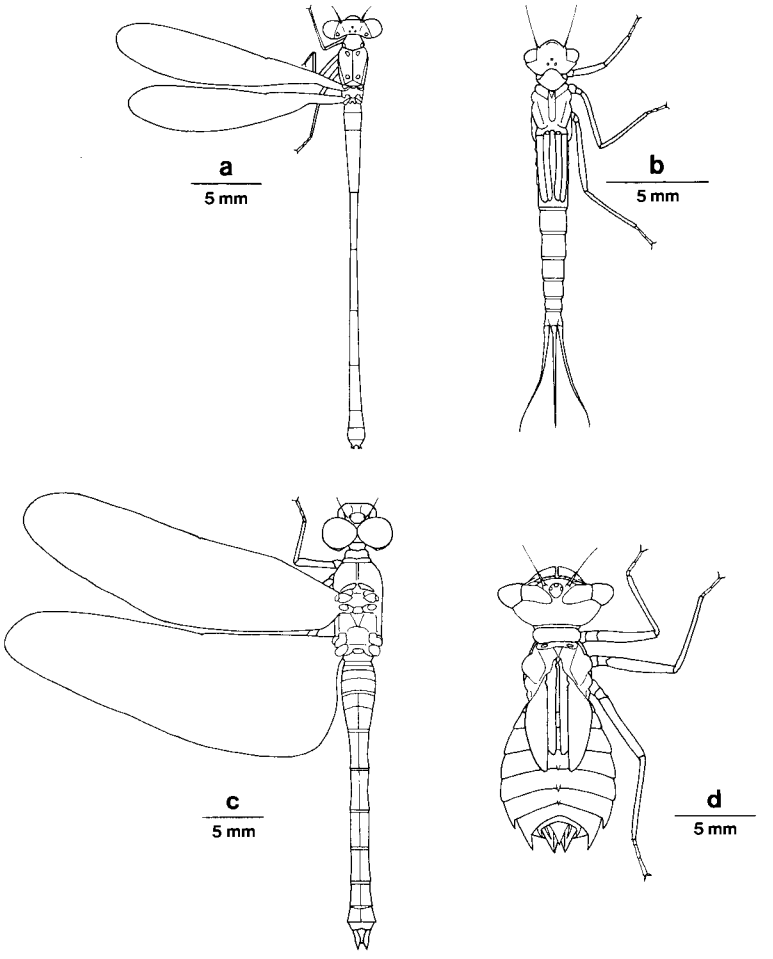


Fig. 7. **a**, Zygoptera adult, *Ischnura cervula* ♂; **b**, Zygoptera larva, *I. cervula* ♂; **c**, Anisoptera adult, *Sympetrum occidentale* ♂; **d**, Anisoptera larva, *S. occidentale* ♂.

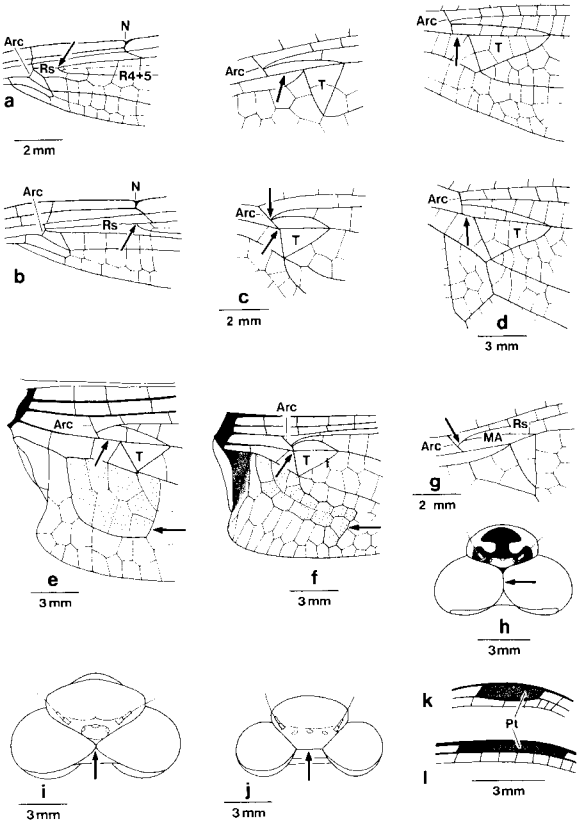


Fig. 8. Family characteristics in wing venation (**a–g**), heads in dorsal aspect (**h–j**), and pterostigma (**k, l**) of adult dragonflies: **a**, Lestidæ (*Lestes disjunctus*); **b**, Cœnagriidæ (*Argia emma*); **c**, Corduliidæ (*Somatochlora franklini*: Top, forewing; bottom, hindwing); **d**, Æshnidæ (*Æshna palmata:* Top, forewing; bottom, hindwing); **e**, Macromiidæ (*Macromia magnifica,* hindwing); **f**, Corduliidæ (*Somatochlora franklini,* hindwing); **g**, Libellulidæ (*Sympetrum vicinum,* hindwing); **h**, Æshnidæ (*Æshna sitchensis*); **i**, Cordulegastridæ (*Cordulegaster dorsalis*); **j**, Gomphidæ (*Ophiogomphus severus*); **k**, Gomphidæ (*Octogomphus specularis*); **l**, Petaluridæ (*Tanypteryx hageni*) (*see* p. 243 for explanation of letters).

5a. Rs and MA distinctly separate beyond the arculus (Fig. 8c); body usually metallic ..... Corduliidæ (p. 155)

5b. Rs and MA fused for a little way beyond the arculus (Fig. 8g); body not metallic ..... Libellulidæ (p. 182)

6a. Eyes meeting on top of head 7

6b. Eyes widely separated on top of head (Fig. 8j) 8

7a. Eyes meeting at a single point (Fig. 8i) ..... Cordulegastridæ (p. 149)

7b. Eyes meeting broadly on top of head (Fig. 8h) ..... Æshnidæ (p. 98)

8a. Pterostigma widened near middle (Fig. 8k) and shorter than half the distance from the nodus to the inner edge of pterostigma ..... Gomphidæ (p. 135)

8b. Pterostigma not widened near middle (Fig. 8l) and longer than half the distance from the nodus to the inner edge of pterostigma ..... Petaluridæ (p. 132)

LARVÆ

1a. Zygoptera 2

1b. Anisoptera 3

2a. Basal half of prementum very slender (Fig. 9a); caudal lamellæ with main tracheal branches unbranched except toward the margins and leaving the main axis at about right angles (Fig. 9j) ..... Lestidæ (p. 42)

2b. Basal half of prementum not greatly narrowed, the margins diverging gradually from the base (Fig. 9b); caudal lamellæ with main tracheal branches freely branched and leaving the main axis at acute angles (Fig. 9k) ..... Cœnagriidæ (p. 52)

3a. Prementum and labial palps flat or nearly so (Fig. 9h), with neither premental nor palpal setæ 4

3b. Prementum and labial palps together spoon-shaped (Fig. 9i), with both premental and palpal setæ 6

4a. Antennæ with 4 segments, segment 3 enlarged and segment 4 minute (Fig. 9b l); mesotarsi with 2 segments (Fig. 9b n) ... Gomphidæ (p. 135)

4b. Antennæ with 6 or 7 segments (Fig. 9b m); mesotarsi with 3 segments (Fig. 9b o) 5

5a. Prementum widest in apical half, narrowing smoothly to the base; no spur at the base of the movable hook (Fig. 9c) ..... Æshnidæ (p. 98)

5b. Prementum with sides parallel in apical three fifths then abruptly narrowed near the base; a spur present at the base of the movable hook (Fig. 9d) ..... Petaluridæ (p. 132)

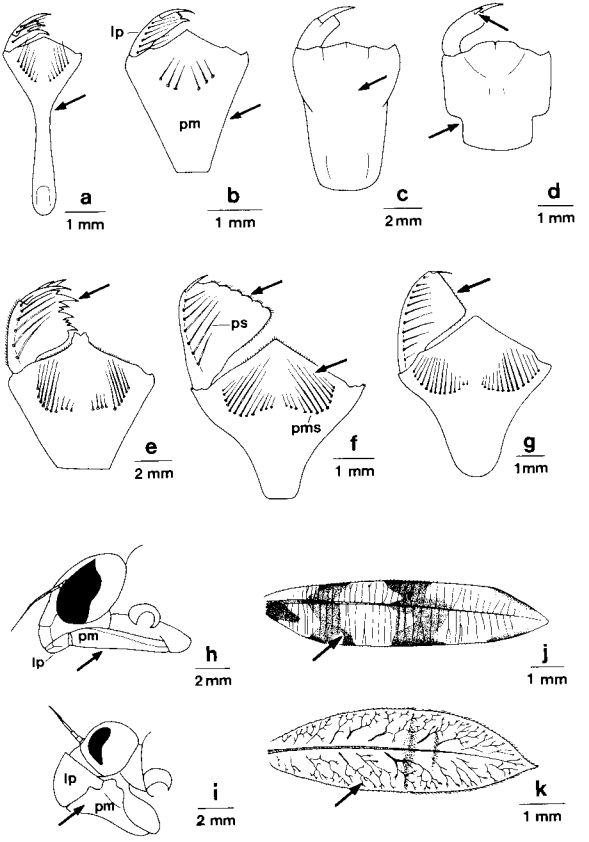


Fig. 9. Family characteristics of the larvæ of dragonflies as seen in the dorsal view of the labium (**a–g**), the lateral view of the head and labium (**h, i**) and the median caudal lamella (**j, k**): **a,** Lestidæ (*Lestes unguiculatus*); **b,** Cœnagriidæ (*Enallagma clausum*); **c,** Æshnidæ (*Æshna eremita*); **d,** Petaluridæ (*Tanypteryx hageni,* after Svilhla, 1958); **e,** Cordulegastridæ (*Cordulegaster dorsalis*); **f,** Corduliidæ (*Epitheca spinigera*); **g,** Libellulidæ (*Sympetrum danæ*); **h,** Æshnidæ (*Æshna eremita*); **i,** Libellulidæ (*Libellula quadrimaculata*); **j,** Lestidæ (*Lestes congener*); **k,** Cœnagriidæ (*Enallagma cyathigerum*) (*see* page 243 for explanation of letters).

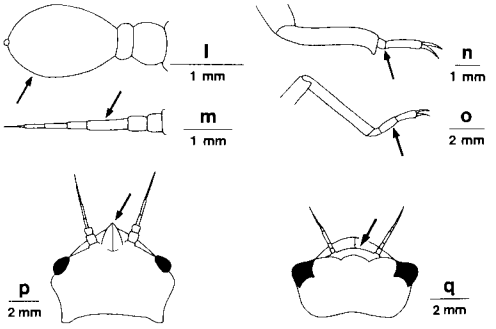


Fig. 9b. Family characteristics in the larvæ of dragonflies as seen in the antenna (**l, m**), the mesotibia and tarsus (**n, o**), and the dorsal view of the head (**p, q**): **l**, Gomphidæ (*Octogomphus specularis*); **m**, Æshnidæ (*Æshna eremita*); **n**, Gomphidæ (*Ophiogomphus severus*); **o**, Æshnidæ (*Æshna eremita*); **p**, Macromiidæ (*Macromia magnifica*); **q**, Libellulidæ (*Libellula quadrimaculata*) (*see* p. 243 for explanation of letters).

6a. Apical margins of labial palps cut into large, irregular teeth without associated setæ (Fig. 9e) ..... Cordulegastridæ (p. 149)

6b. Apical margins of labial palps smooth or evenly toothed, each rounded tooth bearing one or more setæ 7

7a. Head with a prominent horn between the bases of the antennæ (Fig. 9b p) ..... Macromiidæ (p. 151)

7b. Head without a median horn (Fig. 9b q) 8

8a. Cerci more than half as long as paraprocts; apical margins of labial palps with rounded teeth, the largest teeth a third to more than half as high as wide (Fig. 9f) ..... Corduliidæ (p. 155)

8b. Cerci at most half as long as paraprocts; apical margins of labial palps straight or with very low, rounded teeth, many times wider than high (Fig. 9g), except in *Libellula lydia* and *L. julia* where the teeth are more deeply cut ..... Libellulidæ (p. 182)

FAMILY LESTIDÆ

This is a small but widespread family in our fauna, containing one genus, *Lestes*. The family is characterized by vein R4+5 separating from Rs nearer to the arculus than the nodus. The larvæ have remarkably elongate labia.

Genus *Lestes* Leach

The name of the genus comes from the Greek *lestes* = robber or pirate and refers to the predatory nature of the species, especially of the larvæ, which are agile hunters.

These damselflies are large and elongate, usually metallic green or bronze dorsally, pale green or yellow ventrally. These colours are often obscured by pruinosity in old specimens, especially males. The spines of the legs are much longer than the intervening spaces.

Our species inhabit the shores of boggy or marshy waters. Some develop in temporary waters and probably have a life cycle of one year (Walker, 1953). Characteristically, they fly low over the water and rest on emergent vegetation with their wings half spread. Evidently all species oviposit in emergent aquatic plants such as cat-tails (*Typha*), bulrushes (*Scirpus*), and spike-rushes (*Eleocharis*) or even in willows (*Salix*) (Walker, 1953). Oviposition is usually performed well above the waterline, the male and female in tandem.

KEY TO THE SPECIES OF *LESTES*

MALES

1a. Inferior appendages less than half the length of the superior appendages (Fig. 10a) ..... *congener* (p. 45)

1b. Inferior appendages more than half the length of the superior appendages 2

2a. Inferior appendages roughly S-shaped, with the apices curved in the opposite direction to the superior appendages (Fig. 10b) ..... *unguiculatus* (p. 50)

2b. Inferior appendages not S-shaped 3

3a. Superior appendages with distinct basal and apical teeth on the inner margin; inferior appendages almost straight (Fig. 10c) ..... *disjunctus* (p. 47)

3b. Superior appendages with a distinct basal tooth only; inferior appendages curved in the same direction as the superior appendages (Fig. 10d) ..... *dryas* (p. 49)

FEMALES

1a. Dorsum of thorax bright metallic green ..... *dryas* (p. 49)

1b. Dorsum of thorax black or dark brown 2

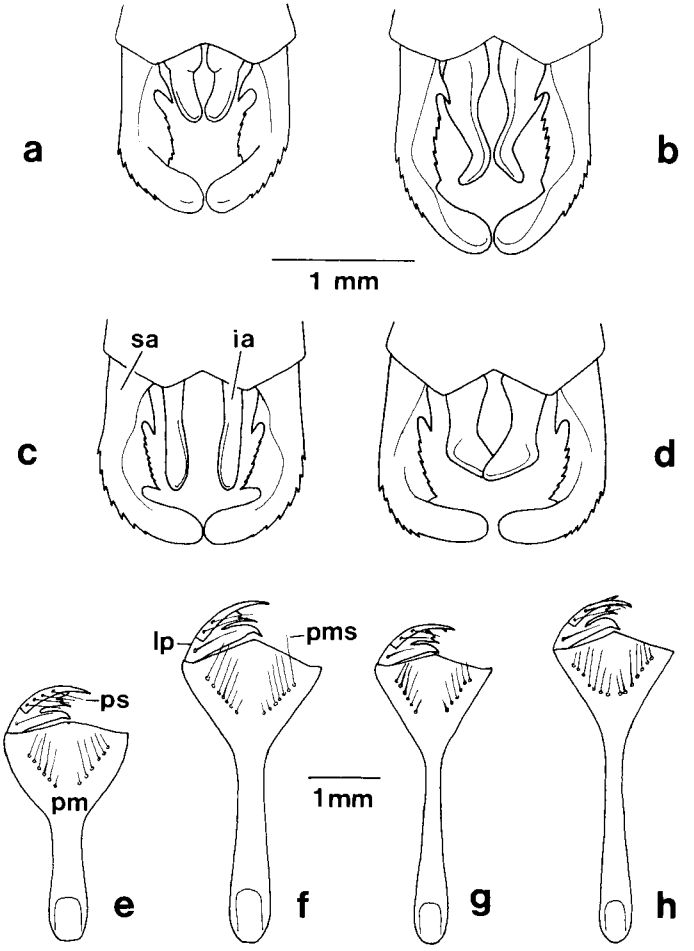


Fig. 10. *Lestes:* Characteristics as seen in the dorsal view of the male appendages (**a–d**) and the dorsal view of the larval labia (**e–h**); **a**, *L. congener;* **b**, *L. unguiculatus;* **c**, *L. disjunctus;* **d**, *L. dryas;* **e**, *L. congener;* **f**, *L. unguiculatus;* **g**, *L. disjunctus;* **h**, *L. dryas* (*see* p. 243 for explanation of letters).

2a. Metepimeron with a black mark on the anterior half ..... *congener* (p. 45)

2b. Metepimeron without a black mark 3

3a. Rear of head partly yellow; dorsum of abdomen with a greenish tint ..... *unguiculatus* (p. 50)

3b. Rear of head black or dark brown; dorsum of abdomen bronzy ..... *disjunctus* (p. 47)

LARVÆ

1a. Prementum with basal part relatively stout, its least width about a third that of the wide apex; palpal setæ, **4** or 5 (Fig. 10e) ..... *congener* (p. 45)

1b. Prementum with basal part very slender, its least width not more than a fifth that of the wide apex; palpal setæ usually 3 2

2a. Prementum with slender basal part 1.5 times as long as the wide apical part (Fig. 10f) ..... *unguiculatus* (p. 50)

2b. Prementum with slender basal part at least 2 times as long as the wide apical part 3

3a. Premental setæ usually 5 or 6 (Fig. 10g); apex of median caudal lamella usually tapering but rounded; in female, ovipositor extending to about the posterior margin of abdominal segment 10 ..... *disjunctus* (p. 47)

3b. Premental setæ usually 7 (Fig. 10h); apex of median caudal lamella usually acute; in female, ovipostor extending well beyond abdominal segment 10, reaching basal joint of caudal lamellæ ..... *dryas* (p. 49)

Lestes congener Hagen

L. congener Hagen, 1861. Syn. Neur. N. Amer. p. 67

L. congener, Walker, 1953. Odonata of Canada and Alaska 1:93

congener=belonging to the same genus (*Lestes*); a rather redundant name.

Distinguishing characteristics—Male (Fig. 37a, p. 235): Length, 38–42 mm; hindwing, 21–24 mm. Head dull black with yellow mouthparts; rear of head pale dorsally, dark ventrally. Thorax dull bronze-black with yellow mid-dorsal line; mesopleural sulcus with a narrow yellow stripe constricted behind the middle to a fine line; metepimeron with two dark spots; venter yellow. Abdomen bronze-black dorsally with pale basal rings on segments 3–7; venter yellow. Superior appendages twice as long as inferior appendages (Fig. 10a, p. 44). White pruinosity appears on head, thorax, and abdominal segments 1, 2, and 8–10.

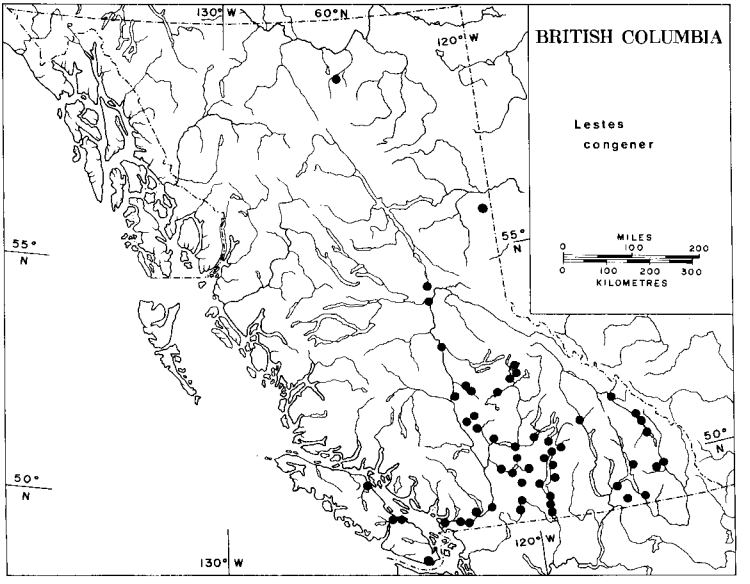
Female: Length, 39 mm; hindwing, 25mm. Similar to male in colour and pattern but paler. Pruinosity restricted to sides and venter of pterothorax.

Larva: Length, 22–26 mm; labium length (folded), 2.8–3.0 mm. Prementum with basal part relatively stout, its least width about a third that of the wide apex; premental setæ, 6 or 7; palpal setæ, 4 or 5 (Fig. 10e, p. 44). Caudal lamellæ with apices bluntly pointed; median lamella slightly shorter than lateral lamella. Ovipositor extending slightly beyond segment 10.

Range—British Columbia east through the Northwest Territories to Nova Scotia; south to New Jersey, Missouri, and California.

Distribution in British Columbia—General throughout the Province south of Prince George and probably widely scattered farther north, as indicated by records from Dawson Creek and Toad River Lodge, Alaska Highway.

Field-notes—In British Columbia *L. congener* reaches a larger size than it does anywhere else in Canada. It is also notable for its late emergence, seldom being seen before August. Typical emergence has been recorded



from August 1 to 13 (Nanaimo) and August 14 (Golden) (Walker, 1953). Exceptionally early records occurred at Sooke on June 13 (Whitehouse, 1941) and Wells Gray Park on June 23. *L. congener* was mating and ovipositing at Cosens Bay Pond near Vernon on September 9, 1976. The thick stand of spike-rush (*Eleocharis palustris*) surrounding this small pond was teeming with the species, an estimated four pairs per square foot (approximately 40,000 pairs). They oviposited in tandem, the female looping her abdomen in a high arch and punching eggs into the stems 2–6 cm above the water.

Recorded dates of flight range from June 13 to Novèmber 10, but flight before about July 10 is unusual.

Lestes disjunctus Selys

L. disjunctus Selys, 1862. Bull. Acad. Belg. (2) 13:302

L. disjunctus, Walker, 1953. Odonata of Canada and Alaska 1:104

disjunctus=separated; a reference to the distinctly segmented abdomen.

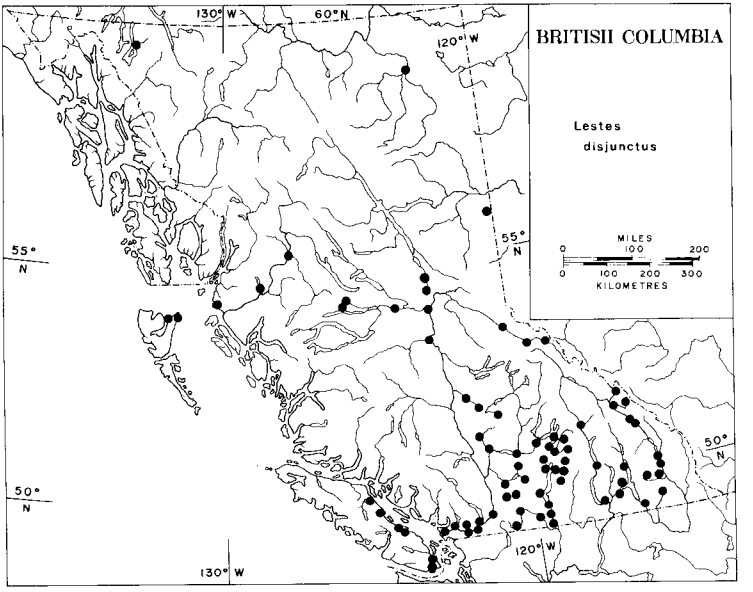
Distinguishing characteristics—Male (Fig. 37b, p. 235): Length, 34–41 mm; hindwing, 18–22 mm. Head with dorsum bronze-black; mouthparts pale yellow-green. Thorax bronze-black with a pale yellow mid-dorsal line; mesopleural sulcus with a pale yellow stripe less than a third as broad as the dark mesepisternal stripe. Abdomen very dark bronze dorsally with a greenish tinge. Superior appendages with long basal and apical teeth on the inner margin; inferior appendages long and straight (Fig. 10c, p. 44). In old specimens, bluish pruinosity develops on the rear of the head, prothorax, venter of pterothorax, and abdominal segments 1, 2, and 8–10.

Female: Length, 33–39 mm; hindwing, 20–25 mm. Coloration similar to male before pruinosity except pale areas more extensive. Ovipositor not quite reaching the end of segment 10.

Larva: Length, 23–29 mm; labium length (folded), 3.5–5.0 mm. Slender base of prementum about five eighths of total length; premental setæ, 5 or 6; palpal setæ, 3 (Fig. 10g, p. 44). Median caudal lamella shorter than lateral lamellæ and with rounded, tapering apex. Ovipositor extending to approximately the posterior margin of segment 10.

Range—Alaska east to the Northwest Territories, Labrador, and Newfoundland; south to Florida, Texas, and Arizona.

Distribution in British Columbia—General throughout the Province.



Field-notes—This is a common dragonfly, inhabiting a wide range of aquatic habitats. It emerges rather late, seldom appearing before the last week of June and is most often seen for the first time in July. The earliest records are for June 24 from such widely separated locations as Thetis Lake, near Victoria, and Kaslo in the West Kootenay district. Mating begins about a week after emergence (July 14, Wellington; July 22, Atlin) (Walker, 1953). The latest record for a pair in copulation is September 2 at Vancouver (Whitehouse, 1941). On August 5, 1976, near Crooked River, north of Prince George, *L. disjunctus* was mating and ovipositing in the company of *Lestes dryas, Cœnagrion resolutum,* and *Leucorrhinia hudsonica,* among others.

Flight records for *L. disjunctus* in British Columbia are from June 24 to October 2.

Lestes dryas Kirby

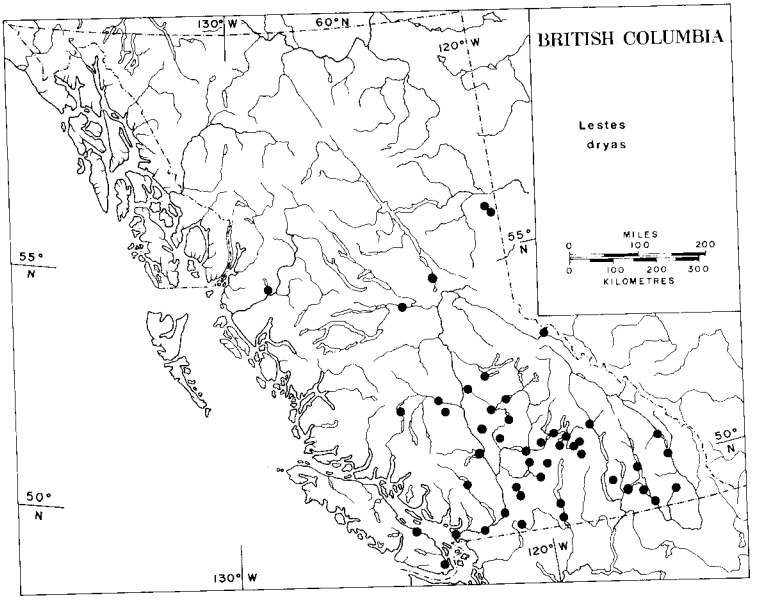
L. dryas Kirby, 1890. Syn. Cat. Od. p. 160

L. uncatus Kirby, 1890. Syn. Cat. Od. p. 160

L. dryas, Walker, 1953. Odonata of Canada and Alaska 1:100

dryas=a mythical Greek wood nymph.

Distinguishing characteristics—Male (Fig. 37c, p. 235): Length, 35–38 mm; hindwing, 18–22 mm. Bright metallic green; teneral deep blue with pale markings not visible from above. Head dark with pale greenish-yellow mouthparts. Thorax of tenerals with pale mid-dorsal line and yellow stripe on the mesopleural sulcus; these pale markings lacking in mature specimens. Thoracic venter and lower lateral areas pale in tenerals; mature specimens with a dark metepimeral spot which spreads to replace most of the pale areas. Abdomen dark green dorsally with pale basal segmental rings; venter light yellow or brown. Superior appendages strongly curved with a distinct basal tooth; inferior appendages about three fourths as long as superior



appendages, widened apically (Fig. 10d, p. 44). Light grey pruinosity appears on prothorax, thoracic venter, and abdominal segments 1, 2, and 8–10.

Female: Length, 32–37 mm, hindwing, 21–24 mm. Bright metallic green with pale pattern similar to teneral male. No pruinosity.

Larva: Length, 23–25 mm; labium length (folded), 4.5–5.0 mm. Prementum with slender basal part at least twice as long as the wide apex; premental setæ, 7; palpal setæ, 3 or 4 (Fig. 10h, p. 44). Caudal lamellæ with long, acute apices. Ovipositor extending well beyond segment 10.

Range—Alaska and the Yukon east to the Northwest Territories, James Bay, the north shore of the St. Lawrence River, and Nova Scotia; south to New Jersey, Oklahoma, and California; Europe and Asia.

Distribution in British Columbia—Widespread in the Province. Although *dryas* probably occurs in the far north, there are no records from north of the Skeena and Peace River valleys.

Field-notes—With its bright, metallic green body, *L. dryas* is easily recognizable in the field. It is the earliest of the genus to appear in the adult stage, usually well before *disjunctus* and *congener* and between one and two weeks before *unguiculatus*. Adults have been recorded at Oliver as early as May 26, but most emergence begins in early June. Dates of mating range from June 7 (Sooke) to August 6 (Clinton). On the latter date, pairs in tandem were laying eggs in the stems of bulrushes (*Scirpus*) and spike-rushes (*Eleocharis*) growing in a grassland alkaline pond. Other species breeding at the same time were *Sympetrum madidum, S. internum,* and *Æshna interrupta*.

Flight in British Columbia has been recorded from May 26 to September 6.

Lestes unguiculatus Hagen

L. unguiculatus Hagen, 1861. Syn. Neur. N. Amer. p. 7

L. unguiculatus, Walker, 1953. Odonata of Canada and Alaska 1:96

unguiculatus=with claws; probably a reference to the tarsal claws at the end of the legs, or perhaps the S-shaped inferior appendages of the male.

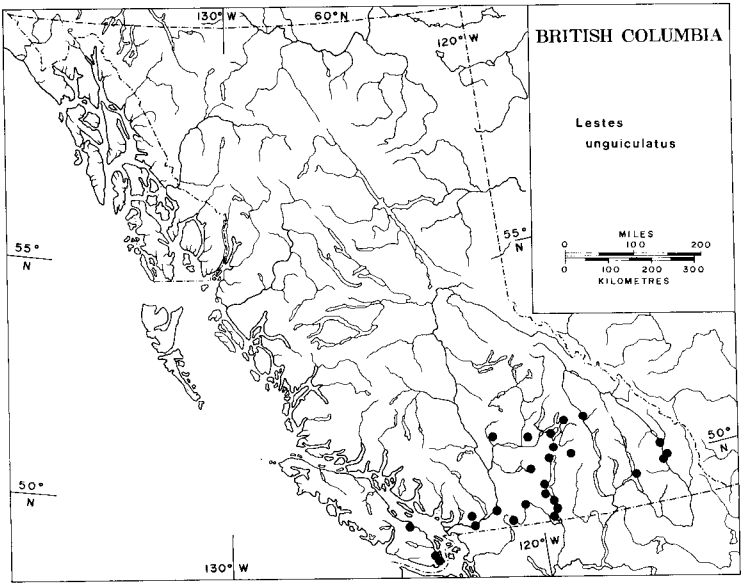
Distinguishing characteristics—Male (Fig. 37d, p. 235): Length, 34–41 mm; hindwing, 18–21 mm. Head dark bronze-brown; rear with a yellow transverse bar dorsally; mouthparts greenish-yellow. Thorax bronze-brown dorsally; tenerals with mid-dorsal line and stripe on the mesopleural sulcus

pale brown becoming green with maturity; tenerals with a pale, yellow, 7-shaped mark on dark lateral area which is restricted in mature specimens to a bar by the dark metepimeral spot. Abdomen bright bronze-brown with a greenish tinge and pale basal segmental rings; venter and sides yellow. Inferior appendages more than half the length of the superior appendages and roughly S-shaped with the apices curved in the opposite direction to the superior appendages (Fig. 10b, p. 44). Bluish pruinosity appears on the rear of head, thorax, and abdominal segments 1, 2, 9, and 10.

Female (Fig. 37e, p. 235): Length, 30–39 mm; hindwing, 18–22 mm. Colour similar to teneral male; abdomen with dorsum dark metallic green, light yellow laterally.

Larva: Length, 27–28 mm; labium length (folded), 3.8–4.5 mm. Prementum with slender basal part one and one-half times as long as the wide apical part (Fig. 10f, p. 44); premental setæ, 6 or 7; palpal setæ, 3–5. Caudal lamellæ with apices moderately acute. Ovipositor extending slightly beyond the posterior margin of abdominal segment 10.

Range—British Columbia east to Nova Scotia; south to New Jersey, Tennessee, Oklahoma, and California.



Distribution in British Columbia—Found south of 51°N (Revelstoke).

Field-notes—*Lestes unguiculatus* is more distinctly southern than any of our other *Lestes* species and in British Columbia is relatively more restricted to the lowlands. It prefers small ponds in the open and is especially abundant around bodies of water that dry up in summer. It is a typical dragonfly of the alkaline ponds of the southern Interior. In British Columbia emergence of *unguiculatus* has been recorded on June 13 (Sooke) and mating on June 30 (White Lake, Okanagan Falls).

Flight in British Columbia is known from June 6 to September 7.

FAMILY CŒNAGRIIDÆ

The Cœnagriidæ is the larger of the two Zygopteran families in British Columbia and consists of six genera and 18 species in our territory. The adults are usually small and brightly coloured, frequently blue but sometimes green, yellow, orange, red, or purple, marked with black. There are often two female colour forms, the homeochromatic much like the male and the heterochromatic with a different ground colour and pattern. Unlike the wing venation of the Lestidæ, that of the Cœnagriidæ is characterized by vein R4+5 forking from Rs nearer to the nodus than to the arculus.

Larvæ are green or brown and climb in aquatic vegetation or walk on the bottom sediments. The labium is much shorter than in the Lestidæ and is not stalked at the base. The tracheæ of the caudal lamellæ branch from near their bases and leave the axis at acute angles.

KEY TO THE GENERA OF CŒNAGRIIDÆ

ADULTS

1a. Tibiæ with long spines, twice as long as the intervening spaces ..... *Argia* (p. 57)

1b. Tibiæ with short spines, never more than one and one-half times as long as the intervening spaces 2

2a. Head with pale postocular spots (Fig. 11c) 3

2b. Head without pale postocular spots 5

3a. R2 and R3 diverging near the fourth postnodal crossvein on the forewing and near the second or third on the hindwing (Fig. 11a); dorsum of abdominal segment 10 of male raised and bifid (Fig. 11d) ..... *Ischnura* (p. 86)

3b. R2 and R3 diverging near the fifth postnodal crossvein or beyond on the forewing and near the fourth or beyond in the hindwing (Fig. 11b); dorsum of segment 10 of male not raised and bifid (Fig. 11e) 4

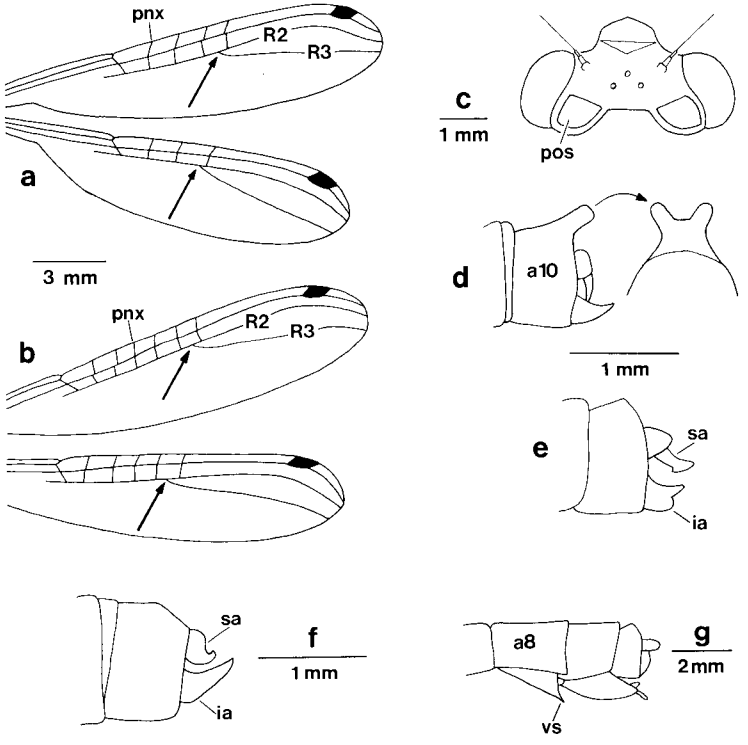


Fig. 11. Cœnagriidæ: Adult characteristics; **a**, wings of *Ischnura perparva* ♀; **b**, wings of *Cœnagrion resolutum* ♂; **c**, dorsal view of head of *Enallagma boreale* ♂; **d**, lateral and longitudinal views of anal appendages of *Ischnura cervula* ♂; **e**, anal appendages of *Cœnagrion resolutum* ♂; **f**, anal appendages of *Enallagma cyathigerum* ♂; **g**, end of abdomen of *Enallagma cyathigerum* ♀ (*see* p. 243 for explanation of letters).

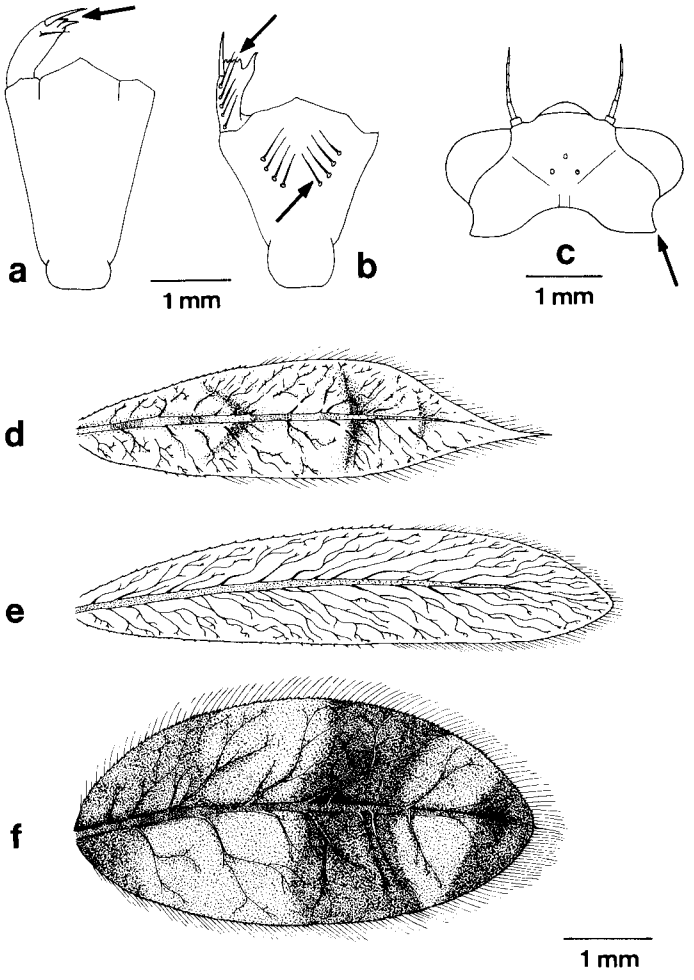


Fig. 12. Cœnagriidæ: Larval structures as seen in the dorsal view of the labium (**a, b**), dorsal view of the head (**c**), and the median caudal lamella (**d–f**); **a, f,** *Argia emma;* **b, d,** *Ischnura cervula;* **c, e,** *Amphiagrion abbreviatum* (after Cook and Antonelli, 1969); **e,** *Cœnagrion resolutum.*

4a. Male inferior appendages triangular in lateral view; with apices hooked or curved upward (Fig. 11f); venter of abdominal segment 8 of female with a vulvar spine (Fig. 11g) ..... *Enallagma* (p. 68)

4b. Male inferior appendages not triangular in lateral view (or if so with apices ventral), with broad bases and slender apical processes (Fig. 11e); venter of abdominal segment 8 of female without a vulvar spine ..... *Cœnagrion* (p. 61)

5a. Mature coloration red and black ..... *Amphiagrion* (p. 55)

5b. Mature coloration metallic green ..... *Nehalennia* (p. 96)

LARVÆ

1a. Premental setæ absent; labial palps bifid (Fig. 12a); caudal lamellæ ovate, more than a third as wide as long (Fig. 12f) ..... *Argia* (p. 57)

1b. Premental setæ usually 3 or 4 (1 in *Nehalennia*); labial palps with a truncate, toothed apex (Fig. 12b); caudal lamellæ not more than a third as wide as long (Fig. 12d) 2

2a. Posterior corners of head sharply angled (Fig. 12c) ..... *Amphiagrion* (p. 55)

2b. Posterior corners of head rounded 3

3a. Premental seta, 1 ..... *Nehalennia* (p. 96)

3b. Premental setæ, 3 or 4 (Fig. 12b) 4

4a. Antennæ with 6 segments ..... *Enallagma* (p. 68)

4b. Antennæ with 7 segments 5

5a. Caudal lamellæ tapering to very acute apices (Fig. 12d) ..... *Ischnura* (p. 86)

5b. Caudal lamellæ bluntly pointed (Fig. 12e) ..... *Cœnagrion* (p. 61)

Genus *Amphiagrion* (Selys)

Amphiagrion comes from the Greek words *amphi*=around and *agrios*=field, presumably referring to the habitat of the species. The single species found in British Columbia breeds in shallow ponds and flooded meadows.

This is a North American genus of two similar species; the western representative, A. *abbreviatum,* is the only Zygopteran in British Columbia with both sexes red and black. The adults are distinctively thick-set with short legs and abdomens and a prominent tubercle on the venter of the thorax.

The larvæ are easily recognized by the acute, out-turned corners of the rear of the head.

Amphiagrion abbreviatum (Selys)

Pyrrhosoma abbreviatum Selys, 1876. Bull. Acad. Belg. (2) 41:1299

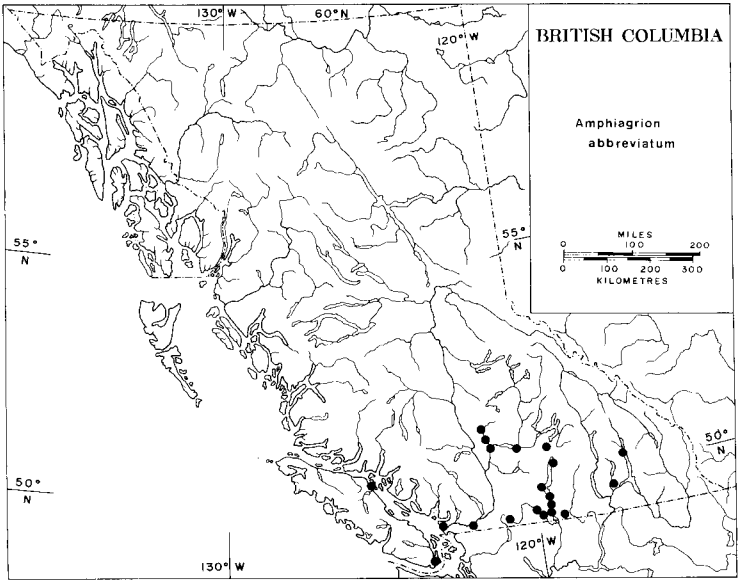
A. saucium (Selys), Kennedy, 1915. Proc. U.S. Nat. Mus. 49:326

A. abbreviatum, Walker, 1953. Odonata of Canada and Alaska 1:165

abbreviatum=shortened; referring to the short, thick-set abdomen.

Distinguishing characteristics—Male (Fig. 38a, p. 236): Length, 26–28 mm; hindwing, 17–18 mm. Body robust and hairy; head black. Thorax black, pale red laterally; venter red with a prominent tubercle. Legs reddish-brown with a longitudinal black streak. Abdomen red; segments 2, or 3, to 10 with black dorsolateral spots; intersegmental areas black.

Female: Length, 27–28 mm; hindwing, 17 mm. Colour varies from dark reddish-brown with black markings as in male to a uniform pale reddish-brown without black markings.



Larva: Length, 19 mm; metafemur, 2.6 mm. Rear angles of head acute (Fig. 12c, p. 54). Premental setæ, 3–5; palpal setæ, 6.

Range—British Columbia east to Saskatchewan; south to Oklahoma, Utah, and California.

Distribution in British Columbia—Widely but locally distributed south of 52°N.

Field-notes—This species is at home in a variety of habitats, but typically develops in shallow ponds or sloughs with firm bottoms and abundant sedge growth. Marshy places in flooded fields are often good places to search for *abbreviatum*.

The adults are not adventurous, staying close to the ground among the vegetation, perching often, and seldom flying out over the water (Cook and Antonelli, 1969).

In British Columbia *A. abbreviatum* is known to fly from May 14 (McIntyre, Vaseux Lake) to August 11 (Swan Lake, Saanich).

Genus *Argia* Rambur

The name of this genus probably comes from the Greek *argos* =bright, alluding to the colours of some species in the genus.

These are rather large damselflies in our fauna, the males predominantly purple or blue, the females olive or brown. The spines of the tibiæ are unusually long for the Cœnagriidæ, being about twice as long as the intervening spaces. The superior appendages of the male are short; the inferior appendages are longer, their apices (in our species) bifid. Females lack a vulvar spine on abdominal segment 8.

The species have very distinctive behaviour. They prefer bare, sunny places on which to land and thus are often found flying low over rocks, roads, and railway tracks. They are more active and alert than most of our Zygoptera. The species live mostly around streams; females oviposit in wet logs or the bark of submerged roots.

The larvæ are stream-dwellers and are characteristically short, stocky, and flattened. The labial palps are acutely bifid and there are no premental setæ. Compared to other Cœnagriidæ, *Argia* larvæ have unusually broad caudal lamellæ, rarely less than two fifths as broad as long. These lamellæ are heavily pigmented; the tracheæ are more or less obscured.

Our two species are strictly western in North America. *Argia* is mainly a tropical American genus.

KEY TO THE SPECIES OF *ARGIA*

ADULTS

1a. Dark stripe on thoracic dorsal carina as wide as, or wider than, the adjacent pale stripes on the mesepisternum ..... *vivida* (p. 60)

1b. Dark stripe on thoracic dorsal carina less than half as wide as the adjacent pale stripes on the mesepisternum ..... *emma* (p. 58)

LARVÆ

1a. Antennæ shorter than head; 4 palpal setæ ..... *vivida* (p. 60)

1b. Antennæ longer than head; 1 palpal seta ..... *emma* (p. 58)

Argia emma Kennedy

A. emma Kennedy, 1915. Proc. U.S. Nat. Mus. 49:271

A. emma, Walker, 1953. Odonata of Canada and Alaska 1:153

emma=Kennedy's mother; when he discovered the species, he named it after her.

Distinguishing characteristics—Male (Fig. 38b, p. 236): Length, 33–39 mm; hindwing, 20–24 mm. Head violet and black with large pale postocular spots; small T-spot above the median ocellus. Prothorax violet with a pair of dark mid-dorsal stripes. Pterothorax violet dorsally; dark stripe on mid-dorsal carina less than half as wide as the mesepisternal pale stripe; dark mesepimeral stripe narrowed posteriorly; metapleural sulcus with a thin, dark line. Abdomen violet; segment 1 with a black transverse spot; 2 with black spots; 3–6 with black on posterior one fourth; 7 black except for a pale anterior spot; venter of 8–10 with a dark marginal stripe. Superior appendages with pointed apices directed ventrally; inferior appendages bifid. Tenerals pale brown or creamy white; old specimens with pruinosity on thorax and legs.

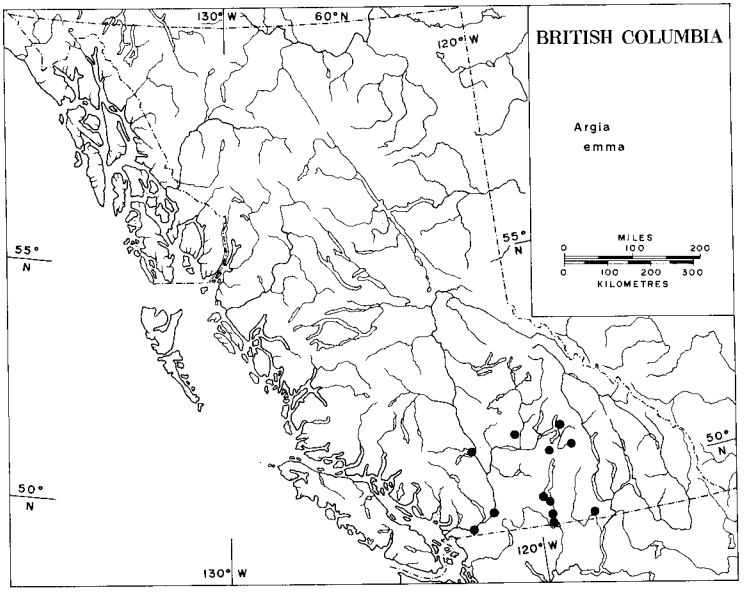
Female: Length, 34–38 mm; hindwing, 22–25 mm. Colour from creamy white through darker shades of brown to olive or slate blue. Head as in male. Prothorax without dark spots. Pterothorax as in male but dark line on mesopleural sulcus may be lacking. Abdomen with paired dark brown spots on segment 2; 3–6 with anterior, posterior, and lateral dark spots; 7 with two long dark spots. Ovipositor not reaching the end of segment 10.

Larva: Length, 20–21 mm; metafemur, 4.0–4.5 mm. Antennæ slightly longer than head. Labial palps acutely bifid; premental setæ lacking; palpal setæ, 1 (Fig. 12a, p. 54). Caudal lamellæ twice as long as broad and densely

fringed with short setæ (Fig. 12f, p. 54). Colour light brown with dark brown markings; pale mid-dorsal and lateral stripes edged with black.

Range—British Columbia south to Nebraska, Nevada, and California.

Distribution in British Columbia—Known from the Mainland from the central Fraser Valley east to Christina Lake and north to Shuswap Lake and Lillooet.



Field-notes—Adults of this species are usually found near the riffles and bars of the creeks in which they breed; they also frequent the shores of lakes near these streams. For example, at the south end of Vaseux Lake near the outlet of the Okanagan River, *emma* is very abundant, habitually resting on the railway tracks in the sun.

Larvæ are found in the trash on the bottoms of pools or under rocks in the rapids; they crawl just clear of the water to emerge. Emergence has been recorded on June 18 at Cultus Lake with the first adults maturing by June 25 (Whitehouse, 1941). Pairing was noted there from June 25 to August 19 (Walker, 1953).

Kennedy (1915) observed pairs in tandem, laying eggs in willow roots hanging in a creek pool. The male "supports himself solely by his hold on

the female and, scorning other support, stands stiffly out of the water with his wings folded and his legs drawn tightly against his thorax until the female, backing down into the water, submerges him with her", as Whitehouse (1941) observes, "a most unusual sight, and not without a touch of the humorous." In British Columbia adults of *A. emma* have been recorded from June 5 to September 1.

Argia vivida Hagen

A. vivida Hagen, 1865. Bull. Acad. Belg. (2) 20:406

A. vivida, Walker, 1953. Odonata of Canada and Alaska 1:149

vivida=vivid; a reference to the bright colour of the adult.

Distinguishing characteristics—Male (Fig. 38d, p. 236): Length, 29–34 mm; hindwing, 18–21 mm. Head blue, labium buff; postocular spots blue; median T-spot black. Prothorax black with blue lateral margins and blue dorsolateral spots. Pterothorax blue; black mid-dorsal stripes as wide or wider than blue mesepisternal stripes; black mesepimeral stripe bifid posteriorly; metapleural sulcus with heavy black line. Abdomen blue; segment 1 with a small black dorsal spot; 2 with two black posterior triangles and black lateral streaks; 3–6 with paired, black posterior spots and lateral streaks often joined; 7 black with blue anterior spot; 8–10 usually wholly blue. Superior appendages long and decurved; inferior appendages bifid.

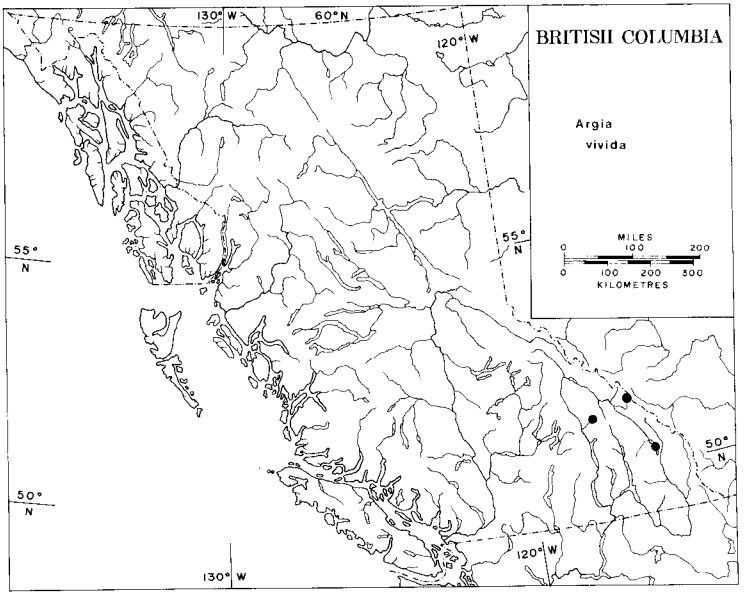
Female (Fig. 38c, p. 236): Length, 30–35 mm; hindwing, 21–24 mm. Colour yellowish or greenish-grey to pale brown or blue. Head and thorax marked as in male; lower branch of mesepimeral black stripe may be a separate spot or lacking. Abdomen with black markings as in male except segments 9 and 10 sometimes with paired black dorsal spots.

Larva: Length, 17 mm; metafemur, 4 mm. Antennæ shorter than head. Labial palp acutely bifid; premental setæ lacking; palpal setæ, 4. Caudal lamellæ fringed with stout setæ mixed with long slender hairs toward the acute apices. Colour dark with obscure markings except for pale mid-dorsal stripe edged with black.

Range—Eastern British Columbia and the Rocky Mountains of Alberta, south to Texas, California, and Mexico.

Distribution in British Columbia—Known only from Field and Fairmont in the Rocky Mountains and from Glacier in the Selkirk Range.

Field-notes—This is a very local insect found around pools near springs or spring-fed streams inhabited by the larvæ. As yet it is known only from the mountains of the eastern part of the Province but may also occur in suitable locations in the drier parts of the southern Interior.



Larvæ cling to the underside of rocks in these trickling streams and muddy pools; the exuviæ may be found on the rocks a few inches above the water. The adults usually rest on the bare earth nearby but when alarmed frequently dodge into vegetation unlike *emma,* which will fly for the open (Kennedy, 1915). The species is associated with warm springs at Banff and Fairmont but with cold springs at Field and Glacier. Williamson states that "so dependent is it on springs that its presence anywhere may be taken as positive proof of adjacent spring water" (Walker, 1953).

The British Columbia records range from June 12 to August 27.

Genus *Cœnagrion* Kirby

The generic name is the result of a nomenclatural shuffle. The old name *Agrion,* from the Greek *agrios*=field, presumably referring to the species' habitat, was considered to belong properly to another genus. The new name *Cœnagrion,* from the Greek *koinos* =common or shared, was coined to indicate the new genus shared all the characteristics of the old one.

Cœnagrion is mainly a genus of Europe and northern Asia but contains three North American boreal species, all of which are recorded from British Columbia.

These are medium-sized damselflies, the males blue and black, the females either blue or shades of green or brown. The genus is similar to *Enallagma* but males differ in the form of the anal appendages and females have no ventral spine on abdominal segment 8.

The larvæ resemble those of *Enallagma* but have seven antennal segments instead of six. The caudal lamellæ lack pigment and have distinct nodal lines.

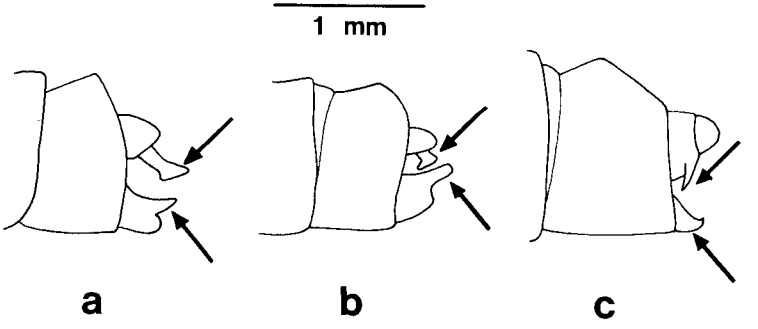


Fig. 13. *Cœnagrion:* Anal appendages of males; **a**, *C. resolutum*; **b**, *C. interrogatum;* **c**, *C. angulatum.*

KEY TO THE SPECIES OF *CŒNAGRION*

ADULTS

1a. Superior appendages of male without a process directed posteriorly (Fig. 13c); abdominal segment 8 of female broadly pale at base ..... *angulatum* (p. 63)

1b. Superior appendages of male with a process directed posteriorly (Fig. 13a, b); abdominal segment 8 of female broadly black at base.... 2

2a. Venter of thorax marked with black ..... *interrogatum* (p. 64)

2b. Venter of thorax completely pale ..... *resolutum* (p. 66)

LARVÆ

1a. Antennal segments 2 and 3 nearly equal in length; caudal lamellæ with tracheal branches very long and tending to run longitudinally ..... *resolutum* (p. 66)

1b. Antennal segment 3 much longer than segment 2; caudal lamellæ with tracheal branches leaving the axis at acute angles of about 45 degrees ..... *angulatum* (p. 63)

Larva of *C. interrogatum* unknown.

Cœnagrion angulatum Walker

C. angulatum Walker, 1912. Can. Ent. 44:256

C. angulatum, Walker, 1953. Odonata of Canada and Alaska 1:183

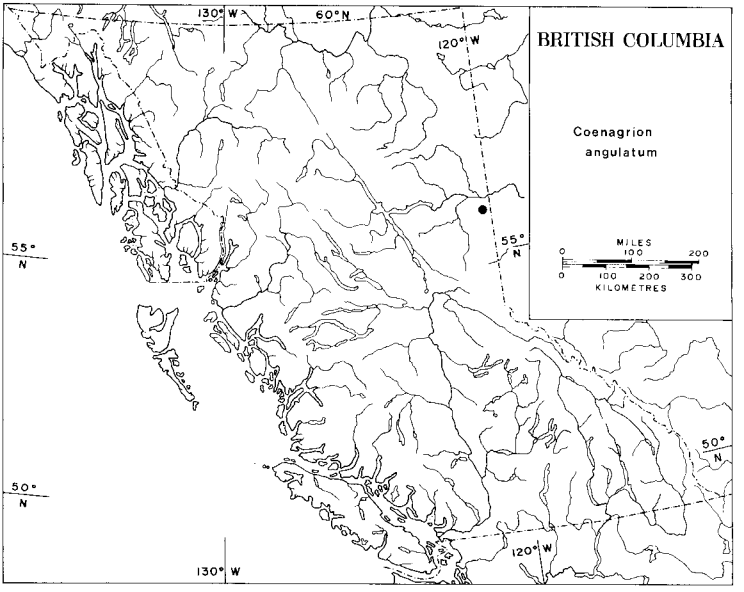
angulatum=angled; probably a reference to the triangular inferior appendages of the male.

Distinguishing characteristics—Male (Fig. 39b p. 237): Length, 28–30 mm; hindwing, 16–18 mm. Postocular spots blue without a line between them; face pale green. Prothorax black, blue laterally. Pterothorax black dorsally, blue to green laterally; mesepisternum with a narrow, parallel-sided, black stripe; mesopleural sulcus stripe black, tapering dorsally; interpleural suture and metapleural sulcus each with a black streak; venter pale green. Abdomen blue; segment 1 with a small black dorsal spot; 2 with a transverse black spot; 3–7 black with a pale blue spot anteriorly; 8 and 9 wholly blue; 10 black dorsally. Apices of superior appendages with a pale rounded tubercle (Fig. 13c, p. 62).

Female (Fig. 39a, p. 237): Length, 29–34 mm; hindwing 18–22 mm. Colour yellow-green to pale brown with black markings. Head and thorax marked as in male; dorsum of prothorax with posterior margin trilobate; mesostigmal laminæ triangular. Abdominal segment 1 with a small antero-dorsal black spot; 2 with an elongate black spot; 3–7 as in male; 8 with a large black dorsal spot; 9 and 10 black with pale margins.

Larva: Length, 17–19 mm; metafemur, 3.5–4.0 mm. Antennæ longer than head, 7-segmented, segment 3 longer than segment 2. Premental setæ, 4 or 5; palpal setæ, 6. Caudal lamellæ broad, pointed, and without bands or spots; nodal line transverse, distinct, at about three fifths the lamellar length; margins constricted at the nodus. Ovipositor barely projecting beyond the venter of segment 10.

Range—Northeastern British Columbia, northeast to the Northwest Territories; south to extreme western Ontario, Minnesota, Iowa, and Alberta.



Distribution in British Columbia—Known only from Dawson Creek in the Peace River District.

Field-notes—*C. angulatum* is a species of the prairie ponds and open marshes in the boreal forest to the north; little is known of its habits in British Columbia. Walker (1953) notes that the flight period begins before the end of May in the southern part of its range and reaches a peak in June. Mating has been observed as early as June 9 at Regina, Saskatchewan.

Cœnagrion interrogatum (Hagen)

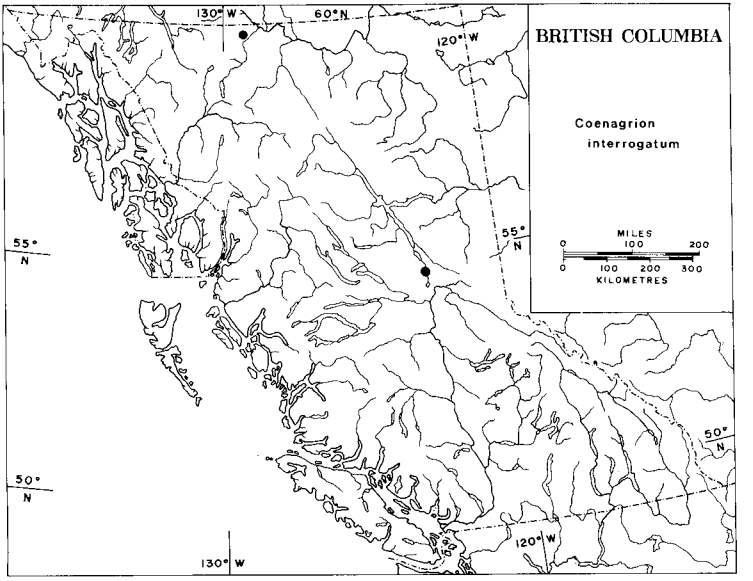
Agrion interrogatum Hagen, 1876, in Selys, Bull. Acad. Belg. (2) 41:1254

Cœnagrion interrogatum, Walker, 1953. Odonata of Canada and Alaska 1:180

interrogatum=questioned; the meaning is unclear. Although there are thoracic markings that look like exclamation marks, none resemble question marks. Perhaps Hagen was unsure this was a true species.

Distinguishing characteristics—Male (Fig. 39e, p. 237): Length, 28–31 mm; hindwing, 17–18 mm. Postocular spots blue; face blue; postclypeus and labrum black. Prothorax black with blue stripes. Pterothorax pale blue with dorsum black; mesopleural sulcus with a black stripe widening in front; blue mesepisternal stripe divided in posterior third; interpleural suture with a black stripe and a black dot anteriorly; metapleural sulcus with two black spots, usually joined; metepimeron margined with black; venter with distinct black markings shaped like an exclamation mark. Abdomen blue; segment 1 black ventrolaterally; 2 with a black transverse bar often joined to black lateral spots; 3 with posterior one fourth black, a blue posterolateral spot and a black streak along lateral margin; 4 black on posterior half or more; 5 and 6 black on posterior three fourths or more; 7 black on anterior three fourths, posterior fourth blue; 8 and 9 blue with a few small black spots; 10 black dorsally, blue laterally. Anal appendages as in Fig. 13b, p. 62.

Female (Fig. 39c and d, p. 237): Length, 30–32 mm; hindwing, 18–20 mm. Colour blue or pale green with black markings. Head and thorax as in male. Abdominal segment 1 as in male; 2 blue with a black diamond-



shaped dorsal mark joined to a black transverse bar in posterior third, and black lateral streaks; 3 black on posterior four fifths or more of dorsum and joined to black lateral streaks by a black bar to enclose a blue posterolateral spot; 4–6 as in 3 except black more extensive; 7 black with posterior margin blue; 8 as in 7 but with larger blue margin; 9 blue with black dorsal spot; 10 wholly blue.

Larva: Unknown (Walker, 1953).

Range—Northwest Territories east to Newfoundland; south to Maine, Michigan, Wisconsin, and northern British Columbia.

Distribution in British Columbia—This species has been found near the Blue River north of Cassiar, 25 kilometres south of the Yukon boundary, and near Crooked River Provincial Park north of Prince George.

Field-notes—Little is known of the habits of *C. interrogatum*. It is adapted to life in cold northern swamps and bogs and its southern limit is farther north than that of any other species of North American Zygoptera (Walker, 1953).

The period of flight probably is similar to that of *C. resolutum;* Ontario dates range from June 3 to July 25 (Walker, 1953). The British Columbia records are from July 11 to August 5.

Cœnagrion resolutum (Hagen)

Agrion resolutum Hagen, 1876, in Selys, Bull. Acad. Belg. (2) 41:1263

C. resolutum, Walker, 1953. Odonata of Canada and Alaska 1:175

resolutum=resolute; an allusion to the species' adaptation to a northern habitat.

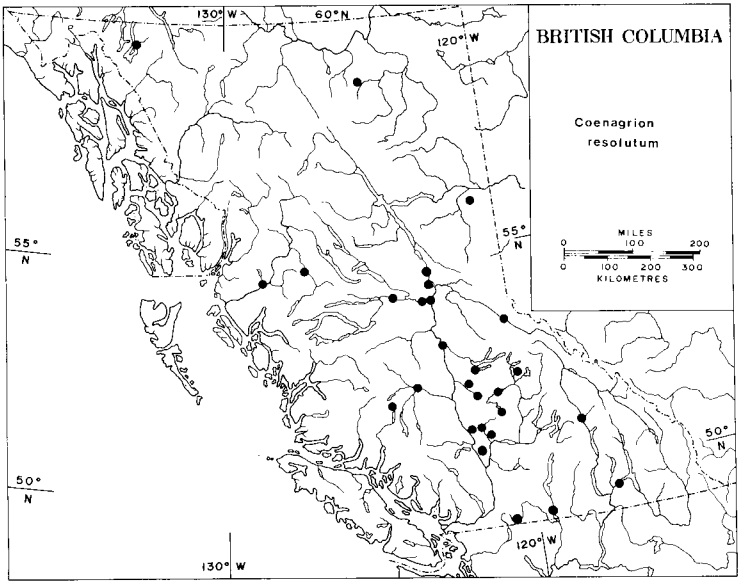
Distinguishing characteristics—Male (Fig. 39g, p. 237): Length, 27–30 mm; hindwing, 15–18 mm. Head black dorsally with large blue postocular spots. Prothorax black with blue margins and paired blue spots on middle lobe. Pterothorax pale greenish-blue with dorsum black; mesopleural sulcus stripe black; blue mesepisternal stripe sometimes forming an exclamation mark; interpleural suture with a black streak; metapleural sulcus with a black spot; venter pale greenish-yellow without black markings. Abdomen pale blue dorsally to greenish-yellow ventrally; segment 1 with a black dorsal spot; 2 with a black posterior spot often joined to the black lateral streaks; 3–5 with posterior half, or more, black; 6 and 7 black with pale basal rings; 8 and 9 blue, sometimes with black markings; 10 black dorsally. Anal appendages as in Fig. 13a, p. 62.

Female (Fig. 39f, p. 237): Length, 28–31 mm; hindwing, 18–20 mm. Homeochromatic, pale greenish-blue with black markings; heterochromatic, yellowish-green to brown with black markings. Head and thorax marked as in male. Abdominal segment 1 as in male; 2 with a black diamond-shaped mark; 3–7 with pale basal rings; 7 with a pale posterior spot; 8–10 black with pale posterior spots.

Larva: Length, 21–22 mm; metafemur, 3.0–3.3 mm. Antennæ 7-segmented, segments 2 and 3 equal in length. Premental setæ, 4, one often vestigial or lacking; palpal setæ, 6, rarely 7. Caudal lamellæ nearly one half longer than outer wing cases; nodal line transverse, slightly curved; tracheal branches arising at a very acute angle (Fig. 12e, p. 54). Ovipositor projecting beyond segment 10.

Range—Alaska east to Hudson Bay and Newfoundland; south to New York, Ontario, Iowa, Alberta, and, in the mountains, to Nevada and California.

Distribution in British Columbia—While there are a few records south of 51°N. (Hat Creek, Nelson, Oliver, Manning Park), *C. resolutum* is generally found north of this latitude in British Columbia.



Field-notes—*C. resolutum* is one of the most widely distributed Odonata in Canada and is especially dominant in the north. The larvæ inhabit a wide variety of still waters from marshy ponds and grassy ditches to sphagnum bogs and weedy streams. On August 5, 1976, at a typical habitat, a pond in a white spruce forest near Crooked River in central British Columbia, *C. resolutum* was very abundant, flying low and mating among the emergent sedges at the water's edge. Among its flying companions were *Lestes dryas, L. disjunctus, Cœnagrion interrogatum, Leucorrhinia hudsonica, Sympetrum obtrusum,* and *Æshna interrupta.*

In British Columbia the species flies at least three weeks longer than in eastern Canada. Dates of flight for this Province range from May 29 to August 22.

Genus *Enallagma* Selys

The apparent source of the name *Enallagma* is the Greek *enallex*=crosswise, perhaps a reference to the striking blue and black bands on the abdomens of the males of this genus.

Enallagma is a large genus of worldwide distribution concentrated in North America; of the 15 Canadian species, seven are known from British Columbia. The group is complex and when better known may be broken into several genera. Nearly all the small blue damseflies that are among the most familiar of Odonata are males of this genus. The females are usually green or brown with more extensive dark markings. The inferior appendages of the males are triangular and upcurved in lateral view; the females possess a prominent vulvar spine on the venter of abdominal segment 8.

The larvæ climb in the aquatic vegetation of quiet waters and are usually patterned in brown or green. Characteristics of the caudal lamellæ are most useful for distinguishing species; nevertheless, the larvæ are very difficult to identify.

KEY TO THE SPECIES OF *ENALLAGMA*

MALES

1a. Superior appendages bifid in lateral view (Fig. 14a) ..... *ebrium* (p. 83)

1b. Superior appendages not bifid in lateral view 2

2a. Superior appendages as long or longer than inferior appendages, a pale tubercle visible at apex in lateral view (Fig. 14b, c) 3

2b. Superior appendages shorter than inferior appendages, the pale tubercle not visible in lateral view 4

3a. Superior appendages asymmetrical in lateral view, the dorsal part more prominent than the ventral part (Fig. 14b) ..... *civile* (p. 78)

3b. Superior appendages symmetrical in lateral view (Fig. 14c) ..... *carunculatum* (p. 76)

4a. Superior appendages a pair of flattened lobes in dorsal view (Fig. 14d) ..... *clausum* (p. 79)

4b. Superior appendages not flattened in dorsal view; a pale tubercle appearing either at the apex or on the inner edge of the appendage 5

5a. Superior appendages with the pale tubercle on the inner edge in dorsal view; these appendages short and rounded in lateral view (Fig. 14e) ..... *boreale* (p. 74)

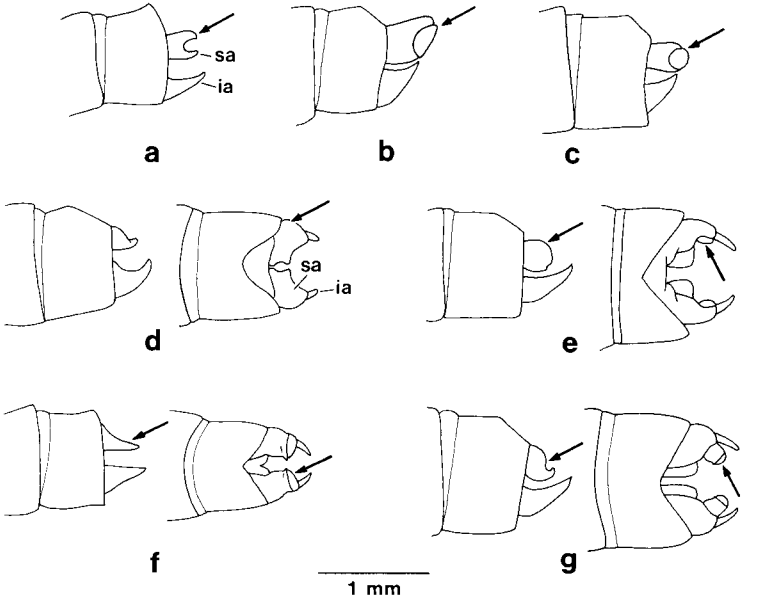


Fig. 14. *Enallagma:* Anal appendages of males (**a–c**, lateral view; **d–g**, lateral view on the left, dorsal view on the right); **a**, *E. ebrium;* **b**, *E. civile;* **c**, *E. carunculatum;* **d**, *E. clausum;* **e**, *E. boreale;* **f**, *E. hageni;* **g**, *E. cyathigerum* (*see* p. 243 for explanation of letters).

5b. Superior appendages with the pale tubercle at the apex in dorsal view (Fig. 14f, g) 6

6a. Superior appendages slender in lateral view; these appendages with the pale tubercle broad in dorsal view (Fig. 14f) ..... *hageni* (p. 84)

6b. Superior appendages short, broad, and with the tip upturned in lateral view; these appendages with the pale tubercle slender in dorsal view (Fig. 14g) ..... *cyathigerum* (p. 81)

FEMALES

1a. Abdominal segments 8–10 entirely dark dorsally, mesostigmal laminæ more than half as broad as long (Fig. 15a, c) 2

1b. Abdominal segments 8–10 partly pale dorsally; mesostigmal laminæ at least twice as long as broad (Fig. 15e–i) 3

2a. In an oblique view from above, the lateral margins of the mesostigmal laminæ raised above the mesepisternum (Fig. 15b) ..... *hageni* (p. 84)

2b. In a similar view, the lateral margins of the mesostigmal laminæ not raised (Fig. 15d) ..... *ebrium* (p. 83)

3a. Abdominal segment 8 with a black dorsal stripe extending its entire length 4

3b. Segment 8 with the black dorsal mark, if present, mainly on the posterior half, or in the form of a triangle with the apex pointing anteriorly 5

4a. Mesostigmal lamina traversed by an oblique ridge (Fig. 15e) ..... *carunculatum* (p. 76)

4b. Mesostigmal lamina without an oblique ridge (Fig. 15f) ..... *civile* (p. 78)

5a. Mesostigmal lamina with a distinct posterior suture only on the lateral half (Fig. 15g) ..... *boreale* (p. 74)

5b. Mesostigmal lamina with a distinct posterior suture along the entire length 6

6a. Abdominal segment 8 dorsally pale or with only a trace of black; mesostigmal laminæ with rami diverging within the frame (Fig. 15h) ..... *clausum* (p. 79)

6b. Abdominal segment 8 almost always apically black, the pale area entire or divided; mesostigmal laminæ with rami diverging behind the frame (Fig. 15i) ..... *cyathigerum* (p. 81)

LARVÆ

1a. Caudal lamellæ with patches of closely branched and deeply pigmented tracheæ, the intervening areas appearing pale (Fig. 16a) 2

1b. Caudal lamellæ with tracheæ uniformly branched, their pigmentation general but often interrupted by clear areas. 3

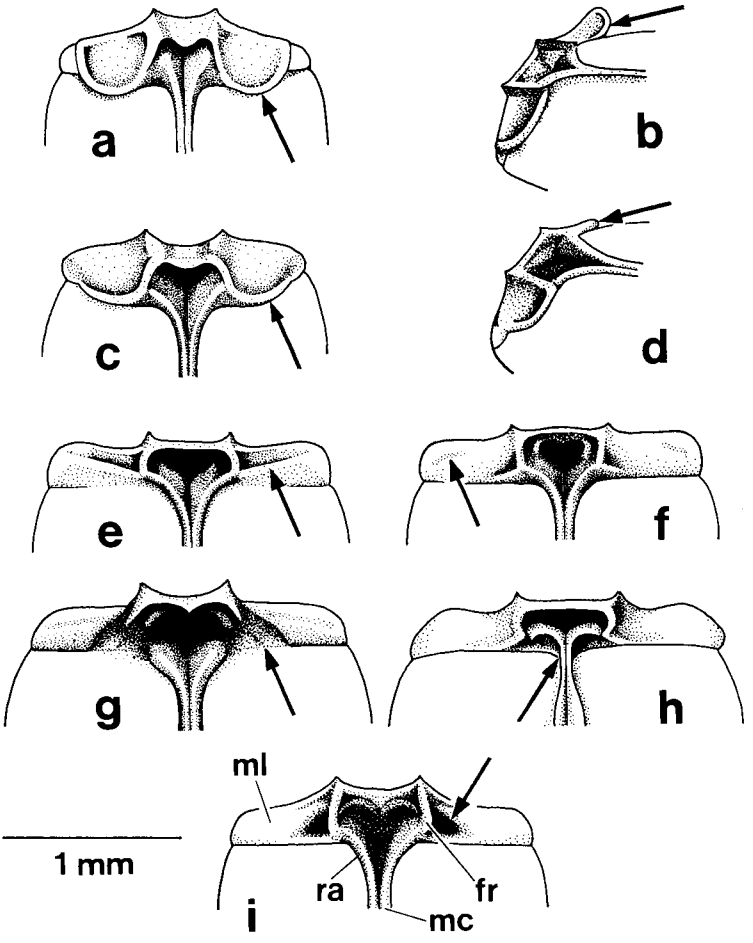


Fig. 15. *Enallagma:* Mesostigmal laminæ on the anterodorsal edge of the mesothorax of females (**a–d**, dorsal and oblique views; **e–i**, dorsal view); **a**, **b**, *E. hageni;* **c**, **d**, *E. ebrium;* **e**, *E. carunculatum;* **f**, *E. civile;* **g**, *E. boreale;* **h**, *E. clausum;* **i**, *E. cyathigerum* (*see* p. 243 for explanation of letters).

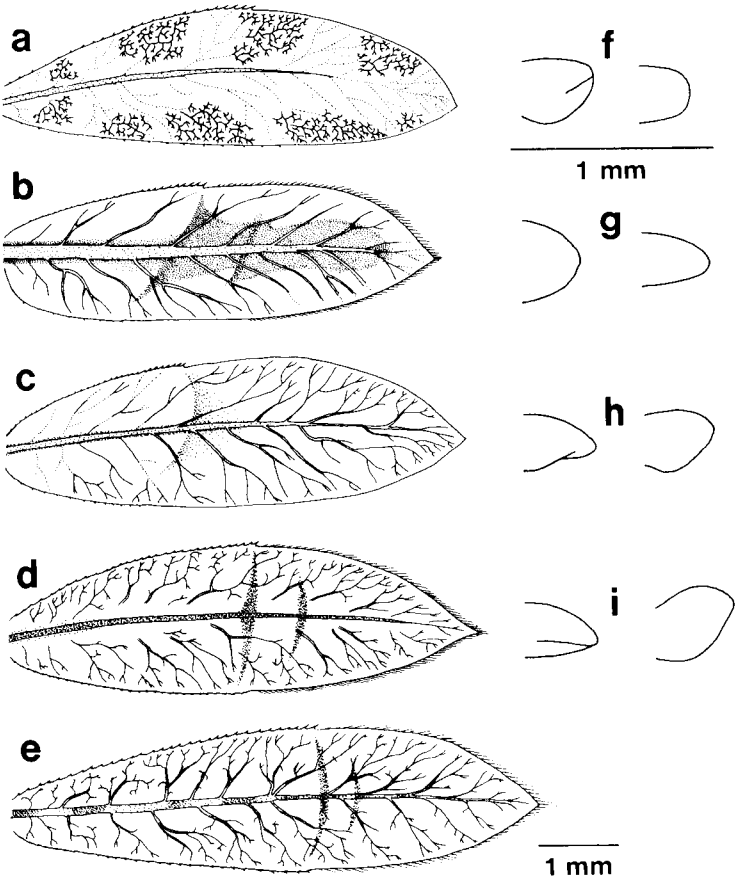


Fig. 16. *Enallagma:* Larval structures. Median caudal lamella (**a–e**), and dorsal (left) and lateral (right) views of the cercus of male (**f–i**); **a**, *E. ebrium;* **b**, *E. clausum;* **c**, *E. carunculatum;* **d**, *E. cyathigerum;* **e**, *E. boreale;* **f**, *E. ebrium;* **g**, *E. hageni;* **h**, *E. carunculatum;* **i**, *E. civile.*

2a. Cerci of male, in dorsal view, with an evenly curved margin and without a ridge; cerci bluntly angular in lateral view (Fig. 16g) ..... *hageni* (p. 84)

2b. Cerci of male, in dorsal view, with the outer margin nearly straight and with an oblique ridge, seen as a line; cerci bluntly rounded in lateral view (Fig. 16f) ..... *ebrium* (p. 83)

3a. Caudal lamellæ with nodal lines oblique and indistinct; on the median lamella the dorsal antenodal series of setæ being much longer than the ventral series and composed of about twice as many setæ; on the lateral lamellæ these features are reversed, the shorter series in each case made up of very small, widely and irregularly spaced setæ (Fig. 16b, c) 4

3b. Caudal lamellæ with nodal lines transverse, suggesting a joint, with the dorsal and ventral series of antenodal setæ of about equal length and consisting of close-set setæ generally increasing in size posteriorly (Fig. 16d, e) 6

4a. Tracheæ of caudal lamellæ with numerous branches, tending to curve; dorsal nodus of median lamella before the middle (Fig. 16c); cerci of male about half as long as abdominal segment 10 5

4b. Tracheæ of caudal lamellæ with fewer and straighter branches; dorsal nodus of median lamella usually about the middle (Fig. 16b); cerci of male hardly more than a third as long as segment 10 ..... *clausum* (p. 79)

5a. Dorsal nodus of median caudal lamella usually at about the basal three sevenths of lamellar length (Fig. 16c); cerci of male slightly longer than wide, their dorsal margin gently convex in lateral view (Fig. 16h); lateral carina of abdominal segment 1 with a few setæ ..... *carunculatum* (p. 76)

5b. Dorsal nodus of median caudal lamella usually at about the basal third of lamellar length; cerci of male as wide as long, their dorsal margin strongly convex in lateral view (Fig. 16i); lateral, carina of segment 1 without setæ ..... *civile* (p. 78)

6a. Caudal lamellæ a fourth to a half longer than hindwing cases; greatest width of median lamella about a fourth of its length, of lateral lamella a fifth of its length (Fig. 16e) ..... *boreale* (p. 74)

6b. Caudal lamellæ a fifth longer than hindwing cases; greatest width of median lamella about a third of its length, of lateral lamella a fourth to three eighths of its length (Fig. 16d) ..... *cyathigerum* (p. 81)

Enallagma boreale Selys

E. boreale Selys, 1876. Bull. Acad. Belg. (2) 41:509

E. calverti Morse, 1895. Psyche 7:208

E. boreale, Walker, 1953. Odonata of Canada and Alaska 1:213

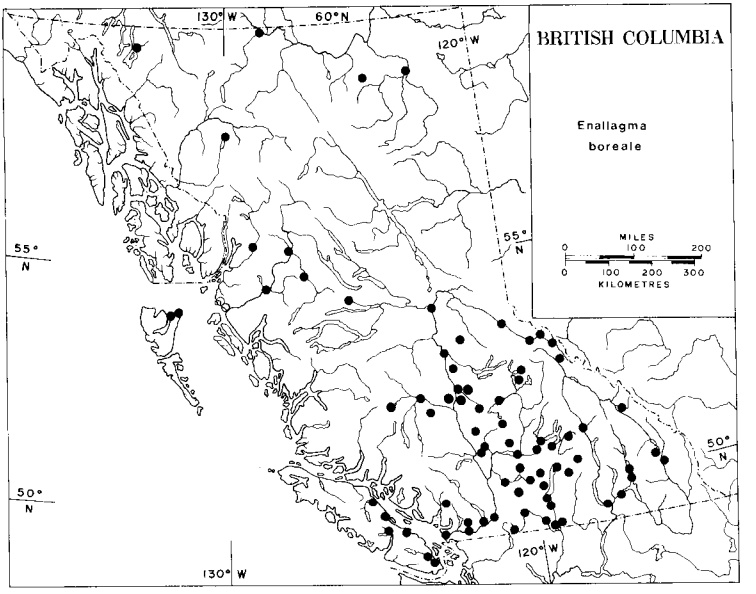
boreale=northern; a reference to the range of the species.

Distinguishing characteristics—Male: Length, 28–37 mm; hindwing, 17–23 mm. Dorsum of head black; postocular spots blue, large, almost touching the eyes and joined by a blue line; face greenish-blue. Pterothorax blue or greenish-blue; blue mesepisternal stripe usually more than half as wide as the black mid-dorsal stripe; mesopleural sulcus stripe narrowly triangular; metepisternum with a black spot close to the metapleural sulcus. Abdomen blue; segment 1 with a black anterior spot; 2 with a black crescentic posterior spot; 3–5 with black marks on the posterior quarter; 6 with black on the posterior three quarters and pointed anteriorly; 7 black with a blue anterior ring; 8 and 9 entirely blue; 10 black dorsally. In northern specimens the black areas are often much more extensive than in typical forms. Superior appendage rounded in lateral view with a ventral notch; in dorsal view the tubercle appears on the inner margin near the apex (Fig. 14e, p. 69).

Female: Length, 30–35 mm; hindwing, 19–22 mm. Light blue to yellowish-green or light brown with black markings. Head and thorax as in male. Abdominal segment 1 as in male; 2 with a diamond-shaped posterior spot and a streak bisecting the pale anterior area; 3 with a black spot, pointed anteriorly, on posterior two thirds; 4–7 similar to 3 but black expanded laterally; 8 usually with posterior half black and with a line sometimes bisecting the pale anterior half; 9 and 10 black dorsally. Mesostigmal laminæ with an oblique groove lateral to the frame, the posterior suture missing where the groove crosses it, being distinct only on lateral half (Fig. 15g, p. 71).

Larva: Length, 20–22 mm; metafemur, 3.5–4 mm. Mid-dorsal length of head about four fifths the length of antennæ. Premental setæ, 4 or 5; palpal setæ, 6. Caudal lamellæ a quarter to a half longer than the hindwing cases, bluntly pointed; median lamella about a quarter as wide as long; lateral lamellæ about a fifth as wide as long; lamellæ with 1 and often 2 or 3 transverse bands, the inner one on the nodal line; pigment of the tracheæ interrupted here and there. Nodal line transverse, not markedly oblique, and at about half the lamellar length (Fig. 16e, p. 72); median lamella with 31–38 dorsal antenodal setæ and 26–30 ventral; lateral lamellæ with 23–33 dorsal, 37–56 ventral. Cerci of male, in dorsal view, broader than long, bluntly angular with the outer edge straight.

Range—Alaska east through the Northwest Territories to Hudson Bay and Newfoundland; south to Massachusetts, Illinois, Manitoba, Alberta, and along the mountains to Utah and California.



Distribution in British Columbia—Over the entire Province.

Field-notes—E. boreale shows considerable variation in size over its large range. The smallest specimens in Canada come from the dry Interior of British Columbia whereas the largest come from the far north (Walker, 1953). The species tolerates a great variety of habitats; this has enabled it to become the most widely distributed of the genus in Canada. It is the common Zygopteran of northern bog pools and also thrives in temporary saline waters in the south of the Province. At White Lake (Clinton) it was emerging and mating among a thick bed of low bulrushes (*Scirpus americanus*). The waters here are quite alkaline, with a salinity of about a quarter that of sea water and a pH of up to 9.6. Adults were very abundant, about five per square foot over a large area. Oviposition is always performed a little above water level in emergent plants (Walker, 1953).

In most of Canada, the season of adult activity is early and brief, coming with the beginning of spring and lasting up to six weeks (Walker, 1953). In western British Columbia, the moderate temperatures allow a long growing season and several broods are produced. Dates of flight range from April 29 to October 10.

Enallagma carunculatum Morse

E. carunculatum Morse, 1895. Psyche 7:208

E. carunculatum, Walker, 1953. Odonata of Canada and Alaska 1:200

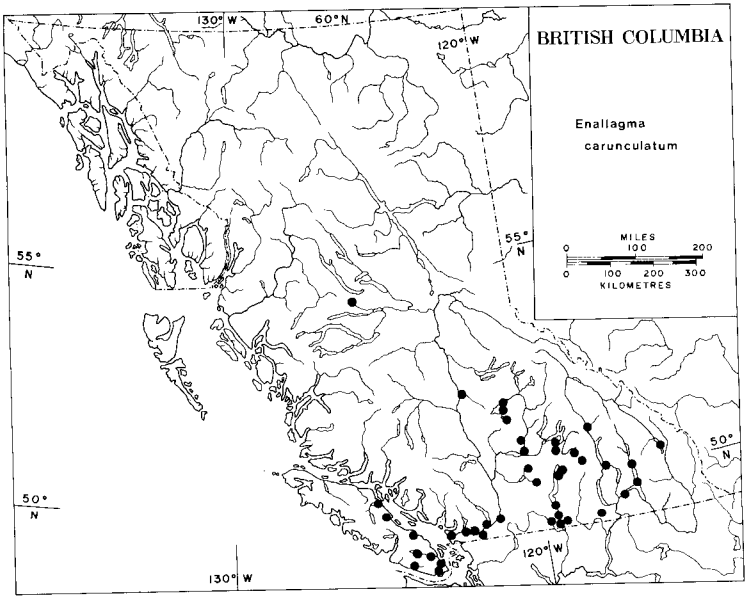
carunculatum=having a small fleshy growth; a reference to the pale tubercle on the male superior appendage.

Distinguishing characteristics—Male: Length, 30–36 mm; hindwing, 17–21 mm. Head with dorsum black; postocular spots blue, rounded, often joined by a transverse bar; face greenish-yellow. Prothorax black dorsally with paired blue spots on middle lobe. Pterothorax blue dorsally, greenish-yellow ventrally; blue mesepisternal stripe equal to or slightly wider than the black mid-dorsal stripe; black mesopleural stripe usually narrower than blue mesepimeral stripe and tapering posteriorly; metapleural sulcus with a black streak posteriorly. Abdomen blue; segment 1 with a black dorsal spot; 2 with a triangular black posterior spot; 3 black over posterior three quarters; 4–6 black over posterior two thirds; 7 black with a narrow anterior half-ring; 8 and 9 blue; 10 black dorsally. Superior appendages longer than inferior appendages, with a pale apical tubercle (Fig. 14c, p. 69).

Female: Length, 32–37 mm; hindwing, 19–21 mm. Colour blue to yellowish-green with black markings. Head and thorax as in male. Abdominal segment 1 with a small black dorsal spot; 2 with a broad black stripe, pointed posteriorly; 3–7 with black dorsal spots, pointed anteriorly and expanded posteriorly; 8 with black mid-dorsal stripe extending the length of the segment, the blue basal parts of the segment, if present, never larger than the blue area of 7, as it is in *boreale* and *cyathigerum;* 9 and 10 black dorsally. Mesostigmal laminæ twice as long as broad and crossed by an oblique ridge (Fig. 15e, p. 71).

Larva: Length, 19–23 mm; metafemur, 3–5 mm. Mid-dorsal length of head about three quarters length of antennæ. Premental setæ, 3 or 4; palpal setæ, 6. Caudal lamellæ usually plain, sometimes with a distal median stripe; greatest width of median lamella about a third the length; lateral lamellæ about a quarter as wide as long. Nodal line oblique and indistinct, the ventral nodus of the median lamella and dorsal nodus of lateral lamella usually at a third the lamellar length (Fig. 16c, p. 72); median lamella with 24–30 dorsal antenodal setæ, 10–17 ventral; lateral lamellæ with 11–22 dorsal and 33–35 ventral; the setæ of the shorter series are small and widely spaced. Cerci of male slightly longer than wide, with the dorsal margin gently convex in lateral view (Fig. 16h, p. 72).

Range—British Columbia east to Nova Scotia (not known from Alberta and Manitoba), south to Pennsylvania, Oklahoma, and Baja California.



Distribution in British Columbia—Widespread in coastal areas and Interior valleys south of 51°N; recorded sporadically north of this latitude at Canim Lake, Bridge Lake, Williams Lake, and Burns Lake.

Field-notes—Unlike other Zygoptera, *E. carunculatum* frequently inhabits the exposed shorelines of large lakes where there are stands of bulrushes (*Scirpus*). There, the larvæ may emerge from several feet of water to transform high on the exposed plant stems (Walker, 1953). Such a habitat exists on Trapp Lake north of Merritt where, on July 18, 1976, *carunculatum* swarmed, in mating pairs, along the rocky shore among the *Scirpus*. It was the only species of *Enallagma* present. Oviposition has been observed as late as October 16 (Victoria). This species can also develop in alkaline water and is common at some of the saline ponds in the south Okanagan.

In British Columbia, adults have been observed from June 4 to October 16.

Enallagma civile (Hagen)

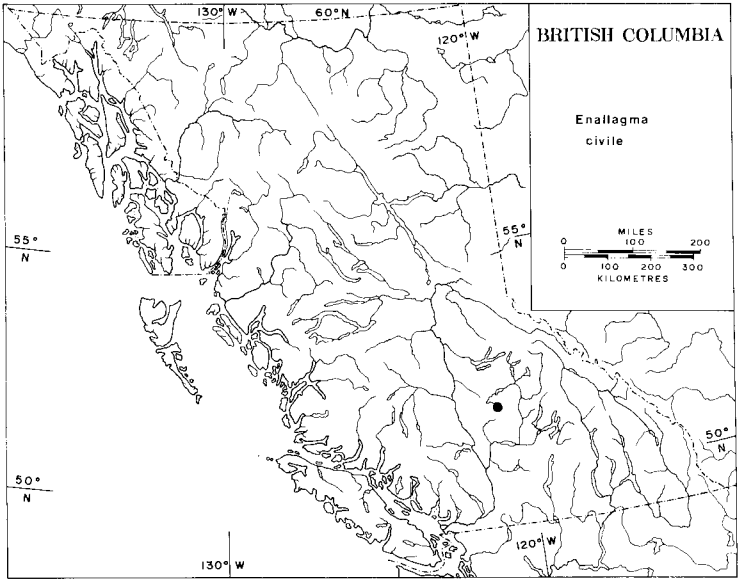
Agrion civile Hagen, 1861. Syn. Neur. N. Amer. p. 88

E. civile, Walker, 1953. Odonata of Canada and Alaska 1:205

civile=polite; an allusion to this insect's retiring habits.

Distinguishing characteristics—Male: Length, 31–39 mm; hindwing, 18–21 mm. Head as in *carunculatum,* the face blue or bluish-green; postocular spots sometimes nearly joined by the blue transverse bar. Pterothorax blue dorsally, light green ventrally; blue mesepimeral stripe half to three quarters as wide as black mid-dorsal stripe and usually twice as wide as black mesopleural stripe; sides of thorax as in *carunculatum.* Abdomen blue; segment 1 with a black dorsal spot; segment 2 with a black dorsal spot on posterior half; 3–5 black over posterior fifth to quarter; 6 black on posterior half to three quarters; 7 mostly black except for a narrow anterior ring; 8 and 9 blue; 10 black dorsally. Superior appendages with the tubercle longer on the dorsal edge (Fig. 14b, p. 69).

Female: Length, 31–34 mm; hindwing, 19–22 mm. Similar to *carunculatum,* more slender, green; head and thorax as in male. Abdominal



segments with black marks reaching closer to the base than in *carunculatum*, the dorsal surfaces of segments 1, 2, and 8–10 almost completely black. Mesostigmal laminæ with prominent rounded ends and distinct posterior suture, but without the oblique ridge found in *carunculatum*.

Larva: Length, 22 mm; metafemur, 3.3–3.5 mm. Antennæ barely longer than mid-dorsal length of head. Premental setæ, 3 or 4; palpal setæ, 6. Caudal lamellæ plain with indistinct nodal lines; the dorsal nodus of the median lamella well before the middle, usually at a third the lamellar length; the ventral nodus of the lateral lamellæ usually before the middle; the nodus on the other margins close to the base of lamellæ, the nodal line thus oblique. Median lamella with 30–35 dorsal antenodal setæ and 6–12 ventral; lateral lamellæ with 10–16 dorsal, 31–47 ventral; the setæ of the short series much smaller and more widely spaced than those of the long series. Cerci of male as wide as long, the dorsal edge strongly convex in lateral view (Fig. 16i, p. 72).

Range—British Columbia east in southern Canada to Nova Scotia (unknown in Alberta); south to Florida, Texas, and Arizona.

Distribution in British Columbia—Recorded only from Bridge Lake in the south-central Interior; there are no other records west of Swift Current, Saskatchewan.

Field-notes—This species is closely related to *E. carunculatum* and, like it, is known to breed to some extent in brackish water (Walker, 1953). *E. civile* may be more widespread in the alkaline ponds of the Cariboo and Chilcotin than is now known. There are no observations of mating or oviposition for *E. civile*.

Like its near ally *E. carunculatum, civile* has a long period of flight. Although there is no indication of the duration of this period in British Columbia, it probably extends from early June to October. The only record is from July 23.

Enallagma clausum Morse

E. clausum Morse, 1895. Psyche 7:209

E. clausum, Walker, 1953. Odonata of Canada and Alaska 1:209

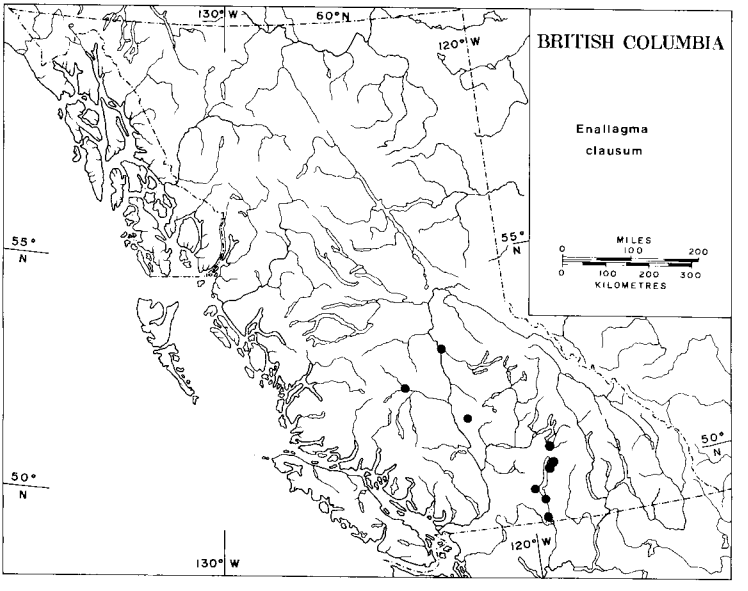
clausum=closed; possibly a reference to the male superior appendages which, unlike those of related species, meet at their bases and are thus closed.

Distinguishing characteristics—Male: Length, 31–37 mm; hindwing, 18–23 mm. Postocular spots blue, small, and not joined by the transverse bar. Pterothorax blue; the blue mesepisternal stripe about as wide as the black mid-dorsal stripe at mid-length; the black mesopleural stripe narrowing in the middle, usually widening posteriorly. Abdomen blue; segment

1 with a black anterodorsal spot; segment 2 with a black dorsal spot on posterior half; 3–6 with black marks lengthening posteriorly from about a third the segment length on 3 to two thirds the segment length on 6; 7 black except for the anterior sixth or less; 8 and 9 blue; dorsum of 10 black. Superior appendages in dorsal view a pair of flattened, wing-like lobes, meeting at the base (Fig. 14d, p. 69).

Female: Length, 33–36 mm; hindwing, 20–23 mm. Pale blue to yellowish-green with black markings. Head and thorax as in male but the black stripe on the mesopleural sulcus tending to disappear in the middle. Dorsum of abdominal segment 1 with a black anterior spot; segment 2 with an elongate spot pointed anteriorly; segments 3–7 black on the posterior three quarters, the spots pointed anteriorly and constricted near their middles, especially on segments 3–5; 8 usually completely blue; 9 and 10 with black dorsal patches. Mesostigmal laminæ with a wavy anterior edge, the rami diverging completely within the frame and in front of the posterior suture (Fig. 15h, p. 71).

Larva: Length, 21–24 mm; metafemur, 3.0–3.6 mm. Antennæ about as long as mid-dorsal length of head. Premental setæ, 3 or 4; palpal setæ, 5 or 6. Caudal lamellæ about a half longer than the length of the forewing cases, about a quarter as wide as long; apices rather blunt; lamellæ either



pigmented only on tracheal branches or with a dark median stripe, often expanded at the nodal line. Dorsal nodus of median lamella at about the middle, the ventral nodus at about a fifth the length, the nodal line thus very oblique (Fig. 16b, p. 72). Median lamella with 30–41 dorsal antenodal setæ and 8–12 ventral; lateral lamellæ with 12–19 dorsal, 40–48 ventral; setæ of the long series prominent toward the nodus, those of the short series minute and far apart. Tracheal branches regular, straight, not crowded, and at an angle of about 45 degrees.

Range—Southern British Columbia east to Manitoba (rare in Ontario and Quebec); south to Kansas, Utah, and Washington.

Distribution in British Columbia—Restricted to the south-central Interior (Okanagan, Shuswap, and Cariboo-Chilcotin districts).

Field-notes—*E. clausum* is typically found around saline lakes in the dry Interior. In Saskatchewan, adults have been taken at lakes where the salinity ranged from 0.04–2 per cent (up to four sevenths that of sea water) and the pH from 8.3–9.4 (Walker, 1953). The habits of *clausum* are similar to those of an *Argia*, the adults flying alertly and very low, alighting frequently and nervously on the ground (Kennedy, 1917). Eggs are usually laid in mats of decomposing, floating algæ. In the Okanagan, typical flying companions of *clausum* are *Argia emma, Lestes unguiculatus, Ischnura cervula,* and *Gomphus graslinellus.*

In British Columbia this species is known to fly between June 21 and August 22.

Enallagma cyathigerum (Charpentier)

Agrion cyathigerum Charpentier, 1840. Lib. Eur. p. 163

E. cyathigerum, Walker, 1953. Odonata of Canada and Alaska 1:217

cyathigerum=cup-bearer; Charpentier felt the dorsal black marks on the abdominal segments of the male resembled miniature goblets.

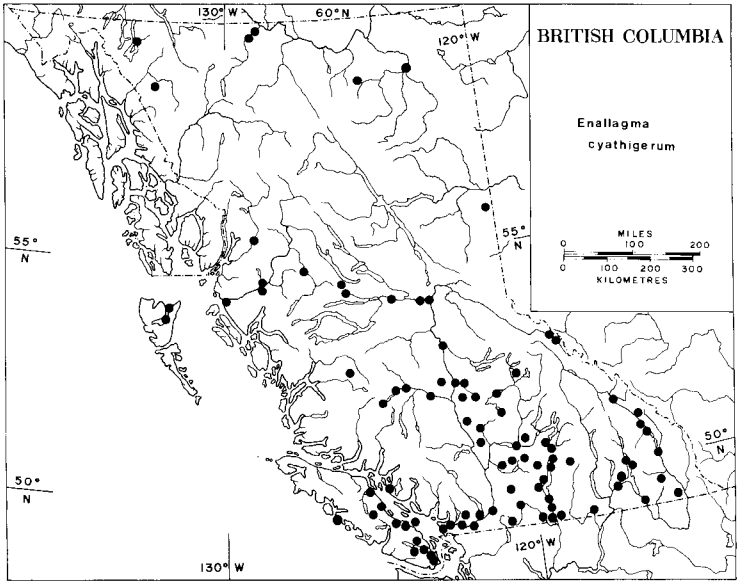
Distinguishing characteristics—Male (Fig. 40b, p. 238): Length, 30–37 mm; hindwing, 17–21 mm. Head as in *boreale.* Pterothorax blue or greenish-blue; blue mesepisternal stripe about three quarters as wide as the black mid-dorsal stripe; black mesopleural stripe narrowly triangular, at mid-length usually less than half the width of the mesepisternal stripe; sides of thorax as in *boreale.* Abdomen coloured like that of *boreale.* As in *boreale,* northern specimens may have the black areas of the thorax and abdomen much more extensive than in the typical form. Superior appendages with the apices upturned in lateral view; in dorsal view the tubercles are small, slightly inturned, and apically situated (Fig. 14g, p. 69).

Female (Fig. 40a, p. 238): Length, 29–34 mm; hindwing, 19–21 mm. Marked as in *boreale,* the black dorsal mark on abdominal segment 8 usually triangular anteriorly and often reaching the base of the segment. Mesostigmal laminæ with distinct posterior sutures, the rami diverging posterior to the frame (Fig. 15i, p. 71).

Larva: Length, 24–27 mm; metafemur, 4.3 mm. Mid-dorsal length of head about four fifths the length of antennæ. Premental setæ, 3–5; palpal setæ, 6 or 7. Caudal lamellæ about a fifth longer than the hindwing cases, apices acute; median lamella about a third as wide as long, lateral lamellæ about a quarter to three eighths as wide as long; marked as in *boreale;* the bases of the tracheal branches often clear. Nodus transverse, not markedly oblique, and at about half the lamellar length (Fig. 16d, p. 72); median lamella with 28–42 dorsal antenodal setæ and 24–31 ventral; lateral lamellæ with 28–36 dorsal, 42–56 ventral.

Range—This species, along with *Lestes dryas,* is our only circumboreal Zygopteran. Alaska, east to Hudson Bay and Newfoundland; south to Connecticut, Ohio, Saskatchewan, Utah, and California; Eurasia.

Distribution in British Columbia—General throughout the Province.



Field-notes—This is the commonest *Enallagma* in British Columbia. Several students have noted that *cyathigerum* and the closely related *boreale* are seldom found together on the same water body although their ranges in Canada are very similar. The reasons for this ecological separation are unknown. Mating has been recorded on June 12 (Sooke) and from August 15 to 19 (Harrison Bay).

E. cyathigerum appears on the wing about two weeks after *boreale*. In British Columbia, the earliest date is May 13 (Penticton), although at Langford Lake, Victoria, a fully mature male was observed on May 16, 1976. The latest date is October 20, also at Victoria, although there is an unsubstantiated record for early November at Cultus Lake (Walker, 1953).

Enallagma ebrium (Hagen)

Agrion ebrium Hagen, 1861. Syn. Neur. N. Amer. p. 89

E. ebrium, Walker, 1953. Odonata of Canada and Alaska 1:228

ebrium=inebriated; perhaps the often erratic flight of the species gave Hagen the impression of insect drunkenness.

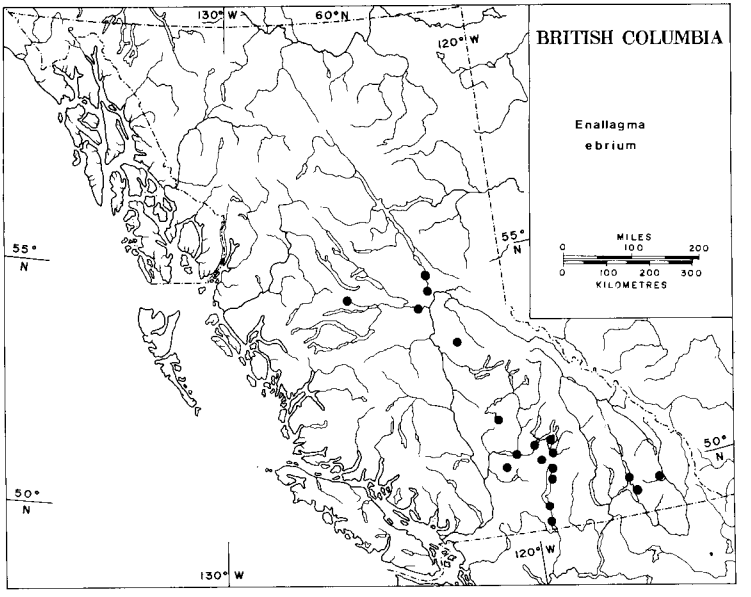
Distinguishing characteristics—Male: Length, 26–31 mm; hindwing, 15–18 mm. Very similar to *hageni* except in the anal appendages; superior appendages bifid in lateral view (Fig. 14a, p. 69).

Female: Length, 28–33 mm; hindwing, 16–20 mm. Identical in colour pattern to *hageni,* usually with the pale areas greenish-yellow but sometimes greyish-blue. Mesostigmal laminæ similar to *hageni* but with the lateral margins not projecting from the mesepisternum (Fig. 15d, p. 71).

Larva: Length, 16–20 mm; metafemur, 3.0–3.5 mm. Mid-dorsal length of head six sevenths the length of antennæ. Premental setæ, 3; palpal setæ, 5 or 6. Caudal lamellæ with patches of dark tracheæ (Fig. 16a, p. 72); median lamella a third as wide as long, lateral lamellæ a quarter as wide as long; nodal line oblique; the median lamella with dorsal nodus at about half the lamellar length; lateral lamellæ with ventral nodus at about three fifths the lamellar length. Median lamella with 17–27 dorsal antenodal setæ and 6–12 ventral; lateral lamella with 6–8 dorsal, 31–38 ventral. Cerci of male differing from *hageni,* in dorsal view, with the outer margin straight and with an oblique ridge (Fig. 16f, p. 72).

Range—British Columbia east to Newfoundland and south to Maryland, Ohio, Iowa, and Utah.

Distribution in British Columbia—Widespread records from east of the Coast Range as far north as Crooked River and Burns Lake.



Field-notes—*E. ebrium* is most common around waters on calcareous soils; boggy, acid conditions are usually unsuitable to this species (Walker, 1953). Oviposition may be performed in tandem or by the female alone and is known to occur in floating, dead water plants and algæ as well as in the stems of living vascular plants. In some instances the insects may descend a foot or more under the water to lay eggs.

In British Columbia, *E. ebrium* is known to fly from June 8 to September 3.

Enallagma hageni (Walsh)

Agrion hageni Walsh, 1863. Proc. Ent. Soc. Phila. 2:234

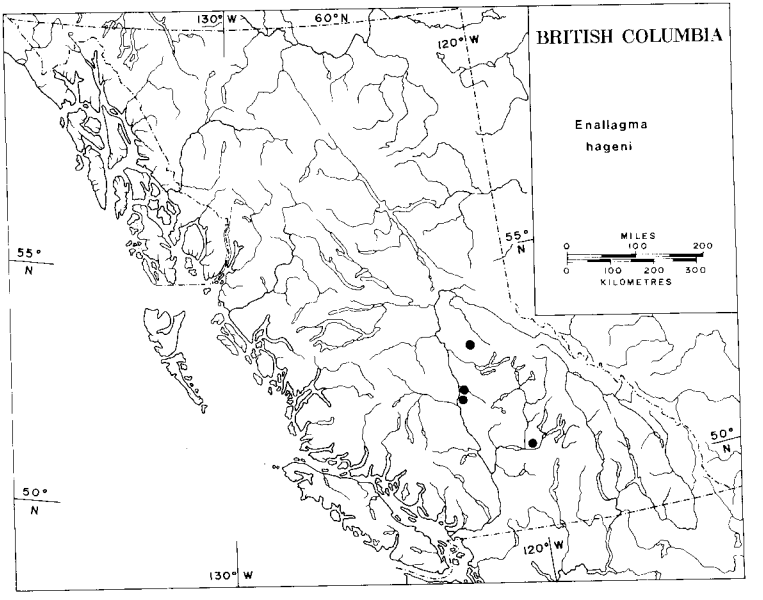
E. hageni, Walker, 1953. Odonata of Canada and Alaska 1:225

hageni=named after Hermann Hagen, 19th-century entomologist.

Distinguishing characteristics—Male: Length, 26–32 mm; hindwing, 15–18 mm. Dorsum of head black; postocular spots not nearly touching the eyes and not connected by the blue bar. Pterothorax blue, the blue mesepi-

sternal stripe about three quarters the width of the black mid-dorsal stripe; black mesopleural stripe not narrowing much posteriorly, the width at mid-length half or less the width of the blue mesepisternal stripe; a black spot on the interpleural suture at its posterior end. Abdomen blue; dorsum of segment 1 with black anterior spot; 2 with a black posterior spot; 3 and 4 with posterior fifth to a third black; 5 with posterior third to a half black; 6 and 7 mostly black with short anterior blue areas; 8 and 9 blue; 10 black dorsally. Superior appendages in lateral view slender and tapering to the apex; in dorsal view the tubercles are apical and much broader than in *cyathigerum* (Fig. 14f, p. 69).

Female: Length, 29–33 mm; hindwing, 18–20 mm. Greenish-yellow to pale brown with extensive black areas. Head and thorax as in male. Abdomen mainly black dorsally, greenish-yellow on the sides; segment 1 with a dorsal black spot; 2 with a broad black stripe widening posteriorly; 3–10 with the black areas continuous along the mid-line, the patches on 3–8 narrowed anteriorly. Mesostigmal laminæ more than half as wide as long with a prominent, curved margin; small lateral lobe curled up, projecting from the mesepisternum in an oblique view (Fig. 15b, p. 71).



Larva: Length, 17–22 mm; metafemur, 3.0–3.5 mm. Mid-dorsal length of head about three quarters the length of antennæ. Premental setæ, 3 or 4; palpal setæ, 5 or 6. Caudal lamellæ with patches of dark tracheæ, the intervening areas pale; median lamella four elevenths as wide as long, lateral lamellæ three tenths as wide as long; nodal line curved and oblique; the median lamella with the indistinct dorsal nodus at about half the lamellar length; lateral lamellæ with ventral nodus about three fifths the lamellar length. Median lamella with 20–26 dorsal antenodal setæ and 7–9 ventral; lateral lamellæ with 7–9 dorsal, 29–32 ventral. Cerci of male with an evenly curved outer margin and without an oblique ridge in dorsal view (Fig. 16g, p. 72).

Range—British Columbia east to Nova Scotia; south to North Carolina, Ohio, and Kansas.

Distribution in British Columbia—Apparently restricted to the Cariboo district except for a southerly record from Pinantan Lake near Kamloops.

Field-notes—E. hageni is common in eastern Canada but is only local in the west. Little is known of the species in British Columbia except that it seems to prefer rather productive waters with abundant bulrush (*Scirpus*) beds. Most of the Cariboo localities represent alkaline waters although *hageni* tolerates acid waters in Ontario (Walker, 1953). Oviposition is performed in tandem and the eggs are inserted in plants just below the surface of the water (Walker, 1953); Walker has never seen the female *hageni* become submerged as the female of closely related *E. ebrium* sometimes does.

The few British Columbia records range from May 25 (Pinantan Lake) to July 9 (Stanley). The flight period is probably from late May to early August.

Genus *Ischnura* Charpentier

The generic name is derived from the Greek words *ischnos*= thin and *oura*=tail and refers to the slender abdomen of most species.

Ischnura is a cosmopolitan genus with six species in Canada. Four of these species inhabit British Columbia. The males are generally black and green with blue on abdominal segments 8 and 9. Their most characteristic feature is the elevated, bilobed dorsum of abdominal segment 10. The females have distinctive mesostigmal laminæ with the posterior margin developed into a high ridge. Females are also remarkable in displaying two colour phases. The heterochromatic one is the commoner, the pale green colour of the

males being replaced by more extensive orange or light brown areas. In both phases the colour pattern is obscured by heavy pruinosity as the females age.

The larvæ are very similar to *Enallagma* species, but can be separated by the 7-segmented antennæ and the caudal lamellæ with long-tapering, acute apices.

KEY TO THE SPECIES OF *ISCHNURA*

MALES

1a. Light stripes on mesepisterna divided into anterior and posterior spots 2
1b. Light stripes on mesepisterna complete 3
2a. Dorsum of abdominal segment 10 raised into a bifid process half as high as the segment (Fig. 17a); apices of inferior appendages flattened and angular ..... *cervula* (p. 89)
2b. Dorsum of segment 10 raised into a lower process, about a third as high as the segment (Fig. 17b); apices of inferior appendages bluntly hooked ..... *damula* (p. 91)
3a. Apices of inferior appendages bifid or trifid (Fig. 17c) ..... *perparva* (p. 94)
3b. Inferior appendages very long and bluntly pointed (Fig. 17d) ..... *erratica* (p. 92)

FEMALES

1a. Mesostigmal laminæ with posterior margins raised into 2 large rounded lobes (Fig. 17h) ..... *erratica* (p. 92)
1b. Mesostigmal laminæ with posterior margins raised into 2 long ridges (Fig. 17e, f, g) 2
2a. Venter of abdominal segment 8 with a vulvar spine (Fig. 17i) 3
2b. Venter of abdominal segment 8 without a vulvar spine ..... *perparva* (p. 94)
3a. Dorsum of prothorax with a pair of nipple-like elevations; posterior margin without a truncate process (Fig. 17e) ..... *damula* (p. 91)
3b. Dorsum of prothorax without nipple-like elevations; posterior margin with a median truncate process (Fig. 17g) ..... *cervula* (p. 89)

LARVÆ

1a. Femora with 3 distinct pale bands; caudal lamellæ marked with dark bands ..... *cervula* (p. 89)
1b. Bands on femora, if any, fewer and not sharply defined; caudal lamellæ usually without distinct dark bands 2
2a. Metafemur less than 3 mm long ..... *perparva* (p. 94)
2b. Metafemur 3 mm or longer 3

3a. Caudal lamellæ 7 mm or longer; in British Columbia known only from the Lower Mainland and southern Vancouver Island ..... *erratica* (p. 92)

3b. Caudal lamellæ less than 7 mm long; in British Columbia known only from east of the Rockies ..... *damula* (p. 91)

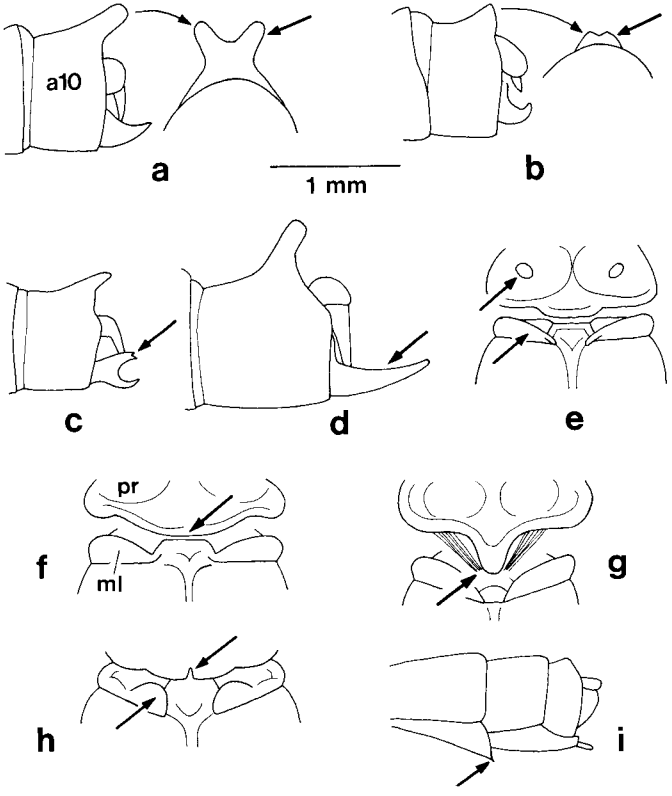


Fig. 17. *Ischnura:* Lateral view of male anal appendages (**a–d**), dorsal view of mesostigmal laminæ and posterior edge of female prothorax (**e–h**), and lateral view of end of abdomen (**i**); **a**, *I. cervula;* **b**, *I. damula;* **c**, *I. perparva;* **d**, *I. erratica;* **e**, *I. damula;* **f**, *I. perparva;* **g**, *I. cervula;* **h**, *I. erratica;* **i**, *I. cervula* ♀ (*see* p. 243 for explanation of letters).

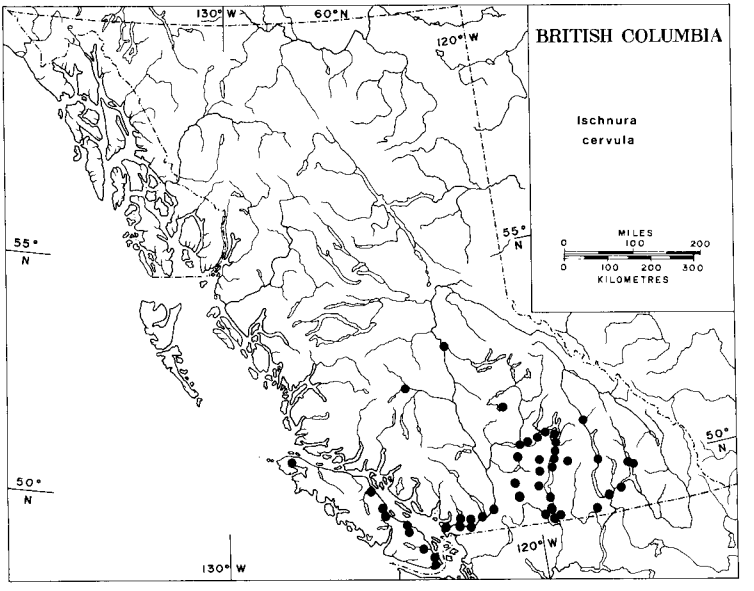
Ischnura cervula Selys

I. cervula Selys, 1876. Bull. Acad. Belg. (2) 41:262

I. cervula, Walker, 1953. Odonata of Canada and Alaska 1:264

cervula=small deer; the forked, dorsal projection on the end of the abdomen of the male resembles the antlers of a young deer.

Distinguishing characteristics—Male: Length, 26–32 mm; hindwing, 15–17 mm. Blue postocular spots very small and not joined; face blue with black on clypeus and labrum. Pterothorax black dorsally, the blue mesepisternal stripes reduced to paired spots; sides blue, shading to green ventrally, with thin black markings. Abdomen black dorsally, yellow ventrally; segments 1 and 2 bluish-green laterally; 3–7 with narrow pale basal rings; 8 and 9 blue with lateral spots; 10 black dorsally. Dorsum of segment 10 with a bifid projection half as high as segment (Fig. 17a, p. 88); inferior appendages with apices flattened, upturned, and angular.



Female: Length, 27–31 mm; hindwing, 16–19 mm. The typical form is heterochromatic but is very variable in colour pattern. Reduction in dark markings is associated with a brown ground colour; an increase in black markings with the pale areas blue is found in specimens approaching the homeochromatic form. In the light form, postocular spots large, joined by a line; pale mesepisternal stripe wider than dark mid-dorsal stripe; mesopleural sulcus stripe variable, often reduced to a thin line. Abdomen pale brown with black markings; dorsum of segment 2 with a narrow spot on posterior half; 3–7 black dorsally; 4–7 with pale basal rings; 8 blue, often with a lateral spot; 9 and 10 black dorsally. Dark form: postocular spots as in male; mesepisternal stripe narrower than black mid-dorsal stripe; mesopleural sulcus stripe often half as wide as pale mesepisternal stripe. Abdomen blue with black markings; segment 1 with a black dorsal spot; 2 with a black stripe constricted anteriorly, sometimes only a line; 3–10 as in light form. A rare homeochromatic phase has mesepisternal stripes divided as in male. All forms become pruinose with age. Dorsum of prothorax with a posterior projection bordered by long hairs (Fig. 17g, p. 88). Abdominal segment 8 with a vulvar spine.

Larva: Length, 19–20 mm; metafemur, 2.9–3.1 mm. Colour usually very dark with pale stripes and bands; even when ground colour is light, the bands on femora are sharply defined. Metafemur usually 3 mm or more. Caudal lamellæ usually 6.3–7.0 mm long with 2 or 3 distinct dark bands.

Range—British Columbia and Alberta south to New Mexico and Baja California.

Distribution in British Columbia—Vancouver Island; on the Mainland from Vancouver east to Kootenay Lake and north to Revelstoke and Quesnel.

Field-notes—*I. cervula* is the commonest species of *Ischnura* in British Columbia, reaching its greatest abundance in semiarid areas where saline ponds occur. At Banff, Alberta, well out of its usual lowland habitat, *cervula* develops in warm springs (Walker, 1953). Adults seldom fly far from the vegetation bordering the pond or stream; their irregular flight and their habit of resting with wings half-spread gives them the appearance of a miniature *Lestes*. Emergence was observed at Langford Lake, Victoria, on May 8, 1976. Males were then fully mature and mostly females were emerging on bulrush (*Scirpus*) stems and floating logs. Immature larvæ were found on the underside of waterlily (*Nuphar*) leaves. Mating and oviposition has been observed between June 14 and 19.

In British Columbia, *I. cervula* has one of the longest flight periods of any species of dragonfly; records range from May 7 to October 25.

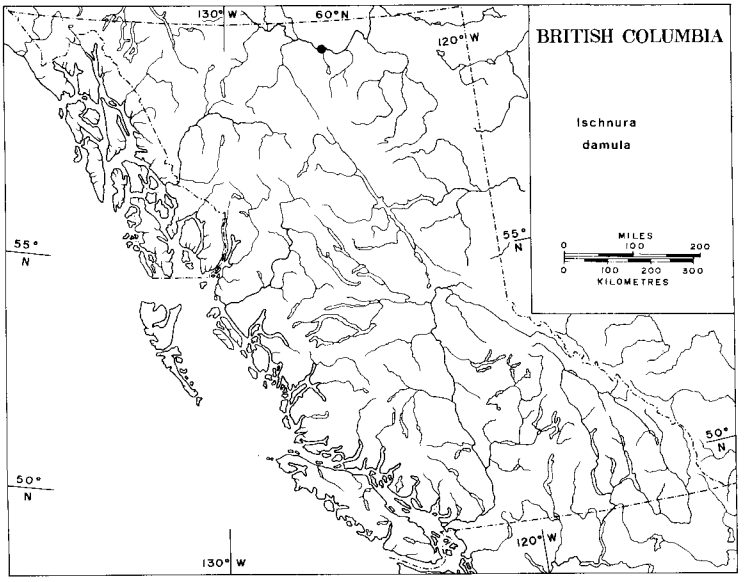
Ischnura damula Calvert

I. damula Calvert, 1901. Biol. Centr. Amer. p. 126

I. damula, Walker, 1953. Odonata of Canada and Alaska 1:268

damula=small deer; alluding to the similarity of this species to *I. cervula.*

Distinguishing characteristics—Male (Fig. 40e, p. 238): Length, 25–28 mm; hindwing, 20–23 mm. Face green with black on cylpeus and labrum. Pterothorax black dorsally; pale mesepisternal stripes each reduced to a pair of spots; sides green with a black line on metapleural sulcus. Abdomen black dorsally, yellow-green ventrally; segment 1 with a black dorsal spot, the intersegmental membrane blue as in *cervula;* 2 with black dorsal area narrowed posteriorly; 3–7 black dorsally, 4–7 with a pair of small pale basal spots; 8 and 9 blue with black lateral spots; 10 black dorsally. Dorsum of segment 10 elevated into a bilobed projection less than a third the height of the segment (Fig. 17b, p. 88); inferior appendages short, hooked apically.



Female (Fig. 40c, d, p. 238): Length, 26–27 mm; hindwing, 20–21 mm. Homeochromatic form similar in colour pattern to male. Abdominal segment 2 pale with an arrow-shaped apical spot, sometimes connected to a basal spot; 8 and 9 blue with black lateral spots joined over the dorsum by a black line, 9 also with 3 dorsal spots. Heterochromatic form with more extensive pale areas, these areas orange. Postocular spots large and connected with a line; pterothorax with the pale mesepisternal stripes complete. Dorsum of abdominal segment 9 black with a median pale spot. Dorsum of prothorax with a pair of tubercles (Fig. 17e, p. 88); abdominal segment 8 with a small vulvar spine.

Larva: Length, 16.5 mm; metafemur, 3.25 mm. Colour usually uniform yellow-brown; metafemur over 3 mm long. Caudal lamellæ about 6 mm long, without distinct bands but often with a faint crescent on the nodal line.

Range—Northeastern British Columbia east to Manitoba (not known from Alberta); south to New Mexico and Arizona.

Distribution in British Columbia—Known only from Liard River Hotsprings on the Alaska Highway.

Field-notes—Almost nothing is known of the habits and ecology of this species. The British Columbia specimens come from hot springs and the larval environment is thus warmer than it would otherwise be at the latitude (about 59°30'N) of their discovery. Nevertheless, the occurrence of *damula* at Liard River is remarkable considering the large gap in distributional records between this northern point and the centre of its range far to the south.

The dates of capture in British Columbia range from June 28 to August 7.

Ischnura erratica Calvert

I. erratica Calvert, 1895. Proc. Calif. Acad. Sci. 4:491

I. erratica, Walker, 1953. Odonata of Canada and Alaska 1:272

erratica=erratic; probably a reference to the flight of the species.

Distinguishing characteristics—Male (Fig. 40g, p. 238): Length, 31–33 mm; hindwing, 17–18 mm. Face yellow-green with black on clypeus and labrum. Pterothorax bronze-black dorsally; green mesepisternal stripes about half the width of the black mid-dorsal and mesopleural sulcus stripes; sides of thorax light blue dorsally, yellow ventrally with black lines on interpleural suture and metapleural sulcus. Abdominal segment 1 pale with a black anterior spot dorsally; 2 black dorsally with a blue apical spot; 3–7 black dorsally, yellow ventrally, with paired pale basal spots on 3–6; 7 with a dorsal apical blue spot; 8 and 9 blue dorsally, black laterally, yellow ventrally; 10 black dorsally. Segment 10 with a bifid dorsal projection, the arms

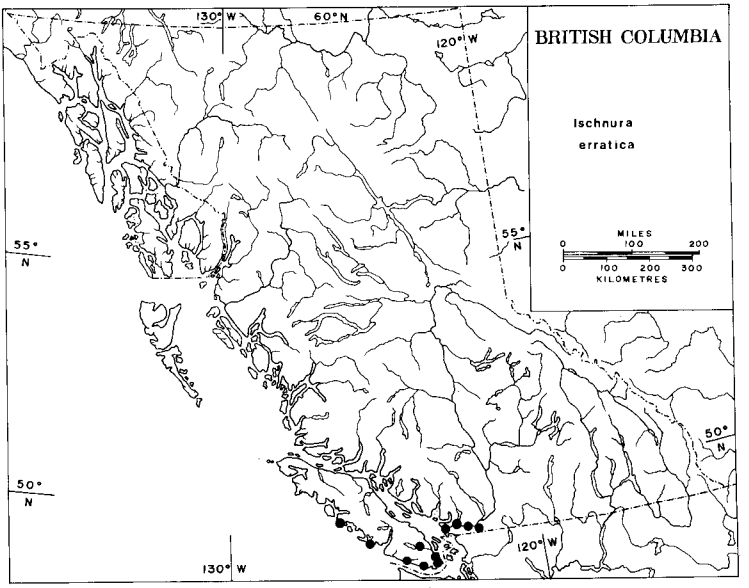
shorter than half the height; inferior appendages very long, with a high base and pointed apices (Fig. 17d, p. 88).

Female (Fig. 40f, p. 238): Length, 31–33 mm; hindwing, 18–21 mm. Homeochromatic form much like male in colour. A slightly more heterochromatic phase is usual. It is dark brown with the pale areas yellow-green. Metapleural sulcus marked with black only at its dorsal end; abdomen yellow-green, marked with dark brown on entire dorsum except for pale basal rings on segments 3–7. Dorsum of prothorax with posterior edge shallowly trilobate; raised posterior margin of mesostigmal laminæ with inner ends strongly lobed (Fig. 17h, p. 88).

Larva: Length, 20–24 mm; metafemur, 3.4–3.8 mm. A large *Ischnura* larva with the metafemur over 3 mm long; femora with a dark ring before the apices. Caudal lamellæ 7 mm or longer, dark brown with pale apices. Ovipositor of female 4 mm long.

Range—Along the Pacific Coast from southern British Columbia to Baja California.

Distribution in British Columbia—On Vancouver Island south of Nootka Sound; on the Mainland restricted to the Fraser Valley west of Hope.



Field-notes—Compared to *I. cervula* and *I. perparva,* this is a rather rare and local species throughout its range. Whitehouse (1941) considers this is due to strict habitat requirements. George Doerksen (*pers. comm.*) recently located the first larvæ of *erratica* found in Canada and observed the adult behaviour of the species, at Pitt Meadows, in a small, shallow pond surrounded by woodreed grass (*Cinna latifolia*) within the dykes of the Alouette River. The observations were made in early May, 1976, when the air temperature at 9 p.m. was 10°C, the water temperature at 20-cm depth was 15°C, and the pH was 7.2. On April 28, larvæ were observed partly out of the water and breathing air in preparation for emergence. Adults emerged on the stems of *Cinna* from April 30 to May 3. Males flew low over the water, defending loose territories, while females skulked in the shore grasses. Copulation was recorded from May 6 to 16 and oviposition from May 7 to June 8. The unattended female usually laid her eggs in the stems of *Cinna,* submerging her abdomen well below the water surface. Up to 48 eggs were placed in a single stem. No other *Ischnura* species was seen at the pond until May 21 when *cervula* appeared. By mid-June most *erratica* had disappeared from this locale and *cervula* and *perparva* were abundant.

The flight period of *erratica* appears to be early and short. British Columbia dates range from April 30 to August 4, but most are from May and June.

Ischnura perparva Selys

I. perparva Selys, 1876. Bull. Acad. Belg. (2) 41:263

I. perparva, Walker, 1953. Odonata of Canada and Alaska 1:261

perparva=very small: this, and the similarly sized *Nehalennia irene,* are our smallest dragonflies.

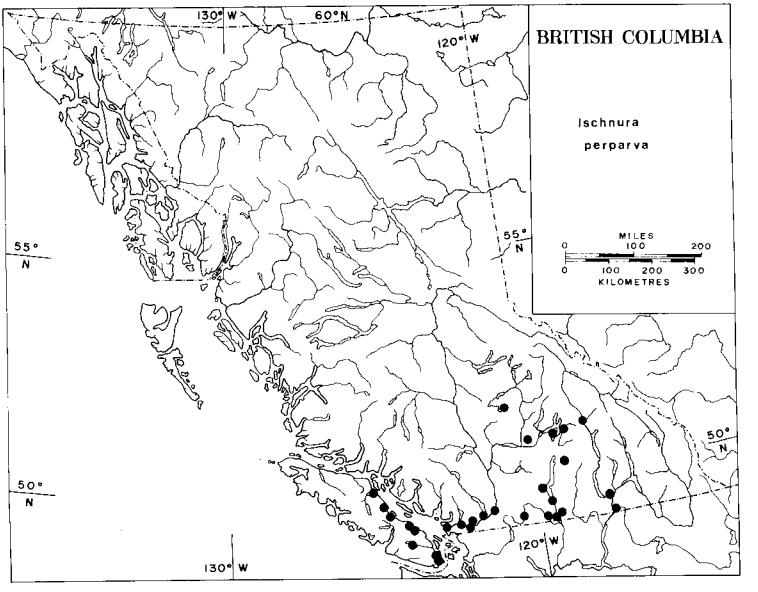
Distinguishing characteristics—Male: Length, 23–28 mm; hindwing, 12–15 mm. Face green with black on clypeus and base of labrum. Pterothorax with pale mesepisternal stripe about a quarter as wide as black middorsal stripe and half as wide as mesopleural sulcus stripe at the middle; sides light green with a black line on dorsal end of interpleural suture; metapleural sulcus with a black line and dorsal spot. Abdomen black dorsally, yellow-green ventrally; dorsum of segment 1 with a square black spot; 2 with the dorsal black area narrowing posteriorly; 3–7 bronze-black dorsally with yellow basal rings, the dark area narrowed posteriorly; 8 and 9 blue with black lateral lines; 10 black dorsally. Segment 10 with dorsum raised into a bifid projection nearly half as high as the segment; inferior appendages bifid, one branch often secondarily divided (Fig. 17c, p. 88).

Female: Length, 25–28 mm; hindwing, 13–17 mm. Apparently only the heterochromatic form occurs, light orange-brown with metallic greenish-black markings. Pale mesepimeral stripe more than half as wide as black mid-dorsal stripe; mesopleural sulcus stripe only a heavy line; sides of thorax orange with black lines on dorsal end of interpleural suture and metapleural sulcus. Abdomen with segments 1 and 2 entirely pale; 3 and 4 with a black posterior dorsal spot, that on 4 usually with an anterior dark line; 5–7 with black markings covering dorsum except for pale anterior rings; 8 with a bilobed black basal spot; 9 with a pair of small spots; 10 entirely pale. In old specimens the whole body may become pruinose blue. Mesostigmal laminæ as in Fig. 17f, p. 88. Abdominal segment 8 without a vulvar spine.

Larva: Length, 15–18 mm; metafemur, 2.5–2.8 mm. Colour usually pale brown, sometimes dark, but with only indistinct markings; bands on femora, if any, not sharply defined. Metafemur usually less than 3 mm long. Caudal lamellæ usually 5.5–6.2 mm long, without dark bands.

Range—British Columbia south to Texas and California.

Distribution in British Columbia—Vancouver Island from the Campbell River district south; on the Mainland from Vancouver east to Robson and north mainly in the Okanagan Valley to Revelstoke and Bridge Lake.



Field-notes—I. perparva is similar in habits and choice of habitat to *I. cervula,* although it is not as widely distributed nor as abundant as its relative. In British Columbia, as a general rule, where *perparva* is found, *cervula* will also occur, but the reverse is not necessarily true. Although both *perparva* and *cervula* inhabit alkaline ponds and stagnant marshes, the larva of the former is apparently mud-loving whereas the latter prefers the trash and aquatic vegetation above the mud surface (Kennedy, 1915). In this context it is noteworthy that *perparva* larvæ are uniformly coloured whereas those of *cervula* are camouflaged with light and dark markings. On June 27, 1976, along stagnant Colquitz Creek in Victoria, *perparva* females were abundant, ovipositing alone in floating algal mats and cat-tail leaves. Their bodies were completely pruinose. Flying with *perparva* at that time were *I. cervula, Enallagma carunculatum, Æshna multicolor,* and *Sympetrum illotum.*

British Columbia records are from May 13 to September 9.

Genus *Nehalennia* Selys

Nehalennia, according to Selys, who established the genus, was the name of a goddess of Belgian Gaul.

There are two species of *Nehalennia* found in Canada; one of these reaches British Columbia. They are small, extremely fragile dragonflies, brilliantly metallic green dorsally and light green or yellow ventrally. They have no postocular spots. The male anal appendages are remarkably short and the female lacks a vulvar spine on abdominal segment 8.

Nehalennia irene (Hagen)

Agrion irene Hagen, 1861. Syn. Neur. N. Amer. p. 74

N. irene, Walker, 1953. Odonata of Canada and Alaska 1:168

irene=peaceful; woman's name.

Distinguishing characteristics—Male (Fig. 38e, p. 236): Length, 26–27 mm; hindwing, 14–15 mm. Dorsum of head metallic greenish-black; face pale with black on clypeus and labrum, rear of head black without postocular spots. Dorsum of prothorax metallic green, sides yellow. Pterothorax green dorsally, light bluish-green laterally, yellowish-green ventrally. Abdomen very slender; segments 1–7 metallic green dorsally; 1 and 2 pale blue laterally; 3–7 pale yellow laterally; 8 bronze-green dorsally with the posterior

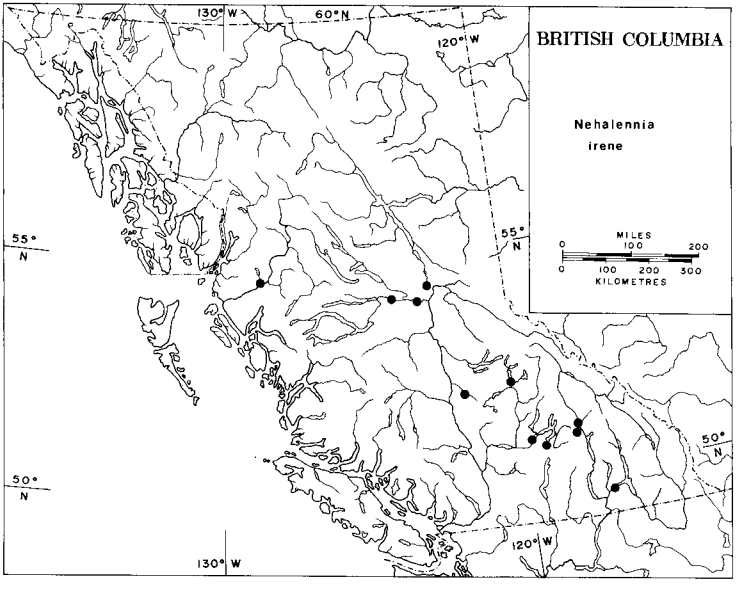
quarter blue; 9 and 10 blue with paired dark anterior spots. Superior appendages largely hidden by the inferior appendages in lateral view.

Female: Length, 25–28 mm; hindwing, 15–17 mm. Colour as in male except abdominal segments 8 and 9 with only small blue posterior areas.

Larva: Length, 14–17 mm; metafemur, 3.0 mm. Antennæ nearly as long as head. Basal width of prementum a third of the apical width; premental setæ, 1; palpal setæ, 6. Caudal lamellæ with slender, acute apices, with small marginal spots and sometimes a transverse band.

Range—British Columbia east through the Northwest Territories to James Bay and Nova Scotia; south to Maryland, Illinois, Saskatchewan, Alberta, and Washington.

Distribution in British Columbia—Restricted to the Interior; records from Terrace and Summit Lake in the north to Chase and Nelson in the south.



Field-notes—Although not rare in British Columbia, *N. irene* is not as abundant here as it is in the eastern provinces. *N. irene* shares the distinction of being our smallest dragonfly with *Ischnura perparva*. The weak-flying adults seldom stray from the protection of the sedges and rushes

thickly surrounding the marshes and bogs that they inhabit. While ovipositing in floating plant material the female rests in a horizontal position; the male clasping her prothorax, is raised at an angle of 45 degrees (Walker, 1953).

N. irene has an early flight period that ends in mid-summer. It is known to fly in British Columbia from May 10 to August 2.

FAMILY ÆSHNIDÆ

Who does not know these large, swift-flying dragonflies with spear-shaped bodies conspicuously marked with blue or green? The darners, as they are often called, are common about lakes, ponds, and streams, tirelessly hawking after the insects that are their prey. When they alight, it is usually in a vertical position, hanging from a leaf or the bark of a tree. During early adult life, æshnids may fly many miles from their place of emergence, often appearing in cities and towns. In British Columbia the family Æshnidæ is practically synonymous with the genus *Æshna,* the only other genus of the family being represented by one species, *Anax junius*.

The compound eyes are very large and meet broadly on top of the head. The wings are almost as long as the abdomen and are clear, sometimes tinted with yellow or brown, but never patterned. The anal appendages are long and flattened and the ovipositor is well developed for laying eggs in plant tissue. The ovipositor resembles that of the Zygoptera. In this respect Æshnidæ are the most primitive Anisopterans.

The triangles of the wings are remote from the arculus and greatly elongated; the anal loop is short. The pterostigma has a brace-like crossvein behind its inner end and veins R3 and IR3 are strongly arched.

Most larvæ climb in aquatic vegetation, stalking their prey with cat-like stealth. They are among the most rapacious predators and are habitual cannibals. Their distinctive bodies are gracefully slender and smooth, patterned with camouflaging green and brown. The eyes are prominent and the labium is extremely long and flat, without setæ.

KEY TO THE GENERA OF ÆSHNIDÆ

ADULTS

1a. Thorax brown marked with blue, green, or yellow ..... *Æshna* (p. 99)

1b. Thorax entirely green ..... *Anax* (p. 130)

LARVÆ

1a. Compound eyes as long as their greatest width; lateral spines on abdominal segments 7–9 only ..... *Anax* (p. 130)

1b. Compound eyes shorter than their greatest width; lateral spines usually on segments 6–9, rarely on segments 5–9 or 7–9 only ..... *Æshna* (p. 99)

Genus *Æshna* Fabricius

The origin of the name *Æshna* is obscure. One of the more original suggestions is that it is a printer's error for the Greek *Æchma*=a spear—certainly an appropriate name for these slender, swift fliers.

Æshna is the dominant genus of the family in the Northern Hemisphere; in British Columbia alone there are 13 species. In our area both the largest and smallest species are of boreal origin.

In general our species of *Æshna* are quite uniform in size and colour pattern, the thorax being brown with a pair of green dorsal stripes and a lateral pair of blue, green, or yellow stripes. The abdominal spots are usually blue in males and green in females. The spots on the abdominal segments follow a basic pattern with only slight differences between species. On each segment there are, typically, a series of dorsal and lateral spots. The dorsal series has anterodorsal, mid-dorsal, and posterodorsal spots; the lateral series with anterolateral, midlateral, and posterolateral spots on each segment. The anterodorsal is very small, often absent; the mid-dorsal may be differently coloured from the other spots; the posterodorsal may be joined to the posterolateral. The anterolateral and midlateral are separated by the transverse carina except on segment 2 where they unite as an irregular single spot; the posterolateral may be joined to the posterodorsal or absent. The anterodorsal is a single spot on all segments, all other spots are typically paired in each segment. Heterochromatic females are

usually the rule. A conspicuous feature is the dark T-spot on the dorsum of the frons.

The spines of the anterior lamina, the anterior hamuli, and the superior appendages are important structures in male *Æshna* classification. In females the structures associated with the ovipositor offer similarly useful characteristics.

KEY TO THE SPECIES OF ÆSHNA

MALES

1a. Anal triangle with 2 cells (Fig. 18a) 2
1b. Anal triangle with 3 cells (Fig. 18b) 9
2a. Lateral thoracic stripes less than 1 mm broad, the mesepimeral stripe bent twice at alternate angles (Fig. 19i, j); hamular processes with straight, contiguous inner margins (Fig. 18l, m) 3
2b. Lateral stripes more than 1 mm broad, or when narrower always straight; hamular processes never with straight, contiguous inner margins 4
3a. Transverse frontal stripe produced forward on each side of T-spot (Fig. 20f); spines of anterior lamina longer than hamular processes, curved ventrally and tapering to a point (Fig. 18l) ..... *sitchensis* (p. 124)
3b. Transverse frontal stripe not produced forward on each side of T-spot (Fig. 20g); spines of anterior lamina not longer than hamular processes, straight and blunt (Fig. 18m) ..... *septentrionalis* (p. 122)
4a. Hamular processes short and continuous with hamular folds; spines of anterior lamina short and straight (Fig. 18k) 5
4b. Hamular processes long and narrow, separated from hamular folds; spines of anterior lamina long, tapering to a fine point (Fig. 18n, o) 8
5a. Superior appendages with a prominent ventral basal tubercle (Fig. 18e); lateral thoracic stripes broad, not wavy in front (Fig. 19a); abdominal segment 10 wholly black ..... *tuberculifera* (p. 127)
5b. Superior appendages without a ventral basal tubercle; lateral thoracic stripes usually wavy in front; abdominal segment 10 with a pair of pale dorsal spots, sometimes joined 6
6a. Mesepisternal stripes reduced to a pair of small spots, or absent; lateral thoracic stripes narrow and nearly straight (Fig. 19c, d) or each divided into 2 spots (Fig. 19b); vein IR2 normally arising beyond the middle of the pterostigma (Fig. 20d) ..... *interrupta* (p. 115)
6b. Mesepisternal stripes complete and expanded at posterior ends; lateral thoracic stripes broad, more or less wavy on front edges; vein IR2 normally arising before the middle of the pterostigma (Fig. 20e) 7

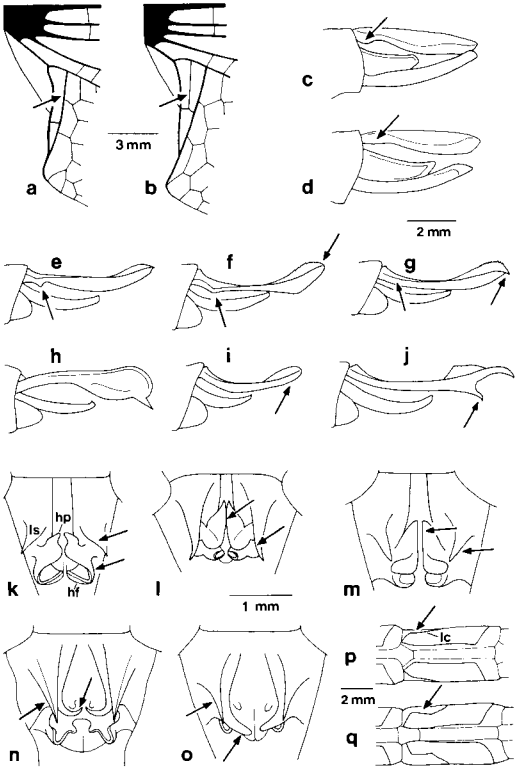


Fig. 18. *Æshna* (males): Base of hindwing (**a, b**), oblique view of anal appendages from above (**c, d**), lateral view of anal appendages (**e–j**), hamuli—ventral view of abdominal segment 2 (**k–o**) and ventral view of abdominal segment 7 (**p, q**); **a**, *A. canadensis;* **b**, *A. palmata;* **c**, *A. interrupta interna;* **d**, *A. i. lineata;* **e**, *A. tuberculifera;* **f**, *A. eremita;* **g**, *A. canadensis;* **h**, *A. palmata;* **i**, *A. californica;* **j**, *A. multicolor;* **k**, *A. eremita;* **l**, *A. sitchensis;* **m**, *A. septentrionalis;* **n**, *A. juncea;* **o**, *A. subarctica;* **p**, *A. palmata;* **q**, *A. umbrosa* (*see* p. 243 for explation of letters).

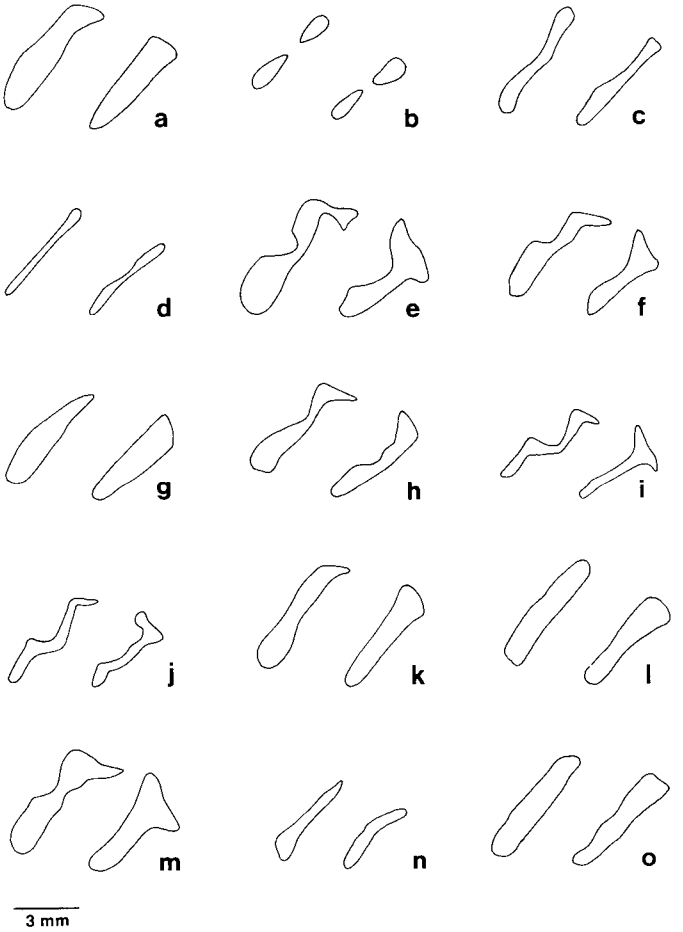


Fig. 19. *Æshna:* Left-lateral views of the thoracic stripes (left, mesepimeral stripe; right, metepimeral stripe); **a**, *A. tuberculifera* ♂; **b**, *A. interrupta interrupta* ♂; **c**, *A. i. interna* ♂; **d** *A. i. lineata* ♂; **e**, *A. eremita* ♂; **f** *A. canadensis* ♀; **g**, *A. juncea* ♂; **h**, *A. subarctica* ♂; **i**, *A. septentrionalis* ♂; **j**, *A. sitchensis* ♂; **k**, *A. umbrosa* ♂; **l**, *A. palmata* ♂; **m**, *A. constricta* ♀; **n**, *A. californica* ♂; **o**, *A. multicolor* ♂.

7a. Superior appendages with a low ventral prominence near the base, apices rounded and without a decurved terminal spine (Fig. 18f); mesepimeral stripe constricted near the middle (Fig. 19e) ..... *eremita* (p. 113)

7b. Superior appendages without a ventral, basal prominence, apices with a terminal spine, usually decurved (Fig. 18g); mesepimeral stripe narrowed but not constricted above the middle (Fig. 19f) ..... *canadensis* (p. 110)

8a. Lateral thoracic stripes broad and straight (Fig. 19g); spines of anterior lamina curved ventrally, apices of hamular processes acute and hooked (Fig. 18n) ..... *juncea* (p. 117)

8b. Lateral thoracic stripes narrowed at the middle, the mesepimeral stripe with a slender, posterior offshoot from the dorsal end (Fig. 19h); spines of anterior lamina straight, apices of hamular processes rounded and obscuring the hamular folds (Fig. 18o) ..... *subarctica* (p. 125)

9a. Abdominal segment 1 without a ventral tubercle; superior appendages broad and with an apical, ventral spine (Fig. 18h) 11

9b. Abdominal segment 1 with a ventral tubercle (Fig. 20h); superior appendages not broad and without an apical spine (Fig. 18i, j) 10

10a. Fronto-clypeal suture with a black line; superior appendages without a ventral process (Fig. 18i) ..... *californica* (p. 108)

10b. Fronto-clypeal suture with a light brown line; superior appendages with a ventral process (Fig. 18j) ..... *multicolor* (p. 119)

11a. Rear of head partly yellow; lateral carina of abdominal segment 7 strongly curved in ventral view (Fig. 20q) ..... *umbrosa* (p. 129)

11b. Rear of head black; lateral carina of segment 7 more or less straight in ventral view (Fig. 20p) 12

12a. Fronto-clypeal suture with a black line ..... *palmata* (p. 120)

12b. Fronto-clypeal suture with a light brown line ..... *constricta* (p. 111)

FEMALES

1a. Abdominal segment 1 with a ventral tubercle (Fig. 20h) 2

1b. Abdominal segment 1 without a ventral tubercle 3

2a. Fronto-clypeal suture with a black line; hindwing less than 40 mm ..... *californica* (p. 108)

2b. Fronto-clypeal suture with a light brown line; hindwing more than 40 mm ..... *multicolor* (p. 119)

3a. Lateral thoracic stripes more than 1 mm broad, when narrower never S-shaped 5

3b. Lateral thoracic stripes less than 1 mm broad, the mesepimeral stripe bent twice at alternate angles (Fig. 19i, j) 4

4a. Transverse frontal stripe produced forward on each side of the T-spot (Fig. 20f) ..... *sitchensis* (p. 124)

4b. Transverse frontal stripe not produced forward on each side of the T-spot (Fig. 20g) ..... *septentrionalis* (p. 122)

5a. Basal plate of ovipositor bilobate; lateral plates absent (Fig. 20c) 6

5b. Basal plate of ovipositor with posterior margin straight or slightly curved; lateral plates present (Fig. 20a, b) 7

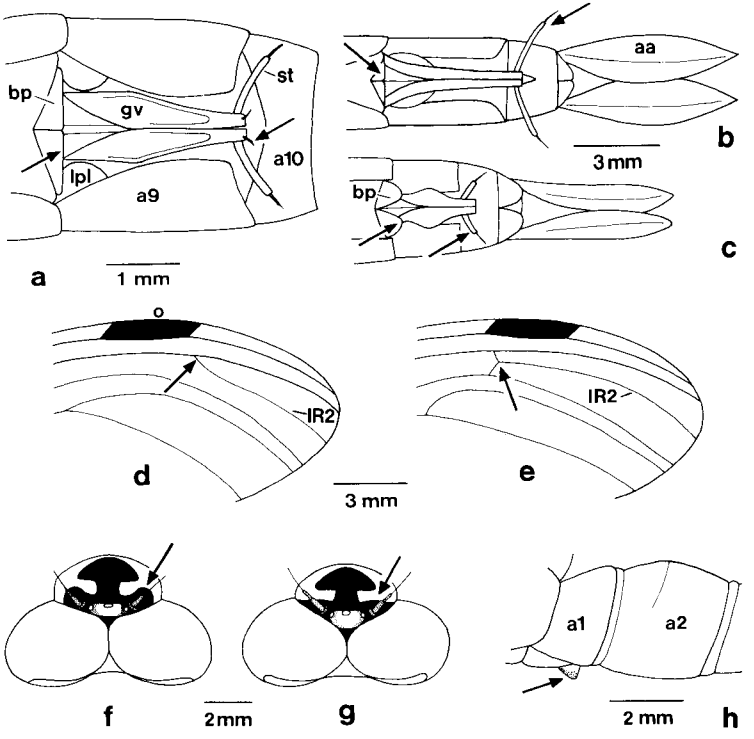


Fig. 20. *Æshna:* Ventral view of female genitalia (**a–c**), apex of forewing (**d, e**), dorsum of head (**f, g**) and lateral view of base of abdomen (**h**); **a**, *A. interrupta;* **b**, *A. constricta;* **c**, *A. juncea;* **d**, *A. interrupta;* **e**, *A. eremita;* **f**, *A. sitchensis;* **g**, *A. septentrionalis;* **h**, *A. californica* (*see* page 243 for explanation of letters).

6a. Lateral thoracic stripes broad and straight (Fig. 19g); anal appendages shorter than abdominal segments 8+9 (5 mm or less) ..... *juncea* (p. 117)

6b. Lateral thoracic stripes wavy in front, the mesepimeral stripe with a slender, posterior offshoot from the dorsal end (Fig. 19h); anal appendages about as long as segments 8+9 (6–7 mm) ..... *subarctica* (p. 125)

7a. Styli much shorter than abdominal segment 10 (1 mm or less) (Fig. 20a); anal appendages less than 1.5 mm wide 9

7b. Styli at least as long as segment 10 (1.5–2 mm) (Fig. 20b) 8

8a. Mesepimeral stripe nearly straight in front, tapering dorsally; metepimeral stripe not widened dorsally (Fig. 19a); genital valves 3–3.5 mm long, the apices bearing a minute pencil of hairs (*see* Fig. 20a) ..... *tuberculifera* (p. 127)

8b. Mesepimeral stripe wavy in front, with a posterior offshoot from the dorsal end; metepimeral stripe widened dorsally (Fig. 19m); genital valves 4–4.5 mm long, the apices without a pencil of hairs ..... *constricta* (p. 111)

9a. Fronto-clypeal suture with a light brown line 10

9b. Fronto-clypeal suture with a black line 11

10a. Lateral thoracic stripes green or rarely blue; the mesepimeral stripe wavy in front, the metepimeral stripe triangular (Fig. 19f); genital valves 2.0–2.6 mm long, the apices bearing a minute pencil of hairs (*see* Fig. 20a) ..... *canadensis* (p. 110)

10b. Lateral thoracic stripes yellow, darkly margined; the mesepimeral stripe straight in front, the metepimeral stripe not triangular (Fig. 19k); genital valves 2.7–3.0 mm long, the apices without a pencil of hairs ..... *umbrosa* (p. 129)

11a. Genital valves 3–3.5 mm long, the apices without a minute pencil of hairs; lateral thoracic stripes straight and about 1 mm broad ..... *palmata* (p. 120)

11b. Genital valves 2–2.5 mm long, the apices bearing a minute pencil of hairs (Fig. 20a) 12

12a. Lateral thoracic stripes very narrow (Fig. 19c, d), often divided into two spots (Fig. 19b); vein 1R2 normally arising beyond the middle of the pterostigma (Fig. 20d) ..... *interrupta* (p. 115)

12b. Lateral thoracic stripes wide, the mesepimeral stripe wavy in front, the metepimeral stripe widened dorsally (Fig. 19e); vein 1R2 normally arising before the middle of the pterostigma (Fig. 20e) ..... *eremita* (p. 113)

LARVÆ

1a. Labial palps tapering to slender points (Fig. 21a) ..... *constricta* (p. 111)

1b. Labial palps truncate or abruptly hooked (Fig. 21b, j) 2

2a. Antennæ with 6 segments 3

2b. Antennæ with 7 segments 4

3a. Greatest width of folded labium about six tenths of length; basal width of prementum about half of apical width (Fig. 21b) ..... *septentrionalis* (p. 122)

3b. Greatest width of folded labium about seven tenths of length; basal width of prementum about six tenths of apical width (Fig. 21c) ..... *sitchensis* (p. 124)

4a. Greatest width of folded labium about four fifths of length; basal width of prementum about half of apical width (Fig. 21d, e) 5

4b. Greatest width of folded labium less than three quarters of length; basal width variable 6

5a. Posterior supracoxal process much larger than anterior one (Fig. 21o); lateral spines on segment 6 half as long as the distance from base of spine to posterior margin of segment; width of head less than 7.5 mm ..... *californica* (p. 108)

5b. Supracoxal processes of about equal size (Fig. 21n); lateral spines on segment 6 less than half as long as the distance from base of spine to posterior margin of segment; width of head over 7.5 mm ..... *multicolor* (p. 119)

6a. Greatest width of folded labium about six elevenths of length (Fig. 21f) ..... *tuberculifera* (p. 127)

6b. Greatest width of folded labium about six tenths or more of length 7

7a. Short lateral spines on segment 5; posterolateral margins of head angulate (Fig. 21p) ..... *eremita* (p. 113)

7b. No lateral spines on segment 5; posterolateral margins of head more rounded (Fig. 21q, r) 8

8a. Lateral spines on segment 6 vestigial, being merely acute angular prolongations of the posterior corners of the segment, at most about a quarter as long as the distance from base of spine to posterior margin of segment (Fig. 21s, t) 9

8b. Lateral spines on segment 6 well developed though sometimes small, usually more than a third as long as the distance from base of spine to posterior margin of segment 10

9a. Labial palp more than 1.5 times as wide as the movable hook, measured at the base of the hook; apical margin of palp squarely truncate (Fig. 21h) ..... *juncea* (p. 117)

9b. Labial palp less than 1.5 times as wide as the movable hook, measured at the base of the hook; anterior apical angle of palp broadly rounded (Fig. 21i) ..... *subarctica* (p. 125)

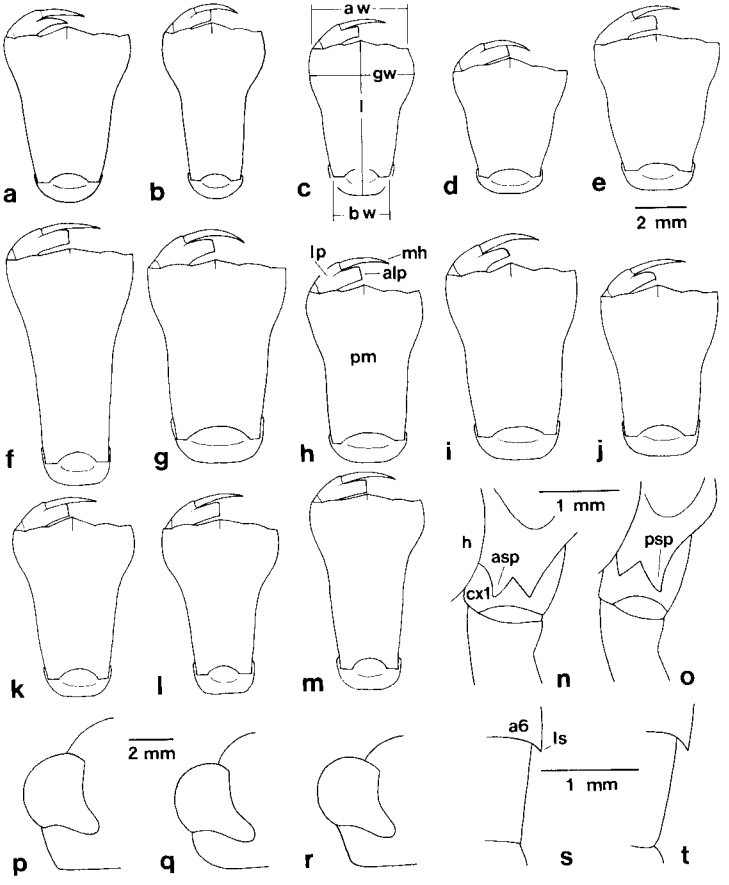


Fig. 21. *Æshna* larval structures: Ventral view of folded labium (**a–m**), dorsal view of supracoxal processes (**n, o**), dorsal view of left side of head (**p–r**), and posterolateral margin of abdominal segment 6 (**s, t**); **a,** *A. constricta;* **b,** *A. septentrionalis;* **c,** *A. sitchensis;* **d,** *A. californica;* **e,** *A. multicolor;* **f,** *A. tuberculifera;* **g,** *A. eremita;* **h,** *A. juncea;* **i,** *A. subarctica;* **j,** *A. canadensis;* **k,** *A. interrupta;* **l,** *A. palmata;* **m,** *A. umbrosa;* **n,** *A. multicolor;* **o,** A. *californica;* **p,** *A. eremita;* **q,** *A. interrupta;* **r,** *A. palmata;* **s,** *A. juncea;* **t,** *A. subarctica* (*see* p. 243 for explanation of letters). (On figure **c**, l=length of folded labium, gw=greatest width of labium, bw=basal width of prementum and aw=apical width of prementum.)

10a. Labial palp ending in an abruptly curved, almost truncate hook (Fig. 21j) ..... *canadensis* (p. 110)

10b. Labial palp squarely truncate, the anterior apical angle hardly rounded (Fig. 21k) 11

11a. Basal width of prementum about five elevenths of width at papal base (Fig. 21k); lateral margins of head behind the eyes convexly curved (Fig. 21q); ovipositor of female not quite reaching posterior margin of segment 9 ..... *interrupta* (p. 115)

11b. Basal width of prementum about half or less of width at palpal base; lateral margins of head behind the eyes nearly straight (Fig. 21r); ovipositor of female reaching the posterior margin of segment 9 12

12a. Supracoxal processes about equal in length and width; greatest width of folded labium usually six elevenths or more of its length (Fig. 21l); ovipositor of female extending well over the posterior margin of segment 9 ..... *palmata* (p. 120)

12b. Posterior supracoxal process distinctly wider than anterior one; greatest width of folded labium usually about six tenths of its length (Fig. 21m); ovipositor of female reaching just to the posterior margin of segment 9 ..... *umbrosa* (p. 129)

Æshna californica Calvert

A. californica Calvert, 1905. Odon. Centr. Amer. p. 183

A. californica, Walker, 1958. Odonata of Canada and Alaska 2:113

californica=from California; the species was first described from this state.

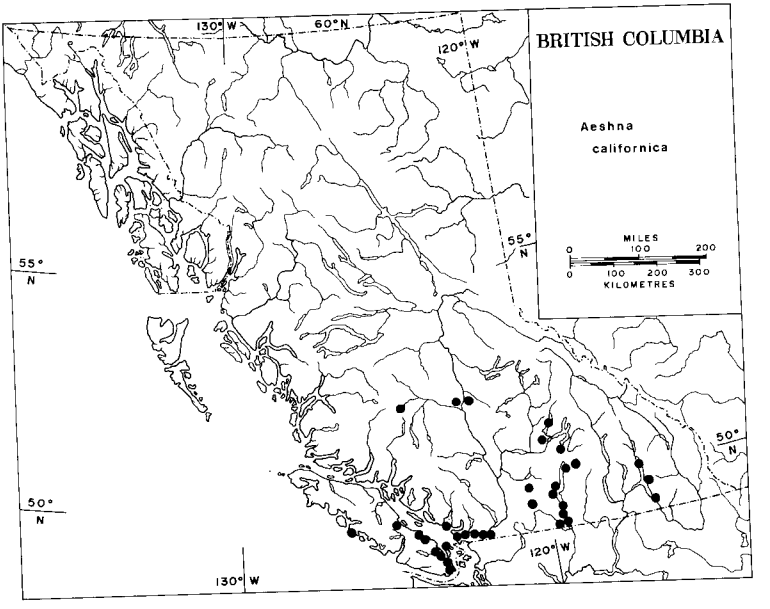
Distinguishing characteristics—Male: Length, 57–64 mm; hindwing, 38–49 mm. Face blue or green; labrum blue to yellow; fronto-clypeal suture with a black line; eyes, in life, pure blue. Thorax dark brown; mesepisternal stripe reduced to two pale yellow spots; lateral stripes bluish-white, shaped as in Fig. 19n, p. 102. Abdomen brown with typical blue spots except lateral spots on segment 2 and basal spots on segment 3, which are blue. Abdominal segment 1 with a ventral tubercle (Fig. 20h, p. 104). Anal appendages as in Fig. 18i, p. 101.

Female: Length, 58–60 mm; hindwing, 37–40 mm. Homeochromatic form brown with blue spots and blue eyes; heterochromatic form yellow-brown with yellow spots and green eyes. Fronto-clypeal suture with a black line. Abdominal segment 1 with a ventral tubercle (Fig. 20h, p. 104).

Larva: Length, 33–37 mm; metafemur, 5.5–6.0 mm. Head with posterolateral margins short, broadly curved. Folded labium, excluding palps, with greatest width about four fifths the length; prementum with basal width half of apical width; labial palps squarely truncate (Fig. 21d, p. 107). Supracoxal processes acute, the posterior process recurved, larger than anterior (Fig. 21o, p. 107). Abdomen with lateral spines on segments 6–9. Ovipositor not reaching posterior margin of segment 9.

Range—British Columbia south to Idaho, Arizona, and Baja California.

Distribution in British Columbia—Vancouver Island; the Mainland south of 52°N, the most northerly record being from Riske Creek, Chilcotin.



Field-notes—A. californica is a small southern species inhabiting a wide range of waters from the alkaline ponds of the Chilcotin and Okanagan to forest lakes on Vancouver Island. It is remarkable for its springtime flight period, emerging with the earliest spring dragonflies, *Enallagma boreale* and *Libellula quadrimaculata*. In Washington, *californica* may appear as early as April 1 (Kennedy, 1915), but in British Columbia the earliest record of flight is May 4. On July 21, oviposition was observed by Walker (1958) at the lake on Newcastle Island, Nanaimo: "The female rested on a water-

lily leaf and with the abdomen curved around the edge, inserted the eggs on the underside of the leaf." The punctures were arranged in radiating rows.

Unlike other British Columbia species of *Æshna, californica* has a flight period that is over before August. The latest record is from July 27.

Æshna canadensis Walker

A. canadensis Walker, 1908. Can. Ent. 40:384

A. canadensis, Walker, 1958. Odonata of Canada and Alaska 2:68

canadensis=from Canada; the species was named from specimens collected in eastern Canada.

Distinguishing characteristics—Male: Length, 64–72 mm; hindwing, 43–47 mm. Face blue or green; fronto-clypeal suture with a fine brown line; T-spot heavy. Thorax chocolate brown; mesepisternal stripe green, pointed ventrally, widened dorsally, often as two spots; lateral stripes blue-green, shaped as in Fig. 19f, p. 102. Abdomen dark brown with typical blue and yellow spots. Superior appendages with apices bearing a decurved terminal spine (Fig. 18g, p. 101). Hamular processes short and continuous with the hamular folds; spines of anterior lamina short and straight.

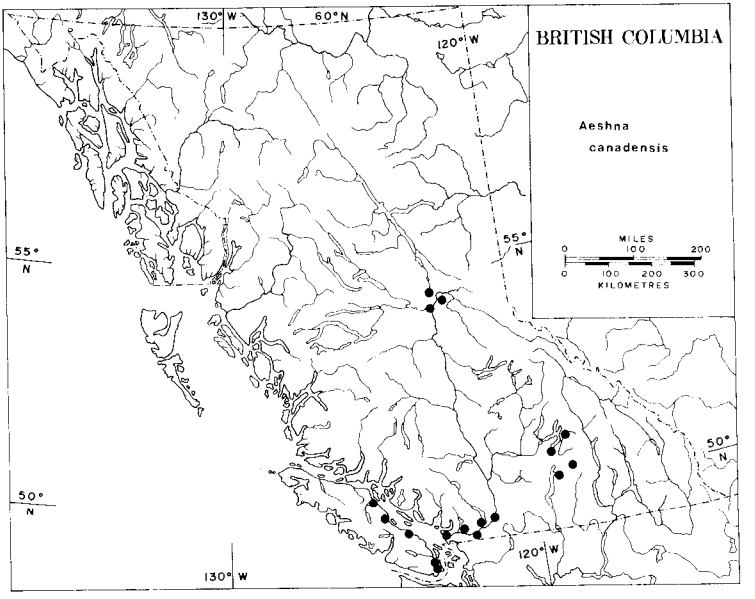
Female: Length, 66–73 mm; hindwing, 42–47 mm. The heterochromatic form, with yellow to blue-green spots, is most common, with colour graduations to the homeochromatic form less common. Mesepisternal stripes or spots narrower than male, often obscured by dull coloration. Genital valves 2.0–2.6 mm long, apices with a minute pencil of hairs.

Larva: Length, 35–40 mm; metafemur, 6.0–6.6 mm. Folded labium, excluding palps, with greatest width seven tenths of the length; prementum with basal width six tenths of the length; labial palp with an abruptly curved, truncate hook (Fig. 21j, p. 107). Supracoxal processes equal in length, posterior wider than anterior. Abdomen with lateral spines on segments 6–9. Ovipositor nearly reaching posterior margin of segment 9. Femur without dark markings; abdomen with well-defined mid-dorsal dark stripe.

Range—British Columbia east to Quebec and Newfoundland; south to Maryland, Missouri, and Washington.

Distribution in British Columbia—Recorded from eastern Vancouver Island, the Lower Mainland, and the North Okanagan-Shuswap and Prince George areas.

Field-notes—In British Columbia, *A. canadensis* is most common on Vancouver Island and in the Fraser Valley; in the Interior it is rather local. It is particularly partial to bodies of water with areas of flooded marginal



vegetation; beaver dams provide ideal habitats for this species (Walker, 1958). Whitehouse (1941) notes that when hunting for flies, *canadensis* "will follow the contour of the lakeshore, entering and searching the low bushes in a most systematic manner." At Cosens Bay Pond near Vernon, on September 9, 1976, *canadensis* was mating and ovipositing among the spike-rushes at the pond's edge. Other *Æshna* species present were *interrupta* and *juncea*.

British Columbia records for *canadensis* are from June 19 to September 29.

Æshna constricta Say

A. constricta Say, 1830. J. Acad. Phila. 8:11

A. constricta, Walker, 1958. Odonata of Canada and Alaska 2:109

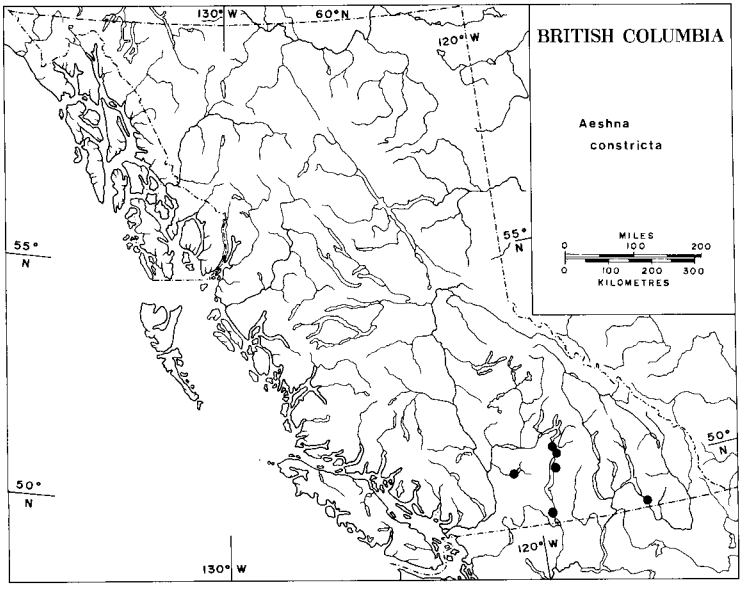
constricta=constricted; as in the males of all *Æshna* species, abdominal segment 3 is greatly narrowed.

Distinguishing characteristics—Male (Fig. 41b, p. 239): Length, 69–73 mm; hindwing, 42–45 mm. Face pale green-yellow; fronto-clypeal suture

with a fine brown line; T-spot dark brown. Thorax reddish-brown; mesepisternal stripe yellow-green, narrow; lateral stripes blue dorsally, yellow-green ventrally and margined with black, shaped as in Fig. 19m, p. 102. Abdomen dark brown with typical blue-green spots. Abdominal segment 7 with lateral carina more or less straight. Superior appendages broad with an apical ventral spine as in *palmata*.

Female: Length, 65–71 mm; hindwing, 43–45 mm. Homeochromatic form brown with blue-green spots, common; colour graduations to the heterochromatic form with bright yellow spots. Genital valves 4.0–4.5 mm long, the apices without a pencil of hairs; styli 2 mm long. Anal appendages as long as segments 8 and 9 together, apices acute (Fig. 20b, p. 104).

Larva: Length, 36–38 mm; metafemur, 6.0–6.2 mm. Head with well-rounded posterolateral angles. Folded labium, excluding palps, with greatest width three quarters of the length; prementum with basal width half of the apical width; labial palps tapered with slender, pointed apices (Fig. 21a, p. 107). Supracoxal processes equal in size, bluntly conical. Abdomen with lateral spines on segments 6–9. Ovipositor reaching the hind margin of segment 10. Femur without dark markings; mid-dorsal line pale between two dark stripes.



Range—British Columbia; Saskatchewan east to Nova Scotia; south to Maryland, Illinois, Colorado, and California.

Distribution in British Columbia—Recorded from Nicola, Enderby, Armstrong, Okanagan Landing, Oliver, and Creston.

Field-notes—A dragonfly that develops in slow streams and ponds in open marshes, *A. constricta* is not well known in British Columbia. It is seen most often in August when it may fly over fields far from water, often landing on vegetation close to the ground. The mating flight of the species is characteristically wild and erratic (Walker, 1958). Oviposition is reminiscent of *Lestes* since it is performed in aquatic plants between one-half and 1 metre above the water (Walker, 1958).

The few British Columbia records are from August; Whitehouse (1941) estimates the flight season to last from the third week in July well into October.

Æshna eremita Scudder

A. eremita Scudder, 1866. Proc. Boston Soc. Nat. Hist. 10:213

A. eremita, Walker, 1958. Odonata of Canada and Alaska 2:57

eremita=hermit; discovered by Scudder at Hermit Lake, New Hampshire.

Distinguishing characteristics—Male: Length, 72–79 mm; hindwing, 45–52 mm. Face and labium yellow-green, margined with black; frontoclypeal suture with a black line; T-spot black. Thorax brown; mesepisternal stripe bluish-green, sometimes divided into two spots; lateral stripes blue-green, shaped as in Fig. 19e, p. 102; blue patch below spiracle. Abdomen brown with a typical pattern of blue and yellow spots. Superior appendages with a low ventral prominence near the base, apices rounded (Fig. 18f, p. 101). Hamular processes short and continuous with hamular folds; anterior lamina with spines short and straight (Fig. 18k, p. 101).

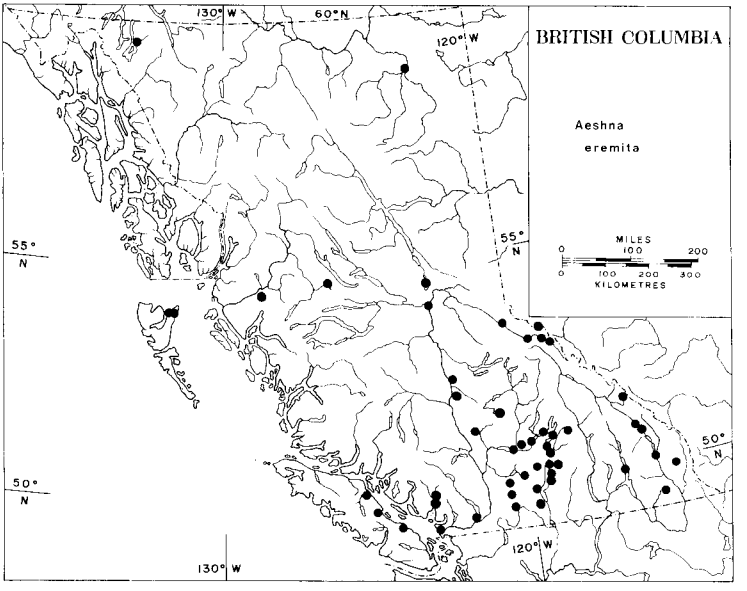
Female: Length, 66–78 mm; hindwing, 41–50 mm. Heterochromatic form with yellow-green markings is most common, but a blue homeochromatic form also occurs. Pale mesepisternal stripe divided into two distinct spots. Genital valves about as long as segment 9; apices with a minute pencil of hairs.

Larva: Length, 41–47 mm; metafemur, 7.5–8.7 mm. Head with posterolateral margins obtusely angulate (Fig. 21p, p. 107). Folded labium, excluding palps, with greatest width about seven tenths of the length; prementum with basal width six tenths of the apical width; labial palps squarely truncate (Fig. 21g, p. 107). Supracoxal processes equal in size, acute. Abdomen with lateral spines on segments 5–9, those on 5 very small.

Ovipositor not reaching posterior margin of segment 9. Femur brown with three pale rings; abdomen with a series of paired pale dorsal blotches each enclosing a median dark spot.

Range—Alaska east through the Northwest Territories to Labrador and Newfoundland; south to Massachusetts, Ohio, Wisconsin, Manitoba, and Utah.

Distribution in British Columbia—Throughout the Province.



Field-notes—This, our largest *Æshna,* tolerates a wide variety of habitats; it frequents almost all forested regions of Canada. *A. eremita* appears early in the summer; at Atlin recently emerged adults were observed on July 6 (Whitehouse, 1941) and Walker (1958) reports the species flying on June 11 near the same latitude in the Northwest Territories. Walker believes larvæ usually reach their full size in the summer and overwinter at this stage before emerging the next year. Females oviposit in floating or emergent vegetation, inserting their eggs in the plant tissue under water. Even such a large and aggressive species is often vulnerable to predation. Walker (1953) records an ovipositing female having her submerged abdomen seized by a full-grown larvæ of her own species. On July 10, 1976, at Davis

Lake north of Princeton, a male was observed emerging on a thistle at the side of a lake. After painstakingly expanding its body and wings in the sun it fluttered off on its first flight. It had flown only 20 metres when a Western Tanager (*Piranga ludoviciana*) swooped out of a nearby tree and snapped it up.

In British Columbia, *eremita* is known to fly between June 19 and September 21.

Æshna interrupta Walker

A. interrupta Walker, 1908. Can. Ent. 40:381

A. interrupta, Walker, 1958. Odonata of Canada and Alaska 2:60

interrupta=interrupted; the lateral thoracic stripes of the typical form are broken into two spots.

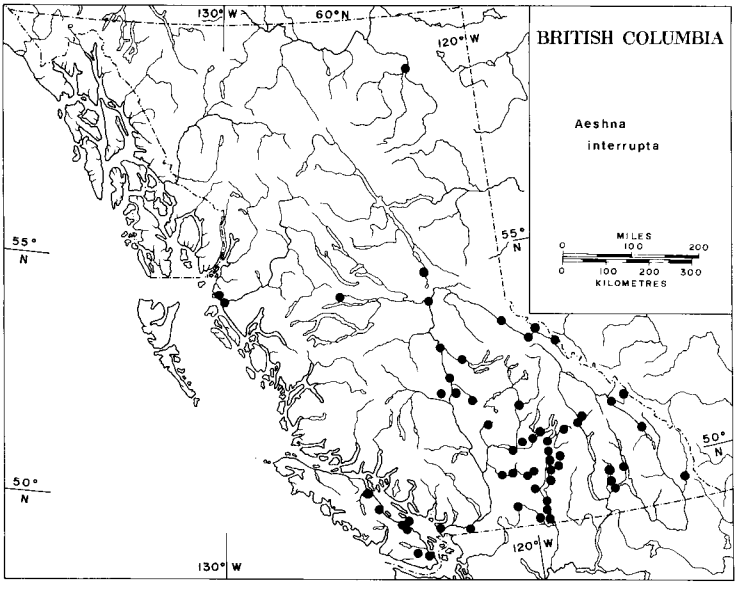
Distinguishing characteristics—Male: Length, 66–74 mm; hindwing, 41–47 mm. Face pale greenish-yellow; fronto-clypeal suture black; T-spot black, heavy. Thorax dull yellow to grey-brown; mesepisternal stripe absent or reduced to two narrow green spots; mesepimeral and metepimeral stripes, each reduced to two spots (*A. i. interrupta* Walker) or a narrow streak (*A. i. lineata* Walker and *A. i interna* Walker), are blue posteriorly and green anteriorly (Fig. 19b, c, d, p. 102). Abdomen brown with the typical pattern of blue and green spots. Wings with vein IR2 normally arising beyond the middle of the pterostigma (Fig. 20d, p. 104). *A. i. lineata* has lateral thoracic stripes usually 0.5–0.75 mm wide at lower end and the superior appendages without a ventral basal tubercle (Fig. 18d, p. 101); *A. i. interna* has these stripes usually 0.75–1 mm wide at lower end and the superior appendages with a basal tubercle (Fig. 18c, p. 101).

Female: Length, 61–70 mm; hindwing, 41–46 mm. Heterochromatic form with yellow-green markings; the homeochromatic, with blue-green markings. Genital valves reaching the posterior margin of segment 9; apices with a minute pencil of hairs (Fig. 20a, p. 104).

Larva: Length, 39–42 mm; metafemur, 6.5–7.2 mm. Head with postero-lateral angles broadly rounded (Fig. 21q, p. 107). Folded labium, excluding palps, with greatest width about seven tenths of the length; prementum with basal width five elevenths of the apical width; labial palps squarely truncate (Fig. 21k, p. 107). Supracoxal processes with anterior longer and more slender than posterior. Abdomen with lateral spines on segments 6–9. Ovipositor not reaching posterior margin of segment 9. Femur brown with three pale rings; abdomen mottled.

Range—Alaska east through the Northwest Territories to Newfoundland; south to New Hampshire, Michigan, North Dakota, and in the western mountains to New Mexico and California.

Distribution in British Columbia—Widespread south of 55°N, especially on the southern Interior Plateau; north of this latitude there is a record from Fort Nelson. Walker (1958) recognizes three distinct forms, but these are not definitely separated geographically (*see* below).



Field-notes—This is British Columbia's most variable *Æshna;* it is readily identified in the field by its dark thorax. According to Walker (1958), *A. i. interrupta* inhabits the forests of Canada east of the Great Plains and *A. i. lineata* is found on the prairies and in the British Columbia Interior. *A. i. interna* is a form of the mountains, typically ranging from the Selkirk Range and southern Rocky Mountains south to New Mexico. On the coast a form identical to the eastern *A. i. interrupta* appears. Since the ranges of these forms overlap considerably, especially in areas such as the Okanagan Valley, their validity as subspecies is questionable. Some specimens even show mixed characteristics; a specimen from Oyama has the left thoracic stripes typical of *interrupta* and those on the right typical of *interna*.

As *A. interrupta* is the dominant *Æshna* of the prairie provinces, it is not surprising it is also the commonest *Æshna* in the prairie-like country of the Cariboo and Chilcotin where it hawks over rangeland ponds. *A. interrupta* is known to fly long after dark. As dusk deepened at Nelson, on August 9, 1976, males of *A. i. interna* were feeding on teneral *Lestes disjunctus* and *Sympetrum pallipes* that were settling on the tall grasses at the edge of a pond. The flight of these *Æshna* males was unusually erratic.

Although there are several June records, *interrupta* usually does not emerge until July; there is an extraordinarily early record of May 27, 1923, at Oliver. Few specimens are seen after mid-September; the latest record is October 8.

Æshna juncea (Linnæus)

Libellula juncea Linnæus, 1758. Syst. Nat. p. 544

A. juncea, Walker, 1958. Odonata of Canada and Alaska 2:83

juncea=of the rushes; alluding to the insect's aquatic habitat.

Distinctive characteristics—Male: Length, 63–69 mm; hindwing, 42–46 mm. Face yellow to yellow-green; fronto-clypeal suture with a heavy black line; T-spot heavy. Thorax reddish-brown; mesepisternal stripe green; mesopleural sulcus sometimes with a green streak; lateral stripes blue dorsally, yellow-green ventrally, bordered with black, shaped as in Fig. 19g, p. 102; metepisternum with a wavy yellow streak or two spots. Abdomen red-brown with typical blue-green spots. Hamular processes short and continuous with hamular folds, apices acute and hooked; spines of anterior lamina curved ventrally (Fig. 18n, p. 101). Apices of superior appendages with a decurved terminal spine.

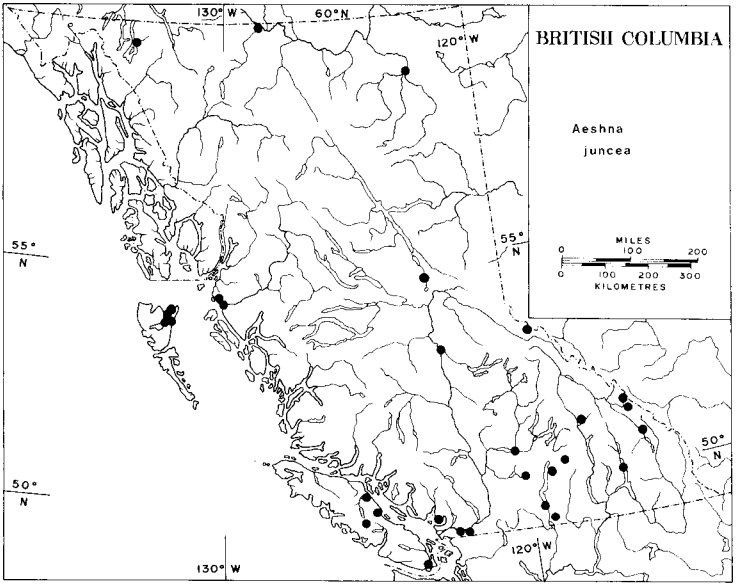
Female: Length, 61–66 mm; hindwing, 39–47 mm. Brown with pale spots varying from blue to greenish-yellow. Ovipositor with basal plate bilobed; lateral plates absent. Anal appendages 5 mm or less in length.

Larva: Length, 37–41 mm; metafemur, 6.2–6.9 mm. Folded labium, excluding palps, with greatest width six elevenths of the length; prementum with basal width six tenths of the apical width; labial palps truncate (Fig. 21h, p. 107). Supracoxal processes equal in length, the posterior wider than anterior. Abdomen with lateral spines on segments 6–9, spines on 6 minute. Ovipositor reaching posterior margin of segment 9. Femur without pale rings; mid-dorsal dark stripe divided by a pale line and bounded by two lateral pale stripes.

Range—Alaska east through the Mackenzie Delta to Labrador; south to Newfoundland and New Hampshire, Ontario, Manitoba, and in the moun-

tains from Alberta and British Columbia to Colorado. Also found in northern and alpine Europe and Asia. The North American subspecies is *A. j. americana.*

Distribution in British Columbia—Scattered localities throughout the Province.



Field-notes—This colourful *Æshna* of northern and mountainous regions is found in a variety of habitats, chiefly acidic waters. In Europe, studies have shown that eggs laid in summer hatch the following spring; the larvæ develop through 13 instars, usually taking four years to produce the adult (Walker, 1958). Emergence has been recorded by Walker on June 16 (Prince Rupert) and by Whitehouse in the second week of July (Atlin). Mating was observed August 12, 1974, around the bog ponds near Masset, Queen Charlotte Islands.

Known dates of flight in British Columbia are from June 10 to September 9.

Æshna multicolor Hagen

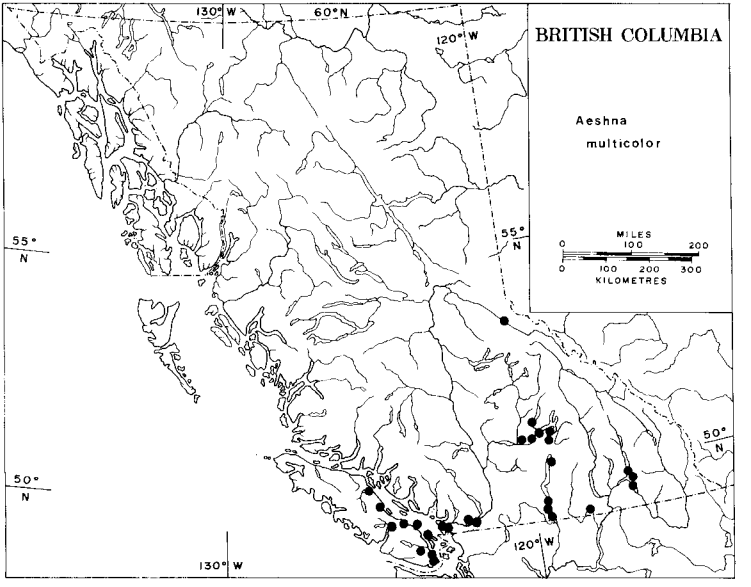
A. multicolor Hagen, 1861. Syn. Neur. N. Amer. p. 121

A. multicolor, Walker, 1958. Odonata of Canada and Alaska 2:117

multicolor=many coloured; an inappropriate name for this predominantly blue species.

Distinguishing characteristics—Male: Length, 67–70 mm; hindwing, 43–45 mm. Face pale blue; fronto-clypeal suture with a light brown line; eyes, in life, bright blue. Thorax coppery-brown; mesepisternal, mesepimeral, and metepimeral stripes pale blue, sometimes green ventrally, shaped as in Fig. 19o, p. 102. Abdomen dark coppery-brown with typical blue spots. Abdominal segment 1 with a ventral tubercle. Superior appendages with a ventral hooked process (Fig. 18j, p. 101).

Female: Length, 65–68 mm; hindwing, 42–44 mm. Homeochromatic form not known. Heterochromatic form with green spots and blue eyes; intermediates with blue-green spots also common. Abdominal segment 1 with a ventral tubercle (Fig. 20h, p. 104).



Larva: Length, 35–40 mm; metafemur, 6.0–6.5 mm. Folded labium, excluding palps, with greatest width about eight tenths of the length; prementum with basal width about half of the apical width; labial palps squarely truncate (Fig. 21e, p. 107). Supracoxal processes equal in size, short and conical (Fig. 21n, p. 107). Abdomen with lateral spines on segments 6–9, spines on 6 vestigial. Ovipositor not reaching posterior margin of segment 9. Femur with three pale rings; dorsal pattern mottled, obscure.

Range—British Columbia south through Idaho, Kansas, Colorado, and California to Texas, Arizona, Mexico, and Panama.

Distribution in British Columbia—Widespread south of 51°N; surprisingly common at McBride, well north of its typical habitat.

Field-notes—*A. multicolor* is easily recognized in the field by its sky-blue eyes and face. It is one of the commonest species in the southwest of the Province from June through August, replacing the earlier-flying *A. californica*. Walker (1958) states that *multicolor* "is a lover of the open spaces and may be seen in numbers coursing swiftly over fields and roads in sunshine. In this habit it resembles *Anax junius* and *Æshna constricta*." On June 26, 1976, on a stagnant stretch of Colquitz Creek, Victoria, *multicolor* males flew beats of about 100 metres in length, frequently dashing off to chase other insects and even clashing with, and driving off, low-flying Barn Swallows (*Hirundo rustica*). Females secretively hovered among the emergent grasses, landing now and then on floating debris. Resting horizontally, they laid eggs in submerged sticks, algal mats, and floating cat-tail (*Typha*) leaves.

Records in British Columbia range from May 18 to October 16.

Æshna palmata Hagen

A. palmata Hagen, 1856. Stett. Ent. Zeit. 17:369

A. palmata, Walker, 1958. Odonata of Canada and Alaska 2:99

palmata=hand-shaped; the superior appendages of the male have broad, flattened tips.

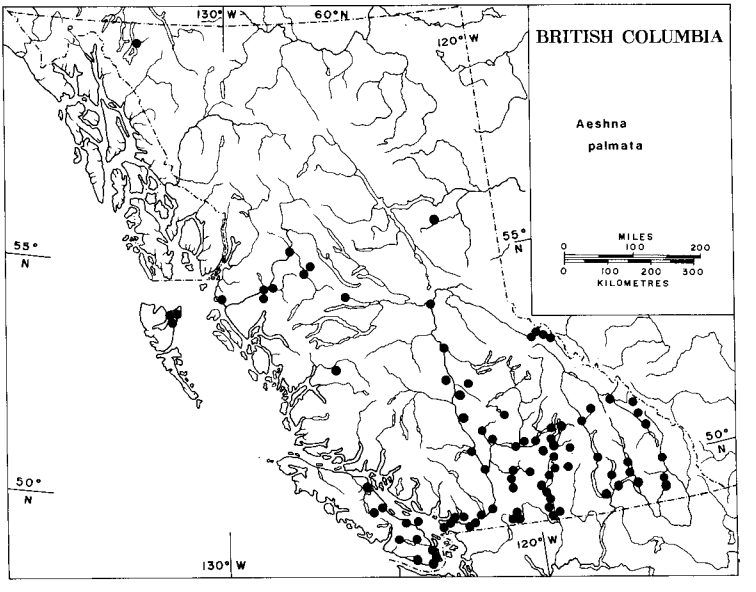
Distinguishing characteristics—Male: Length, 69–74 mm; hindwing, 42–46.5 mm. Face pale green or greenish-yellow; fronto-clypeal suture with a black line; T-spot black, sometimes obscured by dark markings. Thorax dark reddish-brown; mesepisternal stripe yellowish-green; lateral stripes bright greenish-yellow, often blue dorsally, shaped as in Fig. 19l, p. 102; metepisternum with two green spots. Abdomen brown with typical blue and yellow spots. Superior appendages as in Fig. 18h, p. 101.

Female: Length, 63–70 mm; hindwing, 39–43 mm. Homeochromatic form reddish-brown with blue spots, rare; heterochromatic form with greenish-yellow spots, common; intermediate most common. Thoracic stripes may be reduced or obscured. Genital valves 3.0–3.5 mm long, apices without a pencil of hairs.

Larva: Length, 37–43 mm; metafemur, 7.5–8.0 mm. Head with lateral margins long and straight; posterolateral angles not broadly rounded (Fig. 21r, p. 107); folded labium, excluding palps, with greatest width about six elevenths of the length; prementum with basal width half the apical width (Fig. 21l, p. 107). Supracoxal processes equal in length, the posterior slightly wider than anterior. Abdomen with lateral spines on segments 6–9, spines divergent except spines on 9 parallel. Ovipositor extending beyond posterior margin of segment 9.

Range—Alaska south through British Columbia and the Rocky Mountains of Alberta to California, Utah, and Colorado; also in Cypress Hills, Saskatchewan; Kamchatka.

Distribution in British Columbia—Widespread throughout the Province.



Field-notes—*A. palmata* is the commonest and most widely distributed *Æshna* in British Columbia, perhaps even the most often-observed dragonfly in the Province. Its abundance may be due to tolerance of a wide variety of larval habitats, although typically it develops in partly shaded ponds in or near woodland. At Atlin near the Yukon boundary it develops in warm springs. Emergence has been recorded from July 9 (Prince Rupert) to July 28 (Mount Robson) and mating from July 20 to August 12 (Tow Hill, Queen Charlotte Islands). The latest oviposition date is October 11 (Victoria). *A. palmata* usually is not seen until July although there are several records from late June. A single record from Lillooet on May 22, 1950, is exceptional. The latest date *palmata* has been collected is November 1.

Æshna septentrionalis Burmeister

A. septentrionalis Burmeister, 1839. Handb. Ent. 2:839

A. cærulea septentrionalis Walker, 1908. Can. Ent. 40:386

A. septentrionalis, Walker, 1958. Odonata of Canada and Alaska 2:94

septentrionalis=northern; alluding to the distribution of the species.

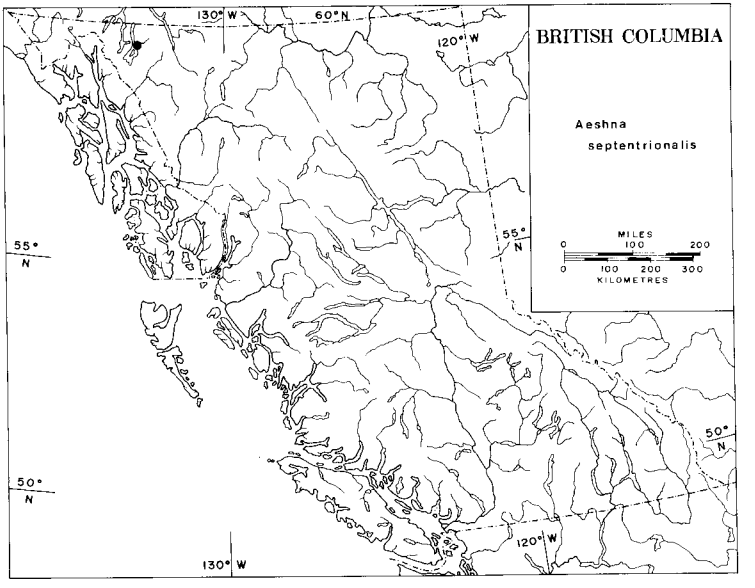
Distinguishing characteristics—Male: Length, 45–47 mm; hindwing, 38–39 mm. Face olive-green; similar to *A. sitchensis* but the transverse frontal bar of the T-spot straight, not crescentic (Fig. 20g, p. 104). Thorax dull grey-olive; lateral stripes pale green as in *A. sitchensis* except metepimeral stripe slightly curved (Fig. 19i, p. 102). Abdomen dark brown with typical blue spots. Anterior lamina with spines shorter than the hamular processes, straight and blunt (Fig. 18m, p. 101). Superior appendages with an apical dorsal ridge, apex rounded.

Female: Length, 45–46 mm; hindwing, 37–39 mm. Homeochromatic form olive-brown with blue spots; heterochromatic form with yellow-green spots. Very similar to *A. sitchensis* except the T-spot lacks a crescentic base. Anal appendages tapered more towards base than towards apex.

Larva: Length, 35–38 mm; metafemur, 6.5–7.2 mm. Head with posterolateral angles broadly rounded; folded labium, excluding palps, with greatest width six tenths of the length; prementum with basal width about half the apical width (Fig. 21b, p. 107). Supracoxal processes equal in length, posterior much wider than anterior. Abdomen with lateral spines on segments 6–9, spines on 6 vestigial or absent. Ovipositor reaching posterior margin of segment 9.

Range—Yukon Territory east to the Mackenzie Delta, Hudson Bay, Ungava, and Labrador; south to Newfoundland, New Hampshire, James Bay, Great Slave Lake, and south in the Rocky Mountains to 51°N.

Distribution in British Columbia—Atlin; undoubtedly in the Rocky Mountains of British Columbia since is has been collected at Banff and Boom Creek, Alberta, the latter on the British Columbia boundary.



Field-notes—*A. septentrionalis* is closely related to *A. sitchensis* but has a more northerly distribution; it has been found at almost 70°N (Walker and Corbet, 1975). Nevertheless, *septentrionalis* emerges two or three weeks earlier than *sitchensis* in the same habitat (Whitehouse, 1941). *A. septentrionalis* typically flies with *Somatochlora septentrionalis* and *Leucorrhinia hudsonica*. According to Whitehouse the requirements of *septentrionalis* are strict; "they require a small bog pool with an edge levelling off into muskeg slime and wet moss, for . . . it is in such that eggs are deposited." Oviposition has been recorded on July 14 (Whitehouse, 1941). Although this species has been recorded flying from July 28 to August 28, the flying period is estimated to be from June 25 to mid-September.

Æshna sitchensis Hagen

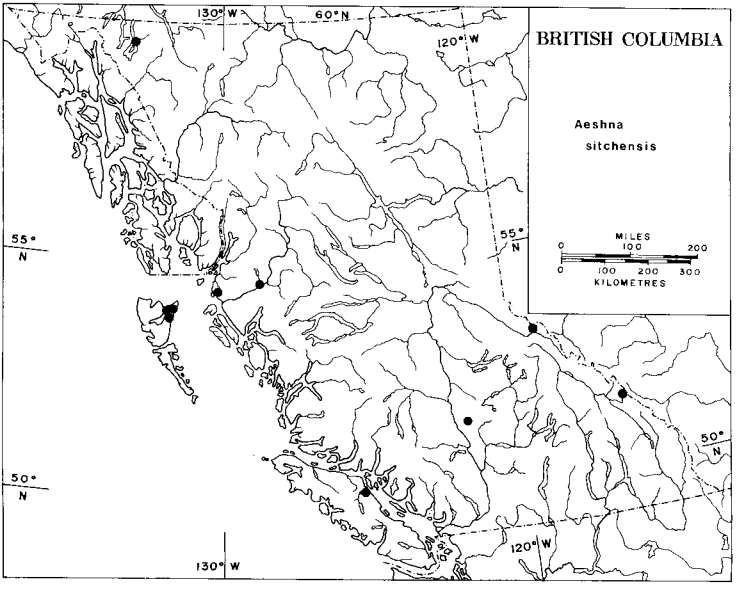
A. sitchensis Hagen, 1861. Syn. Neur, N. Amer. p. 119

A. sitchensis, Walker, 1958. Odonata of Canada and Alaska 2:90

sitchensis=from Sitka; the first specimens described came from Sitka, capital of Russian Alaska.

Distinguishing characteristics—Male: Length, 57–60 mm; hindwing, 38–41 mm. Face green; fronto-clypeal suture with a black line; T-spot heavy and with a crescentic base (Fig. 20f, p. 104). Thorax dull olive; mesepisternal stripe reduced to two yellow spots; lateral stripes yellow, bluish dorsally, shaped as in Fig. 19j, p. 102; metepisternum with a pale yellow streak. Abdomen brown with typical blue-green spots. Anterior lamina with spines longer than the hamular processes, curved ventrally and tapering to a point (Fig. 18l, p. 101). Superior appendages straight in lateral view, apices with decurved spine.

Female: Length, 57–59 mm; hindwing, 36–40 mm. Homeochromatic form with blue-green spots; heterochromatic form with yellow-green spots.



Transverse frontal stripe produced forward on each side of the T-spot to form a crescentic base. Anal appendages tapered equally at base and apex.

Larva: Length, 30–31 mm; metafemur, 5.2–6.0 mm. Head with well-rounded posterolateral angles; folded labium, excluding palps, with greatest width seven tenths of the length; prementum with basal width six tenths of the apical width (Fig. 21c, p. 107). Supracoxal processes equal in length, posterior wider than anterior. Abdomen with lateral spines on segments 7–9, spines on 7 very short. Ovipositor extending beyond the posterior margin of segment 9.

Range—Alaska east to Hudson Bay, Labrador, and Newfoundland; south to Maine, central Ontario, Michigan, southern Manitoba, the Alberta Rocky Mountains, and British Columbia.

Distribution in British Columbia—Scattered localities from Atlin in the north to Field in the southeast; coastal British Columbia from Prince Rupert and the Queen Charlotte Islands south to central Vancouver Island.

Field-notes—This small species is common only in northern bogs. Walker (1927) found exuviæ at Prince Rupert in June and Whitehouse observed emergence on July 14 at Atlin. Recently emerged adults of both sexes were flying among the Sitka spruces near the mouth of the Oeanda River, Queen Charlotte Islands, on August 1, 1974. These insects frequently landed on tree trunks and logs lying on the sand dunes. As noted by Whitehouse (1941), *sitchensis* is extraordinarily tame compared to other species of *Æshna,* and several were picked off tree trunks with the fingers. Oviposition is recorded from August 5 to 9 by Walker (1958); females thrust their eggs into wet *Sphagnum* moss. On the Mainland, *sitchensis* usually flies with *Somatochlora franklini.*

A. sitchensis has been recorded from July 14 to August 29 in British Columbia. The average flight period is probably from the third week of June to the second week of September (Walker, 1958).

Æshna subarctica Walker

A. subarctica Walker, 1908. Can. Ent. 11:385

A. subarctica, Walker, 1958. Odonata of Canada and Alaska 2:87

subarctica=subarctic; referring to the northern distribution of the species.

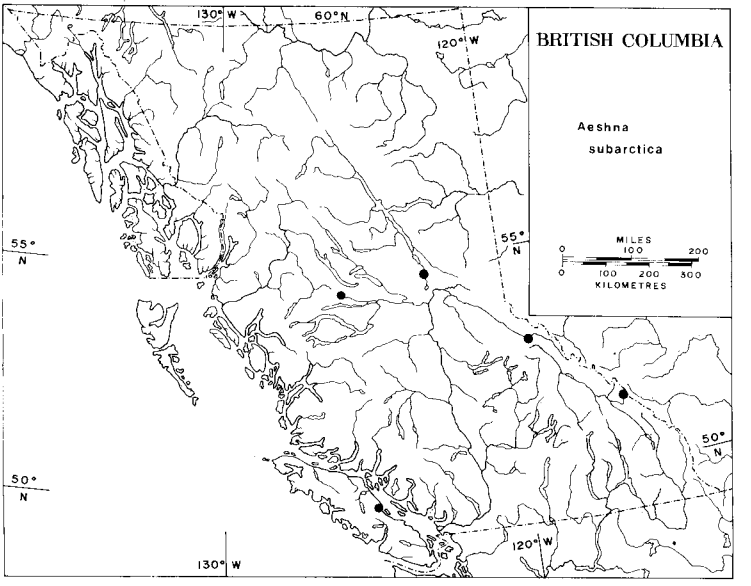
Distinguishing characteristics—Male: Length, 65–70 mm; hindwing, 42–46 mm. Head as in *A. juncea.* Thorax dark brown to almost black ventrally; mesepisternal stripe yellow-green, strongly curved dorsally; mesopleural sulcus with a faint yellow streak; lateral stripes light blue dorsally,

greenish-yellow ventrally, shaped as in Fig. 19h, p. 102; metepisternum with a long blue spot above the spiracle and a triangular yellow spot below. Abdomen dark brown with typical green-blue spots. Hamular processes long and narrow, not continuous with the hamular folds, apices rounded and obscuring the hamular folds; anterior lamina with straight spines (Fig. 18o, p. 101).

Female: Length, 63–69 mm; hindwing, 39–45 mm. Homeochromatic form with pale blue to white spots; heterochromatic form with yellow spots. Very similar to *A. juncea* except the anal appendages are 5–7 mm long. Ovipositor with basal plates bilobed (Fig. 20c, p. 104).

Larva: Length, 40–42 mm; metafemur, 6–7 mm. Folded labium, excluding palps, with greatest width seven tenths of the length; prementum with basal width six tenths of the apical width; labial palps tapering apically, anterior angle rounded. Supracoxal processes equal in length, posterior wider than anterior. Abdomen with lateral spines on segments 6–9, spines on 6 vestigial. Ovipositor barely reaching posterior margin of segment 9. Femur without pale rings; abdomen with a dark mid-dorsal stripe.

Range—British Columbia north to the Mackenzie Delta; east to James Bay and Newfoundland; south to Nova Scotia, Quebec, central Ontario, northern Michigan, and Manitoba. Also northern and central Europe.



Distribution in British Columbia—The central part of the Province; Burns Lake and Crooked River southeast to Field. Also known from Courtenay, Vancouver Island.

Field-notes—A. subarctica is closely related to *A. juncea* and is often found in the same habitat. In British Columbia, *subarctica* is the rarer of the two species, although its distribution in the north is probably more extensive than the scanty records indicate. In both North America and Europe *subarctica* is a typical dragonfly of sphagnum bogs and cold northern swamps. At Tête Jaune, Whitehouse (1941) found the species restricted to "muskeg pools bordering a large, reedy slough", whereas *A. palmata, umbrosa,* and *eremita* patrolled the slough itself. At 11 a.m. on August 5, 1976, at a small forest pond near Crooked River Park north of Prince George, a female *subarctica* emerged to fly with *A. juncea* and *A. interrupta.* British Columbia records of *subarctica* are from August 5 to September 4; Walker estimates the species flies from early July to mid-September.

Æshna tuberculifera Walker

A. tuberculifera Walker, 1908. Can. Ent. 40:385

A. tuberculifera, Walker, 1958. Odonata of Canada and Alaska 2:79

tuberculifera=bearing a tubercle; the superior appendage of the male bears a distinctive basal knob.

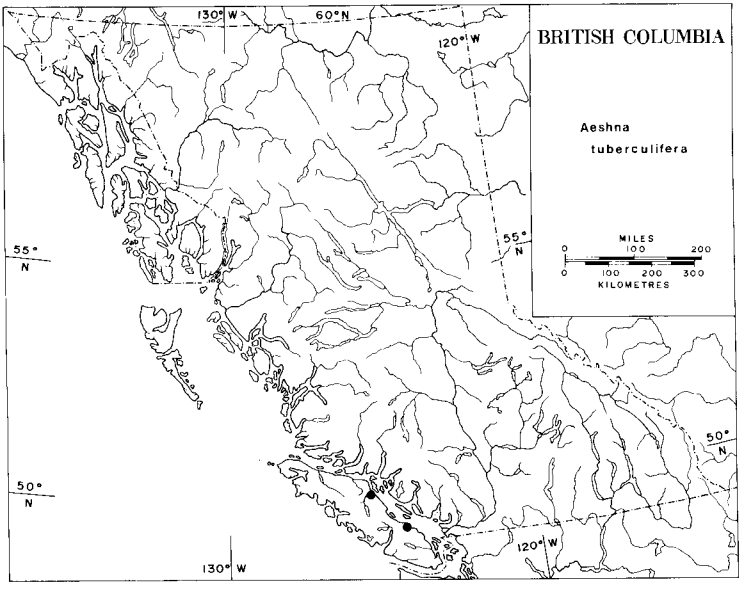
Distinguishing characteristics—Male: Length, 72–74 mm; hindwing, 45–49 mm. Face olive-green; fronto-clypeal suture with a fine brown line; T-spot black. Thorax dark brown; mesepisternal stripe green, almost straight; lateral stripes blue dorsally, green ventrally, shaped as in Fig. 19a, p. 102. Abdomen brown with typical blue spots except lateral spots small or absent and segment 10 wholly black. Superior appendages with a prominent ventral basal tubercle (Fig. 18e, p. 101).

Female: Length, 71–78 mm; hindwing, 44–51 mm. Homeochromatic form, with blue spots, most common. Genital valves 3.0–3.5 mm long, apices with a minute pencil of hairs; styli long, about 1.5 mm.

Larva: Length, 41–45 mm; metafemur, 7.7–8.3 mm. Folded labium, excluding palps, with greatest width five elevenths of length; prementum with basal width one half the apical width; labial palps squarely truncate (Fig. 21f, p. 107). Supracoxal processes equal in length, the posterior wider than anterior. Abdomen with lateral spines on segments 6–9. Ovipositor extending slightly beyond the posterior margin of segment 9. Femur with two pale apical rings; dorsum mottled.

Range—Wisconsin to Nova Scotia south to Pennsylvania and Indiana; also in coastal British Columbia and Washington.

Distribution in British Columbia—Found in the Nanaimo and Campbell River districts on Vancouver Island.



Field-notes—This species, though locally common, is known in British Columbia only from boggy-margined ponds and lakes on Vancouver Island. Near Wellington, Vancouver Island, Walker (1958) recorded *tuberculifera* emerging from July 31 to August 3. Whitehouse (1941) observed oviposition in mid-August, noting that the females landed on sedges growing in shallow water and punched eggs into the stems, apparently above the waterline.

Whitehouse assumes the flight period lasts from early July well into September; actual records in British Columbia are from July 26 to August 19.

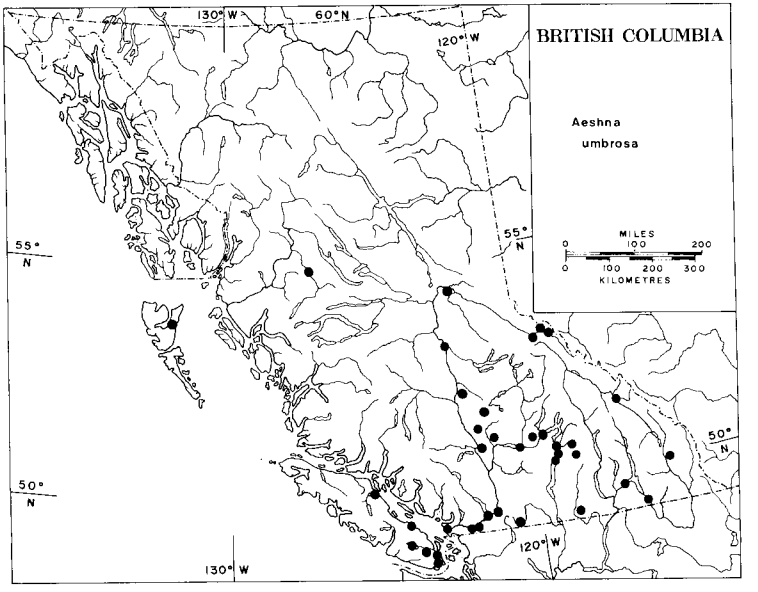
Æshna umbrosa Walker

A. umbrosa, Walker, 1908. Can. Ent. 40:380

A. umbrosa, Walker, 1958. Odonata of Canada and Alaska 2:102

umbrosa=shady; a reference to the distinct preference of the species for shady habitats.

Distinguishing characteristics—Male: Length, 64-73 mm; hindwing, 41–47 mm. Face pale bluish-green; rear of head partly yellow; fronto-clypeal suture with a fine brown line; T-spot dark brown. Thorax dark reddish-brown; mesepisternal stripes yellow-green; lateral stripes yellow or greenish-yellow margined with dark brown, shaped as in Fig. 19k, p. 102; metepisternum sometimes with two green spots near the spiracle. Abdomen dark brown with a greenish tinge, the dorsal spots small and green. In *A. u. occidentalis* Walker, these spots are large and blue. Abdominal segment 7 with lateral carina strongly curved in ventral view (Fig. 18q, p. 101). Superior appendages similar to those of *A. palmata,* broad with an apical ventral spine.



Female: Length, 65–71 mm; hindwing, 38–47 mm. Homeochromatic form dark reddish-brown with green spots. Genital valves 2.7–3.0 mm long, apices without a pencil of hairs.

Larva: Length, 39–44 mm; metafemur, 7.0–7.2 mm. Folded labium, excluding palps, with greatest width six tenths of the length; prementum with basal width half the apical width; labial palps squarely truncate (Fig. 21m, p. 107). Supracoxal processes with posterior longer and wider than anterior. Abdomen with lateral spines on segments 6–9. Ovipositor reaching the posterior margin of segment 9.

Range—The Yukon east to Hudson Bay, Labrador, and Newfoundland; south to Alabama, Oklahoma, Utah, and California.

Distribution in British Columbia—According to Walker (1958), the typical form *A. u. umbrosa* is transcontinental in Canada and in British Columbia meets a western form *A. u. occidentalis*. The two are not geographically distinct in British Columbia; the zone of intergradation is the whole width of the Province. Although the most northerly record in British Columbia is from Smithers, *umbrosa* probably inhabits the more northerly parts of the Province since there are records from the Yukon (Walker, 1958).

Field-notes—Walker (1958) states that slow-flowing streams, partly in shade, in or near woodlands, are typical habitats for *umbrosa*. The male patrols a limited section of the stream, hovering in the shade close to the bank. The species often is found with its close relative *A. palmata*, and may forage for insects until dark. Females oviposit in wet, decaying wood, sometimes above the water, in stumps and logs (Walker, 1958). The status of the two forms *umbrosa* and *occidentalis* is undetermined; their validity as subspecies is questionable since both are found in such widely separated locations as Nanaimo, Nelson, and Quesnel.

The earliest record for *A. umbrosa* is July 7; the flight period is known to last until the end of October.

Genus *Anax* Leach

Anax in Greek is lord or master, referring to the large size and powerful attitude of these impressive insects.

Four species of this cosmopolitan genus are known from North America, but only *Anax junius* reaches Canada. *A. walsinghami*, of the southwestern United States and Mexico, is North America's largest dragonfly—it has a wingspan of up to 150 millimetres.

Unlike the closely related genus *Æshna*, species of *Anax* usually have an unmarked, green thorax and in both sexes the margin of the base of the hindwing is rounded, not stiffened by an anal triangle.

The larvæ closely resemble those of *Æshna,* both in appearance and habits. The eyes are very large but not laterally prominent, being longer than those of *Æshna.* Lateral spines are present only on abdominal segments 5–7.

Anax junius (Drury)

Libellula junius Drury, 1770. Illus. Exot. Ins. 1:112

A. junius, Walker, 1958. Odonata of Canada and Alaska 2:126

junius=the month of June; part of the insect's flight period.

Distinguishing characteristics—Male: Length, 69–78 mm; hindwing, 45–50 mm. Head yellow-green; frons with a dark dorsal spot surrounded by blue; eyes blue. Prothorax dark grey-brown. Pterothorax light green with pale brown suture lines; legs reddish-brown basally, black apically. Abdomen dark brown dorsally, light green ventrally; segment 2 with a brown anterodorsal spot; segments 3–10 with irregular blue lateral stripes. Superior appendages straight in lateral view with a prominent dorsal ridge and apical spine; inferior appendage very short, only a quarter the length of superior appendage.

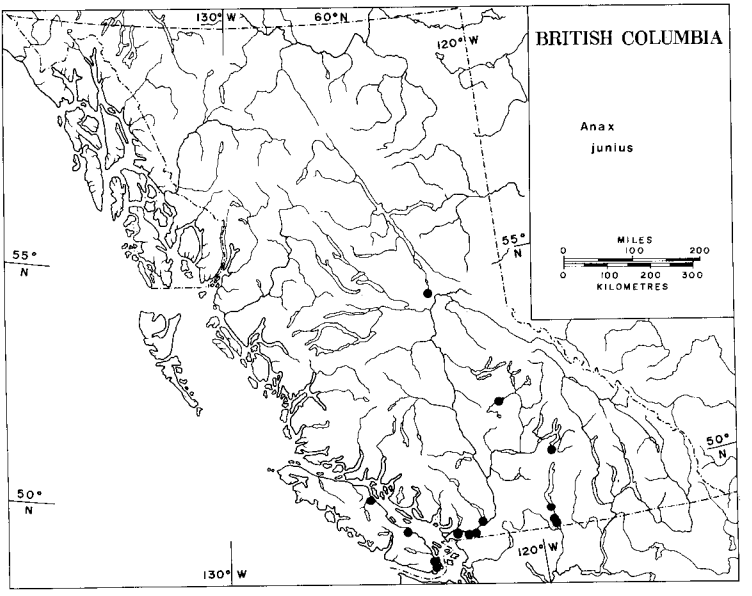
Female: Length, 68–84 mm; hindwing, 45–52 mm. Homeochromatic form as in male. Heterochromatic type with abdomen uniformly light reddish-brown with segments 1 and 2 greenish-yellow.

Larva: Length, 43–47 mm; metafemur, 8.5–9.5 mm. Antennæ 7-segmented, segment 3 longer than 1 and 2 together. Head with eyes longer than their greatest width, not laterally prominent; folded labium extending well beyond mesocoxæ; palps apically hooked. Abdomen with lateral spines on segments 7 to 9, ovipositor shorter than segment 9. Colour green marked with brown, femur with two apical dark rings.

Range—Alaska east to Nova Scotia and south to Panama; also the West Indies, Hawaii, and Tahiti. In Asia south from Kamchatka to Japan and China.

Distribution in British Columbia—Found mainly on southern Vancouver Island, in the Fraser Valley and the Okanagan-Shuswap region. There are isolated northern records from Canim Lake and Summit Lake (near Prince George).

Field-notes—In all of Canada *A. junius* has a peculiar life history. Fully mature adults arrive from the United States in the spring and early summer and the females immediately begin to oviposit. According to Walker (1958), these dragonflies usually disappear by the end of July and by August a new emergence of adults begins. Walker also notes that as far as is known, individuals of this emergence have never been seen in mature condition in Canada and probably migrate south in late summer. Studies have shown



that larval development takes about a year (Walker, 1958) and it thus appears that adults of *junius* emerging in southern Canada in late summer are the progeny of the previous year's spring migrants from the south.

The female oviposits alone or in tandem, placing her eggs in floating water-plants or submerged, decaying wood. In British Columbia oviposition has been observed on July 2 and July 5. Emergence usually occurs in early morning from a variety of still-water habitats containing submerged vegetation.

In British Columbia adults have been recorded from April 29 to September 6.

FAMILY PETALURIDÆ

The eight living species of the ancient family Petaluridæ are widely scattered—three are found in Australia, two in North America, and one in each of New Zealand, Chile, and Japan. Such a limited and disjunct distribution, along with their primitive structure, indicates that this family is a relic of a formerly more widespread fauna. The abundance of their fossils in the rocks of the

Jurassic Period (the height of the dinosaur age) shows that at that time they were among the world's most numerous dragonflies.

The adults are black, strikingly marked with yellow, and possess a mixture of primitive characteristics. The eyes are widely separated as in the Gomphidæ, the labium has a median cleft as in the Cordulegastridæ, and the ovipositor is well developed and resembles that of the Æshnidæ. The extremely long, parallel-sided pterostigma is an ancient feature of the wing venation.

Petalurid larvæ are elongate and hairy with stout, flattened legs. The labium, flat and without setæ, is similar to that of the Æshnidæ and Gomphidæ. The larvæ are mostly inhabitants of mountain swamps. In some species they live in burrows constructed in moss or mud.

Genus *Tanypteryx*

The generic name comes from the Greek meaning "long-winged." There are two North American genera of the Petaluridæ—*Tachopteryx* and *Tanypteryx*. *Tachopteryx,* represented by a single species, *T. thoreyi* (Hagen), ranges widely in the eastern United States, but the only Canadian records are from Quebec. *Tanypteryx* has two species—*T. hageni,* an insect found locally in the mountains of western North America, and *T. pryeri* Selys, found in Japan.

Distinctive features of *Tanypteryx* include the hairy tubercle on the venter of the metathorax of the adult, and the spur at the base of the movable hook on the larval labium.

Tanypteryx hageni (Selys)

Tachopteryx hageni Selys, 1879. C.R. Soc. Belg. 22:68

Tanypteryx hageni, Walker, 1958. Odonata of Canada and Alaska 2:134

hageni=named after Hermann Hagen, 19-century entomologist and pioneer in the study of Odonata.

Distinguishing characteristics—Male: Length, 55–59 mm; hindwing, 34–37 mm. Head brownish-black; frons yellow; mandibles and occiput with yellow spots. Thorax black with yellow markings; prothorax with a pair of

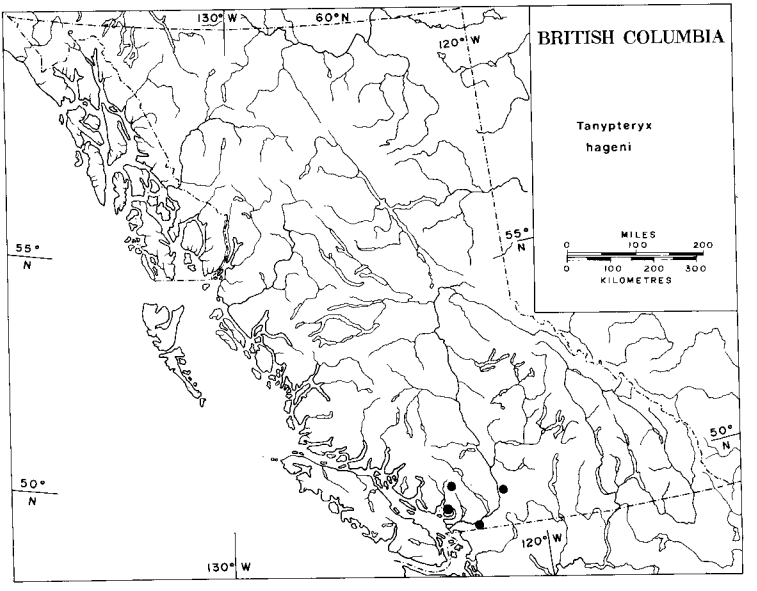
dorsal spots; mesepisterna with a pair of spots, the anterior ones the larger; meso- and metathorax each with two large lateral spots. Legs black. Abdomen black; segments 2–8 with paired orange-yellow anterodorsal spots. Superior appendages black, flattened, and divergent. Inferior appendage black, trifid, and as long as superiors.

Female: Length, 53–55 mm; hindwing, 35–37 mm. Colour pattern as in male except yellow abdominal spots closer together; segment 8 lacking yellow spots. Ovipositor short and upturned.

Larva: Length, 26–31 mm; metafemur, 6 mm. Antennæ hairy, 6-segmented. Head rectangular with eyes protruding anteriorly; prementum as wide as long, abruptly narrowed at base and lacking setæ (Fig. 9d, p. 41). Dorsum of abdomen with two rows of paired hair tufts.

Range—Southwestern British Columbia south in the mountains to California and Nevada.

Distribution in British Columbia—Recorded only from the Cascade Mountains, near Cultus Lake and Yale, and from the Coast Mountains at Diamond Head (Garibaldi Park) and Black Mountain (Cypress Park).



Field-notes—Perhaps our rarest dragonfly, *T. hageni* has been captured only five times in Canada. The species is very local, preferring spring-fed mountain bogs; its occurrence at low elevations is apparently accidental. The adults are strong fliers and patrol territories in forest openings, often settling on the ground. Females, despite the possession of well-developed ovipositors, deposit eggs loosely in the moss of wet areas (Svihla, 1959). In Oregon, mating has been observed on July 6 and oviposition on July 8 (Svihla, 1959).

Although the larvæ have not been found in British Columbia, in Washington and Oregon they are known to construct burrows in muck and mosses associated with the slow, trickling flow of springs. These burrows are 9–13 millimetres in diameter and are L-shaped, the lower, horizontal part pointing upstream. Each arm of the "L" is 75–100 millimetres long (Svihla, 1959). The larvæ are most active after dark, appearing at the burrow entrance to await their prey. They also can breathe air for long periods and may forage out of water, eating spiders and other small animals among the moss and sedges.

In British Columbia, *T. hageni* is known to fly between July 8 and August 30 (Whitehouse, 1941).

FAMILY GOMPHIDÆ

A family of medium-sized dragonflies, the Gomphidæ in British Columbia contains three genera and six species. They are easily recognized by their widely separated eyes, the black or brown and green coloration, and the club-like swelling of the end of the abdomen. The anal appendages of the males are short, the inferior member being unusually broad and forked. There is no ovipositor in the female, it being reduced to a bifid vulvar lamina.

Wing venation is relatively primitive. The triangles are equidistant from the arculus and there is usually no anal loop. The anal margin of the hind wing of the male is strikingly angulate; radial and median supplements are not present.

Although most Gomphidæ are inhabitants of streams, some develop in lakes; in British Columbia they are not particularly common. They do not hover in the open as the Libellulidæ do; rather, they fly swiftly for short distances, settling frequently on the ground or some stone, log, or low foliage where they are beautifully camouflaged.

The larvæ burrow shallowly in the bottom sediments; most species have hooks on the front two pairs of tibiæ that are evidently

used for this purpose. The tarsi on these legs are unusual in having only two segments. The labium is flat and without setæ. The antennæ are 4-segmented; the third segment greatly enlarged, the fourth vestigial.

KEY TO THE GENERA OF GOMPHIDÆ

ADULTS

1a. Anal loop semi-circular, composed of 3 cells (Fig. 22a) ..... *Ophiogomphus* (p. 143)

1b. Anal loop indistinct or absent (Fig. 22b) 2

2a. Dark mid-dorsal thoracic stripe present ..... *Gomphus* (p. 138)

2b. Dark mid-dorsal thoracic stripe absent ..... *Octogomphus* (p. 141)

LARVÆ

1a. Labial palps with apices hooked (Fig. 23a) ..... *Gomphus* (p. 138)

1b. Labial palps with apices rounded and not hooked (Fig. 23b) 2

2a. Abdominal segments with dorsal hooks or knobs ..... *Ophiogomphus* (p. 143)

2b. Abdominal segments without dorsal hooks or knobs ..... *Octogomphus* (p. 141)

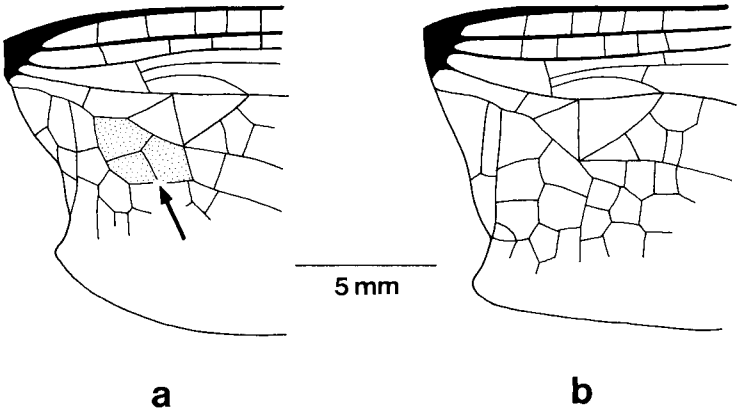


Fig. 22. Gomphidæ: Base of hindwing; **a**, *Ophiogomphus severus;* **b**, *Gomphus graslinellus;* stippled area is anal loop.

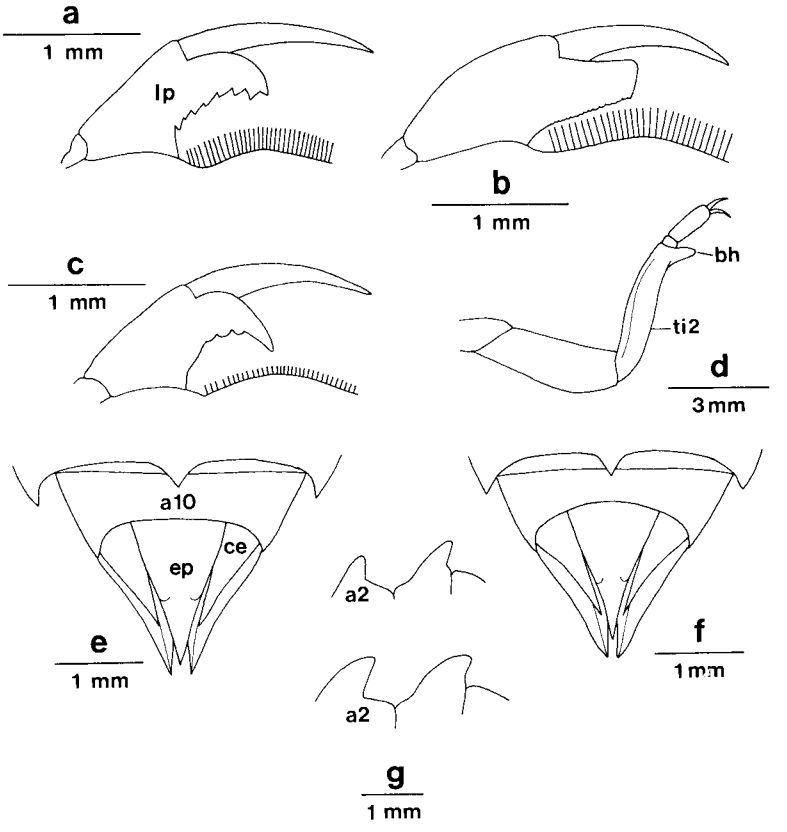


Fig. 23. Gomphidæ larval structures: The venter of the labial palp (**a–c**), the right middle leg (**d**), dorsal view of anal appendages (**e, f**), and lateral view of the dorsum of abdominal segments 2 and 3 (**g**); **a,** *Gomphus graslinellus;* **b,** *Ophiogomphus severus;* **c,** *G. olivaceous;* **d,** *G. graslinellus;* **e,** *O. colubrinus;* **f,** *O. severus;* **g,** *O. colubrinus* (top) and *O. severus* (bottom) (*see* p. 234 for explanation of letters).

Genus *Gomphus* Leach

The generic name is derived from the Greek *gomphos*=bolt, and refers to the similarity of the shape of the body to the arrow of a crossbow. This allusion is an old one in the English language.

The genus is complex and the largest in North America with about 50 species, 23 of which enter Canada. Our two British Columbia species are restricted to lakeshores and slow rivers in the southern Interior.

The larvæ of our species are easily distinguished by the hooked apex of the labial palp.

KEY TO THE SPECIES OF *GOMPHUS*

ADULTS

1a. Dark lateral thoracic stripes present on interpleural suture and metapleural sulcus; tibiæ yellow externally ..... *graslinellus* (p. 138)

1b. These lateral thoracic stripes absent; tibiæ black ..... *olivaceus* (p. 140)

LARVÆ

1a. Tibial burrowing hooks well developed (Fig. 23d); labial palp as in Fig. 23a ..... *graslinellus* (p. 138)

1b. Tibial burrowing hooks very small; labial palp as in Fig. 23c ..... *olivaceus* (p. 140)

Gomphus graslinellus Walsh

G. graslinellus Walsh, 1862. Proc. Acad. Phila. p. 394

G. graslinellus, Walker, 1958. Odonata of Canada and Alaska 2:211

graslinellus=the diminutive of *graslini,* the specific name of a similar European gomphid named after Adolphe de Graslin (1802–82), French entomologist.

Distinguishing characteristics—Male: Length, 44–52 mm; hindwing, 28–31 mm. Head with dorsum black; occiput green; face olive-green; labium brown. Prothorax brown with a yellow median dorsal spot and yellow lateral spots. Pterothorax olive-green; mid-dorsal stripe brown, broad; mesopleural sulcus with a broad brown stripe partly divided longitudinally by a green line; interpleural suture with a brown stripe; metapleural sulcus green, edged with brown. Abdomen black; segments 1–10 with a yellow

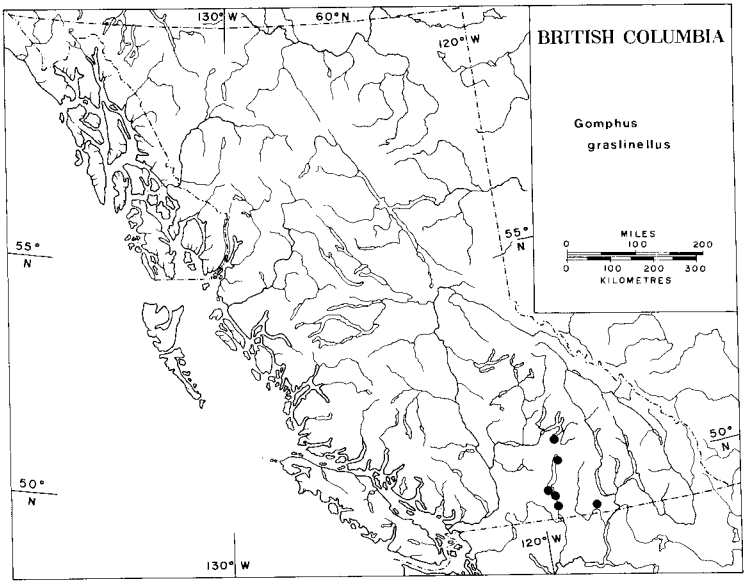
mid-dorsal stripe; segments 1, 2, 8 and 9 yellow laterally; segments 3–7 with small yellow basolateral spots. Superior appendages bifid, strongly divergent. Inferior appendange diverging at a wider angle than the superiors.

Female: Length, 48–53 mm; hindwing, 29–35 mm. Similar to male except the abdomen has a continuous yellow lateral stripe replacing the lateral spots. Vulvar lamina very short, bilobed, cleft to the base.

Larva: Length, 29 mm; metafemur, 6 mm. Antennæ 4-segmented; segment 3 two thirds longer than 1 and 2 together. Labial palp with a short end-hook and 6 or 7 teeth (Fig. 23a, p. 137). Tibiæ with well-developed burrowing hooks (Fig. 23d, p. 137). Abdomen with small dorsal hooks on segments 2–9 and lateral spines on segments 7–9.

Range—Southern Manitoba and Ontario south through Minnesota and Ohio to Oklahoma, with a separate population in British Columbia and Washington.

Distribution in British Columbia—The southern Interior of the Province from Shuswap Lake south through the Okanagan Valley east to Christina Lake.



Field-notes—At Vaseux Lake on June 27, 1974, recently emerged males of *graslinellus* were flying low over the railway tracks and sunning themselves on the ties. The similarity of this habit to that of *Argia emma*, flying at the same location, was striking. A day later, on a hot clay flat behind a Summerland beach, tenerals of this species were making their first flights after emerging that morning from Okanagan Lake. The exuviæ lay a few inches from the water among the sand and gravel. *G. graslinellus* often exhibits a peculiar roller-coaster flight, rising and falling in a series of undulations.

Records of flight range from June 27 to July 25, but *graslinellus* probably flies well into August.

Gomphus olivaceus Selys

G. olivaceus Selys, 1873. *Bull Acad. Belg.* (2) 35:749

G. olivaceus, Walker, 1958. Odonata of Canada and Alaska 2:282

olivaceus=olive-coloured; a reference to the unusually extensive ground colour of the species.

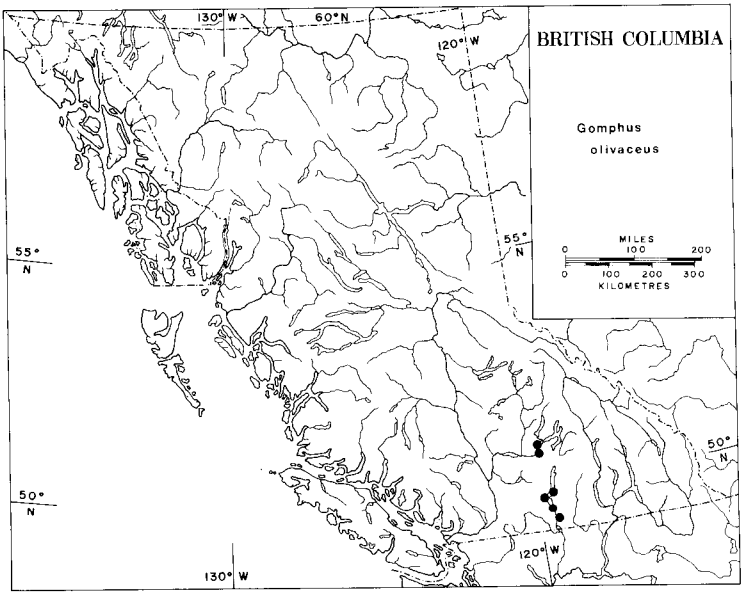
Distinguishing characteristics—Male: Length, 51–54 mm; hindwing, 31–32 mm. Head pale green dorsally with a brown transverse stripe; face green; labrum pale yellow. Prothorax brown with a large yellow median dorsal spot. Pterothorax green; brown mid-dorsal stripe narrow; mesopleural sulcus with a brown stripe widely divided ventrally by a pale green area; interpleural suture and metapleural sulcus stripes lacking. Tibiæ black. Abdomen dark brown; segments 1–9 marked dorsally with yellow elongated basal spots; segments 1, 2, and 7–10 marked with yellow laterally; segment 3 with a yellow lateroventral edge; segments 4-6 marked laterally with yellow apical and basal spots. Superior and inferior appendages diverging at similar angles, the former without the prominent lateral tooth seen in *G. graslinellus*.

Female: Length, 53–57 mm; hindwing, 31–32 mm. Similar to the male except green areas more extensive. Vulvar lamina with lobes short and broadly angulate.

Larva: Length, 38 mm; metafemur, 5.5 mm. Antennæ 4-segmented. Labial palps with 3 or 4 teeth on the concave edge, tapering to a curved toothless end-hook (Fig. 23c, p. 137). Tibiæ with rudimentary burrowing hooks. Abdominal segments 3–7 with a dorsal groove; lateral spines on segments 6–9.

Range—Southern British Columbia south to Utah and California. The subspecies found in Canada is *G. o. olivaceus*.

Distribution in British Columbia—Known only from the semi-arid region of the Okanagan and South Thompson valleys.



Field-notes—Apparently a rare dragonfly in British Columbia, *olivaceus* usually inhabits sandy or muddy-edged rivers in hot, dry areas. In this Province it also appears to develop in lakes since there is a record from Peachland, on Okanagan Lake, and, on the shore of Vaseux Lake, July 26, 1975, an exuvia was found half a metre above the water on a bulrush (*Scirpus acutus*) stem.

Males fly low over the water in a zigzag fashion, resting occasionally on shoreline vegetation. Kennedy (1917) noted that females usually fly in the sun away from water. Here they are engaged in copulation by the males, the pair making a short nuptial flight before coming to rest on bushes where they remain in copulation for an indefinite period.

British Columbia records range from July 28 to October 1.

Genus *Octogomphus* Selys

The Greek *octo*=eight, and *gomphos*=bolt (*see Gomphos*), refers to the peculiarly enlarged, 8-pointed anal appendages of the male abdomen.

The genus contains one species, *O. specularis,* restricted to the Pacific Coast. The 4-branched inferior appendage of the male and the four prongs on the dorsum of the female head distinguish this genus from all others in the family.

Octogomphus specularis (Hagen)

Neogomphus ? specularis Hagen, 1859. in Selys, Bull. Acad. Belg. (2) 7:544

O. specularis, Walker, 1958. Odonata of Canada and Alaska 2:182

specularis=pertaining to watching or searching; presumably a reference to the alert habit of the species of flying erratically from one perch to another.

Distinguishing characteristics—Male (Fig. 42a, p. 240): Length, 46–50 mm; hindwing, 28–31 mm. Labium mostly black; face yellow-green marked with black stripes on dorsum and venter of labium, in middle of clypeus, and on fronto-clypeal suture; yellow spot on vertex and behind occiput. Prothorax black with pale spots. Pterothorax greenish-yellow; mesopleural sulcus with a heavy broad black stripe, faintly divided longitudinally; indistinct dark patches on sides. Abdomen black; segment 1 wholly yellow; segment 2 yellow dorsally with lateral yellow spots; segment 3–9 with a broken yellow mid-dorsal line and indistinct yellow lateral spots; segment 10 with a single yellow mid-dorsal spot. Superior appendages yellow, bifid, and acute. Inferior appendage divided into 4 processes.

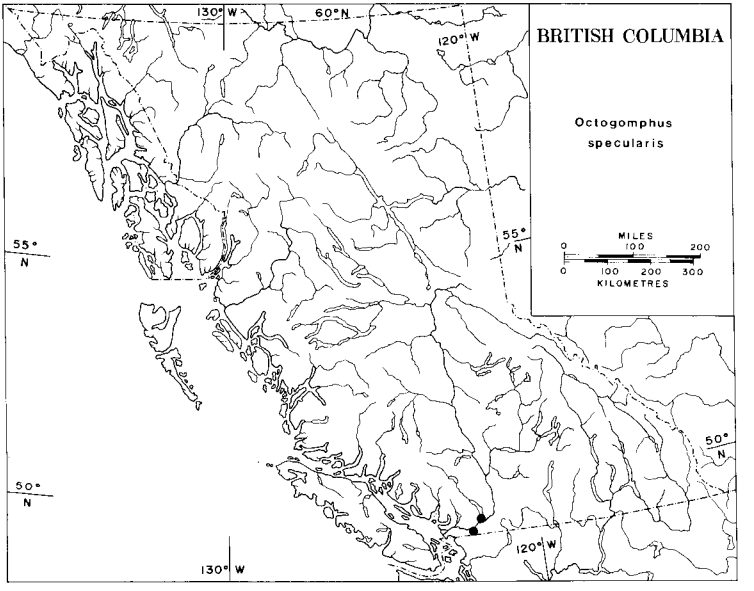
Female: Length, 44–45 mm; hindwing, 30–31 mm. Colour as in male except the yellow abdominal mid-dorsal line continuous to segment 7 and yellow lateral spots more extensive. Head with four prominent tubercles behind the ocelli.

Larva: Length, 24 mm; metafemur, 5 mm. Antennæ 4-segmented; segment 3 half as wide as long. Labial palps short with apices rounded and 6–8 blunt teeth. Abdomen oval, blunt, with short lateral spines on segments 7–9; dorsal hooks lacking. Profemora and mesofemora with burrowing hooks.

Range—British Columbia south along the Pacific Coast to Baja California.

Distribution in British Columbia—Known only from the Fraser Valley near Cultus Lake and Harrison Lake.

Field-notes—*O. specularis* is a species of coastal mountain streams where the larvæ live in the loose detritus that collects in creek pools (Kennedy, 1917). Males are most often seen along the creeks, darting in and out of the shade and perching frequently on stones, logs, and tree branches. Females evidently fly along the streams only to oviposit, dipping the abdomen



into the water at intervals of about 1 metre, releasing eggs as they do so. Emergence is recorded by Walker (1958) from June 10 to 19 and Whitehouse (1941) noted mating and oviposition in mid-August.

In British Columbia adults have been captured from June 10 to September 21.

Genus *Ophiogomphus* Selys

Greek *ophis,* a snake, and *gomphos,* a bolt (*see Gomphus*), recalls "adder bolt," the medieval English name for dragonflies. The reptilian overtone in names of Odonata is widespread even today. Species of *Ophiogomphus* have a snake-like pattern of yellow and brown on the abdomen.

The genus is most abundant in eastern North America. The three species in British Columbia are found along clear mountain streams and are rare in settled areas because the larvæ are highly

sensitive to changes in water flow and siltation. They are, therefore, good indicators of undisturbed streams.

The larvæ are characterized by widely divergent wing cases, dorsal hooks on the abdomen, and labial palps with blunt apices.

KEY TO THE SPECIES OF *OPHIOGOMPHUS*

ADULTS

1a. Face striped with black ..... *colubrinus* (p. 144)

1b. Face not striped with black 2

2a. Dark thoracic stripes on mesepisternum and mesopleural sulcus complete and separated at most by a very thin line ..... *occidentis* (p. 146)

2b. Dark thoracic stripes widely separated, the mesepisternal stripe an oval spot, that on the mesopleural sulcus a thin line ..... *severus* (p. 147)

LARVÆ

1a. Lateral spines on abdominal segments 6–9 ..... *occidentis* (p. 146)

1b. Lateral spines on segments 7–9 2

2a. Cerci four fifths as long as epiproct (Fig. 23f); dorsal knob on abdominal segment 2 more or less recurved (Fig. 23g) ..... *severus* (p. 147)

2b. Cerci three fourths as long as epiproct (Fig. 23e); dorsal knob on segment 2 erect, not or scarcely curved (Fig. 23g) ..... *colubrinus* (p. 144)

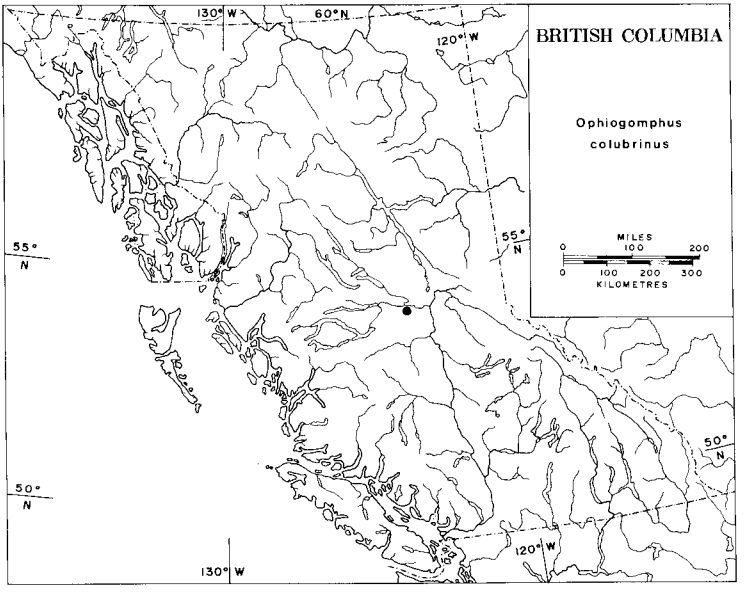
Ophiogomphus colubrinus Selys

O. colubrinus Selys, 1854. Bull. Acad. Belg. 21:40

O. colubrinus, Walker, 1958. Odonata of Canada and Alaska 2:158

colubrinus=snake (*see* Genus *Ophiogomphus*).

Distinguishing characteristics—Male: Length, 45–49 mm; hindwing, 26–28 mm. Face green striped with black around labrum, on lateral margins of clypeus, and on fronto-clypeal suture; vertex black, occiput green. Prothorax brown with paired pale dorsal tubercles. Pterothorax green; mid-dorsal stripe brown; brown mesopleural sulcus stripe wide, divided longitudinally by a curved green line; interpleural suture and metapleural sulcus with a brown line. Legs black marked with green or anterior surfaces of femora. Abdomen dark brown; segments 3–7 with triangular yellow dorsal spots; segment 8 with a yellow dorsal stripe; segment 9 with a round yellow dorsal spot; segments 7–9 with wide yellow lateral areas. Superior appendages slightly bowed in both dorsal and lateral views; inferior appendage as long as superiors, divided more than half way to the base.



Female: Length, 45–49 mm; hindwing, 27–31 mm. Colour as in male. Vulvar lamina about three fifths as long as segment 9, equilaterally triangular, cleft half way to the base.

Larva: Length, 26–30 mm; metafemur, 4.7–5.0 mm. Antennæ 4-segmented; segment 3 more than three times as long as broad, spatulate. Abdominal segments 2–9 with well-developed dorsal hooks, hook on 2 erect and slender (Fig. 23g, p. 137); lateral spines on segments 7–9.

Range—Northwest Territories east to Newfoundland and south to Maine, Michigan, and British Columbia.

Distribution in British Columbia—Known only from Cluculz Creek near Prince George; probably more widely distributed in the north than this single record indicates.

Field-notes—*O. colubrinus* is the most northerly distributed species of the North American Gomphidæ, being found as far north as 60°. Walker has observed the species flying low over the rapids and pools of northern creeks and perching on rocks and logs. Females oviposit in the rapids. Dr. W. E. Ricker found *colubrinus* in Cluculz Creek on July 15, 1938.

The flight period recorded in Ontario is June 20 to September 5 (Walker, 1958); in British Columbia it is probably similar.

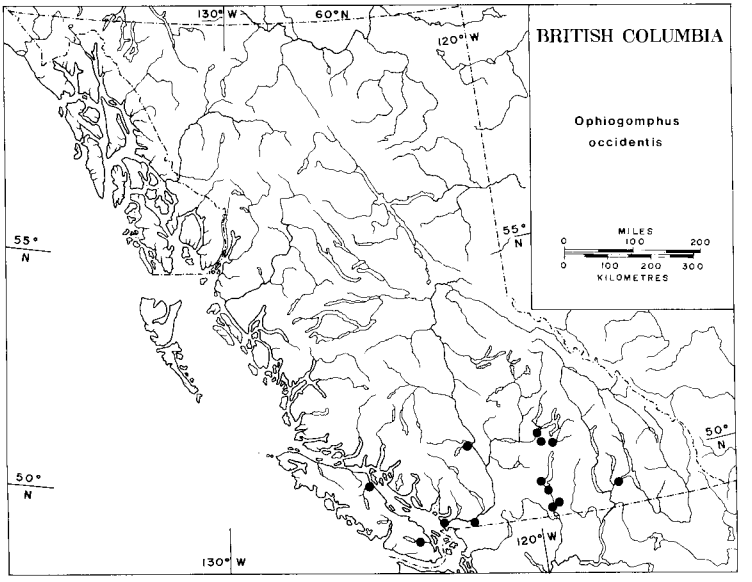
Ophiogomphus occidentis Hagen

O. occidentis Hagen, 1882. Nature 27:173

O. occidentis, Walker, 1958. Odonata of Canada and Alaska 2:167

occidentis=western; a reference to the range of the species.

Distinguishing characteristics—Male: Length, 49–51 mm; hindwing, 30–31 mm. Face and occiput yellow-green; vertex black with pale spots and paired yellow lateral tubercles. Prothorax brown with a yellow median dorsal spot. Pterothorax yellow-green; mid-dorsal stripe brown; brown mesopleural stripe strongly curved, sometimes divided by a green line; thinner brown lines on metapleural sulcus and on ventral margins of mesepimeron, mesepisternum, and metepimeron. Legs mainly yellow basally, black apically. Abdomen black; segments 1 and 10 yellow dorsally; segments 2–9 with round, yellow anterodorsal spots, becoming triangular posteriorly; segments 1–10 with yellow anterolateral spots. Superior appendages longer than segment 10, apices rounded. Inferior appendage strongly concave dorsally, two thirds as long as superiors, divided half way to base.



Female: Length, 52–53 mm; hindwing, 32–34 mm. Colour as in male. Head with a pair of strong hooks on the occiput. Vulvar lamina about three fourths as long as venter of segment 10, narrowing posteriorly with convex sides, apices divergent.

Larva: Length, 27–29 mm; metafemur, 4.7–5.0 mm. Antennæ 4-segmented. Abdominal segments 2–9 with well-developed dorsal hooks; lateral spines prominent on segments 6–9.

Range—Southern British Columbia south to Nevada and California.

Distribution in British Columbia—Southern; from Vancouver Island east to Kootenay Lake; the northernmost locality is Pritchard on the South Thompson River.

Field-notes—Whitehouse (1941) observed the peculiar oviposition behaviour of the female of *occidentis* at Sweltzer Creek near Cultus Lake on July 19, 1936: "She flew over the water, apparently washing eggs from the tip of her abdomen; the operation being concluded by plunging full length into the water and rising again three times." He also noted females ovipositing in rapids at the outlet of Lower Campbell Lake on Vancouver Island from July 25 to August 22. Whitehouse recorded copulation on July 16, a female being seized by a male as she flew over the water, the pair then soaring into a high tree. The species appears also to develop in lakes; on June 22, 1974, an adult was discovered emerging on the gravelly beach at Okanagan Lake Park.

Records of flight for *occidentis* range from June 8 to October 1.

Ophiogomphus severus Hagen

O. severus Hagen, 1874. Geol. Surv. Terr. Col. p. 591

O. severus, Walker, 1958. Odonata of Canada and Alaska 2:154

severus=severe; perhaps a reference to the predatory nature of the insect.

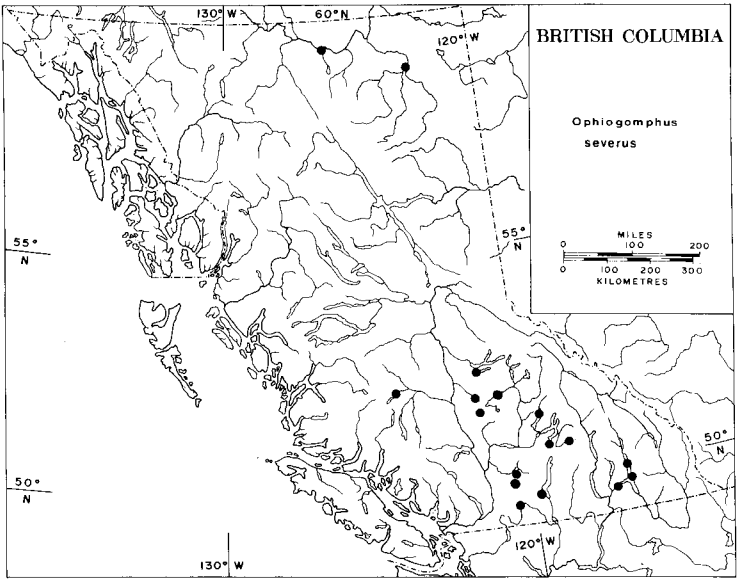
Distinguishing characteristics—Male (Fig. 42b, p. 240): Length, 50–52 mm; hindwing, 34–35 mm. Face light yellow; vertex black in front. Prothorax dark brown. Pterothorax pale green to olive-yellow; dark middorsal stripe twice as wide in front as behind; mesepisternum with a large brown oval spot; mesopleural sulcus with a brown stripe narrowed ventrally; interpleural suture with a brown stripe above the spiracle; metapleural suture with a narrow brown line. Abdomen black; segments 1–6 with large yellow dorsal spots and united anteriorly with yellow lateral spots; segments 7–10 mainly yellow. Superior appendages with acute apices; inferior appendage about three quarters as long as superiors, cleft more than half way to the base, the apices meeting.

Female: Length, 46–53 mm; hindwing, 31–32 mm. Colour as in male. Vulvar lamina more than half as long as segment 9, cleft three quarters of the way to the base, apices divergent.

Larva: Length, 25–28 mm; metafemur, 5–6 mm. Antennæ 4-segmented. Abdomen with dorsal hooks on segments 2–9, hooks on 2 and 3 erect and recurved (Fig. 23g, p. 137), hooks on 8 and 9 almost straight; lateral hooks on segments 7–9.

Range—British Columbia east to Saskatchewan and south to Nebraska and California. The subspecies of our area, *O. s. montanus* Kennedy, is confined to the cordillera.

Distribution in British Columbia—Recorded from the southern Interior and the far north (Liard River Hotsprings and Fort Nelson); probably general east of the Coast Range.



Field-notes—Kennedy (1915) recorded emergence of this species from the mud-bottomed pools of Status Creek near Yakima, Washington, from the second week of June to the first week of July. Oviposition, however, occurred only in the riffles, the female repeatedly flying out from her perch on a stone and tapping her abdomen in the water once with each sortie. Ovi-

position was observed mainly in early August. *Ophiogomphus occidentis* also frequented the stream and Kennedy once discovered a female of this species copulating with a male of *O. severus*. Both Whitehouse (1941) and Walker (1958) observed this species landing on sunny roads near Kootenay Lake; Walker considers the lake itself to be the larval habitat. On May 10, 1976, larvæ of many ages were found near Summerland in Aeneas Creek, a shallow, clear mountain stream flowing over gravel and silty sand.

British Columbia records of adults range from June 14 to September 5.

FAMILY CORDULEGASTRIDÆ

The Cordulegastridæ is a small family of large black and yellow dragonflies; one species occurs in British Columbia. Characteristic features of the family include a labium with a median cleft, and compound eyes meeting dorsally at a single point. The ovipositor is formed differently than that of the Æshnidæ, being long and spade-like, designed for ovipositing in streambeds rather than in plant tissue.

In the wings the triangles are equidistant from the arculus and the anal loop is compact but well developed. The posterior corners of the hindwings are sharply angled in the male.

The larvæ are elongate and very hairy and lurk in the silt of woodland streams. The small eyes are placed anteriorly on the broad, flat head and the labium, with its prominently toothed palps, is spoon-shaped.

Genus *Cordulegaster* Leach

The name *Cordulegaster* is derived from two Greek words, *kordylios*=club-like and *gaster*=belly, and refers to the swollen basal segments of the abdomen.

Cordulegaster is a genus restricted to the Northern Hemisphere. Adults typically fly low along small, forest streams, although during early adult life they may be found far from such habitats.

The larvæ lie on the bottom of pools in these streams and bury themselves in the silt by kicking it up over their bodies. Only the eyes, antennæ, and the tip of the abdomen project above the mud, the latter acting like a snorkel to provide clean water for respiration. Thus camouflaged, the larva awaits the approach of its prey, which may even include small fish.

Cordulegaster dorsalis Hagen

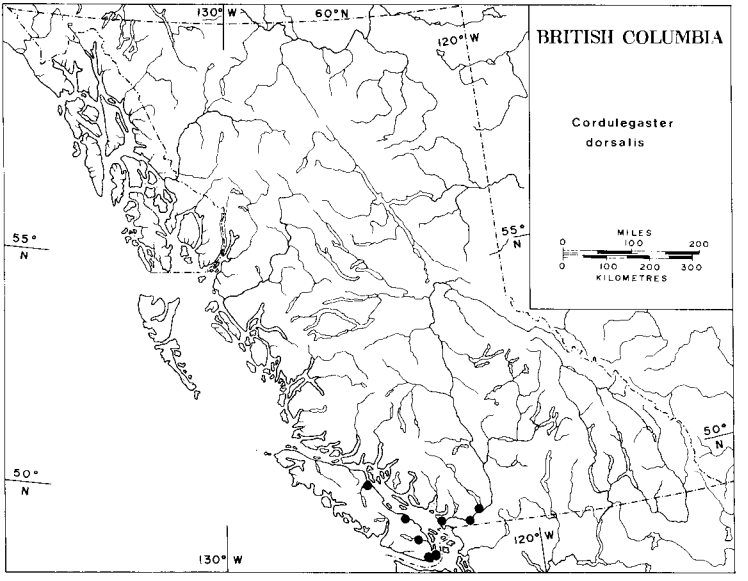
C. dorsalis Hagen, 1858. in Selys, Mon. Gomph. p. 347

C. dorsalis, Walker, 1958. Odonata of Canada and Alaska 2:301

dorsalis=refers to the large, yellow spots on the dorsal, or upper, surface of the abdomen.

Distinguishing characteristics—Male: Length, 70–78 mm; hindwing, 42–45 mm. Mandibles, labrum, and clypeus yellow dorsally, brown ventrally; frons yellow with a brown transverse bar; occiput black with a dense fringe of brown hair. Thorax dark brown; mesepisternal stripe yellow-green; yellow mesepimeral and metepimeral stripes widening dorsally. Abdomen dark brown; segment 2 with a yellow mid-dorsal spot and yellow lateral spots; segments 3–7 with yellow mid-dorsal spots bilobed posteriorly; segments 8 and 9 with transverse yellow bars. Superior appendages slightly shorter than segment 10 with two ventral spines.

Female (Fig. 41a, p. 239): Length, 76–85 mm; hindwing, 46–49 mm. Colour as in male except wings often flushed with yellow. Ovipositor projecting well beyond end of abdomen.



The larvæ are peculiar in having extremely long legs, giving them a spider-like appearance. The head has a prominent horn between the antennæ and the abdomen is very broad and almost circular, bearing a series of high, arched dorsal hooks.

Genus *Macromia* Rambur

The name *Macromia* comes from two Greek words, *makros*= large and *omos*=shoulder, and refers to the powerful thorax of these strong fliers.

Macromia magnifica and *M. rickeri,* despite their considerable colour differences, are perhaps not distinct species. Confirmation of their status will have to await further studies of geographical variation in the genus.

The expanded, concave dorsum of the frons is characteristic, as are the raised, biconical vertex and the long legs with each of the tarsal claws bifid. The yellow and brown coloration has a metallic sheen.

The adults are swift and restless and are almost continuously on the wing when active. They fly on regular beats over streams and lakeshores where the larvæ sprawl on the bottom sand and silt.

KEY TO THE SPECIES OF *MACROMIA*

ADULTS

1a. Yellow of labrum an unbroken stripe; dorsal yellow spots of abdominal segments 3–6 joined across midline ..... *magnifica* (p. 152)

1b. Yellow of labrum divided into 2 spots; dorsal yellow spots of abdominal segments 3–6 separated across midline ..... *rickeri* (p. 154)

The larvæ of these two forms apparently are indistinguishable from each other.

Macromia magnifica MacLachlan

M. magnifica MacLachlan, 1874 in Selys, Bull. Acad. Belg. (2) 37:22

M. magnifica, Walker and Corbet, 1975. Odonata of Canada and Alaska 3:27

magnifica=magnificent.

Distinguishing characteristics—Male (Fig. 42c, p. 240): Length, 69 mm; hindwing, 42–44 mm. Labium, mandible bases, venter of labrum, and dorsum of clypeus yellow; frons dark brown with broad yellow dorsal spots;

Larva: Length, 35–43 mm; metafemur, 4.5 mm. Prementum and labial palps spoon-shaped; labial palps with apical margins irregularly toothed, without hairs; premental setæ, 5 or 6 long, and 4 or 5 short; palpal setæ, 6. Abdomen without lateral spines. Ovipositor extending slightly beyond segment 9.

Range—Alaska south along the Pacific Coast to California.

Distribution in British Columbia—Known from various localities on Vancouver Island and in the Fraser Valley; certainly to be found north along all of the British Columbia Coast.

Field-notes—In British Columbia this large dragonfly is exceeded in size only by *Anax junius*. Whitehouse (1941) states that *C. dorsalis*, "in spite of its size, is in character a tolerant, easy-going creature." Males of the species fly up and down coastal streams for great distances, usually remaining less than a metre above the water. Whitehouse (1941) notes they haunt any type of stream from mountainous torrents to drainage ditches, but they prefer clear, rapid streams with intermittent pools. *Octogomphus specularis* frequently is associated with *dorsalis* in these habitats.

The female has a characteristic ovipositing behaviour. Hovering in a perpendicular position over quiet backwaters along the stream edge, she rhythmically thrusts her abdomen into the sand or silt.

Larvæ are found in pools and along the quieter edges of the streams. Kennedy (1917) estimates they require four years to develop. When ready to transform, they usually crawl up roots or trunks of nearby trees such as red alder (*Alnus rubra*), where the adults emerge.

In British Columbia, mating has been observed on July 12 and August 14 and oviposition as late as August 21 (Whitehouse, 1941). Although recorded dates of flight for *dorsalis* in the Province are June 21 to August 25, Whitehouse estimates adults may appear as early as June 10.

FAMILY MACROMIIDÆ

The Macromiidæ is a small family in our fauna, represented by two species in the genus *Macromia*. The adults are similar to the Æshnidæ in general appearance but are recognizable by the distinctive yellow band that obliquely circles the thorax between the wings.

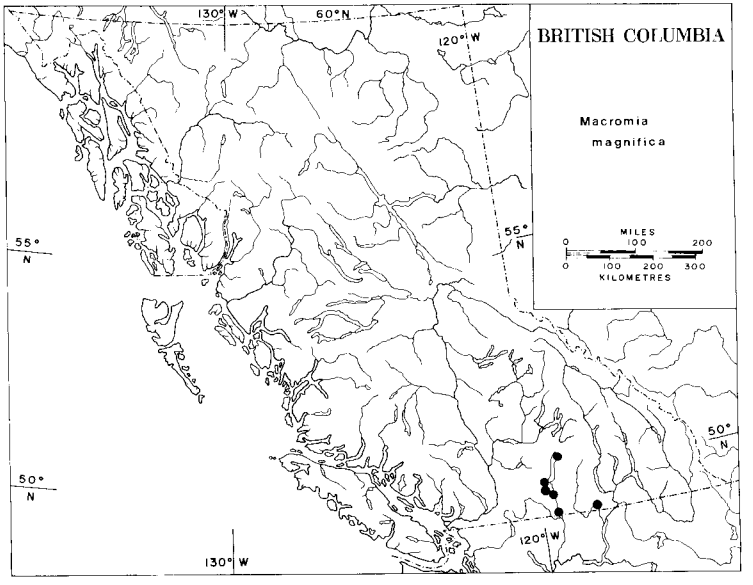
Primitive features of the wing venation include the separation of the triangle and arculus in the hindwing and the short anal loop lacking a midrib. The fusion of the bases of the veins arising from the arculus is an advanced character.

vertex yellow. Thorax metallic brown, sometimes slightly pruinose, densely clothed with long grey hair; mid-dorsal carina yellow with a yellow dorsal cross-stripe anterior to wing bases; yellow stripes on mesepisterna, posterior margin of metepimeron, and a lateral stripe passing over the metathoracic spiracle; venter marked with yellow. Abdomen black; segment 2 with a pair of large yellow dorsal spots; segments 3–10 with broad yellow basal spots, bilobed on segment 3. Superior appendages short and bowed in dorsal view.

Female: Length, 71 mm; hindwing, 46 mm. Colour similar to male except abdominal segment 10 is black. Vulvar lamina very short and deeply excavated.

Larva: Length, 31 mm; metafemur, 13.5 mm. Indistinguishable from the larva of *M. rickeri*. Antennæ 7-segmented; segments 1 and 2 stout and hairy. Head with a prominent horn between the antennæ and prominent eyes (Fig. 9bp, p. 42). Premental setæ, 4, arranged in a row; a single additional seta at inner end, and 2–4 short setæ towards the midline. Abdomen very broad, round, with high slightly arched dorsal hooks. Venter of metathorax with a prominent tubercle.

Range—Southern British Columbia to California and Arizona.



Distribution in British Columbia—All records are from the Okanagan Valley and the Christina Lake region.

Field-notes—In the dry Interior, *M. magnifica* typically associates with *Argia emma, Gomphus graslinellus,* and *Gomphus olivaceus.* Kennedy (1915) states that the flight of males over water usually depends on the presence of ovipositing females and occurs mostly in calm weather from 7 to 10 a.m. Females fly back and forth over the water, striking the abdomen on the surface every 1 to 2 metres, releasing the eggs. The copulatory flight is long and usually occurs in nearby trees.

The larvæ develop among stones, tree roots, or silt in stream pools or the bays of lakes. Larvæ about to transform may crawl considerable distances up tree trunks or branches. At Trout Creek Point, Okanagan Lake, on July 13, 1974, a larva was found crawling up a sandy beach towards the cottonwood trees, about 15 metres away.

British Columbia specimens have been taken from July 1 to July 31; Whitehouse (1941) estimates they fly from mid-June to the second week of September.

Macromia rickeri Walker

M. rickeri Walker, 1937. Can. Ent. 69:6

M. rickeri, Walker and Corbet, 1975. Odonata of Canada and Alaska 3:30

rickeri=named after its discoverer, Dr. W. E. Ricker, Canadian fisheries and aquatic insect biologist.

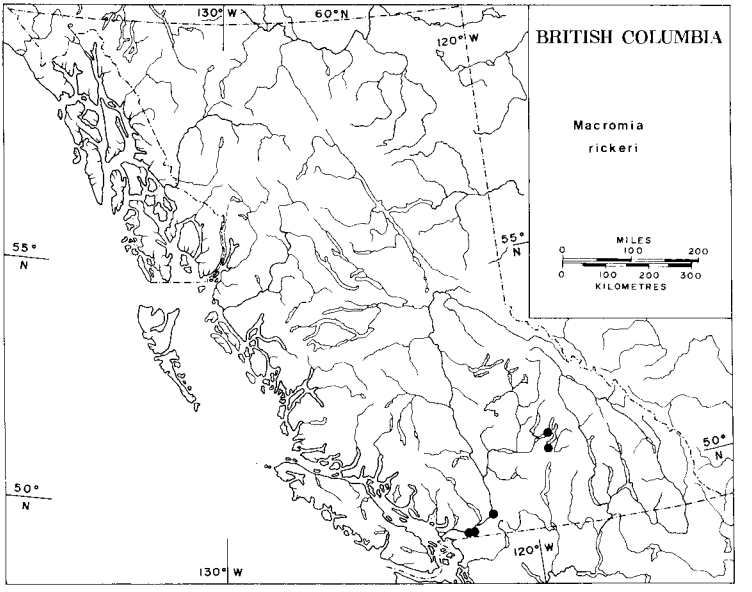
Distinguishing characteristics—Male: Length, 64–68 mm; hindwing, 40–42 mm. Head dark brown; labrum with a pair of yellow spots; frons with a yellow dorsal spot and lateral spots; eyes green. Thorax brown with a dull lustre and grey-brown hairs; yellow stripes similar to *M. magnifica* but shorter. Abdomen dark greenish-brown; segment 2 with a pair of widely separated yellow dorsal spots; segments 3–6 with small, yellow, narrowly separated dorsal spots, sometimes absent on 6; segments 7 and 8 with large yellow undivided dorsal spots; segments 9 and 10 without pale spots.

Female: Length, 65–70 mm; hindwing, 41–44 mm. Colour as in male. Vulvar lamina similar to that of *M. magnifica.*

Larva: Indistinguishable from the larva of *M. magnifica* (*see* larval description of *M. magnifica*).

Rrange—Southwest and south-central British Columbia.

Distribution in British Columbia—Known only from the Fraser Valley and Shuswap Lake.



Field-notes—This species, very closely related to *magnifica* and perhaps not specifically distinct, has been observed most closely at Cultus Lake. Here larvæ live among the stones of the lakeshore. Emergence has been recorded from June 23 to July 3 and Whitehouse (1941) noted that on the former date the majority of insects emerged in darkness between 10 and 11 p.m. Whitehouse also observed copulation on the early date of June 25, and on August 5 at Kawkawa Lake (Hope) he saw a female ovipositing where 2–3 metres of water lay over a muddy bottom. She "flew quickly some eight to ten inches above the water, swooping down every five or six feet to touch the tip of her abdomen."

The flight of *rickeri* is from the third week of June to the second week of September.

FAMILY CORDULIIDÆ

Members of the Corduliidæ are not as familiar to naturalists in the settled parts of British Columbia as are the Æshnidæ and Libellulidæ. Most of our 12 species (in three genera) are inhabitants of streams and lakes in the wilder, more remote areas of the

Province. Mountain streams and lakes and northern muskeg are the places to see this family at its best.

These dragonflies are medium-sized, with slender, often metallic green or brassy bodies. Like the Macromiidæ, the Corduliidæ have a low tubercle on the rear margin of the compound eye. In the wings, the anal loop is foot-shaped as in the Libellulidæ, but has a shorter toe.

Larvæ of the Corduliidæ reveal the close relationship of the family with the Libellulidæ. There is no single characteristic that will reliably separate all members of these two families. The larvæ prefer waters that are high in oxygen.

KEY TO THE GENERA OF CORDULIIDÆ

ADULTS

1a. Hindwing with 2 cubito-anal crossveins (Fig. 24a) ..... *Somatochlora* (p. 164)

1b. Hindwing with 1 cubito-anal crossvein (Fig. 24b) 2

2a. Base of hindwing with brown markings (Fig. 24b) ..... *Epitheca* (p. 159)

2b. Base of hindwing clear or with a yellow wash ..... *Cordulia* (p. 157)

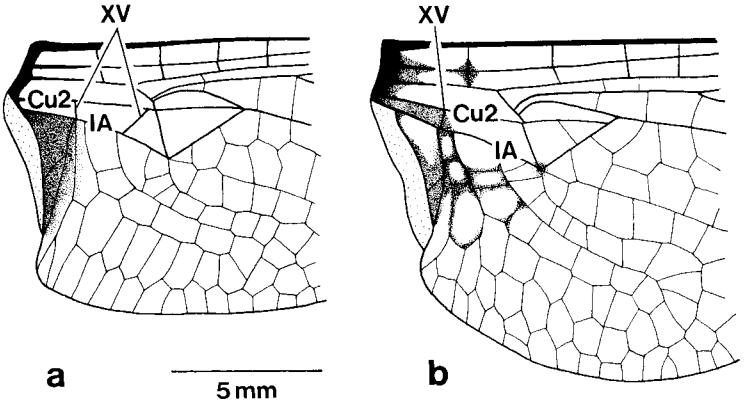


Fig. 24. Corduliidæ hindwings; **a,** *Somatochlora franklini* ♂; **b,** *Epitheca spinigera* ♂ (*see* p. 243 for explanation of letters).

1a. Dorsal hooks present and well developed on some abdominal segments .. 2
1b. Dorsal hooks absent or reduced to low knobs 3

2a. Lateral spines on abdominal segment 9 more than three times as long as those on segment 8 ..... *Epitheca* (p. 159)
2b. Lateral spines on segment 9 less than twice as long as those on segment 8 and often absent ..... *Somatochlora* (p. 164)

3a. Sides of thorax with a broad, dark stripe ..... *Cordulia* (p. 157)
3b. Sides of thorax uniformly coloured ..... *Somatochlora* (p. 164)

Genus *Cordulia* Leach

Cordulia is derived from the Greek *kordylios*=club-like, and apparently refers to the shape of the abdomen.

There are two northern species in the genus, one in the Old World and one in our fauna, *C. shurtleffi*. The genus is similar to *Somatochlora*. Some characteristics include the unmarked, bronzy-green thorax and greenish-black abdomen, the single cubito-anal crossvein in the hindwing and the doubly bifid male inferior appendage.

Cordulia shurtleffi Scudder

C. shurtleffi Scudder, 1866. Proc. Bost. Soc. Nat. Hist. 10:217
shurtleffi=named after a Mr. Shurtleff, of unknown significance.

Distinguishing characteristics—Male: Length, 43–47 mm; hindwing, 27–32 mm. Head metallic blue-green with yellowish-brown markings; eyes brilliant green. Thorax metallic green dorsally, bronze laterally; venter grey-brown; densely covered with grey-brown hairs and without pale markings. Hindwings sometimes with a yellow basal wash. Abdomen metallic greenish-black; segment 2 with tawny dorsolateral spots; intersegmental membrane following segment 2 white. Superior appendages black, strongly divergent in apical half in dorsal view (Fig. 25g, p. 160); inferior appendage black, bilobed, each lobe bifid.

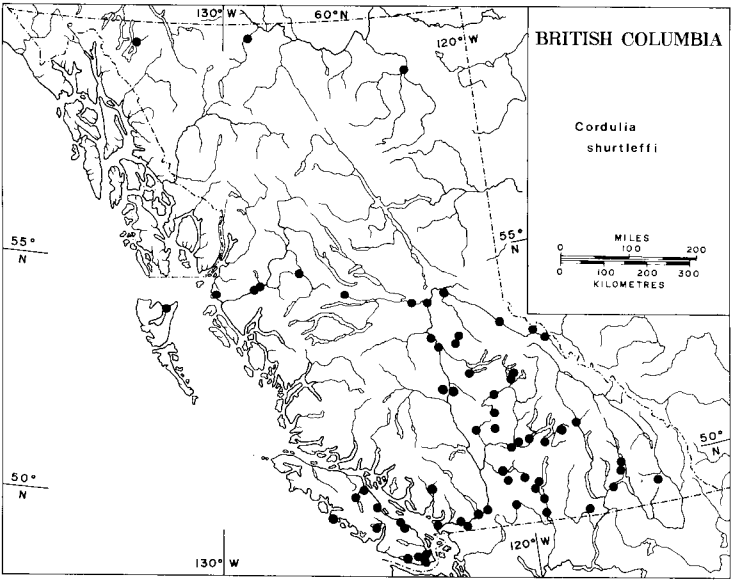
Female: Length, 44–48 mm; hindwing, 29–32 mm. Colour as in male. Vulvar lamina about a fourth as long as segment 9; bilobed half way to base (Fig. 25h, p. 160).

Larva: Length, 20–23 mm; metafemur, 7 mm. Antennæ 7-segmented, as long as head. Premental setæ, 11 or 12; palpal setæ, 7. Abdomen hairy

with dorsal hooks reduced to very low knobs; lateral spines on segments 8 and 9 only. Cerci longer than segment 9; epiproct longer than cerci. Colour greenish-brown with a broad dark lateral thoracic stripe.

Range—Alaska east through the Northwest Territories to Newfoundland; south to Pennsylvania, Ohio, and Saskatchewan, and in the mountains to Utah and California.

Distribution in British Columbia—General throughout the Province.



Field-notes—*C. shurtleffi* is one of the most widespread dragonflies in British Columbia and is probably the commonest member of its family in Canada. The species is often found around forest lakes but is particularly characteristic of sphagnum bogs. It is an early species, emerging in early May in the south. At Langford Lake near Victoria, on May 16, 1976, a female was observed emerging 2 cm above the water on a bulrush (*Scirpus*) stem. *Æshna californica* and *Ischnura cervula* were also flying. On May 8, 1976, exuviæ were thick in the hardhack (*Spiræa douglasii*) bordering a small boggy pond near Squamish; *Leucorrhinia hudsonica* and *Enallagma boreale* were also emerging in abundance. Males patrol the edges of bog ponds, flying about a metre above the water. They may also be seen hunting in forest glades. At dusk, on June 15, 1974, a large congregation of *shurtleffi*

flew over the south end of Clearwater Lake, Wells Gray Park, attacking newly emerged mayflies.

British Columbia records are from May 2 to August 21, with the peak in numbers occurring from the fourth week of May to the fourth week of June (Whitehouse, 1941).

Genus *Epitheca* Burmeister

The generic name means "on" and "sheath" and refers to the unusual gelatinous strands that encase the eggs. The genus was once considered purely North American and was called *Tetragoneuria* Hagen; recently it has been united with the Eurasian genus *Epitheca*.

The two species in British Columbia are mostly brown and black with little metallic sheen and, compared to our other Corduliids, are rather stout and hairy. The wings are basally spotted with brown. The vulvar lamina of the female is bilobed and flexible; this is apparently related to the laying of the distinctive egg masses (Walker and Corbet, 1975).

The larvæ are distinguished by their broad, flattened abdomen bearing dorsal hooks and prominent lateral spines on segment 9.

KEY TO THE SPECIES OF *EPITHECA*

ADULTS

1a. Frons with a T-spot in dorsal view (Fig. 25a); male anal appendages as in Fig. 25b; female vulvar lamina as in Fig. 25c ..... *spinigera* (p. 162)

1b. Frons without a T-spot (Fig. 25d); male anal appendages as in Fig. 25e; female vulvar lamina as in Fig. 25f ..... *canis* (p. 161)

LARVÆ

1a. Lateral spines on abdominal segment 9 extending well beyond the apices of the paraprocts ..... *spinigera* (p. 162)

1b. Lateral spines on abdominal segment 9 shorter than the paraprocts ..... *canis* (p. 161)

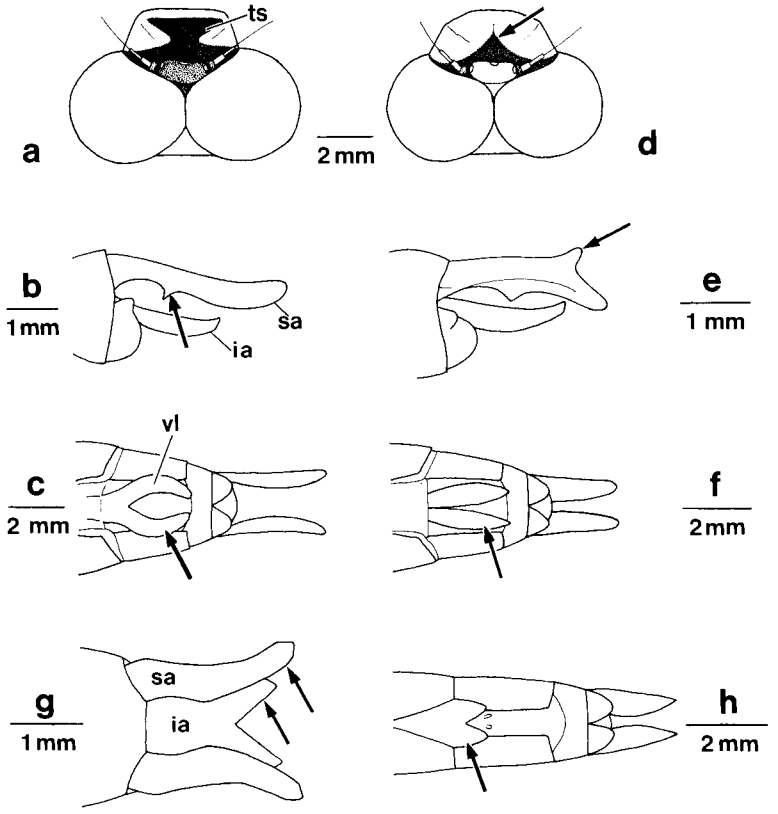


Fig. 25. Corduliidæ: dorsal view of head (**a, d**), lateral view of male anal appendages (**b, e**), ventral view of end of female abdomen (**c, f, h**) and dorsal view of anal appendages, male (**g**); **a, b, c,** *Epitheca spinigera;* **d, e, f,** *E. canis;* **g, h,** *Cordulia shurtleffi* (*see* p. 243 for explanation of letters).

Epitheca canis MacLachlan

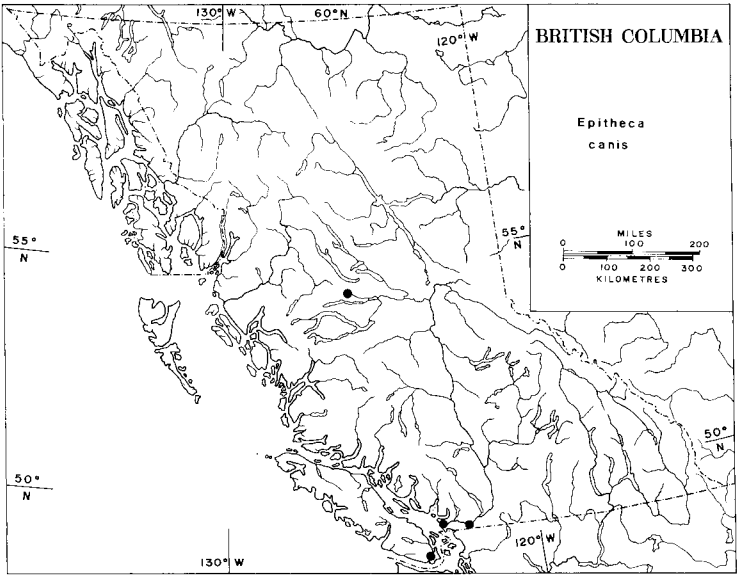
E. canis MacLachlan, 1886. Ent. Mon. Mag. 23:104

Tetragoneuria canis, Needham and Westfall, 1955. Dragonflies of N. Amer. p. 371

E. canis, Walker and Corbet, 1975. Odonata of Canada and Alaska 3:54

canis=dog; perhaps a reference to the brown coloration and densely haired thorax of this species.

Distinguishing characteristics—Male: Length, 44–45 mm; hindwing, 28–32 mm. Head brown with labium, labrum, and frons pale orange-yellow; frons with a brown stripe lacking a cross bar (Fig. 25d, p. 160); eyes blue in life. Thorax light brown with dense grey-brown hair; interpleural suture with a dark brown line; metepisternum with a long yellow spot surrounding the spiracle. Hindwings with small brown markings at the base and anal triangle. Abdomen dark brown; segments 1–9 with orange-brown lateral spots. Superior appendages sharply angled posteroventrally and with a



dorsal knob and ventral tubercle (Fig. 25e, p. 160); inferior appendage bluntly triangular.

Female: Length, 40–47 mm; hindwing, 28–32 mm. Colour as in male except the hindwings lack brown marks at the base and the lateral abdominal spots form an almost continuous line. Vulvar lamina with lobes straight, diverging, and divided to the base (Fig. 25f, p. 160).

Larva: Length, 21–23 mm; metafemur, 7.0–7.7 mm. Head with hind margin deeply concave. Premental setæ, 11 or 12; palpal setæ, 7 or 8. Abdominal segment 9 with lateral spines short, not reaching the tips of the paraprocts; dorsal hooks on segments 1–9.

Range—British Columbia east to Nova Scotia and, in the west, south to California.

Distribution in British Columbia—Southern Vancouver Island, the Fraser Valley, and an isolated northern record from Burns Lake.

Field-notes—This species is probably more widely distributed than is presently known; its season is early and relatively short. Although there are no records of emergence or oviposition in the Province, the earliest observation of flight is May 4, 1975, at Matheson Lake, Victoria. This is the sole Vancouver Island record. Mature females are conspicuous because of the yellow-brown staining of their wings and the habit, similar to that of *E. spinigera,* of curling up the end of the abdomen. Females trailing broken egg strings during flight evidently have been disturbed by aggressive males while ovipositing (Walker and Corbet, 1975).

Flight records range from May 4 in the south to July 5 at Burns Lake, where the flight period was far from being over (Whitehouse, 1941).

Epitheca spinigera (Selys)

Tetragoneuria spinigera Selys, 1871. Bull. Acad. Belg. (2) 31:269

E. spinigera, Walker and Corbet, 1975. Odonata of Canada and Alaska 3:51.

spinigera=bearing a spine; a reference to the prominent ventral spine on the male superior appendage.

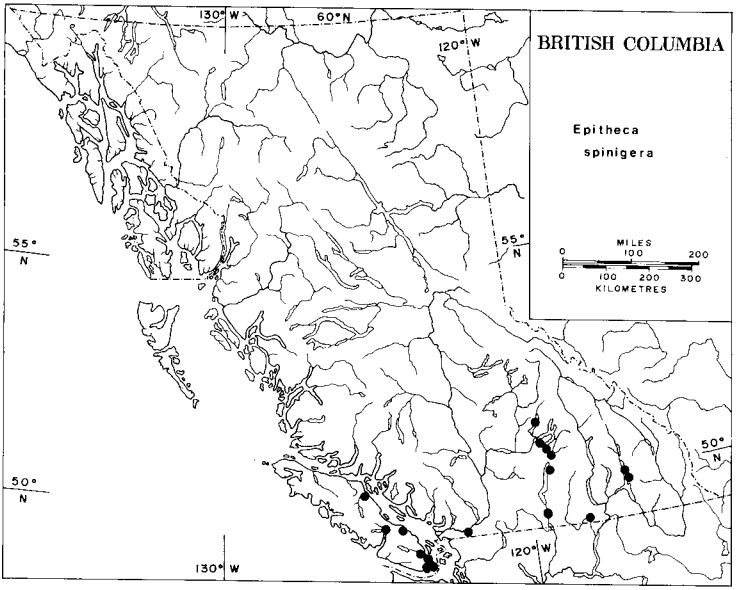
Distinguishing characteristics—Male: Length, 42–53 mm; hindwing, 29–36 mm. Head brown with labium, labrum, and frons orange-yellow; frons with a brown T-spot, the cross bar narrow, the stem wide (Fig. 25a, p. 160). Eyes blue in life. Thorax dark red-brown with dense grey hair; suture lines black. Wings with a yellow tinge; base of hindwings and anal triangle with brown patches (Fig. 24b, p. 156). Abdomen black; segments 1–8 with narrow orange-red lateral spots. Superior appendages with a small ventral spine (Fig. 25b, p. 160); inferior appendages with apex bifid.

Female: Length, 45–52 mm; hindwing, 31–37 mm. Colour as in male. Vulvar lamina with lobes curved, apices slightly convergent (Fig. 25c, p. 160).

Larva: Length, 22–24 mm; metafemur, 7–8 mm. Premental setæ usually 11 or 12; palpal setæ, 7 or 8. Abdominal segment 9 with lateral spines reaching well beyond the tips of the paraprocts; dorsal hooks on segments 1–9.

Range—British Columbia east to Nova Scotia; south to New Jersey, Indiana, and California.

Distribution in British Columbia—Widespread south of 51°N.



Field-notes—Whitehouse (1941) observed *spinigera* emerging June 16, 1937, at Thetis Lake near Victoria. The larvæ were crawling over grassy slopes and paths and transforming into adults on the benches and fences 7 metres from the water. He also noted ovipositing females from June 28 to July 9, some of them flying with about 25 mm of the distinctive gelatinous egg ribbon dangling from the upturned abdomen. These braids of eggs are often laid communally, forming large, floating masses.

Recorded dates of flight in British Columbia are from May 19 to July 30; *spinigera* is most abundant in June and declines in numbers rapidly thereafter.

Genus *Somatochlora* Selys

The Greek words *soma,* body, and *khloros,* green, are the source of the name of this genus, the largest in the Corduliidæ. Species of *Somatochlora* are metallic, dark bronzy-green dragonflies and when they are alive their eyes are a brilliant green.

The genus is predominantly northern, with its centre of distribution in Canada. There are 24 North American species; 17 occur in Canada and nine are known from British Columbia. *S. sahlbergi,* a subarctic species, has been found with *Æshna septentrionalis* and *Enallagma boreale* at about 69°30′N, which is as far north as Odonata are known to exist.

Useful characters for identification include the presence or absence of yellow lateral thoracic spots, the form of the male anal appendages, and the female vulvar lamina.

The larvæ may or may not possess dorsal hooks and lateral spines and lack the dark longitudinal stripe on the side of the thorax found in *Cordulia.* The larvæ of most species sprawl in the bottom detritus of mountain lakes, slow streams, and bog ponds.

KEY TO THE SPECIES OF *SOMATOCHLORA*

MALES

1a. Apices of superior appendages curved upward 2

1b. Apices of superior appendages not curved upward 8

2a. Superior appendages parallel or only slightly bent inwards beyond the middle (Fig. 26a, b), thorax with 2 yellow lateral spots 3

2b. Superior appendages strongly bent inwards beyond the middle, forming a definite angle; metepimeral spot absent 4

3a. Superior appendages with a conspicuous apical tuft of hair (Fig. 26a); mesepimeral spot elongate ..... *walshi* (p. 179)

3b. Superior appendages without an apical tuft of hair (Fig. 26b); mesepimeral spot rounded ..... *minor* (p. 174)

4a. Hindwing with a dark brown basal spot (Fig. 26j) 5

4b. Hindwing without a dark brown basal spot 6

5a. Superior appendages converging from base to middle and with a lateral tooth anterior to the posterior bend; in lateral view with a ventral tooth about a third the distance from base to apex (Fig. 26e) ..... *whitehousei* (p. 181)

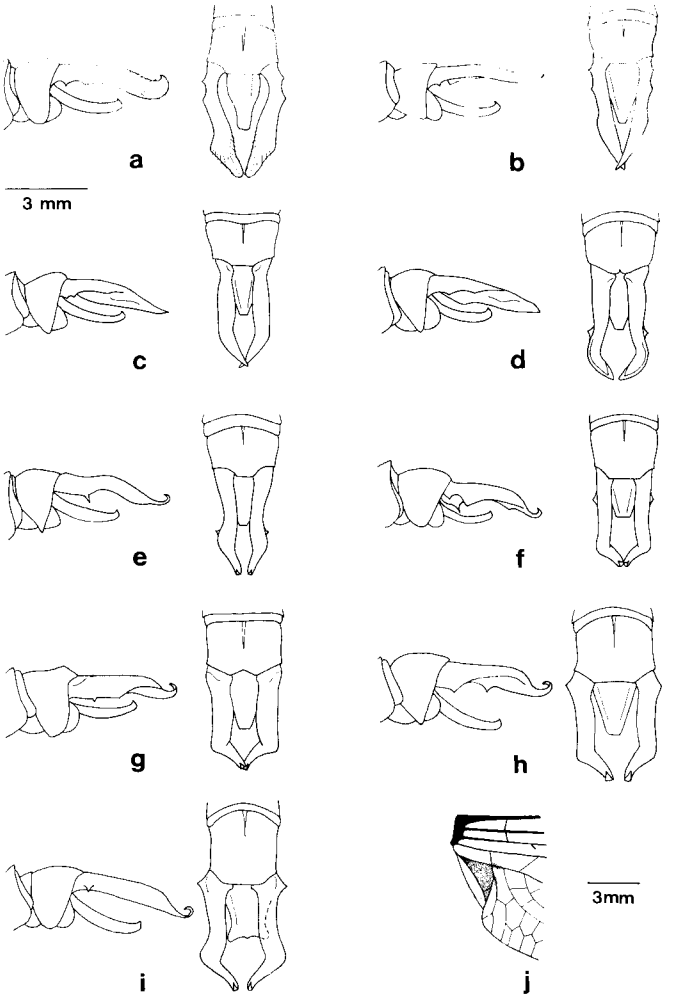


Fig. 26. *Somatochlora:* Anal appendages in the males (left, ventral view; right, dorsal view); **a,** *S. walshi;* **b,** *S. minor;* **c,** *S. franklini;* **d,** *S. semicircularis;* **e,** *S. whitehousei;* **f,** *S. septentrionalis;* **g,** *S. albicincta;* **h,** *S. hudsonica;* **i,** *S. cingulata;* and base of hindwing (**j**) of *S. septentrionalis.*

5b. Superior appendages parallel and with a lateral tooth about a third the distance from base to apex; in lateral view with a ventral tooth about a sixth the distance from base to apex (Fig. 26f) ..... *septentrionalis* (p. 178)

6a. Inferior appendage bilobed (Fig. 26i) ..... *cingulata* (p. 170)

6b. Inferior appendage triangular 7

7a. Superior appendages with a prominent basal angle; in lateral view with a prominent ventral tooth near the middle (Fig. 26h) ..... *hudsonica* (p. 173)

7b. Superior appendages not angled basally in dorsal view (Fig 26g) ..... *albicincta* (p. 168)

8a. Hindwing with a dark brown basal spot (*see* Fig. 26j) *franklini* (p. 171)

8b. Hindwing without a brown basal spot ..... *semicircularis* (p. 176)

FEMALES

1a. Vulvar lamina erect, laterally compressed and longer than the lateral margin of abdominal segment 9 (Fig. 27a) ..... *minor* (p. 174)

1b. Vulvar lamina usually horizontal or inclined and not compressed, or if slightly so, then shorter than the lateral margin of segment 9 2

2a. Vulvar lamina as long as or nearly as long as the venter of abdominal segment 9, entire and scoop-shaped (Fig. 27b, c) 3

2b. Vulvar lamina distinctly shorter than the venter of segment 9 4

3a. Hindwing with a brown basal spot (*see* Fig. 26j) ..... *franklini* (p. 171)

3b. Hindwing without a brown basal spot ..... *walshi* (p. 179)

4a. Thorax with 2 lateral yellow spots, the mesepimeral spot ovate, the metepimeral spot smaller, sometimes obscure ..... *semicircularis* (p. 176)

4b. Thorax without a yellow metepimeral spot, the mesepimeral spot small or absent 5

5a. Hindwing with a dark brown basal spot (*see* Fig. 26j) 6

5b. Hindwing without a dark brown basal spot 7

6a. Vulvar lamina entire or only slightly notched, somewhat compressed and projecting (Fig. 27e) ..... *whitehousei* (p. 181)

6b. Vulvar lamina bilobed, flattened and not projecting (Fig. 27f) ..... *septentrionalis* (p. 178)

7a. Vulvar lamina more than half as long as the venter of abdominal segment 9, entire or only slightly notched (Fig. 27g) *hudsonica* (p. 173)

7b. Vulvar lamina not more than half as long as the venter of segment 9, more or less bilobed or notched 8

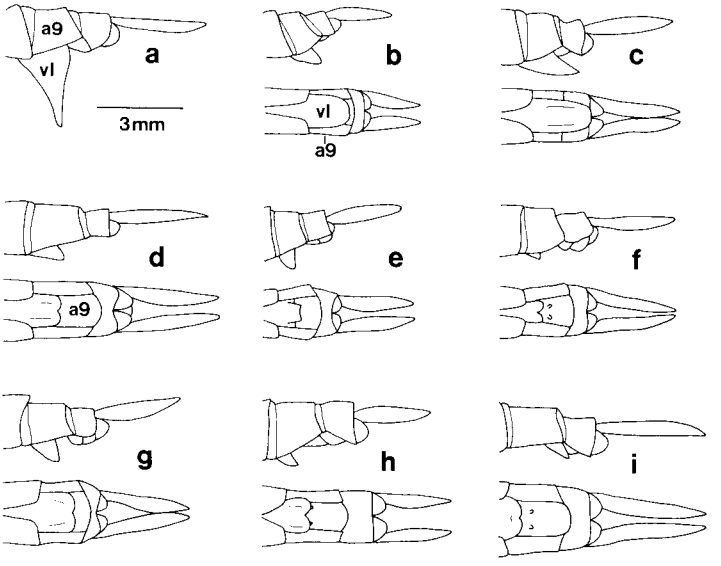


Fig. 27. *Somatochlora:* Vulvar laminæ of females (top, lateral view; bottom, ventral view); **a**, *S. minor;* **b**, *S. franklini;* **c**, *S. walshi;* **d**, *S. semicircularis;* **e**, *S. whitehousei;* **f**, *S. septentrionalis;* **g**, *S. hudsonica;* **h**, *S. albicincta;* **i**, *S. cingulata* (*see* p. 243 for explanation of letters).

8a. Vulvar lamina nearly half as long as the venter of segment 9, bilobed (Fig. 27h); thorax brassy green with a pale mesepimeral spot ..... *albicincta* (p. 168)

8b. Vulvar lamina a third as long as the venter or segment 9, notched (Fig. 27i); thorax very dark brassy and without a pale mesepimeral spot ..... *cingulata* (p. 170)

LARVÆ

1a. Dorsal hooks present on abdomen 2

1b. Dorsal hooks absent 3

2a. Dorsal hook on abdominal segment 4 more than half as long as segment 4 ..... *minor* (p. 174)

2b. Dorsal hook on segment 4 not more than a fourth as long as segment 4 ..... *walshi* (p. 179)

3a. Lateral spines absent, or if present, on abdominal segment 9 only 4

3b. Lateral spines present on abdominal segments 8 and 9 7

4a. Lateral spines present on abdominal segment 9 5

4b. Lateral spines wholly absent 6

5a. Fringe of hair on posterior margin of abdominal segments 8 and 9 as long or nearly as long as mid-dorsal length of these segments; total length 17 mm ..... *franklini* (p. 171)

5b. Fringe of hair on posterior margin of segments 8 and 9 much shorter than mid-dorsal length of these segments; total length 21–22 mm ..... *semicircularis* (p. 176)

6a. Premental setæ, 9 or 10; palpal setæ, 6 or 7 ..... *whitehousei* (p. 181)

6b. Premental setæ, 11–13; palpal setæ, 8 ..... *septentrionalis* (p. 178)

7a. Length over 25 mm; hind femur over 7 mm; abdomen with a series of median dorsal bumps ..... *cingulata* (p. 170)

7b. Length under 25 mm; hind femur under 7 mm; abdomen without a series of median dorsal bumps 8

8a. Lateral spines on abdominal segment 9 a fifth to a third as long as the lateral margin of segment 9, not including the spine ..... *albicincta* (p. 168)

8b. Lateral spines on segment 9 a tenth to a sixth as long as the lateral margin of segment 9 ..... *hudsonica* (p. 173)

Somatochlora albicincta (Burmeister)

Epophthalmia albicincta Burmeister, 1839. Handb. Ent. 2:847

S. albicincta, Walker and Corbet, 1975. Odonata of Canada and Alaska 3:120

albicincta=girdled with white; the abdominal segments have white apical rings.

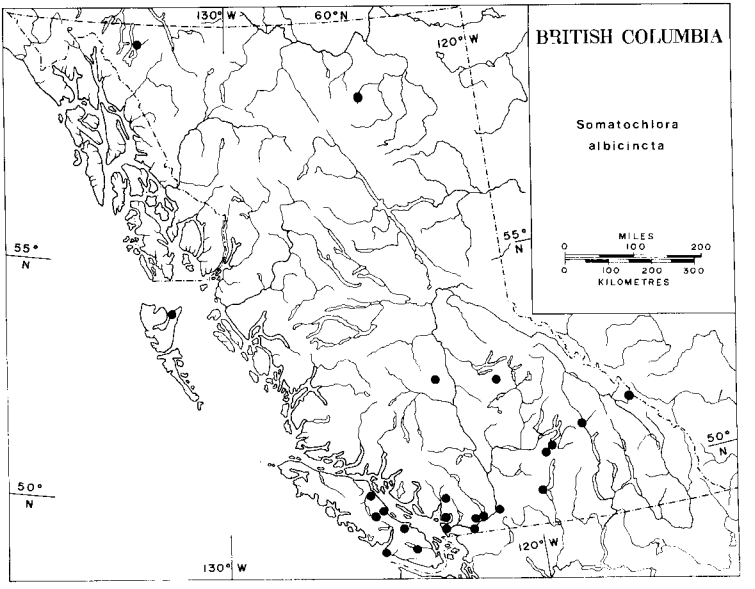
Distinguishing characteristics—Male: Length, 45–50 mm; hindwing, 28–31 mm. Head metallic greenish-black; sides of frons and labium yellowish-brown; dark hairs dorsally, white on the face. Thorax coppery-green; mesepisternum with a pale red spot and narrow yellow spot on upper half; mesepimeron without a pale spot. Abdomen bronze-black; segments 2 and 3 with pale dorsal patches; segments 3–9 with intersegmental membranes partly white; segment 10 with a pair of yellow dorsal spots; segments 4–8 with yellow lateral spots. Superior appendages angled inwards beyond the middle; apices curved upwards (Fig. 26g, p. 165).

Female: Length, 46–52 mm; hindwing, 29–33 mm. Colour as in male except wings may be yellowish-brown. Vulvar lamina less than half as long as segment 9 and distinctly bilobed (Fig. 27h, p. 167).

Larva: Length, 20–24 mm; metafemur, 5.8–6.5 mm. Prementum reaching laterally to edge of eyes; premental setæ, 11 or 12; palpal setæ, 5 or 6. Abdomen without dorsal hooks; lateral spines on segments 8 and 9, spines on 9 a fifth to a third as long as the lateral margin of segment 9. Cerci as long as segments 9 and 10 together; epiproct as wide as long, longer than cerci.

Range—Alaska east to Labrador and Newfoundland; south to New Hampshire, Lake Superior, and north of the Great Plains to the Rocky Mountains; south through British Columbia and Alberta to Washington.

Distribution in British Columbia—Widely scattered; there are no records from the Kootenay region.



Field-notes—Within the genus in British Columbia, *S. albicincta* is second only to *semicircularis* in abundance. The species varies greatly in size in the Province, specimens from the Pacific Coast being distinctly larger and darker than the typical form. On the Queen Charlotte Islands the species

is very large, approaching the size of *cingulata;* Whitehouse calls this form *massettensis* Whitehouse. Emergence has been recorded on July 30 (Grouse Mountain, Vancouver) and oviposition between August 8 and 18 (Campbell River) (Whitehouse, 1941). Walker and Corbet (1975) note that *albicincta* patrols the edges of boggy streams and ponds "showing a tendency to pass in and out of small recesses along the banks, flying usually at a height of somewhat more than a foot above the water."

Flight records in British Columbia are from June 30 to August 29.

Somatochlora cingulata (Selys)

Epitheca cingulata Selys, 1871. Bull. Acad. Belg. (2) 31:302

S. cingulata, Walker and Corbet, 1975. Odonata of Canada and Alaska 3:130

cingulata=girdled; a reference to the conspicuous white-ringed abdomen of the species.

Distinguishing characteristics—Male (Fig. 44a, p. 242): Length, 54–63 mm; hindwing, 33–39 mm. Head metallic blue-black with a thin covering of brown hair; labium pale brown; sides of frons yellow. Thorax brassy red-brown with green reflections. Wings with anal triangle and base of forewings orange-yellow. Abdomen black with a green lustre; intersegmental membranes white; segment 3 with a brown lateral patch; segments 4–8 with dark yellow laterobasal spots. Superior appendages with a prominent basal spine; apices strongly curved upwards, convergent; inferior appendage bilobed (Fig. 26i, p. 165).

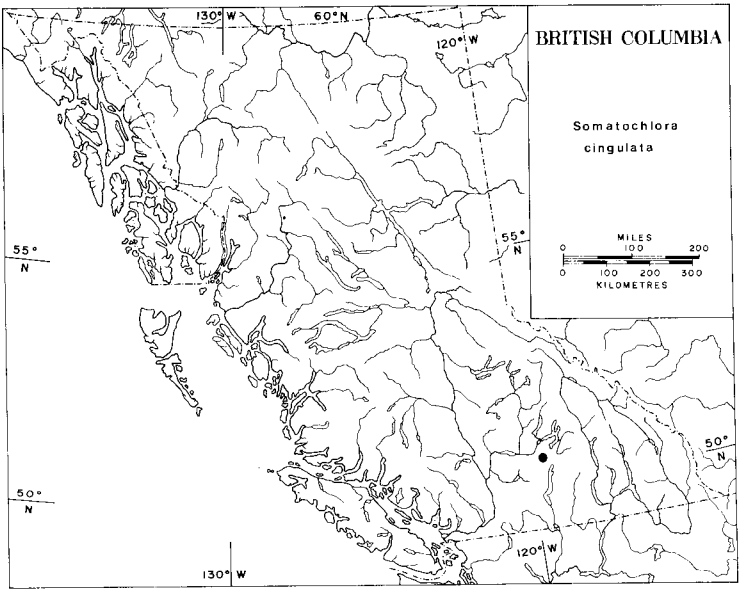
Female: Length, 51–58 mm; hindwing, 35–41 mm. Colour as in male. Vulvar lamina a third as long as segment 9 and notched (Fig. 27i, p. 167).

Larva: Length, 26–28 mm; metafemur, 7.4–7.7 mm. Prementum extending laterally beyond the inner edges of the eyes; premental setæ, 10–13; palpal setæ, 6 or 7. Abdomen without dorsal hooks but with a series of median dorsal bumps; lateral spines on segments 8 and 9. Males with epiproct bearing a pair of prominent lateral tubercles.

Range—British Columbia east to Hudson Bay, Labrador, and Newfoundland; south to New Hampshire, Michigan, the north shore of Lake Superior, and the northern prairies.

Distribution in British Columbia—Arthur Lake (1 200 metres above sea-level), near Falkland.

Field-notes—This boreal species is local in the west, known only from two localities in British Columbia and Alberta. Although *cingulata* must be considered rare in British Columbia, a thorough examination of subalpine lakes in the Province likely will extend its known distribution. Walker and



Corbet (1975) note that in Quebec oviposition always occurred at the lake outlet where there was some current. In eastern North America emergence is recorded between June 24 and July 19, copulation on July 24, and oviposition on July 21. The Arthur Lake specimens were captured on August 10, 1932. Whitehouse (1941) estimates the flying season to last from the fourth week of June to early September.

Somatochlora franklini Selys

S. franklini Selys, 1878. Bull. Acad. Belg. (2) 45:195

S. franklini, Walker & Corbet, 1975. Odonata of Canada and Alaska 3:94

franklini=probably named after Sir John Franklin (1786–1847), arctic explorer.

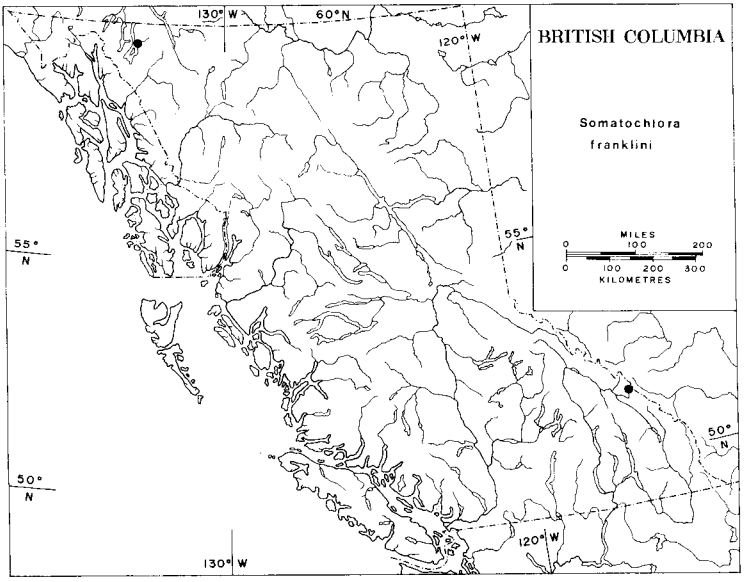
Distinguishing characteristics—Male: Length, 47–54 mm; hindwing, 25–28 mm. Head metallic green-black; labium yellow; frons with lateral yellow spots. Thorax metallic green-black; dorsum with two yellow posterior

spots; mesepimeron with an oval yellow spot; densely covered with brown hair. Hindwings with a brown patch on the anal triangle. Abdomen green-black with a dull lustre; segment 2 with an interrupted yellow posterior intersegmental membrane. Superior appendages slender, not arched; apices convergent (Fig. 26c, p. 165).

Female: Length, 44–45 mm; hindwing, 26–30 mm. Head and thorax as in male. Abdomen green-black; segment 2 with yellow spots obscure and with an indistinct anterodorsal spot; segment 3 with pale ventrolateral basal patches; venter of segments narrowly margined with yellow. Wings sometimes with a yellow-brown wash. Vulvar lamina horizontal, almost as long as segment 9, scoop-shaped and broadly rounded (Fig. 27b, p. 167).

Larva: Length, 17.5 mm; metafemur, 5.2 mm. Prementum as wide as long; premental setæ, 13; palpal setæ, 7 or 8. Abdomen without dorsal hooks; lateral spines on segment 9 small and tooth-like; posterior margins of all segments with a dense fringe of hair; hairs on segment 9 as long as the mid-dorsal length of that segment. Epiproct not as long as segments 9 and 10 together.

Range—Yukon and Northwest Territories east to Labrador; south to Maine, Minnesota, southern Manitoba, and British Columbia.



Distribution in British Columbia—West of the Rocky Mountains this species has been found only at Atlin (60°N) and probably occurs in southern British Columbia only in those mountains where it is known from Field.

Field-notes—*S. franklini* is a species mainly of the far north. At Field the species is known to breed in bog puddles formed by seepage from a cold spring and flies there with *Æshna sitchensis* and *Somatochlora semicircularis* (Walker and Corbet, 1975). Nearby, at Banff, tenerals were found on July 9. Whitehouse (1941) found the species at Atlin on a small stream that drained a large muskeg pool. Here on July 14, females were ovipositing; *Æshna septentrionalis* was ovipositing, and *Æshna sitchensis* was emerging.

Captures of the species range from July 14 to August 27, indicating a flight period from early July to early September.

Somatochlora hudsonica (Selys)

Epitheca hudsonica Selys, 1871. Bull. Acad. Belg. (2) 31:301

S. hudsonica, Walker and Corbet, 1975. Odonata of Canada and Alaska 3:126

hudsonica=Hudson Bay; probably where first recorded.

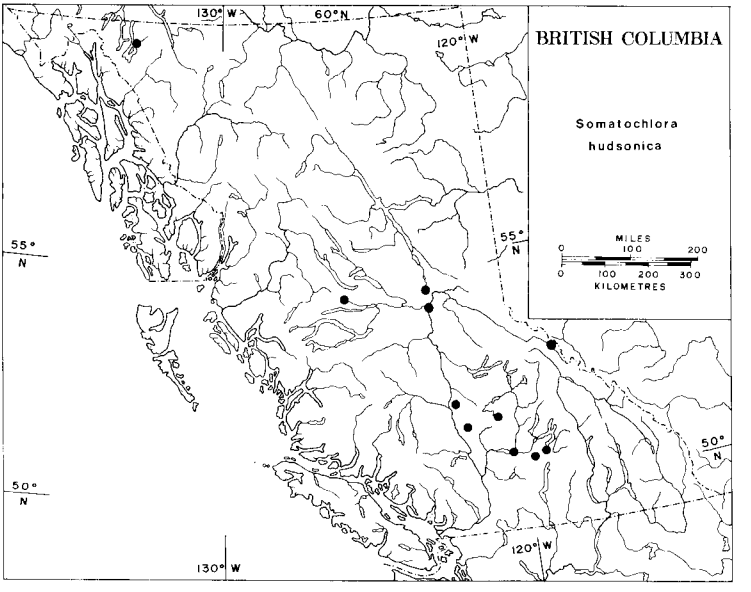
Distinguishing characteristics—Male: Length, 50–54 mm; hindwing, 30–34 mm. Head metallic green-black; sides of frons and labium yellow-brown. Thorax coppery-green; mesepisternum with an orange-brown anterior spot and yellow posterodorsal spot; mesepimeron with a pale brown spot. Abdomen black with a coppery lustre; segments 2 and 3 with pale brown lateral patches; segments 1–9 with white posterior intersegmental membranes. Superior appendages with apices distinctly curved upwards and sharply angled inwards posteriorly; basal angle prominent; venter with a distinct tooth (Fig. 26h, p. 165).

Female: Length, 50–54 mm; hindwing, 32–34 mm. Colour pattern as in male. Vulvar lamina three fifths to two thirds as long as segment 9, slightly projecting, edge entire or slightly notched (Fig. 27g, p. 167).

Larva: Length, 24–25 mm; metafemur, 6.7–7.0 mm. Prementum as wide as long; premental setæ, 10–14; palpal setæ, 7 or 8. Abdomen without dorsal hooks; segments 8 and 9 with very small lateral spines; spines on 9 a tenth to a sixth as long as the lateral margin of segment 9. Epiproct a fourth longer than segments 9 and 10 together; paraprocts a third longer than cerci; cerci not as long as epiproct.

Range—Alaska east through the Northwest Territories to northwestern Ontario; south, at high elevations in the Rocky Mountains, to Colorado.

Distribution in British Columbia—Scattered records in the Interior from Atlin in the north to Falkland in the south.



Field-notes—This northern species is similar to *albicincta* in behaviour and habitat; they often fly together, especially around bog pools with firm, peaty edges (Whitehouse, 1941). Whitehouse once captured a male *albicincta* attempting to mate with a female *hudsonica*. Where the two species fly together, *hudsonica* emerges about 10 days earlier; at Atlin this was about June 12 to 15 (Whitehouse, 1941).

The flight period in British Columbia is probably from the second week in June to early September. Actual records are from June 29 to August 27.

***Somatochlora minor* Calvert**

S. elongata var. *minor* Calvert, 1898. Ent. News 9:87

S. minor, Walker and Corbet, 1975. Odonata of Canada and Alaska 3:78

minor=small; referring to the fact that this species was once considered a variety of the larger *S. elongata* (Scudder).

Distinguishing characteristics—Male: Length, 42–44 mm; hindwing, 30–32 mm. Head metallic green-black; labium and sides of frons yellow.

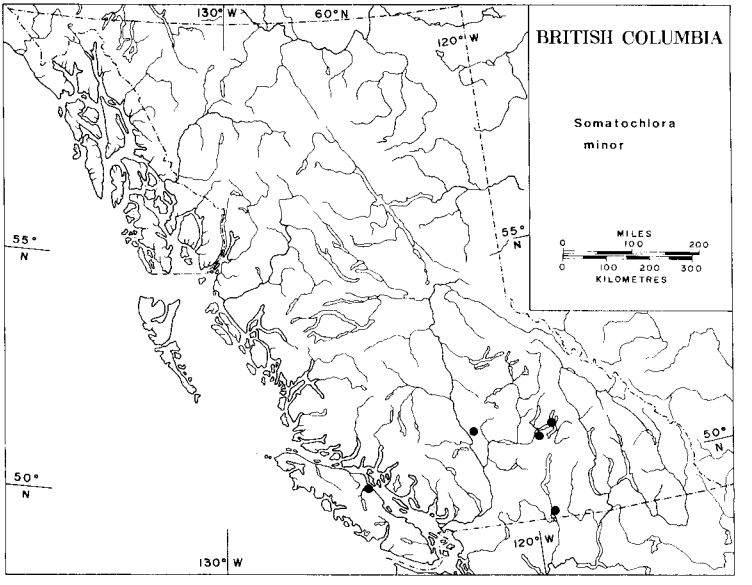
Thorax metallic blue-green; mesepimeron and metepimeron with large yellow oval spots. Wings with a pale yellow wash. Abdomen green-black with a dull lustre; segment 2 with a yellow-brown dorsal spot, paired yellow dorsolateral spots, and brown ventrolateral spots; segment 3 with yellow-brown lateral spots. Superior appendages with apices curved upwards, meeting or overlapping; lateral margins with two small spines or angles (Fig. 26b, p. 165).

Female: Length, 44–50 mm; hindwing, 32–34 mm. Colour as in male except abdominal segment 2 with a single pair of lateral spots; ventral margins of segment 9 and vulvar lamina yellow. Vulvar lamina erect, compressed, and longer than segment 9 (Fig. 27a, p. 167).

Larva: Length, 21–23 mm; metafemur, 6.7–7.0 mm. Premental setæ, 11–13; palpal setæ, 6–8. Abdomen with dorsal hooks on segments 4–9, that on 4 more than half as long as the segment; lateral spines on segments 8 and 9, spines on 9 about a third or more the lateral length of segment 9.

Range—British Columbia east to James Bay and Nova Scotia; south to New York, Michigan, Wyoming, and Washington.

Distribution in British Columbia—It is probable that the localities where this species is known, all well south of 52°N, do not represent the total range in British Columbia. *S. minor* reaches almost 56°N in Manitoba.



Field-notes—At an elevation of 1 200 metres in the mountains east of Vaseux Lake, Okanagan Valley, *minor* was observed in one of its typical habitats—a small willow and sedge meadow bisected by a narrow, clear, gently flowing stream. There, on August 5, 1975, males flew low over the water, often returning to the same spot to hover for short periods. Males of *Æshna palmata* and *Somatochlora semicircularlis* also patrolled the stream, but no aggressive encounters between the three species were noticed.

The females of *minor*, more so than any other species of *Somatochlora*, have the vulvar lamina developed in a conspicuous spout for stabbing eggs into the wet moss or mud of the streambank. Walker and Corbet (1975) observed this behaviour, the insect alternately striking the moss and water nearby. They also note that sometimes egg-laying may occur in shallow running water among stones.

In British Columbia, *minor* is known to fly between June 23 and August 17, but undoubtedly is on the wing into September.

Somatochlora semicircularis (Selys)

Epitheca semicircularis Selys, 1871. Bull. Acad. Belg. (2) 31:295

S. semicircularis, Walker and Corbet, 1975. Odonata of Canada and Alaska 3:106

semicircularis=semicircular; a reference to the sickle-shaped superior appendages of the male.

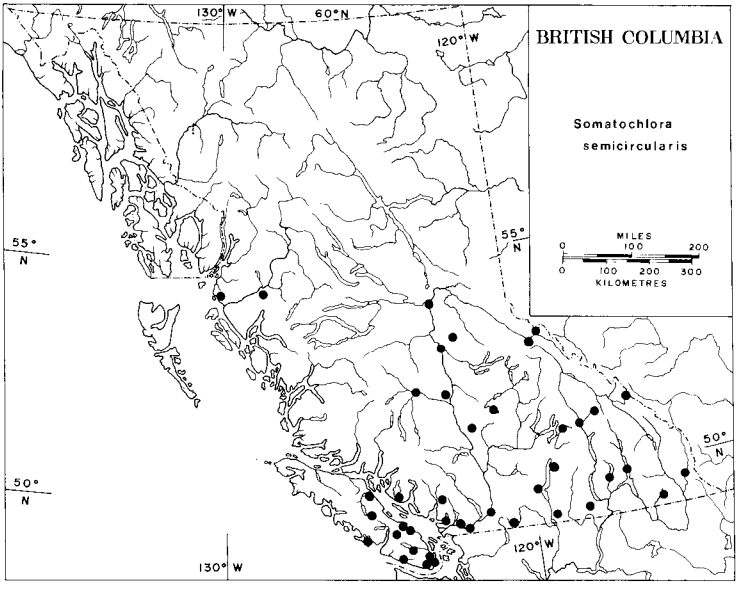
Distinguishing characteristics—Male: Length, 47–52 mm; hindwing, 27–32 mm. Head metallic green-black; labium and sides of frons yellow; covered in pale brown hairs. Thorax metallic blue-green; mesepisternum brown; yellow mesepimeral and metepimeral spots obscure. Hindwings and anal triangle yellow. Abdomen dull black; segment 2 with a pair of dull yellow dorsolateral patches and a pale posterior intersegmental membrane; segment 3 with small brown dorsolateral spots. Superior appendages with apices curving inward to form an arc, not curving upwards (Fig. 26d, p. 165).

Female: Length, 47–52 mm; hindwing, 29–32 mm. Colour as in male except yellow abdominal spots larger. Vulvar lamina half as long as segment 9, flat, emarginate (Fig. 27d, p. 167).

Larva: Length, 21–22 mm; metafemur, 5.8–6.0 mm. Prementum not reaching laterally to inner edge of eye; premental setæ, 10–13; palpal setæ, 7. Abdomen without dorsal hooks; lateral spines on segment 9 only; fringe of hair on posterior margins of segments 8 and 9 much shorter than the length of the segments. Cerci longer than epiproct; paraprocts at least as long as cerci.

Range—Alaska south through British Columbia and the Rocky Mountains to Colorado, Utah, and California.

Distribution in British Columbia—This is the most common and widespread of the genus in the Province and is generally distributed south of 55°N, but it probably occurs north of this line since it has been found in Alaska.



Field-notes—Both Whitehouse (1941) and Walker and Corbet (1975) summarize the habitat of this species as "reedy swamps, small ponds and muskeg potholes (and sometimes) quite large lakes where these have shallow, reedy shores." Whitehouse records mating from June 7 (Sooke) to August 2 (Hope) and oviposition on August 2. Walker and Corbet (1975) quote Kennedy as observing *semicircularis* mating: "the males captured the females while they rested. After capture followed a long nuptial flight, which usually lasted several minutes following which the pair, while yet in copulation, settled on some tree or shrub, where they remained for a long time. The eggs were laid in masses on the surface of the water of the more open pools whereupon the egg masses would immediately disintegrate and fall to the bottom."

British Columbia records are from June 7 to September 9.

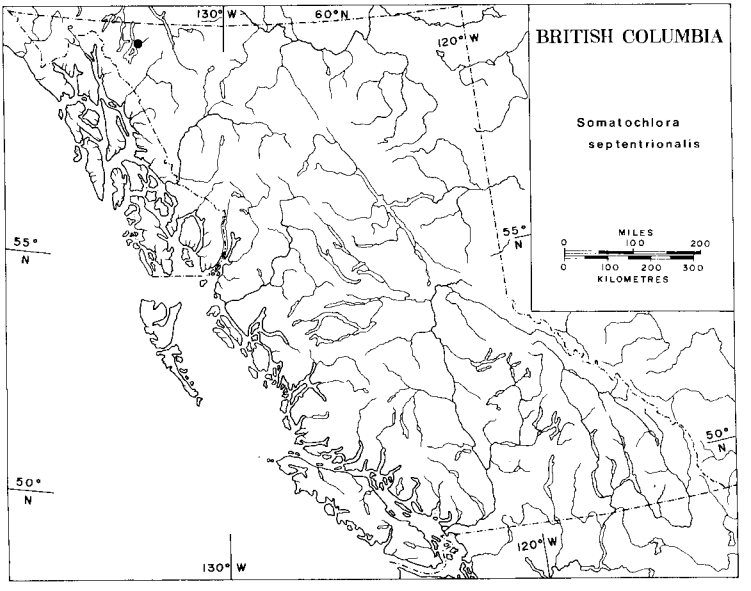
Somatochlora septentrionalis (Hagen)

Cordulia septentrionalis Hagen, 1861. Syn. Neur. N. Amer. p. 139

S. septentrionalis, Walker and Corbet, 1975. Odonata of Canada and Alaska 3:113

septentrionalis=northern; a reference to the distribution of the species.

Distinguishing characteristics—Male: Length, 39–47 mm; hindwing, 25–28 mm. Head metallic black to green; labium and sides of frons yellow; covered with orange-brown hair. Thorax metallic blue-green; mesepisternum with pale brown posterodorsal spots; mesepimeron with a long yellow-brown spot. Hindwings with a brown spot covering the anal triangle. Abdomen dull blackish-green; segments 1 and 2 with pale posterior intersegmental membranes; segment 2 with obscure brown dorsolateral spots; segment 3 with brown dorsolateral spots. Superior appendages parallel basally with 2 ventral spines; apices upcurved, often overlapping (Fig. 26f, p. 165).



Female: Length, 41–48 mm; hindwing, 27–30 mm. Colour as in male. Vulvar lamina a fourth to a third as long as segment 9 and deeply bilobed (Fig. 27f, p. 167).

Larva: Length, 19–20 mm; metafemur, 5.7–6.0 mm. Prementum wider than long; premental setæ, 11–13, palpal setæ, 8, the first smaller than the others. Abdomen without dorsal hooks and without lateral spines. Cerci and epiproct of equal length, paraprocts longer than both.

Range—The Northwest Territories east to Hudson Bay and Labrador; south to Newfoundland, James Bay, and northern British Columbia.

Distribution in British Columbia—Atlin.

Field-notes—At Atlin (Whitehouse, 1941) the habitat of the species is small bog pools 7–15 metres in length with level, wet edges. Whitehouse feels that the choice of this habitat is the result of competition; in these pools the females can oviposit in peace, undisturbed by the males of *S. hudsonica* and *albicincta*. The only occasion a female was seen attempting to oviposit in a large, firm-edged pond she was driven off by males of the larger species. Females oviposit in the centre of the pools, dipping the abdomen either into open water or the patches of decaying slime on the surface. Seldom does more than one male fly at each of these pools. The species rests away from the pools in small bog potholes ringed with grass.

Although actual captures of *septentrionalis* in British Columbia are from July 6 to August 21, Whitehouse estimates the total flying season to be from mid-June to the fourth week of August.

Somatochlora walshi (Scudder)

Cordulia walshi Scudder, 1866. Proc. Bost. Soc. Nat. Hist. 10:217

S. walshi, Walker and Corbet, 1975. Odonata of Canada and Alaska 3:74

walshi=named after the well-known 19th century amateur American entomologist, B. D. Walsh.

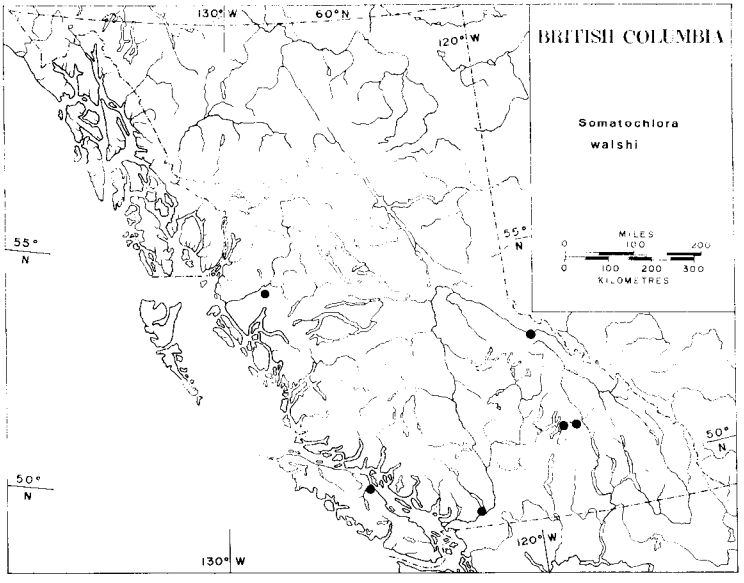
Distinguishing characteristics—Male: Length, 41–46 mm; hindwing, 30–32 mm. Head metallic black; labium and sides of frons pale brown. Thorax coppery-green; mesepimeral spot yellow, long; metepimeral spot yellow short, oval. Hindwings with anal triangle yellow. Abdomen dull metallic-green; segment 2 with orange-yellow anterodorsal and ventrolateral spots; segment 3 with small red dorsolateral spots; segments 5–7 with red anterolateral spots; segments 8 and 9 with pale posterior intersegmental membranes. Superior appendages swollen posteriorly with upcurved apices covered with dense brown hairs (Fig. 26a, p. 165).

Female: Length, 44–52 mm; hindwing, 31–34 mm. Colour as in male except dorsal spots on abdominal segment 2 absent or obscure. Vulvar lamina as long as or longer than segment 9, entire and scoop-shaped (Fig. 27c, p. 167).

Larva: Length, 20.5 mm; metafemur, 6.4 mm. Prementum as wide as long; premental setæ, 10; palpal setæ, 7. Abdomen with dorsal hooks on segments 4–9, that on 4 less than a fourth the length of the segment, longest hook on segment 8; lateral spines on segments 8 and 9. Cerci barely longer than epiproct; paraprocts slightly longer than cerci.

Range—British Columbia east to Newfoundland, north to Hudson Bay, and south to Pennsylvania, Wisconsin, and Washington.

Distribution in British Columbia—Recorded from Vancouver Island, the Fraser Valley, the Revelstoke area, Tête Jaune, and Lakelse near Terrace.



Field-notes—*S. walshi* breeds in small, slow streams of clear water in boggy or marshy places; it avoids ponds of any sort (Walker and Corbet, 1975). In late July or early August, Whitehouse (1941) observed oviposition near Campbell Lake, Vancouver Island. The female went "from one open space to the next, the dip, dip, dip of her abdomen never ceasing

except when she manouvered around the reed stems. Some scores of eggs must have been released at one laying and within an area of three or four feet."

S. walshi has been recorded in the Province from July 11 to August 18, but probably the flight period lasts from early July until the first part of September.

Somatochlora whitehousei Walker

S. whitehousei Walker, 1925. Univ. Tor. Stud. Biol. Serv. 26:154

S. whitehousei, Walker and Corbet, 1975. Odonata of Canada and Alaska 3:110

whitehousei=F. C. Whitehouse, pioneer in the study of Odonata in western Canada.

Distinguishing characteristics—Male: Length, 46–48 mm; hindwing, 26–28 mm. Head metallic green-black; labium pale yellow; sides of frons dark yellow; covered with brownish hair. Thorax metallic blue-green; mesepisternum with an orange-brown posterior patch; mesepimeron with an elongate orange-brown spot. Hindwings with a dark brown spot on the anal triangle. Abdomen dull green-black; segment 2 with dull brown lateral spots and a white posterior intersegmental membrane. Superior appendages converging from base to middle with a lateral tooth anterior to the posterior bend; ventral tooth about a third the distance from base to apex; apices upcurved (Fig. 26e, p. 165).

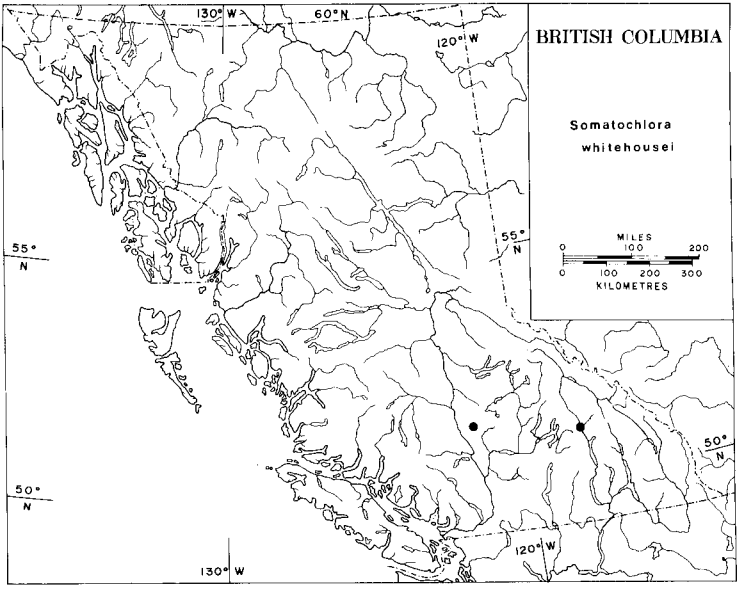
Female: Length, 45–48 mm; hindwing, 29–30 mm. Colour as in male except abdominal segments 2 and 3 with yellow dorsolateral spots. Vulvar lamina shorter than segment 9; edge entire or slightly notched, projecting (Fig. 27e, p. 167).

Larva: Length, 20–22 mm; metafemur, 5.5 mm. Prementum as wide as long, extending laterally to inner edge of eyes; premental setæ, 9 or 10; palpal setæ, 6 or 7. Abdomen without dorsal hooks or lateral spines. Epiproct and cerci about equal in length; paraprocts slightly longer.

Range—British Columbia east to Hudson Bay and Labrador.

Distribution in British Columbia—Revelstoke Mountain (2 000 metres) and Jesmond in the Cariboo.

Field-notes—*S. whitehousei* is a small species of the north; only two specimens have been taken in British Columbia. The species breeds in bog pools. Whitehouse (1941) described the habitat of *whitehousei* above the dam at Jesmond: "It is a wonderful location for the genus, combining the requirements of all: lake, muskeg, flowing creek and stagnant brook." There, on July 7, *whitehousei* flew with *S. hudsonica* and *S. minor*.



Observations of the species in British Columbia were on July 7 and August 12; the range of dates from other parts of Canada is June 12 to August 28 (Walker and Corbet, 1975).

FAMILY LIBELLULIDÆ

This cosmopolitan family, considered to be the family of most recent origin, contains about a quarter of the known species of living Odonata and includes nearly half the North American genera. It is the largest family in British Columbia, with five genera and 22 species. The Libellulidæ are usually colourful dragonflies hovering over the surface of still water and perching horizontally on reed tips and twigs that offer good views of potential food and mates.

The species vary greatly in size. In our fauna the smallest is *Leucorrhinia hudsonica* (27–32 mm long), the largest is *Libellula*

pulchella (43–57 mm long). Their bodies are usually stouter and less elongate than those of the Æshnidæ and Gomphidæ and older specimens are often pruinose. The females do not possess a well-developed ovipositor; the eggs are dropped in the water off the tip of the female's abdomen.

The anal angle of the hindwing is always rounded. In this family there is a marked difference between the venation of the fore and hindwings. The triangle is far beyond the arculus in the forewing but is retracted to the arculus in the hindwing. The foot-shaped anal loop reaches its greatest development in this group and the fusion of the veins rising from the arculus is most pronounced.

The larvæ are squat, hairy, and camouflaged, and sprawl on the bottom mud. They possess a characteristic spoon-shaped labium. Larvæ of the Libellulidæ usually inhabit warmer and more eutrophic waters than the Corduliidæ.

KEY TO THE GENERA OF LIBELLULIDÆ

ADULTS

1a. Vein R3 strongly undulate (Fig. 28a) ..... *Libellula* (p. 200)

1b. Vein R3 more smoothly curved (Fig. 28b) 2

2a. Between R1 and R2, 6–8 postnodal crossveins before the inner edge of the pterostigma, with the first postnodal crossvein much less than a third the distance from nodus to pterostigma (Fig. 28b) ..... *Erythemis* (p. 186)

2b. Between R1 and R2, 3–6 postnodal crossveins before the inner edge of the pterostigma, with the first postnodal crossvein much more than a third the distance from nodus to pterostigma (Fig. 28c, d) 3

3a. Adults black with red or yellow markings, white faces, and bases of hindwings with a dark triangular patch ..... *Leucorrhinia* (p. 188)

3b. Adults without all these characteristics 4

4a. Largest of the cells behind the pterostigma about 1.5 times longer than the pterostigma, the single crossvein being either at the outer end of the pterostigma or just beyond it (Fig. 28c) *Pachydiplax* (p. 211)

4b. Largest of the cells behind the pterostigma always less than 1.5 times longer than the pterostigma (Fig. 28d) ..... *Sympetrum* (p. 213)

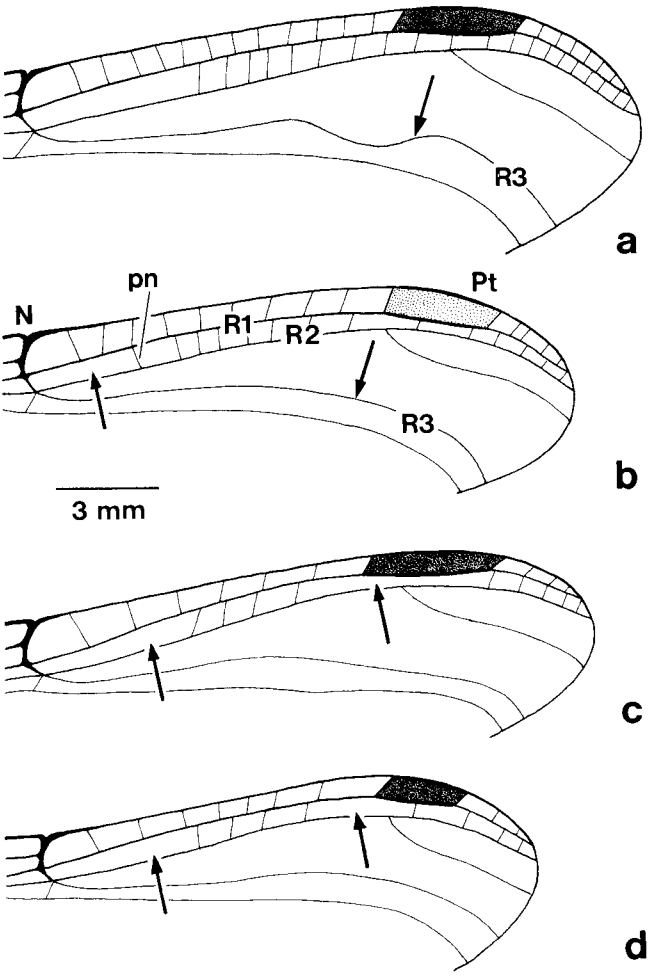


Fig. 28. Libellulidæ wings: **a**, *Libellula quadrimaculata;* **b**, *Erythemis collocata;* **c**, *Pachydiplax longipennis;* **d**, *Sympetrum occidentale* (*see* p. 243 for explanation of letters).

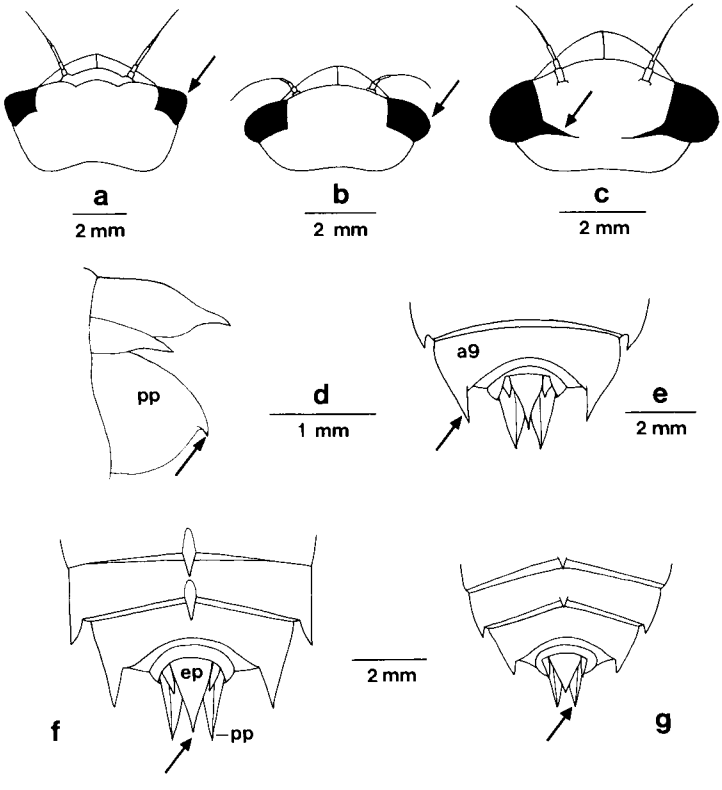


Fig. 29. Libellulidæ larvæ: Dorsal view of head (**a–c**), lateral view (after Musser, 1962) of anal appendages (**d**) and dorsal view of anal appendages (**e–g**); **a**, *Libellula quadrimaculata;* **b**, *Leucorrhinia borealis;* **c**, *Pachydiplax longipennis;* **d**, *Erythemis collocata;* **e**, *P. longipennis;* **f**, *Leucorrhinia intacta;* **g**, *Sympetrum obtrusum* (*see* p. 243 for explanation of letters).

LARVÆ

1a. Eyes oriented somewhat dorsally on the anterolateral corners of the rather rectangular head (Fig. 29a); length usually over 21 mm ..... *Libellula* (p. 200)

1b. Eyes more smoothly rounded and more lateral in position, head rather less angular (Fig. 29b); length usually 21 mm or less 2

2a. In lateral view paraprocts decurved (Fig. 29d); lateral spines absent ..... *Erythemis* (p. 186)

2b. In lateral view paraprocts straight or nearly so; lateral spines usually present 3

3a. Abdominal segments without dorsal hooks 4

3b. Abdominal segments with dorsal hooks 6

4a. Lateral spines on abdominal segment 9 equal to or greater than mid-dorsal length of segment 9 (Fig. 29e); dark ridge running inwards from posterior margin of eye (Fig. 29c) ..... *Pachydiplax* (p. 211)

4b. Lateral spines on segment 9 usually less than mid-dorsal length of segment 9; no dark ridge running inwards from posterior margin of eye 5

5a. Lateral spines on abdominal segment 8 a tenth or less of the mid-dorsal length of segment 8 ..... *Sympetrum* (p. 213)

5b. Lateral spines on segment 8 a third or more of the mid-dorsal length of segment 8 ..... *Leucorrhinia* (p. 188)

6a. Dorsal hook on abdominal segment 3; epiproct only slightly shorter than paraprocts (Fig. 29f) ..... *Leucorrhinia* (p. 188)

6b. No dorsal hook on segment 3; epiproct much shorter than paraprocts (Fig. 29g) ..... *Sympetrum* (p. 213)

Genus *Erythemis* Hagen

"The red one" interprets the generic name, but this refers to the southern species first described; our single representative is mainly green, the male turning blue with age.

There has been some confusion concerning the species of *Erythemis* occurring in British Columbia. Walker and Corbet (1975) state that a single species, *E. simplicicollis* (Say) occurs in Canada and that it is restricted to southern Ontario and southern British Columbia. Paulson (1970), referring to American material, argues that all western records should be assigned to *E. collocata*. The latter view is upheld by the present study, since all British Columbia specimens examined are *collocata*. It is clear that the eastern and western populations of *Erythemis* are not similar.

Erythemis collocata (Hagen)

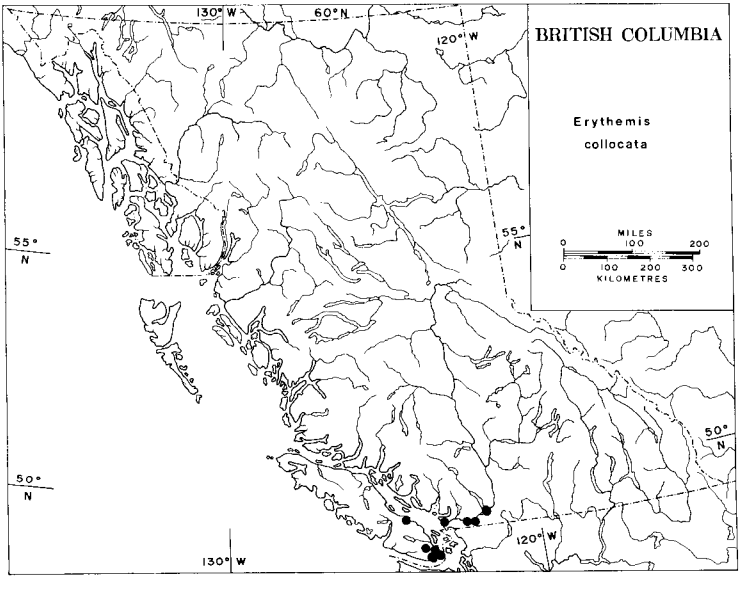
Mesothemis collocata Hagen, 1861. Syn. Neur. N. Amer. p. 171

E. collocata, Calvert, 1893. Trans. Amer. Ent. Soc. 20:265

E. simplicicollis (in part), Walker and Corbet, 1975. Odonata of Canada and Alaska 3:191

collocata=*collum* in Latin=neck, and *cata*=down, but the implication of a neck bent down is not obvious with regard to this species.

Distinguishing characteristics—Male: Length, 41–46 mm; hindwing, 31–33 mm. Teneral: Head with pale yellow labrum and labium; clypeus and frons green with brown hairs; frons with a dark transverse bar; rear of head striped with brown. Thorax green, drying to yellow; legs dark brown; dorsum of femora green. Abdomen green with all carinæ black. Superior appendages black, straight, with acute apices; inferior appendage triangular, curving upward. Adult: Except for the head and legs, the green and brown teneral colouring is replaced by grey-blue pruinosity.



Female: Length, 40–43 mm; hindwing, 30–34 mm. Colour as in teneral male, not becoming grey-blue with age. Vulvar lamina as long as segment 9, blunt and spout-like.

Larva: Length, 15–17 mm; metafemur, 5.0–5.4 mm. Head with large, diagonally striped, dorsolaterally prominent eyes. Labial palps with apical margins smooth; premental setæ, 14 or 15; palpal setæ, 8. Abdomen without dorsal hooks or lateral spines. Anal appendages decurved, paraprocts most strongly so (Fig. 29d, p. 185) (Musser, 1962).

Range—Southwestern British Columbia, the United States west of the Great Plains, and northwestern Mexico.

Distribution in British Columbia—Restricted to southern Vancouver Island and the Fraser Valley.

Field-notes—E. collocata may perch on low foliage but prefers bare ground, rocks, or logs. This habit and its green colour give it the appearance of a gomphid. Whitehouse (1941) observed mating on June 27 and oviposition on July 5 at Florence Lake, Victoria, and on July 24 to 25 at Chilliwack.

Dates of captures range from June 1 to July 25, but probably the species flies well into August.

Genus *Leucorrhinia* Brittinger

This genus of dainty libellulids with conspicuous white faces is well named, for in Greek *leucos* means white and *rhis* is nose.

Our five species of this circumboreal genus are closely related to *Sympetrum* but are easily separable by the dark triangular patch at the base of the hindwing. They are exquisitely beautiful insects, and often tame; the naturalist will greet with delighted surprise the first one that confidingly settles on his arm. Although *Leucorrhinia* is widely distributed, most species favour northern bog pools. Sometimes in these habitats they literally swarm.

The larvæ are much like those of *Sympetrum*. They are clean and pale green, usually distinctively marked on the venter of the abdomen with either three longitudinal dark stripes or parallel rows of spots. As Walker and Corbet (1975) note, the former pattern is associated with few or no dorsal hooks, the latter with many and much larger hooks.

Leucorrhinia frigida Hagen is recorded from Prince Rupert by Walker and Corbet (1975). A single unidentified female from

Prince Rupert standing under *L. frigida* in the collections of the Royal Ontario Museum is in fact a specimen of *L. glacialis*. No other specimens of this eastern species are known from the Province, and so *L. frigida* should be excluded from the British Columbia list.

KEY TO THE SPECIES OF *LEUCORRHINIA*

MALES

1a. Abdominal segments 4–9 black or at most with a thin red line on the dorsal carina 2

1b. Abdominal segments 4–9 black with yellow or red dorsal spots on at least segment 7 3

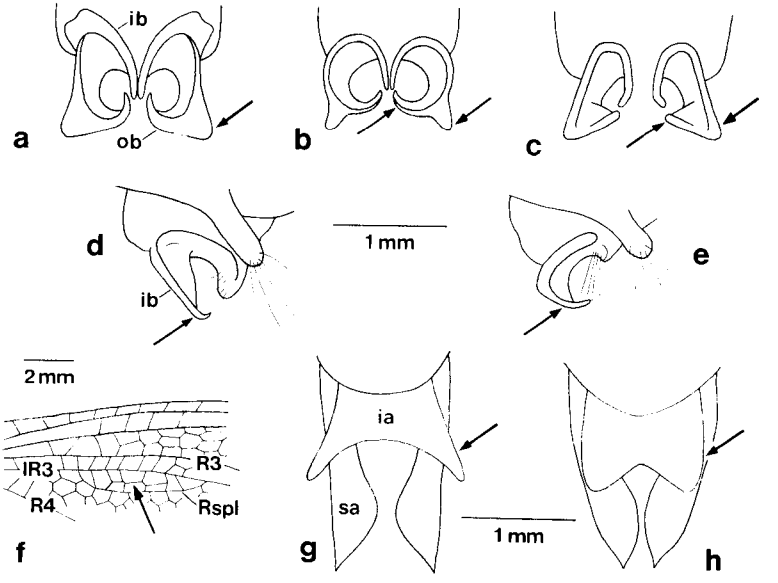


Fig. 30. *Leucorrhinia:* Ventral view of male hamuli (**a–c**), lateral view of male hamuli (**d, e**), section of forewing (**f**), and ventral view of male anal appendages (**g, h**); **a**, *L. intacta;* **b**, *L. hudsonica;* **c**, *L. borealis;* **d**, *L. glacialis;* **e**, *L. proxima;* **f**, *L. glacialis;* **g**, *L. intacta;* **h**, *L. borealis* (*see* p. 243 for explanation of letters).

2a. Hamuli with inner branch abruptly curved at apex in lateral view (Fig. 30d); 2 rows of cells between IR3 and Rspl (Fig. 30f) ..... *glacialis* (p. 194)

2b. Hamuli with inner branch more or less smoothly curved from base to apex in lateral view (Fig. 30e); 1 row of cells between IR3 and Rspl ..... *proxima* (p. 199)

3a. Yellow or reddish spot only on the dorsum of abdominal segment 7; inferior appendage with lateral margins strongly spreading (Fig. 30g ..... *intacta* (p. 197)

3b. Yellow or reddish spots on dorsum of at least segments 1–7; inferior appendage with lateral margins nearly parallel (Fig. 30h) 5

4a. Total length less than 35 mm; hamuli with outer branch bilobed (Fig. 30b) ..... *hudsonica* (p. 196)

4b. Total length more than 35 mm; hamuli with outer branch not bilobed (Fig. 30c) ..... *borealis* (p. 192)

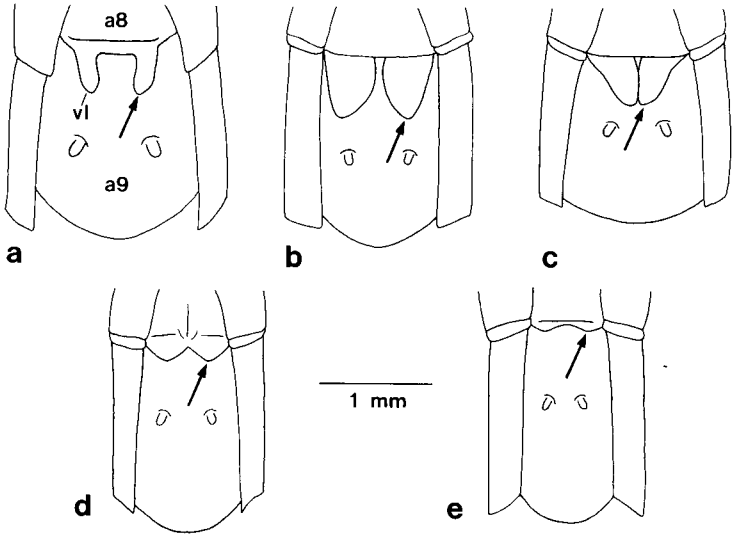


Fig. 31. *Leucorrhinia:* Vulvar laminæ of females (ventral view); **a**, *L. intacta;* **b**, *L. borealis;* **c**, *L. hudsonica;* **d**, *L. proxima;* **e**, *L. glacialis* (*see* p. 243 for explanation of letters).

FEMALES

1a. Scales of vulvar lamina widely separated at their bases, appearing nipple-like (Fig. 31a) ..... *intacta* (p. 197)

1b. Scales of vulvar lamina not widely separated at their bases, appearing flattened (Fig. 31b–e) 2

2a. Scales of vulvar lamina prominent, elongate lobes at least a third as long as lateral margin of abdominal segment 9 (Fig. 31 b, c) 3

2b. Scales of vulvar lamina 2 short lobes much less than a third as long as lateral margin of segment 9 (Fig. 31 d, e) 4

3a. Total length more than 33 mm ..... *borealis* (p. 192)

3b. Total length less than 33 mm ..... *hudsonica* (p. 196)

4a. Scales of vulvar lamina as in Fig. 31d; 1 row of cells between IR3 and Rspl ..... *proxima* (p. 199)

4b. Scales of vulvar lamina as in Fig. 31e; 2 rows of cells between IR3 and Rspl (Fig. 30f) ..... *glacialis* (p. 194)

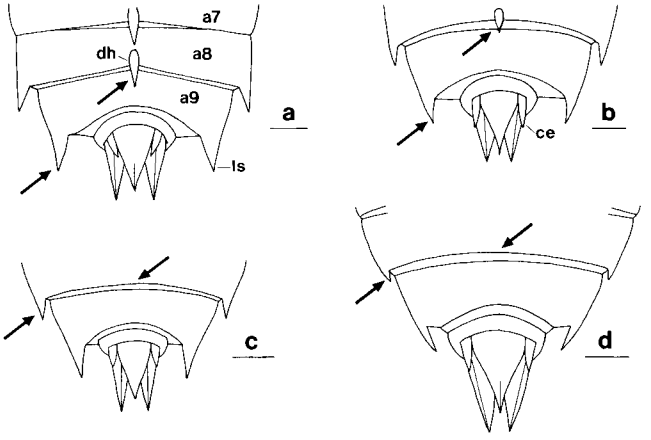


Fig. 32. *Leucorrhinia:* Larval characters (dorsal view of end of abdomen); **a**, *L. intacta;* **b**, *L. proxima;* **c**, *L. hudsonica;* **d**, *L. borealis* (*see* p. 243 for explanation of letters).

LARVÆ

1a. Dorsal hooks on abdominal segments 3–8; venter of abdomen without 3 continuous longitudinal dark stripes 2

1b. No dorsal hooks on segments 7 and 8; venter of abdomen with 3 dark stripes 3

2a. Dorsal hook on abdominal segment 8 extending at least to a third the mid-dorsal length of segment 9; lateral spines on segment 8 slightly divergent; lateral spines on segment 9 extending beyond apices of cerci (Fig. 32a) ..... *intacta* (p. 197)

2b. Dorsal hook on abdominal segment 8 barely reaching base of segment 9; lateral spines on segment 8 following general curve of abdomen; lateral spines on segment 9 not extending beyond apices of cerci (Fig. 32b) ..... *proxima* (p. 199)

3a. Total length less than 18.5 mm; lateral spines on abdominal segment 9 extending beyond apices of cerci; lateral spines on segments 8 and 9 slightly divergent (Fig. 32c) ..... *hudsonica* (p. 196)

3b. Total length more than 18.5 mm; lateral spines on segment 9 not extending beyond apices of cerci; lateral spines on segments 8 and 9 following general curve of abdomen (Fig. 32d) 4

4a. Lateral spines on abdominal segment 8 more than a quarter as long as the lateral margin of segment 8, not including spine ..... *glacialis* (p. 194)

4b. Lateral spines on segment 8 a quarter or less as long as lateral margin of segment 8 (Fig. 32d) ..... *borealis* (p. 192)

Leucorrhinia borealis Hagen

L. borealis Hagen, 1890. Trans. Amer. Ent. Soc. 17:232

L. borealis, Walker and Corbet, 1975. Odonata of Canada and Alaska 3:240

borealis=of the north; a reference to the range of the species.

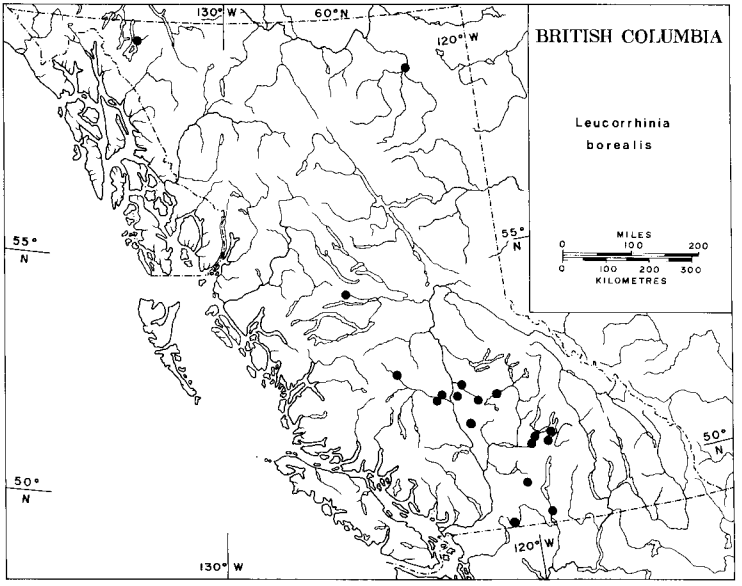
Distinguishing characteristics—Male (Fig. 44b, p. 242): Length, 37–39 mm; hindwing, 30–33 mm. Frons greenish-white; labrum yellow-white; labium and rear of head black. Thorax dark reddish-brown with yellow streaks and a dense covering of hair. Abdomen black; segments 1–3 almost wholly red; segments 4–8 with red, triangular, mid-dorsal spots; segments 9 and 10 black. Superior appendages slightly curved with a ventral prominence towards the apices. Inferior appendage with lateral margins parallel, the apex emarginate (Fig. 30h, p. 189). Hamuli with outer branch entire, not bilobed (Fig. 30c, p. 189).

Female: Length, 35–38 mm; hindwing, 28–31 mm. Colour as in male except thorax with more yellow. Vulvar lamina with two flattened elongate lobes at least a third as long as lateral margin of segment 9, usually not contiguous (Fig. 31b, p. 190).

Larva: Length, 19–23 mm; metafemur, 5–6 mm. Premental setæ, 13, sometimes 14 or 15; palpal setæ, 11, sometimes 10. Abdomen without dorsal hooks; lateral spines on segments 8 and 9, the outer margins of spines following the curve of the abdomen; spines on 8 a seventh to a quarter the lateral length of the segment; spines on 9 two fifths to half the length; spines on segment 9 not reaching tips of cerci (Fig. 32d, p. 191). Venter of abdomen with three longitudinal dark bands.

Range—Alaska and the Yukon east to northwestern Ontario; south to Manitoba, Saskatchewan, and British Columbia. Reported from Wyoming (Needham and Westfall, 1955).

Distribution in British Columbia—L. borealis is most abundant in the Cariboo and Chilcotin regions, but ranges from Atlin and Fort Nelson in the north, to Manning Park and Vaseux Lake in the south. It is not found west of the Coast Mountains.



Field-notes—Because this is mainly a species of the ponds and sloughs of the northern prairies, it is not surprising its centre of distribution in British Columbia is the parklands of the Interior Plateau. Here *borealis* frequents shallow lakes and ponds surrounded by thick stands of bulrushes (*Scirpus*). In the more northerly parts of its range, bog ponds are its habitat.

The flying season is short, lasting from late May to late July. British Columbia records are from May 21 to July 27.

Leucorrhinia glacialis Hagen

L. glacialis Hagen, 1890. Trans. Amer. Ent. Soc. 17:234

L. glacialis, Walker and Corbet, 1975. Odonata of Canada and Alaska 3:249

glacialis=icy; a reference to the cold waters of the northern habitat of this species.

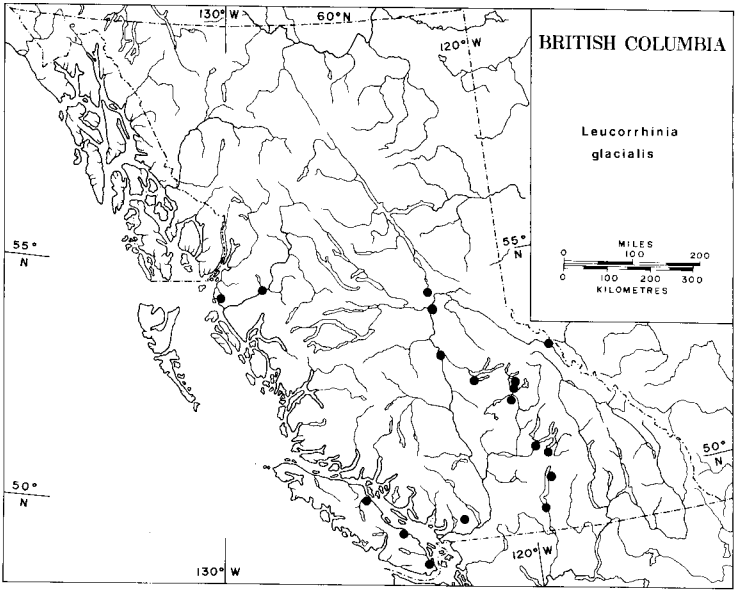
Distinguishing characteristics—Male: Length, 35–37 mm; hindwing, 27–28 mm. Head with labium and vertex black; face greenish-white. Thorax ruby-red with black mid-dorsal triangular stripe and black lateral markings. Wings with two rows of cells between veins IR3 and Rspl (Fig. 30f, p. 189). Abdomen with segments 1–3 red; segments 4–10 black, sometimes very narrowly red mid-dorsally. Superior appendages black with about six ventral teeth; apices very acute. Inferior appendage with sides slightly convergent, the apex shallowly bilobed. Hamuli with inner branch abruptly curved at apex (Fig. 30d, p. 189).

Female: Length, 34–36 mm; hindwing, 26–28 mm. Colour as in male except yellow replaces the red and is usually more extensive on the abdomen. Vulvar lamina with extremely short scales, much less than a third as long as lateral margin of segment 9 (Fig. 31e, p. 190).

Larva: Length, 21 mm; metafemur, 5.5 mm. Premental setæ, 14; palpal setæ, 10. Abdomen without dorsal hooks; lateral spines on segments 8 and 9 following the curve of the abdomen; spines on 8 about two fifths the lateral length of the segment; spines on 9 about half the length; lateral spines on segment 9 almost reaching the tips of the cerci. Venter of abdomen with three dark longitudinal bands.

Range—British Columbia east to Newfoundland; south to Massachusetts, Michigan, and the prairie provinces; in the mountains to Wyoming, Nevada, and California.

Distribution in British Columbia—Vancouver Island; the Lower Mainland east to the Okanagan Valley, north to Prince Rupert in the west, and to Summit Lake and Mount Robson Park in the east.



Field-notes—*L. glacialis* is best observed around northern lakes and bogs where it may be locally very abundant. In the field it is separated from others of the genus by the two rows of cells between IR3 and Rspl. Whitehouse (1941) records breeding at Sooke from June 7 to 9 and near Campbell River from July 25 to August 22. On June 21, 1974, at Five Finger Lake in Wells Gray Park, *glacialis* was emerging and mating. There the species was associated with *Nehalennia irene* and *Cordulia shurtleffi*. When the sun shone, *glacialis* would fill the air, but if a cloud obscured the sun, even for a minute, the insects would alight in long, closely packed lines on fallen logs.

Flight records in British Columbia are from June 7 to August 22.

Leucorrhinia hudsonica (Selys)

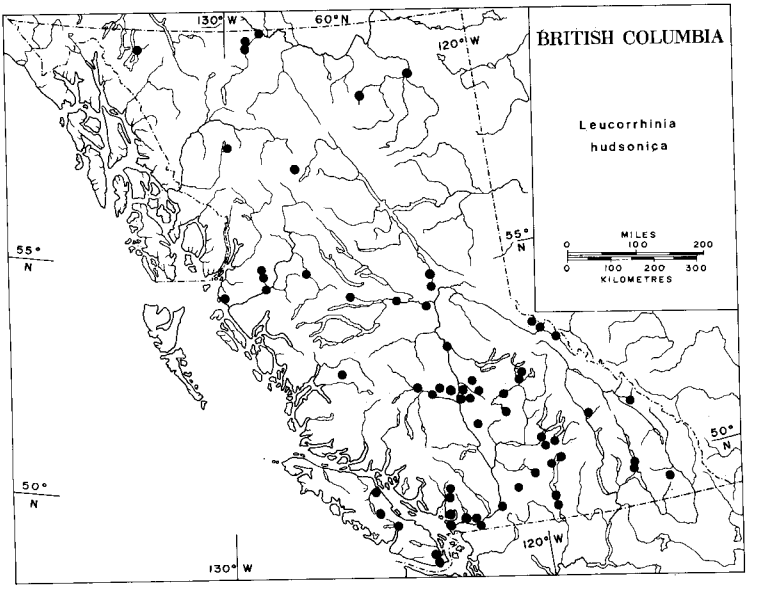
Libellula hudsonica Selys, 1850. Rev. Odon. p. 53

Leucorrhinia hudsonica, Walker and Corbet, 1975. Odonata of Canada and Alaska 3:244

hudsonica=Hudson Bay, the region where the first-named specimens were captured.

Distinguishing characteristics—Male: Length, 27–30 mm; hindwing, 21–25 mm. Head with face greenish-white; labrum and vertex yellowish; rear of head black. Thorax with dorsum and sides marked with red and black. Abdomen black; segments 1 and 2 red dorsally; segments 3–7 with red elongate mid-dorsal spots; segments 8–10 black. Superior appendages arched. Inferior appendage with side parallel, apex notched. Hamuli with outer branch bilobed (Fig. 30b, p. 189).

Female: Length, 26–29 mm; hindwing, 21–24 mm. Colour as in male except red replaced by yellow. Vulvar lamina similar to *borealis,* but usually more contiguous (Fig. 31c, p. 190).



Larva: Length, 16–18 mm; metafemur, 4.0–4.4 mm. Premental setæ, 12–14; palpal setæ, 9–11. Abdomen without dorsal hooks or with small hooks on segments 3 or 4, to 6; lateral spines on segments 8 and 9 diverging from curve of body; spines on 9 extending beyond tips of cerci (Fig. 32c, p. 191). Venter of abdomen with three longitudinal dark bands.

Range—Alaska east through the Northwest Territories to Newfoundland; south to New England, Michigan, the prairie provinces, and British Columbia. Also, in the west, south to Nebraska, Utah, and California.

Distribution in British Columbia—General over the Province.

Field-notes—This is mainly a boreal species that may literally swarm in northern sphagnum bogs and muskegs. In the south it is widely distributed but less abundant. Southern specimens are usually larger than those found further north and emerge earlier in the season. On May 8, 1976, *hudsonica* was emerging from a small acid pond north of Squamish. Exuviæ, with their distinctively striped abdomens, were abundant on the stems of hardhack (*Spiræa douglasii*) and Labrador tea (*Ledum grœnlandicum*). A few larvæ were found sprawling in submerged *Sphagnum* moss. On August 5, 1976, at a sedge-bordered pond near Bear Lake north of Prince George, this species was mating and the females ovipositing. The males, at that time, were guarding their territories and females vigorously, frequently driving off the much larger males of *Æshna interrupta* and *A. juncea* that patrolled the shore.

In the Province, *hudsonica* is known to fly from May 7 to August 26.

Leucorrhinia intacta (Hagen)

Diplax intacta Hagen, 1861. Syn. Neur. N. Amer. p. 179

L. intacta, Walker and Corbet, 1975. Odonata of Canada and Alaska 3:257

intacta=intact, the significance of which is obscure.

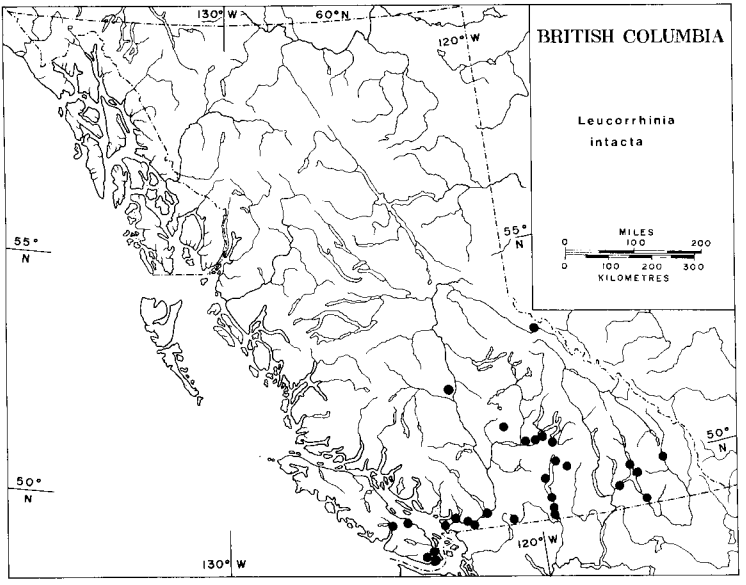
Distinguishing characteristics—Male (Fig. 44d, p. 242): Length, 30–36 mm; hindwing, 24–29 mm. Head with labrum yellow and frons white; labium black, palps with a large pale square spot. Thorax reddish-brown with obscure black lateral markings; thorax often wholly black in old specimens. Abdomen black with a pale mid-dorsal basal twin-spot on segment 7. (In two specimens, from localities as far apart as Skookumchuck and Pitt Meadows, the abdominal segments anterior to segment 7 have red dorsal spots much as in *L. hudsonica;* all other characteristics are those of a typical *intacta.* The cause of this aberrant colour form in an otherwise stable species is unknown.) Superior appendages arched; inferior appendage with margins divergent and apex broadly forked (Fig. 30g, p. 189). Hamuli as in Fig. 30a, p. 189.

Female: Length, 31–33 mm; hindwing, 25–27 mm. Colour as in male except abdominal segments 4–6 with small pale mid-dorsal spots preceding twin-spot on segment 7. Vulvar lamina with scales widely separated basally and appearing nipple-like (Fig. 31a, p. 190).

Larva: Length, 14–19 mm; metafemur, 4.0–4.5 mm. Premental setæ, 12–14; palpal setæ, 10–12. Abdomen with dorsal hooks on segments 3–8, that on 8 lying parallel to the dorsum and reaching a third the mid-dorsal length of segment 9; lateral spines on segments 8 and 9, spines on 8 divergent, spines on 9 extending beyond the apices of the cerci but not as far as the tips of the epiprocts or paraprocts (Fig. 32a, p. 191). Venter of abdomen with transverse dark stripes or rows of spots.

Range—Southern British Columbia east to Nova Scotia; south to Pennsylvania, Missouri, Utah, and California.

Distribution in British Columbia—Generally south of 51°N; two records north of this at Mount Robson Park (53°N) and Riske Creek (52°N).



Field-notes—Unlike its close relatives, *L. intacta* is not at home in northern ponds and lakes; it is an insect of warm waters and is the commonest *Leucorrhinia* in the more heavily populated areas of the Province.

British Columbia specimens are generally much larger than those from eastern provinces. The species was common at Langford Lake, Victoria, on June 26, 1976, with the males holding territories along the edges of water-lily (*Nuphar*) beds. From perches on the floating leaves they would drive off approaching males of *Æshna californica* and males of their own species. On the same day females oviposited among the plants, the male hovering above and behind his mate while she released eggs into the water.

In British Columbia, *L. intacta* is known to fly between May 1 and August 21.

Leucorrhinia proxima Calvert

L. proxima Calvert, 1890. Trans. Amer. Ent. Soc. 17:38

L. proxima, Walker and Corbet, 1975. Odonata of Canada and Alaska 3:251

proxima=closest; possibly a reference to the tameness of this and other species of *Leucorrhinia,* which often alight on the clothing of observers.

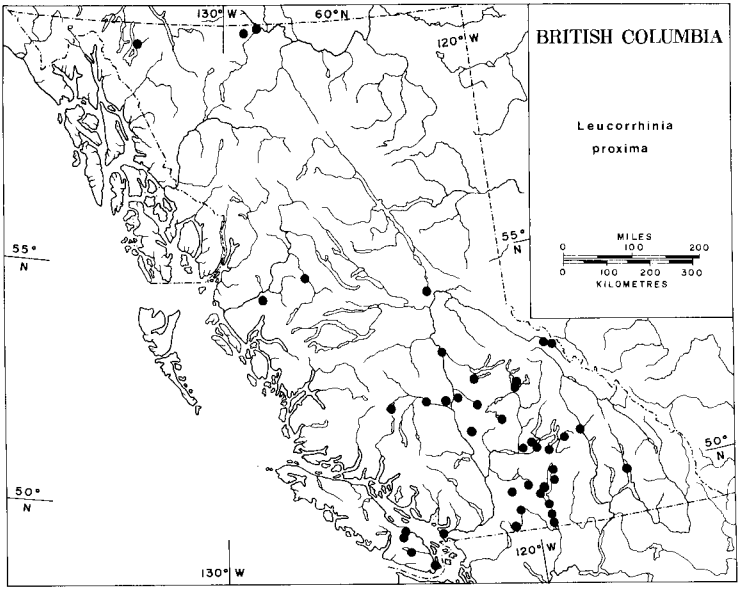
Distinguishing characteristics—Male: Length, 33–37 mm; hindwings, 26–29 mm. Head with labrum and frons white; labium black with pale spots. Thorax brown with long white hair; black lateral stripes forming a letter N. Abdomen black; segments 1–3 red; segments 4–7 often with yellow or red mid-dorsal lines. Superior appendages, straight, slightly club-shaped with 9–11 minute ventral teeth. Inferior appendage with a wide U-shaped notch on posterior margin. Hamuli with inner branch smoothly curved from base to apex in lateral view (Fig. 30e, p. 189).

Female: Length, 31–34 mm; hindwings, 26–29 mm. Colour as in male except labrum black with yellow lateral spots. Vulvar lamina with scales short, flat, much less than a third as long as lateral margin of segment 9 (Fig. 31d, p. 190).

Larva: Length, 19–21 mm; metafemur, 5–6 mm. Premental setæ, 11–15; palpal setæ, 10 or 11. Abdomen with dorsal hooks on segments 2–8, that on 8 barely reaching anterior margin of segment 9; lateral spines on segments 8 and 9; spines on 8 following curve of body, those on 9 not extending beyond apices of cerci (Fig. 32b, p. 191).

Range—Alaska east through the Northwest Territories to Nova Scotia; south to Pennsylvania, Wisconsin, the prairie provinces and British Columbia; and, in the mountains, south to Wyoming and Utah.

Distribution in British Columbia—Widely distributed, but not known east of Kootenay Lake or in the Peace River district.



Field-notes—Among the species of *Leucorrhinia* in British Columbia, only *hudsonica* is more often observed than *proxima*. Many individuals of this species were emerging on the sedges of Shadow Lake, Wells Gray Park, on June 20, 1974. The weakly flying tenerals were quickly snapped up by American Robins (*Turdus migratorius*) and Yellow-bellied Sapsuckers (*Sphyrapicus varius*) flying out over the water from nearby trees. Walker and Corbet (1975) record an attempted mating between a female *proxima* and a male *hudsonica* in Ontario. Such instances do not appear to be common.

The flight period in British Columbia is known to last from May 15 to August 22.

Genus *Libellula* Linnæus

The genus *Libellula* was established by Linnæus in 1758 to include all the Odonata known at that time. It has since been divided into many separate genera. *Libellula* comes from the Latin *libellus* or little book, alluding to the open wings spreading like the pages of a book.

The genus is distributed around the Northern Hemisphere, with most of the species occurring in the United States. Five occur in British Columbia. They are showy insects, perching, hovering, and skimming over the waters of ponds and sluggish rivers. Here the name *Libellula* is used in the broader sense to include *Plathemis* and *Ladona,* which are given generic status by many American entomologists.

Our species are moderate to large, the head is large, the thorax robust and rather hairy, and the abdomen stout and depressed. The body is mainly brown or black with rather indistinct yellow markings, darkening with age and usually obscured with bluish-white pruinosity in the males. In all our species the wings are marked with brown, sometimes with additional yellow or white patches. They are long and densely veined; vein R3 is strongly undulate.

The larvæ are elongate and hairy, living among the debris on the bottom of ponds. A distinctive feature is the prominence of the eyes at the front corners of the head.

A single male specimen of *Libellula luctuosa* Burmeister, labelled Robson, British Columbia, is in the collections of the American Museum of Natural History in New York (Garrison, 1976). The recorded range of *L. luctuosa* extends west to southern Ontario in Canada and to California in the United States. Garrison, studying the geographical variation in the species, believes the specimen, an eastern form, is mislabelled as to locality. The reliability of the record is therefore in doubt and *L. luctuosa* is not included in the British Columbia list.

KEY TO THE SPECIES OF *LIBELLULA*

ADULTS

1a. Area of nodus clear ..... *julia* (p. 205)
1b. Area of nodus with a brown patch 2

2a. Wingtips brown 3
2b. Wingtips clear 4

3a. Nodal patch sometimes a complete band and always extending inward to the forking of Rs; triangle of forewing clear; hindwing less than 37 mm ..... *lydia* (female) (p. 207)

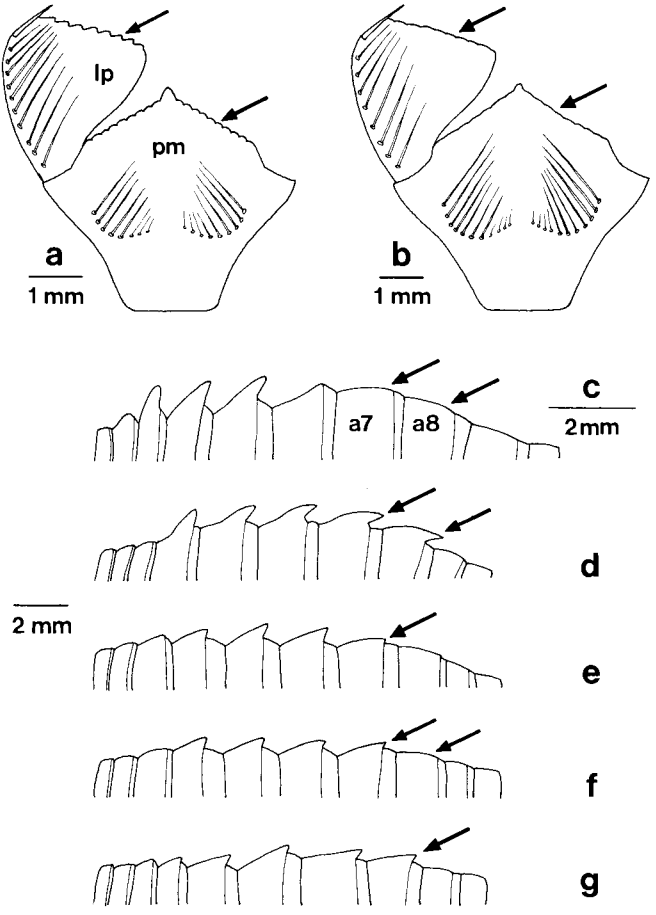


Fig. 33. *Libellula larvæ:* Dorsal view of labium (**a, b**) and lateral view of dorsum of abdomen (**c–g**); **a**, *L. lydia;* **b**, *L. quadrimaculata;* **c**, *L. lydia;* **d**, *L. julia;* **e**, *L. forensis;* **f**, *L. pulchella;* **g**, *L. quadrimaculata* (*see* p. 243 for explanation of letters).

3b. Nodal patch never a complete band and not extending inward to forking of Rs; triangle of forewing partly brown; hindwing more than 37 mm ..... *pulchella* (p. 208)

4a. Nodal patch very small; base of hindwing with a triangular brown patch ..... *quadrimaculata* (p. 210)

4b. Nodal patch a broad band; base of fore- and hindwing with an elongate brown patch 5

5a. Nodal band broad, extending from the forking of Rs to the middle of the pterostigma ..... *lydia* (male) (p. 207)

5b. Nodal band narrow, extending from the nodus to the inner edge of the pterostigma, at most ..... *forensis* (p. 203)

LARVÆ

1a. Apical margin of labial palps with rounded, deeply cut teeth (Fig. 33a); dorsal hook on abdominal segment 4 erect (Fig. 33c, d) ... 2

1b. Apical margin of labial palps smooth or with very low rounded teeth (Fig. 33b); dorsal hook on segment 4 low-lying (Fig. 33e–g) 3

2a. Dorsal hooks on abdominal segments 7 and 8 (Fig. 33d) ... *julia* (p. 205)

2b. No dorsal hooks on segments 7 and 8 (Fig. 33c) ..... *lydia* (p. 207)

3a. Dorsal hook on abdominal segment 7 4

3b. No dorsal hook on segment 7 (Fig. 33e) ..... *forensis* (p. 203)

4a. Palpal setæ, 8 or 9; dorsal hook on abdominal segment 7 but not on segment 8 (Fig. 33f) ..... *pulchella* (p. 208)

4b. Palpal setæ, 7 or 8; dorsal hooks on segments 7 and 8 (Fig. 33g) ..... *quadrimaculata* (p. 210)

Libellula forensis Hagen

L. forensis Hagen, 1861. Syn. Neur. N. Amer. p. 154

L. forensis, Walker and Corbet, 1975. Odonata of Canada and Alaska 3:178

forensis=of the forum, or public market place; this species may enter towns during its early adult life away from water, as do other dragonflies.

Distinguishing characteristics—Male: Length, 46–50 mm; hindwing, 35–41 mm. Head dark olive-brown; labrum with yellow lateral spots; rear of head black with two yellow spots on each side. Thorax orange-brown,

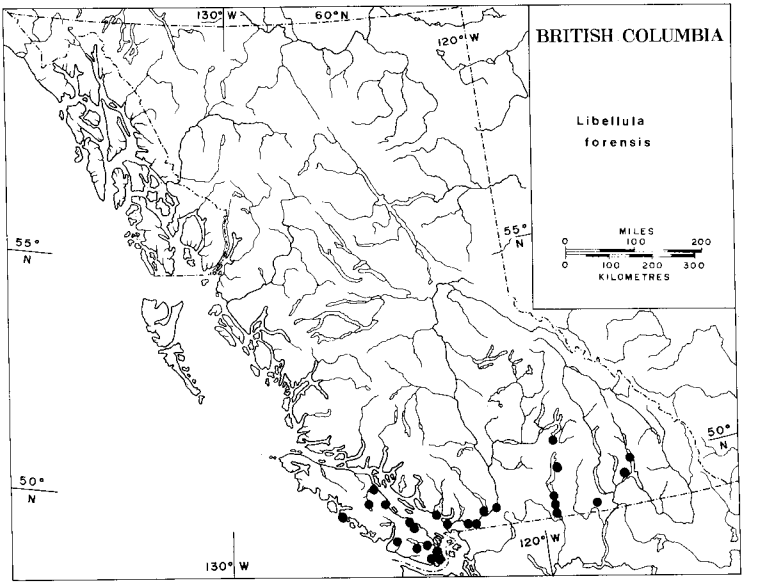
darker on sides; mesepimeron and metepimeron each with a divided yellow stripe. Wings (Fig. 43a, p. 241) with two dark brown patches, one from the base to the triangle, the other from the nodus towards the pterostigma; in mature males opaque white areas alternate with the dark patches. Abdomen brown in tenerals with a broken, yellow lateral stripe, grey pruinosity obscuring the yellow in old specimens.

Female: Length, 44–47 mm; hindwing, 39–41 mm. Colour pattern similar to that of male, including white areas on wings.

Larva: Length, 25–27 mm; metafemur, 6.3–7.0 mm. Labial palps with apical margins cut into low rounded teeth; premental setæ, 10 or 11; palpal setæ, 5–7. Abdominal segments 4–6 with distinct dorsal hooks, low-lying on segment 4 (Fig. 33e, p. 202). Epiproct as long as segments 9 and 10; paraprocts longer than epiproct; cerci two thirds as long as epiproct.

Range—British Columbia south to Arizona and California.

Distribution in British Columbia—Vancouver Island from the Campbell River district southward; on the Mainland, south of 51°N and east to Kootenay Lake.



Field-notes—*L. forensis* is closely related to *pulchella* and replaces it along the coast. Where the ranges of the two overlap, *forensis* is identified by its clear wingtips. At Kawkawa Lake on July 17, 1976, *forensis* was abundant with males swooping over the floating water-lily (*Nuphar*) leaves and perching on rush (*Juncus*) stems over the water. Several pairs flew *in copula* and a female deposited her eggs among the water plants, dipping her abdomen in the water here and there. Whitehouse (1941) notes that the larvæ may transform well away from water: "I took one at Beaver Lake, Vancouver, on June 27, 1935, at 10 am, scrambling across the path in full sunshine, and making good time of it."

According to the record, *forensis* has the longest flight period of the genus, from May 6 (Agassiz) to October 28 (Francis Lake, Victoria). The latter record is unusually late.

Libellula julia Uhler

L. julia Uhler, 1857. Proc. Acad. Phila. 1857:88

Ladona julia, Needham and Heywood, 1929. Dragonflies of N. Amer. p. 218

Libellula julia, Walker and Corbet, 1975. Odonata of Canada and Alaska 3:169

julia=a woman's name.

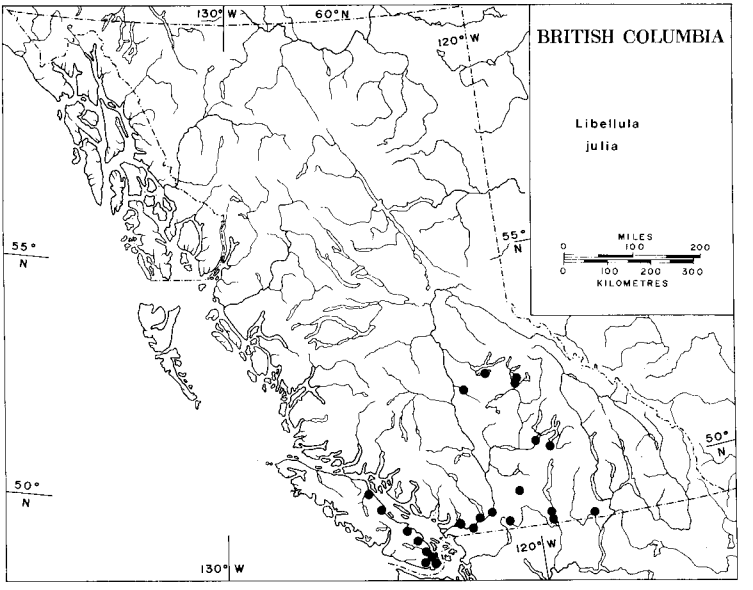
Distinguishing characteristics—Male: Length, 39–44 mm; hindwing, 31–36 mm. Head olive-brown; frons and labrum grey; rear of head yellow and brown with a fringe of grey hairs. Thorax dark brown to black in tenerals; mature males with dorsum entirely white. Hindwings (Fig. 43b, p. 241) with a triangular dark basal spot; nodus clear. Abdomen in tenerals black with orange laterally; adults with segments 1–4 white, segments 5–10 as in teneral.

Female: Length, 38–43 mm; hindwing, 32–37 mm. Colour pattern as in male except pruinosity grey rather than white in mature specimens.

Larva: Length, 24–25 mm; metafemur, 5.6–6.0 mm. Labium with apical margin of prementum cut into rounded teeth; labial palps with rounded, deeply cut teeth (*see* Fig. 33a, p. 202); premental setæ, 3 on each side with two irregular median groups of small setæ; palpal setæ, 6. Abdomen with dorsal hooks on segments 4–8, erect on segment 4 (Fig. 33d, p. 202). Epiproct longer than segments 9 and 10; epiproct as long as paraprocts; cerci three sevenths as long as epiproct.

Range—British Columbia east to Nova Scotia; south to Connecticut and Washington; apparently absent from the treeless plains.

Distribution in British Columbia—South of 53°N; no records from the Kootenay region.



Field-notes—This rather small *Libellula* is especially fond of acid waters near which it may be extremely abundant. It is more retiring than most species of the genus and, like the Gomphidæ, frequently rests on rocks, logs, and bare ground. On the boggy shore of Placid Lake, Wells Gray Park, on June 23, 1974, literally hundreds were flying about and landing in groups of up to 10 or 12 on the willows and *Sphagnum* hummocks. Pairs were also copulating and females quietly ovipositing, unattended, along the shore while the usually easy-going males harassed the males of *Cordulia shurtleffi* patrolling the water's edge.

In British Columbia this species is usually noticeable by mid-June. The earliest record is June 3, the latest is August 26.

Libellula lydia Drury

L. lydia Drury, 1770. Ill. Nat. Hist. 1:112

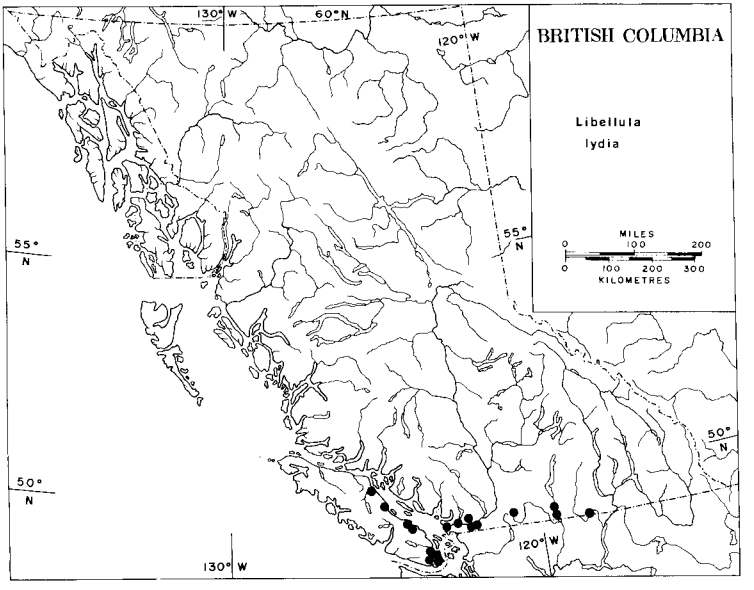
Plathemis lydia, Kirby, 1889. Trans. Zool. Soc. London 12:288

L. lydia, Walker and Corbet, 1975. Odonata of Canada and Alaska 3:173

lydia=a woman's name.

Distinguishing characteristics—Male: Length, 42–47 mm; hindwing, 29–35 mm. Head dark brown; labium orange-brown laterally; rear of head with two pairs of yellow spots. Thorax dark brown with two oblique yellow lateral stripes bordered black in front. Wings (Fig. 43c, p. 241) with a dark basal patch and a broad brown stripe between the nodus and the pterostigma. Abdomen in tenerals, dark brown with a lateral broken yellow stripe; in adults, pruinose white.

Female: Length, 37–41 mm; hindwing, 32–33 mm. Colour pattern as in male but with pruinosity reduced. Wing (Fig. 43d, p. 241) pattern strikingly different from male, each wing with a brown basal patch, a nodal band extending inward to the forking of vein Rs, and an apical spot.



Larva: Length, 21–24 mm; metafemur, 4.4–5.0 mm. Labial palps with apical margin deeply cut into rounded teeth (Fig. 33a, p. 202); premental setæ, 8; palpal setæ, 10. Abdomen with dorsal hooks on segments 3–5 or 6 (Fig. 33c, p. 202). Paraprocts slightly longer than epiproct; cerci half as long as epiproct.

Range—Most of the continental United States and southern Canada; absent from the prairie provinces.

Distribution in British Columbia—Southern Vancouver Island north to Campbell River; on the Mainland, restricted to the extreme south, from Vancouver to the Grand Forks area.

Field-notes—The sexes of *lydia* are strikingly different in colour pattern. In the field the female can easily be mistaken for *L. pulchella.*

Although *lydia* is perhaps the least common of the genus in British Columbia it can be locally abundant, especially in the last week of June, the height of its flight period. When ovipositing, the female will hover over one spot for a considerable time, striking eggs into the shallow water or algal mats. She may do this unattended or with the male hovering protectively nearby. Like *L. julia,* this species tends to rest on the ground rather than on plants.

L. lydia can be seen on the wing for a lengthy period; records in the Province range from May 14 to September 24.

Libellula pulchella Drury

L. pulchella Drury, 1773. Ill. Nat. Hist. 1:pl. 48

L. pulchella, Walker and Corbet, 1975. Odonata of Canada and Alaska 3:179

pulchella=pretty little one.

Distinguishing characteristics—Male: Length, 49–52 mm; hindwing, 40–43 mm. Head dark olive-brown; labium light brown; frons partly yellow; rear of head black with a yellow spot and a marginal stripe. Thorax dark olive-brown with pale lateral stripes and thick grey hairs. Wings (Fig. 43e, p. 241) with three dark brown bands, the basal mark elongate, the nodal band not reaching the fork of vein Rs and the apical spot reaching the pterostigma; adults with opaque white patches between the dark bands. Abdomen in tenerals uniformly brown; mature specimens with segments 1–4 or more white pruinose.

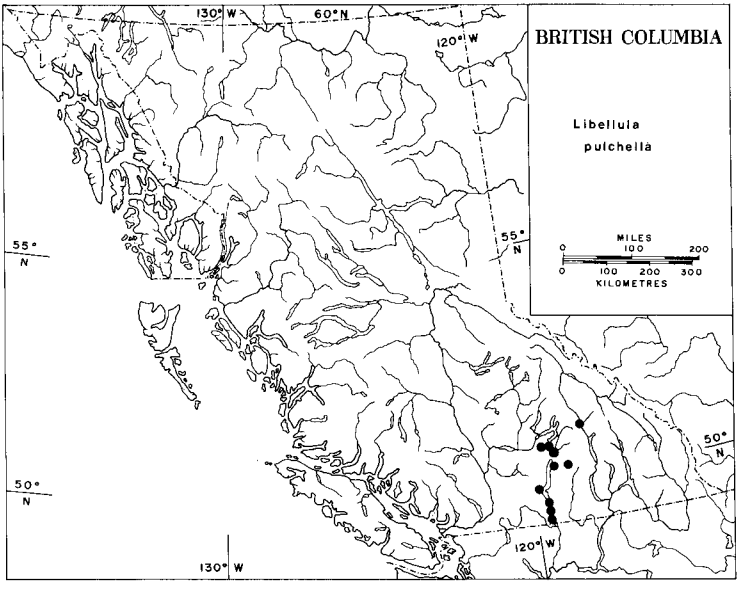
Female: Length, 43–51 mm; hindwing, 39–42 mm. Colour pattern as in male except abdomen with a lateral yellow-green stripe and wings lacking the white patches.

Larva: Length, 24–27 mm; metafemur, 6 mm. Labial palps with apical margins smooth or with very low teeth; premental setæ, 13–15; palpal setæ,

8 or 9. Abdomen with short, inconspicuous dorsal hooks on segments 4–7 (Fig. 33f, p. 202). Epiproct as long as paraprocts; cerci half as long as epiproct.

Range—British Columbia south to California and east through Texas to Florida; north to Nova Scotia, southern Ontario, and Manitoba.

Distribution in British Columbia—Except for one record from Revelstoke, *pulchella* is restricted to the Okanagan Valley and the Shuswap Lake region.



Field-notes—In British Columbia this species is at home only about exposed ponds and the shores of marshy lakes in the dry Interior. Adult males are very aggressive, flying erratically over the water, driving away other dragonflies and accosting ovipositing females. Females usually place their eggs in water choked with aquatic vegetation, rhythmically driving the abdomen into the water while hovering over a favoured spot. Whitehouse (1941) recounts that he observed *pulchella* at Penticton, July 15 to 18, 1938, where *forensis* was also abundant: "If I found it difficult sorting out on the wing those I desired, the insects themselves appeared to be in no better state, for they chased individuals of the allied species into the air as often as their

own. Confusion reigned. These two striking dragonflies were surely never intended to fly together!"

L. pulchella may be expected to fly from the first week of June well into September, although present records are from June 5 to August 20.

Libellula quadrimaculata Linnæus

L. quadrimaculata Linnæus, 1758. Syst. Nat. 1:543

L. quadrimaculata, Walker and Corbet, 1975. Odonata of Canada and Alaska 3:165

quadrimaculata=with four spots; a reference to the dark mark on the nodus of each wing.

Distinguishing characteristics—Male (Fig. 43f, g, p. 241): Length, 40–44 mm; hindwing, 33–37 mm. Head olive-brown; face green; labrum yellow margined with black. Thorax olive-brown, mesepimeron and metepimeron each with a yellow spot bordered with black. Wings with small dark nodal spots and yellow streaks along the anterior margins; hindwing with a basal triangular brown spot. Abdomen light brown basally to black posteriorly with orange-yellow lateral margins.

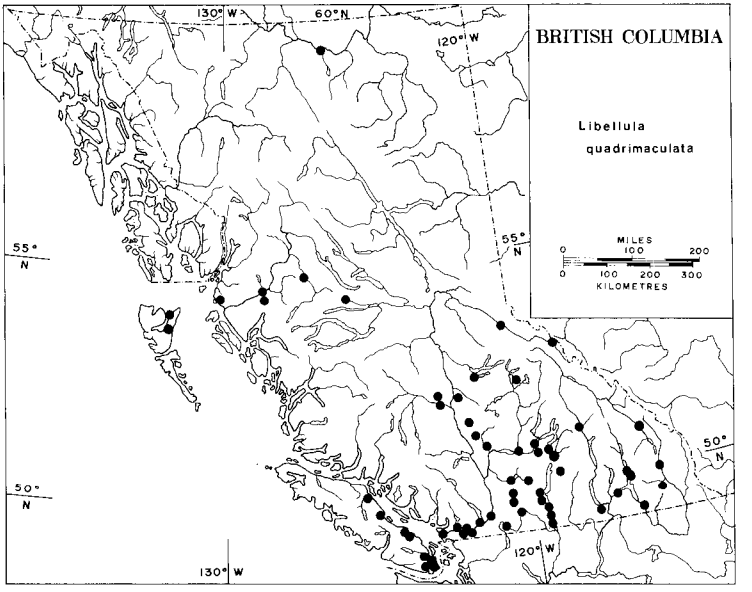
Female: Length, 39–44 mm; hindwing, 31–38 mm. Colour pattern as in male.

Larva: Length, 22–26 mm; metafemur, 5.6–6.0 mm. Labial palps with apical margins smooth; premental setæ, 10–14; palpal setæ, 7–9. Abdomen with small, straight dorsal hooks on segments 3–8 (Fig. 33g, p. 202). Epiproct as long as paraprocts; cerci three fifths as long as epiproct.

Range—Alaska through the Northwest Territories east to Newfoundland; south to Pennsylvania, Texas, and Arizona. Also in northern Europe and Asia.

Distribution in British Columbia—General throughout the Province.

Field-notes—This is probably the commonest large libellulid in Canada. It is at home around marsh-bordered waters of all kinds, from ditches and temporary pools to mountain lakes, northern acid bogs, and alkaline ponds in the dry Interior. *L. quadrimaculata* is one of the earliest dragonflies to appear in the spring, usually in early May. Following emergence the insects spend about two weeks away from water feeding, and often swarm at this time. Aggregations have been known to migrate, but the reasons for this behaviour are not well understood. On May 19, 1862, in eastern Germany, 2.4 billion of these insects were estimated in one massive flight. Much smaller migrations have been recorded in the eastern United States (Corbet, 1963), but none are known from British Columbia.



By June, or early July, adults have returned to their breeding places. Most individuals around water at this time are males; females usually visit water only a few minutes each day to breed. The female lays eggs immediately after copulation, dipping her abdomen in the water around submerged vegetation. The male often drives away other males and ovipositing females of any species while his mate is egg-laying. The larvæ take two years to develop, the adults emerging in the second spring.

The earliest British Columbia record is May 7, but specimens at Vaseux Lake, on May 9, 1974, were already in adult coloration. The species is known to fly until September 29 in the Province.

Genus *Pachydiplax*

Pachys means thick and *diplax* is double, but the significance of the name is obscure. However, *Diplax* is a name formerly applied to some of our species of *Sympetrum,* and *Pachydiplax* is stouter than these forms.

This genus consists of a single species widespread in the United States and barely reaching southern Ontario and British Columbia. It is easily recognized by the combination of green thorax striped with brown and the pruinose blue abdomen of the male, and the green-spotted abdomen of the female. A striking venation character is the unusually long cell behind the pterostigma.

Pachydiplax longipennis (Burmeister)

Libellula longipennis Burmeister, 1839. Handb. Ent. 2:850

P. longipennis, Walker and Corbet, 1975. Odonata of Canada and Alaska 3:193

longipennis=long-winged.

Distinguishing characteristics—Male: Length, 36–41 mm; hindwing, 28–30 mm. Vertex and a large spot on frons metallic-blue; labium and face greenish-white; labrum light yellow. Pterothorax brown dorsally with a pair of short green stripes and a narrow green transverse posterior stripe; sides of thorax green with three oblique brown stripes. Wings with a brown basal spot and often a yellow-brown wash. Abdomen dark brown; segments 1–3 yellow ventrally; abdomen becoming pruinose blue with age.

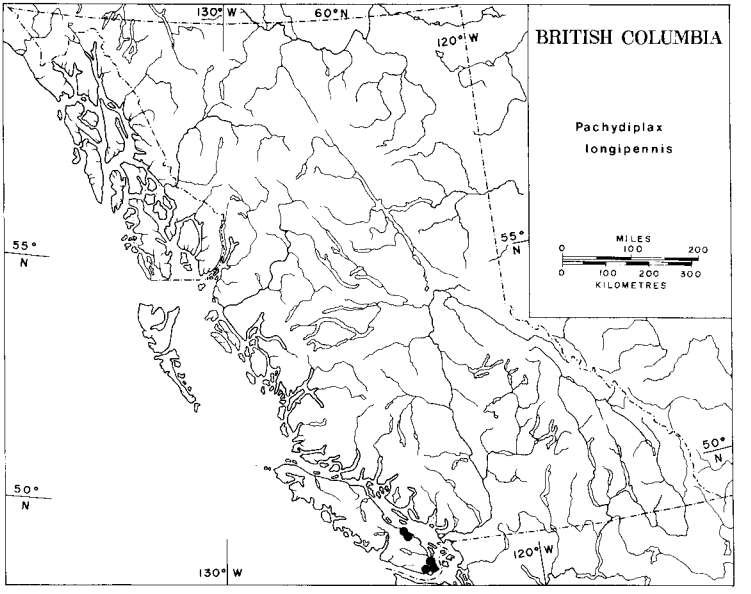
Female: Length, 35–40 mm; hindwing, 29–32 mm. Colour pattern as in male except abdomen with yellow, paired dorsal and lateral segmental spots; wing markings often absent.

Larva: Length, 18–21 mm; metafemur, 4.8–5.2 mm. Eyes prominent with a dark ridge running inward from the posterior margin (Fig. 29c, p. 185). Premental setæ, 10–13; palpal setæ, 9 or 10. Abdomen without dorsal hooks; lateral spines on segments 8 and 9, those on 9 equal to or greater than the mid-dorsal length of the segment (Fig. 29e, p. 185). Paraprocts slightly longer than epiproct. Colour cream, strikingly banded, striped and spotted with brown.

Range—Extreme southern Ontario, Manitoba, and Vancouver Island south through most of the United States to Mexico; also Bermuda and the Bahamas.

Distribution in British Columbia—Southern Vancouver Island north to the Nanaimo district.

Field-notes—This striking dragonfly hovers over still water and perches on projecting twigs with its wings drooped forward. The males dart from these stations to catch insects or confront territorial intruders. Needham and Westfall (1955) note that, when two males meet, they face each other



threateningly then shoot upward together until lost from view. These writers also state that females ovipositing over open water do not rise between egg-laying dips of the abdomen but, unlike other species, fly horizontally close to the surface and periodically strike downward with the abdomen, releasing the eggs.

Sparse British Columbia records are from June 30 to July 23 (Whitehouse, 1941); in Ontario *longipennis* has been recorded from mid-June to early September (Walker and Corbet, 1975).

Genus *Sympetrum* Newman

Joining the Greek words *sym*=together, and *petros*=rock, gives both the name and a common habit of this genus, for some species frequently sun themselves on rocks, especially in cool weather.

Sympetrum is a large genus of more than 50 species, most abundant in eastern Asia. It is well represented in British Colum-

bia where 10 of the 13 species found in Canada occur. These familiar dragonflies are remarkable for their red colour (except *S. danæ*) and their habit of flying late into the autumn. They fly haltingly over ponds and wet meadows, resting frequently.

The larvæ clamber among aquatic plants and sunken debris and are protectively coloured in patterns of green and brown. Dorsal hooks and lateral spines afford the best characteristics for identification, but because even these are variable, identification of larvæ is difficult.

KEY TO THE SPECIES OF *SYMPETRUM*

ADULTS

1a. Abdominal segment 4 with a median encircling ridge in addition to the apical ridge (Fig. 34b) 2

1b. Abdominal segment 4 with an apical ridge only 3

2a. Forewing with 7 antenodal crossveins, hindwing with 5; sides of thorax with 2 white stripes ..... *corruptum* (p. 218)

2b. Forewing with more than 7 antenodal crossveins, hindwing with more than 5; sides of thorax with 2 white spots, wings with brown basal markings ..... *illotum* (p. 224)

3a. Forewing with 2 rows of cells between IR3 and Rspl (Fig. 34a) ..... *madidum* (p. 227)

3b. Forewing with 1 row of cells between IR3 and Rspl 4

4a. Male superior appendages with denticles but not a prominent ventral tooth (Fig. 34c); vulvar lamina of female entire or emarginate, not bifid at posterior margin (Fig. 34e) 5

4b. Male superior appendages with a prominent ventral tooth (Fig. 34d); vulvar lamina of female bidfid at posterior margin (Fig. 34f) 8

5a. Sides of thorax black with yellow markings ..... *danæ* (p. 222)

5b. Sides of thorax red, brown, or yellow 6

6a. Wings tinged with yellow over basal half only ..... *occidentale* (p. 230)

6b. Wings clear or with yellow along the anterior margin or at extreme base 7

7a. Tibiæ entirely yellow or red; male 26 mm or under, female 24 mm or under ..... *vicinum* (p. 233)

7b. Tibiæ striped with black; male 26 mm or over, female 25 mm or over ..... *costiferum* (p. 220)

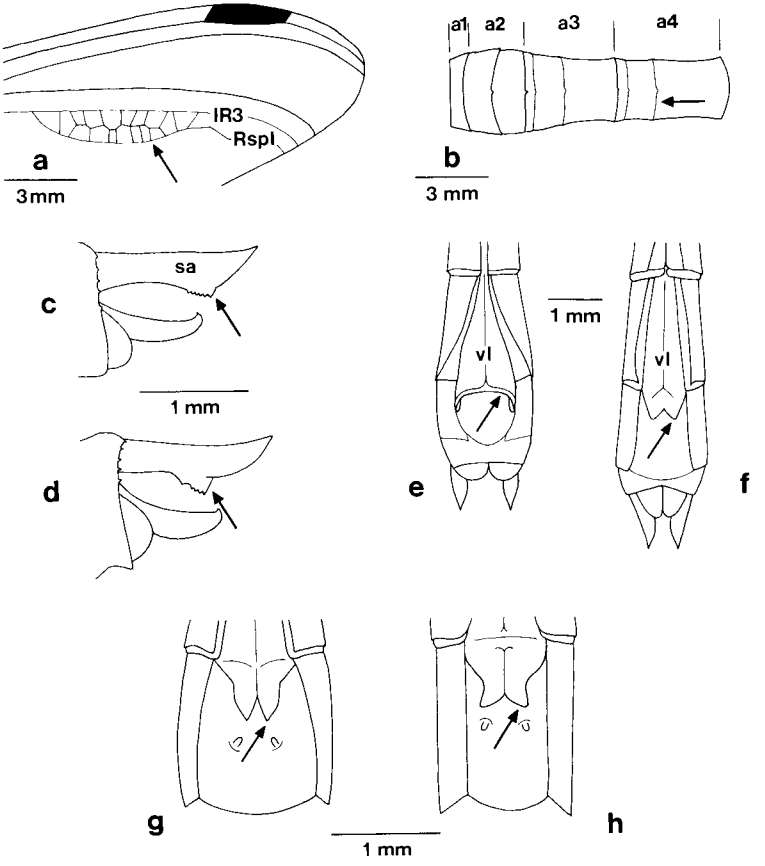


Fig. 34. *Sympetrum:* Apex of forewing (**a**), dorsal view of base of abdomen (**b**), lateral view of anal appendages of males (**c, d**), and ventral view of vulvar laminæ of females (**e–h**); **a**, *S. madidum;* **b**, *S. corruptum,* **c**, *S. vicinum;* **d**, *S. internum;* **e**, *S. vicinum;* **f**, *S. pallipes;* **g**, *S. obtrusum;* **h**, *S. internum* (*see* p. 243 for explanation of letters).

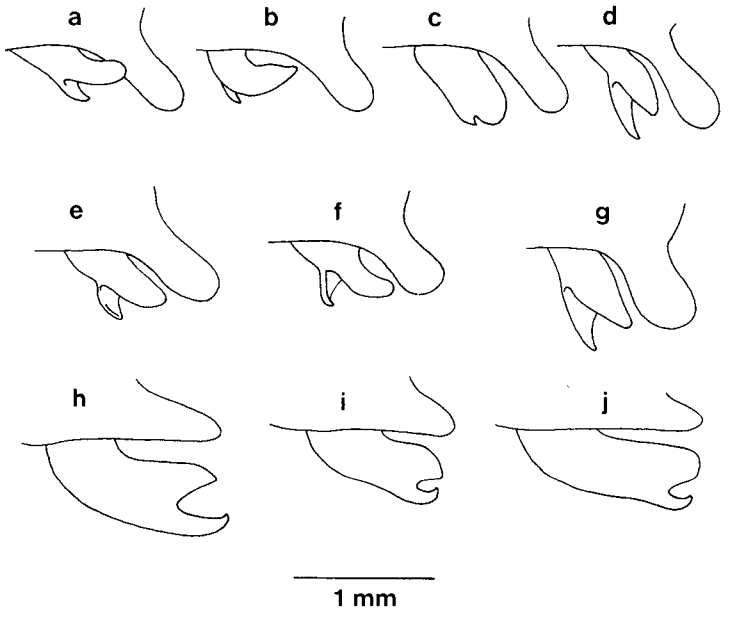


Fig. 35. *Sympetrum:* Hamulus of males, left lateral view; **a**, *S. illotum;* **b**, *S. corruptum;* **c**, *S. madidum;* **d**, *S. vicinum;* **e**, *S. costiferum;* **f**, *S. occidentale;* **g**, *S. danæ;* **h**, *S. internum;* **i**, *S. obtrusum;* **j**, *S. pallipes.*

8a. Sides of thorax with 2 pale stripes, sometimes faint; tibiæ often yellow or brown externally; hamulus as in Fig. 35j; vulvar lamina as in Fig. 34f ..... *pallipes* (p. 231)

8b. Sides of thorax without stripes; tibiæ black 9

9a. Male 10

9b. Female 11

10a. Gap separating branches of hamulus shallower than width of hamulus at apex (Fig. 35i); face usually white ..... *obtrusum* (p. 228)

10b. Gap separating branches of hamulus about as deep as width of hamulus at apex (Fig. 35h); face usually yellow or red ..... *internum* (p. 225)

11a. Apices of vulvar lamina with margins parallel or convergent (Fig. 34g) ..... *obtrusum* (p. 228)

11b. Apices of vulvar lamina distinctly divergent (Fig. 34h) ..... *internum* (p. 225)

LARVÆ

1a. No dorsal hooks on abdomen 2

1b. Dorsal hooks on abdominal segments 5–7 at least 3

2a. Total length about 21 mm; cerci about half as long as paraprocts; palpal setæ, 13 or 14 ..... *corruptum* (p. 218)

2b. Total length about 18 mm; cerci about two thirds as long as paraprocts; palpal setæ, 9 ..... *illotum* (p. 224)

3a. Dorsal hook on abdominal segment 8 4

3b. No dorsal hook on segment 8 7

4a. Lateral spines on abdominal segment 9 extending beyond apices of cerci by at least a third the length of the cerci ..... *vicinum* (p. 233)

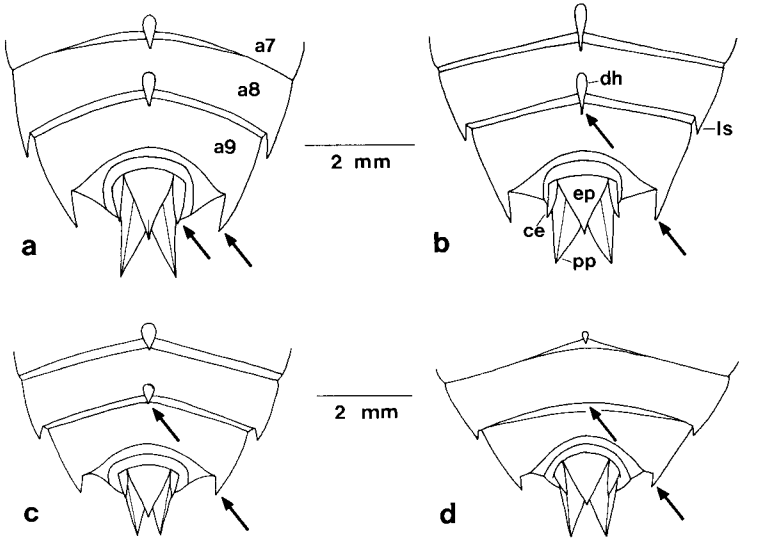


Fig. 36. *Sympetrum:* Dorsal view of end of abdomen of larvæ; **a**, *S. costiferum;* **b**, *S. pallipes;* **c**, *S. obtrusum;* **d**, *S. internum* (*see* p. 243 for explanation of letters).

4b. Lateral spines on segment 9 not extending beyond apices of cerci or, if doing so, then by less than a third the length of the cerci (Fig. 36a–d) 5

5a. Lateral spines on abdominal segment 9 more than a third the lateral length of segment 9, including the spine (Fig. 36a) ..... *costiferum* (p. 220)

5b. Lateral spines on segment 9 less than a third the lateral length of segment 9, including the spine (Fig. 36b, c) 6

6a. Lateral spines on abdominal segment 9 nearly a third the lateral length of segment 9, including the spine; dorsal hook on segment 7 nearly as long as the mid-dorsal length of segment 7 and that on segment 8 usually more than half the mid-dorsal length of segment 8 (Fig. 36b) ..... *pallipes* (p. 231)

6b. Lateral spines on segment 9 about a quarter the lateral length of segment 9; dorsal hook on segment 7 distinctly less than the mid-dorsal length of segment 7 and that on segment 8 rarely half the mid-dorsal length of segment 8 (Fig. 36c) ..... *obtrusum* (p. 228)

7a. Dorsal hook on abdominal segment 4; lateral spines on segment 9 at least three eighths the lateral length of segment 9, including spine ..... *occidentale* (p. 230)

7b. No dorsal hook on segment 4; lateral spines on segment 9 less than three eighths the length of segment 9 (Fig. 36d) 8

8a. Lateral spines on abdominal segment 9 about a quarter the lateral length of segment 9, including spine* ..... *danæ* (p. 222)

8a. Lateral spines on segment 9 about a fifth the lateral length of segment 9 ..... *internum* (p. 225)

Larva of *S. madidum* unknown, according to Walker and Corbet (1975).

* *S. danæ* and *S. internum* larvæ cannot always be reliably distinguished.

Sympetrum corruptum (Hagen)

Mesothemis corrupta Hagen, 1861. Syn. Neur. N. Amer. p. 171

Tarnetrum corruptum, Needham and Westfall, 1955. Dragonflies of N. Amer. p. 546

S. corruptum, Walker and Corbet, 1975. Odonata of Canada and Alaska 3:205

corruptum=corrupt; the name perhaps refers to the stagnant waters with which the insect is associated.

Distinguishing characteristics—Male: Length, 37–40 mm; hindwing, 27–29 mm. Head reddish-brown; labium olive; frons orange-red. Thorax light pinkish-brown; mesepisternum with a narrow, pale yellow stripe; mese-

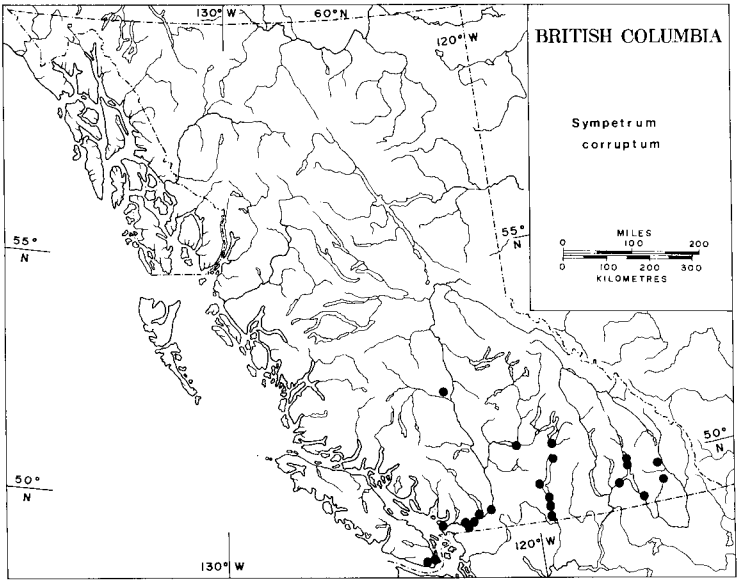
pimeral stripe broad, yellow; metepimeron with a broad yellow stripe along ventral edge; mesepimeral and metepimeral stripes reduced to spots with maturity. Wings with pinkish-brown venation. Abdomen light orange and grey-brown with black lateral markings; segments 8 and 9 with a black mid-dorsal stripe; segment 4 with a median encircling ridge as well as an apical ridge (Fig. 34b, p. 215). Hamulus as in Fig. 35a, p. 216.

Female: Length, 38–43 mm; hindwing, 29–33 mm. Colour pattern as in male. Vulvar lamina two short angular projections.

Larva: Length, 17–19 mm; metafemur, 6.5 mm. Premental setæ, 14–18; palpal setæ, 13–15. Abdomen without dorsal hooks; lateral spines on segments 8 and 9 very small, often absent on 8. Epiproct slightly longer than paraprocts; cerci half as long as paraprocts.

Range—British Columbia east to southern Ontario; south, in the west, to Mexico and Honduras but rare in the eastern United States. Also known from Sable Island, Nova Scotia, and extreme northeastern Asia.

Distribution in British Columbia—This is a widely distributed species south of 51°N. There is one record north of this latitude at Riske Creek (Chilcotin). *S. corruptum* is rare on Vancouver Island.



Field-notes—S. corruptum is adapted to many habitats, but appears partial to arid situations such as alkaline ponds and beach lagoons. In the field it is separated from others of the genus by its large size, the peculiar orange and grey-brown colour pattern, and the pink wing venation. The period of emergence is long and irregular. Whitehouse (1941) observed emergence during the first week of June in Kaslo and on August 8 in the Fraser Valley and considered these two peaks indicated two broods were produced each season. A late emergence date of September 9, 1976, is recorded from Cosens Bay pond near Vernon. The apparent short generation time of *corruptum* may be correlated with the brief period water is present in the temporary ponds in which the species often develops. Needham and Westfall (1975) state that in the United States adults sometimes overwinter.

British Columbia flight records range from May 27 to September 13.

Sympetrum costiferum (Hagen)

Diplax costifera Hagen, 1861. Syn. Neur. N. Amer. p. 174

S. costiferum, Walker and Corbet, 1975. Odonata of Canada and Alaska 3:215

costiferum=ferruginous costa; a reference to the orange or yellow-tinged leading edge of the wing present in young specimens.

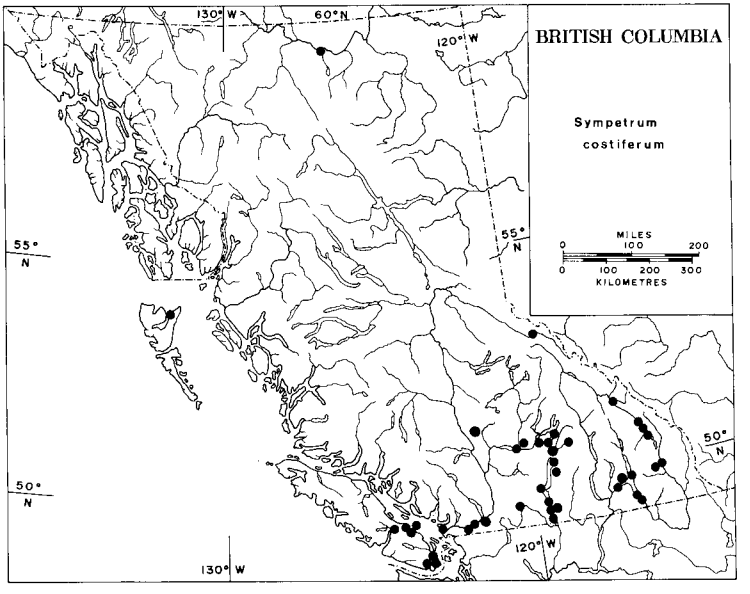
Distinguishing characteristics—Male: Length, 34–37 mm; hindwing, 26–27 mm. Head reddish-brown; face and labrum orange-red. Thorax of teneral yellow with dark brown lines on the sutures; uniform reddish-brown at maturity. Legs red, striped with black; wings with anterior margins yellow in tenerals, this colour spreading or fading with maturity. Abdomen of mature specimens dark red with black lateral markings. Hamulus as in Fig. 35e, p. 216. Superior appendages with denticles, but without a prominent ventral tooth.

Female: Length, 31–36 mm; hindwing, 25–26 mm. Colour pattern as in male except face and labrum greenish-white to buff and wings in some specimens mostly yellow. Vulvar lamina scoop-shaped but not projecting much ventrally.

Larva: Length, 18 mm; metafemur, 8.5 mm. Base of prementum more than a quarter the greatest width of prementum; premental setæ, 13–18, usually 14 or 15; palpal setæ, 10–12, usually 11. Abdomen with dorsal hooks on segments 4–8 narrow and arched; lateral spines on segments 8 and 9, those on 9 more than a third the lateral length of the segment including the spine and not extending beyond the apices of cerci. Cerci more than half the length of epiproct; epiproct two thirds the length of paraprocts (Fig. 36a, p. 217).

Range—British Columbia east through the southern Northwest Territories to Newfoundland, south to New York, Ohio, Missouri, Nevada, and California.

Distribution in British Columbia—Widespread south of 51°N; records north of this latitude are scarce (Liard River Hotsprings, Masset, Tête Jaune, and Golden).



Field-notes—According to most observers, *costiferum* is the *Sympetrum* most tolerant of alkaline waters; Walker and Corbet (1975) report that it favours shallow sandy or gravelly ponds. The species appears late; Whitehouse (1941) recorded emergence on August 8 (Fraser Valley) and August 10 to 11 (Campbell River). On October 14, 1975, when no other species of Odonata were flying in the area, a specimen of *costiferum* fluttered over the railway tracks at Vaseux Lake. It was so sluggish it was caught with bare hands. Kennedy (1915) reports seeing thousands perched on a telephone-line for a stretch of a mile, all facing the same direction.

S. costiferum has a long and late flying season; records are from July 8 to October 19 with Whitehouse's 1936 record of November 1 (Vancouver) being unusually late.

Sympetrum danæ (Sulzer)

Libellula danæ Sulzer, 1776. Abgekürzte Gesch. Ins. p. 169

L. scotica Donovan, 1811. Brit. Ins. 15:523

S. danæ, Walker and Corbet, 1975. Odonata of Canada and Alaska 3:222

danæ=Danæ, a Greek maiden who bore the hero Perseus after being visited by Zeus in a shower of gold.

Distinguishing characteristics—Male: Length, 29–32 mm; hindwing, 22–23 mm. Head dark brown; face yellow edged with black. Thorax black and yellow in tenerals (Fig. 44c, p. 242); mesepisternum with small yellow dorsolateral spots; mesepimeron and metepimeron with large triangular yellow spots; metepisternum with three small yellow spots. Abdomen in tenerals black with paired yellow dorsolateral basal spots on segments 1–9. In adults all yellow markings become black; abdominal spots on segments 2–4, 8, and 9 may remain dull yellow-brown. Hamulus as in Fig. 35g, p. 216. Superior appendages without a prominent ventral tooth.

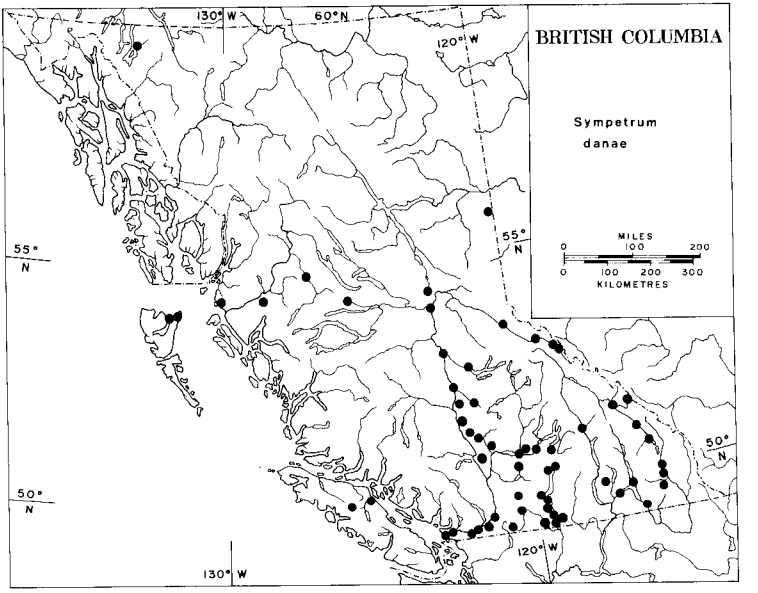
Female: Length, 25–33 mm; hindwing, 21–25 mm. Colour pattern as in teneral male. Vulvar lamina scoop-shaped, the tip narrowed and projecting at right angles to the abdomen.

Larva: Length, 14–16 mm; metafemur, 4.5–5.0 mm. Head about two thirds as long as wide. Premental setæ, 12–15, usually 14; palpal setæ, 10–12, usually 11. Abdomen with dorsal hooks on segments 5–7 with a small denticle on segment 8; lateral spines on segments 8 and 9, those on 9 about a quarter the lateral length of 9, including the spine. Cerci half as long as epiproct; epiproct nearly half as long as paraprocts.

Range—Alaska and the Northwest Territories east to Newfoundland; south to Maine, Kentucky, Manitoba, Alberta, and California. Also in Europe and Asia.

Distribution in British Columbia—Widely distributed on the Mainland from Atlin to Cranbrook, Pouce Coupe to Vancouver. It is common on the Queen Charlotte Islands, but there are no records south of the Gold River-Campbell River area on Vancouver Island.

Field-notes—This is a *Sympetrum* remarkable for its total lack of red coloration; mature males are almost completely black, whereas females and young males have extensive yellow markings. *S. danæ* and *Libellula quadrimaculata* share the distinction of being the only libellulids of circumboreal distribution. *S. danæ* is often found at high elevations (e.g., 1 900 metres near Mount Robson) and is most at home around the acid waters



of sphagnum bogs. Whitehouse (1941) records emergence from July 24 to 26 at Masset and on August 16 (well after the first frosts) at Atlin. On August 1, 1974, at the mouth of the Oeanda River, Queen Charlotte Islands, this species was observed flying out over salt water; on the beach and in adjacent bogs it flew with *Æshna sitchensis*. Females oviposited alone and in tandem in the shallow water among spike-rushes (*Eleocharis palustris*) at Cosens Bay pond near Vernon on September 9, 1975. At this location *danæ* flew with six other species of the genus. In Europe, *danæ* is suspected of hibernating as an adult (Corbet, 1962) and has been seen migrating in large numbers off the Irish Coast (Corbet *et al.*, 1960).

Flight records in British Columbia are from June 14 to October 10.

Sympetrum illotum (Hagen)

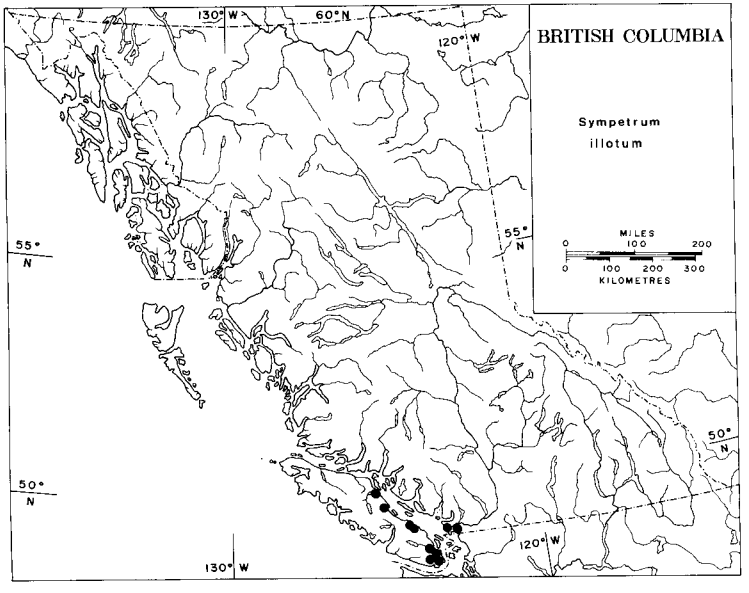
Mesothemis illota Hagen, 1861. Syn. Neur. N. Amer. p. 172

Tarnetrum illotum Kirby, 1890. Cat. Neur. Od. p. 17

S. illotum, Walker and Corbet, 1975. Odonata of Canada and Alaska 3:209

illotum=unwashed; probably a reference to the brown staining on the wing bases.

Distinguishing characteristics—Male: Length, 38–40 mm; hindwing, 26–29 mm. Eyes reddish-brown; face red. Thorax reddish-brown; mesepimeron and metepimeron with yellowish-white stripes in tenerals, reduced to ventral spots at maturity. Wings with yellowish-red venation; a yellow wash extending to beyond the nodus; base of wings with brown streaks. Abdomen red, flat, and parallel-sided; segment 4 with a median encircling ridge in addition to the apical ridge (Fig. 34b, p. 215). Hamulus as in Fig. 35b, p. 216.



Female: Length, 36–37 mm; hindwing, 26–29 mm. Colour pattern as in male. Vulvar lamina scoop-shaped and emarginate.

Larva: Length, 18 mm; metafemur, 5 mm. Premental setæ, 13; palpal setæ, 9. Abdomen without dorsal hooks; lateral spines on segments 8 and 9, sometimes absent on 8. Cerci about two thirds as long as paraprocts; epiproct shorter than paraprocts.

Range—Extreme southwestern British Columbia, Washington, and Montana, south through Nevada, California, and Mexico to Argentina.

Distribution in British Columbia—Abundant only on Vancouver Island from the Campbell River area south; uncommon in the Lower Fraser Valley.

Field-notes—This is one of our most beautiful dragonflies; as Whitehouse (1941) remarks, "what more striking contrast in nature than a number of bright scarlet *illotum* flying over green reeds!" *S. illotum* may be easily recognized in the field by the broad, parallel-sided, red abdomen and the brown marks on the wing bases. The male is easily approached and observed, for he returns again and again to a favourite twig over the water, perching with his back to the sun, the wings drooped forward. On June 26, 1976, on a pond-like reach of Colquitz Creek, Victoria, three males held territories along a 75-metre stretch of water. They clashed frequently and made aggressive dashes at patrolling *Æshna multicolor* males. One individual had very tattered wings. At this location mating and ovipositing took place. During oviposition the male usually flew in tandem with the female, but sometimes either hovered or perched nearby. Whitehouse (1941) records copulation from June 25 to July 16.

Unlike most *Sympetrum* species, *illotum* has an early flight season; recorded dates in British Columbia are from May 20 to August 14.

Sympetrum internum Montgomery

S. rubicundulum decisum (Hagen) Ris, 1911. Coll. Zool. Selys. 13:684

S. decisum, Walker, 1941. Trans. R. Can. Inst. 23:256

S. internum Montgomery, 1943. Can. Ent. 75:57

S. internum, Walker and Corbet, 1975. Odonata of Canada and Alaska 3:230

internum=internal; the meaning is obscure.

Distinguishing characteristics—Male: Length, 29–36 mm; hindwing, 28–29 mm. Head dark brown; face yellowish-red; labrum with a black line along ventral edge. Thorax uniform reddish-brown. Legs black except for a pale mark on profemora; wings with a small area at the base washed

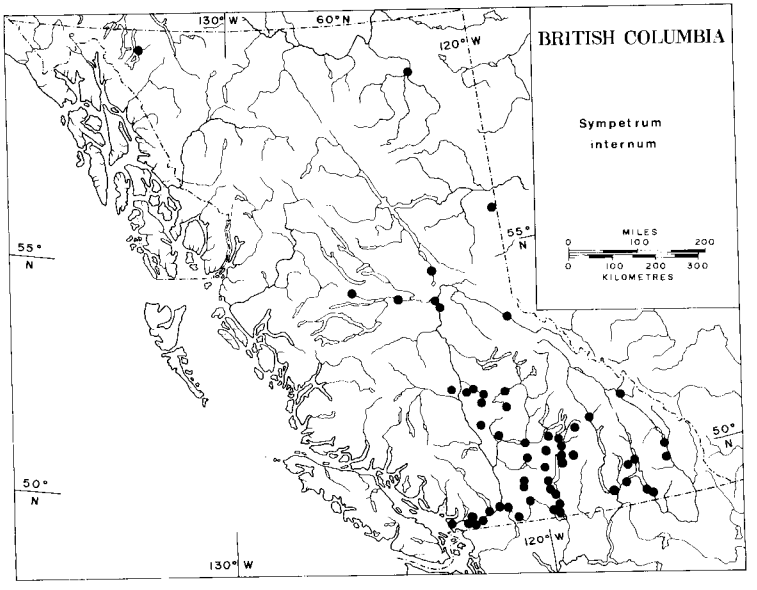
with yellow. Abdomen red; segment 1 with a black transverse dorsal bar; segment 2 and 3 black laterally; segments 4–9 with black lateral triangular spots; segment 10 and anal appendages yellow-brown. Superior appendages with a prominent ventral tooth. Hamulus as in Fig. 35h, p. 216.

Female: Length, 32–36 mm; hindwing, 28–29 mm. Colour pattern as in male, but red often replaced by olive-yellow. Vulvar lamina bifid with apices distinctly divergent (Fig. 34h, p. 215).

Larva: Length, 14–16 mm; metafemur, 4.5–5.0 mm. Often indistinguishable from *S. danæ* except that abdominal segment 8 seldom has a minute dorsal denticle and the spines of segment 9 are usually a fifth the lateral length of segment 9, including the spine (Fig. 36d, p. 217).

Range—Alaska east to the Northwest Territories and Newfoundland; south to Pennsylvania, Missouri, Utah, and California.

Distribution in British Columbia—Widespread on the Mainland; not recorded from any coastal islands.



Field-notes—A common red species, variable in size and often abundant around ponds. The frons of mature specimens tends to be a cherry red; this, and the prominent hamuli, readily identify the male in the hand. At

a cattle-trodden pond west of Clinton on August 6, 1976, *internum* was very abundant; males were sunning on rocks well away from the water and mating with females over the bulrush (*Scirpus*) beds. *S. madidum*, *Æshna interrupta*, *Lestes disjunctus*, and *L. dryas* were also mating and ovipositing.

S. internum has been recorded in British Columbia between June 14 and October 8.

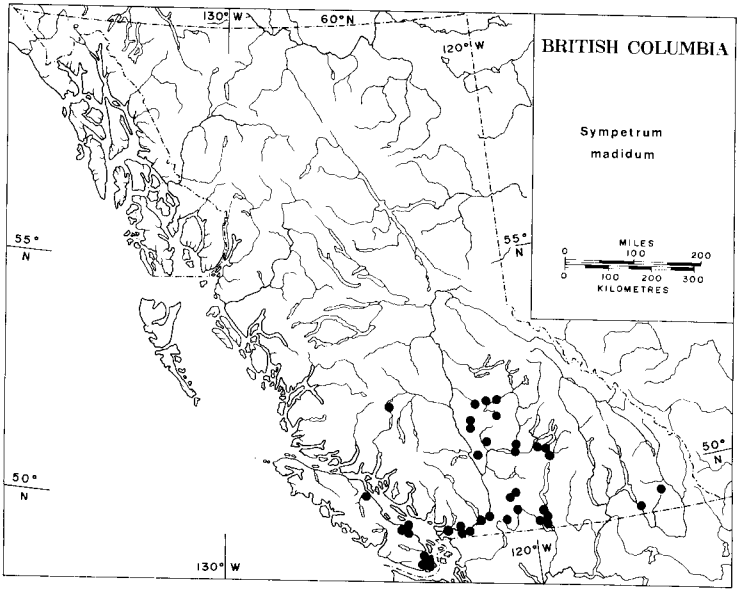
Sympetrum madidum (Hagen)

Diplax madida Hagen, 1861. Syn. Neur. N. Amer. p. 174

S. madidum, Walker and Corbet, 1975. Odonata of Canada and Alaska 3:211

madidum=wet.

Distinguishing characteristics—Male: Length, 38–39 mm; hindwing, 27–30 mm. Head dark red; face red; labium and labrum orange. Thorax red; mesepimeron and metepimeron with white stripes, most prominent ventrally. Wings broadly marked with yellow-orange at bases and along



anterior edges; venation orange; two rows of cells between veins IR3 and Rspl in forewing (Fig. 34a, p. 215). Abdomen red. Hamulus as in Fig. 35c, p. 216. Superior appendages without a prominent ventral tooth.

Female: Length, 38–39 mm; hindwing, 27–30 mm. Colour pattern as in male except abdomen yellow or orange with dark paired stripes on each side and dark dorsal marks on segments 8 and 9. Vulvar lamina divided into two broad triangular lobes.

Larva unknown (Walker and Corbet, 1975).

Range—The Northwest Territories south through British Columbia to California; east to Manitoba in the north and Missouri in the south.

Distribution in British Columbia—Known in southern British Columbia from Vancouver Island east to Cranbrook and as far north as Lac la Hache.

Field-notes—This large *Sympetrum* is easily recognized in the field by the white thoracic stripes and the red-tinged wings. Whitehouse (1941) recorded emergence at Sooke on June 7 and noted mating from July 5 to 15, also on Vancouver Island. Near Clinton on August 6, 1976, *madidum* was common at a grassland pond. Both males and females were wary and, along with the smaller *S. internum*, sunned themselves on rocks near the water. While mating they flew high over the bulrush (*Scirpus*) beds but oviposited in tandem among the water plants in 4–5 centimetres of water. The pond bottom here was of very soft mud and was heavily trampled by cattle. The male often disengaged from the female and hovered or perched nearby as she dipped her abdomen here and there in the shallow water.

In British Columbia flight is recorded from May 26 to September 9.

Sympetrum obtrusum (Hagen)

Diplax obtrusa Hagen, 1867. Stett. Ent. Zeitung 28:95

S. obtrusum, Walker and Corbet, 1975. Odonata of Canada and Alaska 3:232

obtrusum=thrust forward; the meaning is obscure but may refer to the alternating hovering and darting flight.

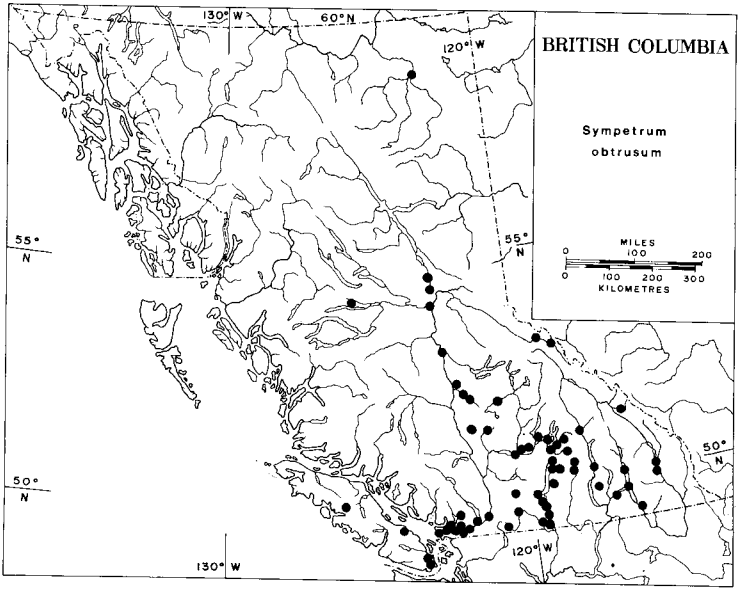
Distinguishing characteristics—Male: Length, 33–36 mm; hindwing, 22–26 mm. Head brown; labrum and frons yellowish-white, yellow in tenerals. Thorax uniform golden-brown; tenerals with one or two pale lateral blotches. Legs black except for pale inner surfaces of profemora. Wings with small yellow basal spots. Abdomen red, yellow to reddish-brown in tenerals; segments 4–9 with black lateral triangular spots. Superior appendages with a prominent ventral tooth (Fig. 34d, p. 215). Hamulus as in Fig. 35i, p. 216.

Female: Length, 30–34 mm; hindwing, 22–26 mm. Homeochromatic form, with colour pattern as in male, is rarely seen. Usually heterochromatic with general colour olive-yellow; thorax with large yellow blotches laterally and ventrally, fading with maturity. Vulvar lamina bifid with apices parallel or convergent (Fig. 34g, p. 215).

Larva: Length, 16–18 mm; metafemur, 4.5–5.0 mm. Premental setæ, 12–15, usually 13; palpal setæ, 10 or 11, usually 11. Abdomen with dorsal hooks on segments 4–8, that on 7 distinctly less than the mid-dorsal length of the segment; lateral spines on segments 8 and 9, those on 9 about a quarter the lateral length of the segment (Fig. 36c, p. 217).

Range—British Columbia east through the southern Northwest Territories to Nova Scotia; south to Kentucky, Kansas, and Utah.

Distribution in British Columbia—Widely distributed in the Province, although there are no records for the northwest quarter.



Field-notes—This is probably the most common *Sympetrum* in British Columbia. In the field the male is quickly told from the similar *internum* by its white face; *internum* usually has a red or yellow frons. Emergence has been observed on June 24 (Kaslo), an early date, and mating on August

5 (Crooked River). On the latter date *obtrusum* hovered among flooded grasses in a white spruce (*Picea glauca*) marsh with *S. internum* and *Leucorrhinia hudsonica.* Whitehouse (1941) notes that it is unwise to accept mated pairs as positive identification of *Sympetrum* females: He once captured a red *obtrusum* male clasping a black *danæ* female: "a case where mistaken identity must fail as an excuse. However, fertilization apparently does not result, for the species of this genus produce nothing leading to a suspicion of hybridism." The flight period of *obtrusum* in British Columbia is some 10 days later than that of *internum.* Records range from June 24 to October 19.

Sympetrum occidentale Bartenev

S. semicinctum occidentalis Bartenev, 1915. Univ. Izviestija Varsava 46:1

S. occidentale, Walker and Corbet, 1975. Odonata of Canada and Alaska 3:220

occidentale=western; a reference to the range of the species in North America.

Distinguishing characteristics—Male: Length, 32–40 mm; hindwing, 25–28 mm. Face yellow. Thorax yellow in tenerals, yellow-green to grey in adults; sulci marked with black; interpleural suture with a black stripe. Wings with a broad yellow band over the basal half. Abdomen dull yellow to red, with black lateral triangular spots on segments 3–8. Superior appendages without a prominent ventral tooth. Hamulus as in Fig. 35f, p. 216.

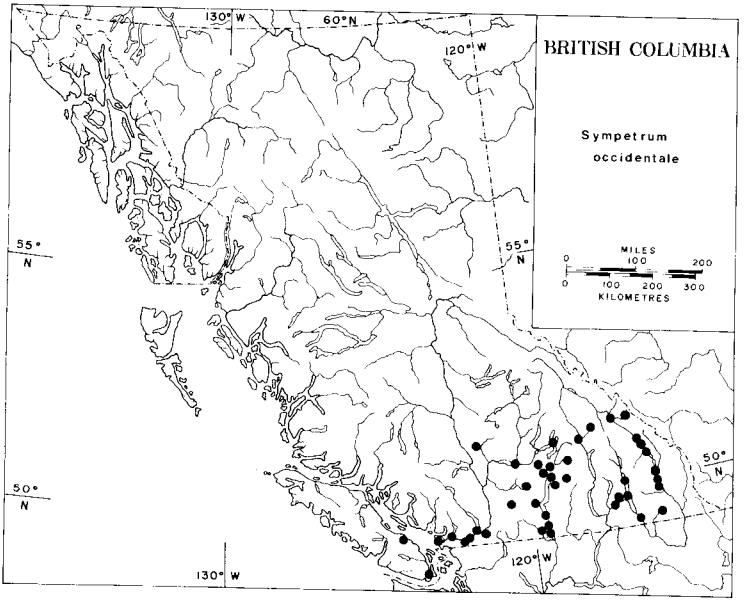
Female: Length, 31–35 mm; hindwing, 24–26 mm. Colour pattern similar to that of male. Vulvar lamina scoop-shaped, entire.

Larva: Length, 16 mm; metafemur, 5 mm. Premental setæ, 13–15; palpal setæ, 10. Abdomen with dorsal hooks on segments 5–7; lateral spines on segments 8 and 9, the spines on 9 at least three eighths the lateral length of the segment, including the spine.

Range—British Columbia and Alberta south to California and Utah. The subspecies found in British Columbia, Washington, and Oregon is *S. o. occidentale.*

Distribution in British Columbia—General in the southern part of the Province. A line drawn through Clinton and Field approximates the known northern limit of the species in the Province.

Field-notes—*S. occidentale* is striking in the field with its broad yellow basal wing bands. Unlike many species of the genus, *occidentale* does not often appear in large numbers; however, in mid-August Whitehouse (1941) has



seen swarms of pairs ovipositing in the open water of Harrison Bay (Fraser Valley). Although the earliest British Columbia record is June 20, most are after the third week of July. Walker noted emergence on July 22 and 23 at Penticton. The latest record is October 8.

Sympetrum pallipes (Hagen)

Diplax pallipes Hagen, 1874. Rep. Neur. Colorado p. 589

S. pallipes, Walker and Corbet, 1975. Odonata of Canada and Alaska 3:234

pallipes=white-footed; some specimens have tibiæ with pale external surfaces, but this is not a constant characteristic of British Columbia specimens, especially mature ones.

Distinguishing characteristics—Male: Length, 32–37 mm; hindwing, 24 mm. Face light yellow; occiput metallic-green. Thorax yellowish-brown to red, a pair of narrow white stripes dorsally; mesepimeron with a wide

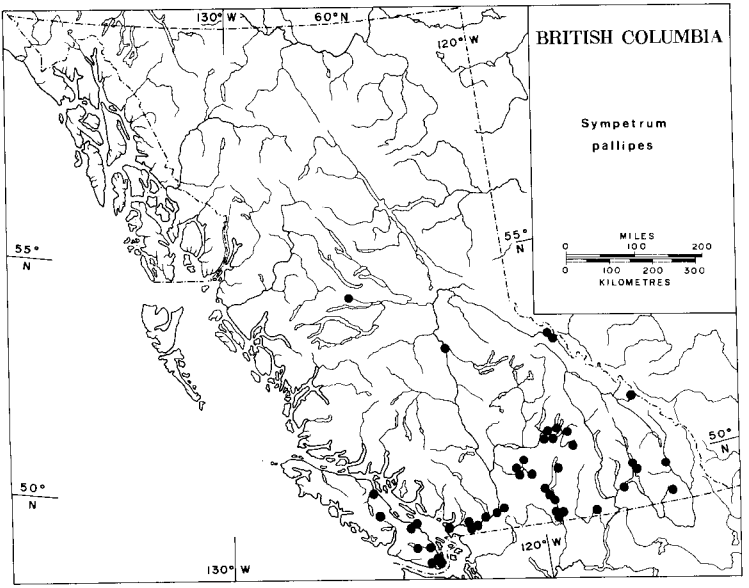
yellowish-white stripe and metepimeron with a narrow stripe; all these stripes often indistinct. Legs brown, tibiæ often yellow externally; in mature specimens legs may be wholly dark. Abdomen yellow-brown to red; segments 4–8 with black lateral margins. Superior appendages with a prominent ventral tooth (Fig. 34d, p. 215). Hamulus as in Fig. 35j, p. 216.

Female: Length, 32–37 mm; hindwing, 27 mm. Colour pattern as in male. Vulvar lamina bifid with slender parallel or divergent apices (Fig. 34f, p. 215).

Larva: Length, 16–18 mm; metafemur, 4.6–5.0 mm. Not always distinguishable from *S. obtrusum*. Premental setæ, 12–15, usually 13; palpal setæ, 10 or 11, usually 10. Abdomen with prominent dorsal hooks on segments 4–8, the hook on 8 usually more than half the mid-dorsal length of the segment; lateral spines on segments 8 and 9, those on 9 nearly a third the lateral length of 9, including the spine (Fig. 36b, p. 217).

Range—British Columbia and Alberta south to California and Texas.

Distribution in British Columbia—Widely scattered throughout the southern part of the Province; northerly records are from Burns Lake and Mount Robson Park.



Field-notes—This species is very similar to *obtrusum,* but the white lateral thoracic stripes of *pallipes* separate the two species in the field. On Vancouver Island, Whitehouse found *pallipes* emerging between June 6 (Sooke) and July 25 (Campbell River). Mating has been recorded from August 9 and October 11. Like its close relative *obtrusum, pallipes* usually develops in semi-permanent ponds. Near Nelson, where it is perhaps the commonest *Sympetrum, pallipes* swarmed at a sedge pond in an abandoned orchard. There, on August 9, 1976, adults were emerging with the exuviæ clustered in the sedges and tenerals fluttered with *Lestes disjunctus* and *L. dryas* among the grasses near the water; some were attacked and eaten by males of *Æshna interrupta.*

British Columbia records for *pallipes* range from June 6 to October 17.

Sympetrum vicinum (Hagen)

Diplax vicina Hagen, 1861. Syn. Neur. N. Amer. p. 175

S. vicinum, Walker and Corbet, 1975. Odonata of Canada and Alaska 3:213

vicinum=neighbour; as Whitehouse (1941) observes, the name refers to the friendliness or tameness of this species, an unusual trait in the genus.

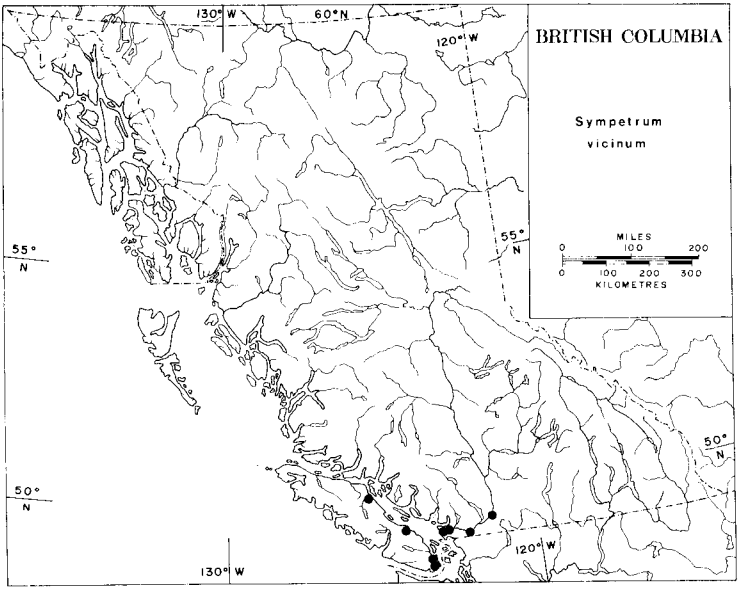
Distinguishing characteristics—Male: Length, 32–35 mm; hindwing, 23–26 mm. Head red with face orange-red. Thorax uniform yellow in tenerals, bright red in adults. Legs without black markings; wings with a small yellow-orange basal spot. Abdomen red in mature specimens. Superior appendages with large ventral denticles but no prominent tooth (Fig. 34c, p. 215). Hamulus as in Fig. 35d, p. 216).

Female: Length, 26–32 mm; hindwing, 20–24 mm. Colour pattern as in male. Vulvar lamina scoop-shaped, broadly emarginate, conspicuously projecting after oviposition.

Larva: Length, 12–15 mm; metafemur, 4.5 mm. Premental setæ, 11–13; palpal setæ, 9 or 10. Abdomen with dorsal hooks on segments 4–8; lateral spines on segments 8 and 9 long, those on 9 extending beyond apices of cerci by at least a third the length of the cerci.

Range—Mainly the eastern half of the continent; sporadic westward to Kansas and Colorado; a distinct western population occurs in extreme southwestern British Columbia and in Washington.

Distribution in British Columbia—Known only on Vancouver Island, from the Campbell River district south, and on the Mainland from Vancouver to Hope.



Field-notes—S. vicinum is the only *Sympetrum*, besides *illotum*, that is apparently confined to the south coast in British Columbia; Paulson (1970) records it on both sides of the Cascade Mountains in Washington. The female has a scoop-shaped vulvar lamina similar to that of certain species of *Somatochlora;* this is apparently correlated with the habit of laying eggs in wet moss or other material at the water's edge rather than in the water itself. The eggs probably do not hatch until submerged, an adaptation ensuring that the larvæ begin development at a period of high water (Corbet, 1962). Whitehouse (1941) records emergence on July 31 (Hope) and August 15 (Chilliwack) and oviposition from mid-September to the end of October (Vancouver).

The flight period of *vicinum* in British Columbia is perhaps the latest of any Odonata; records are from July 20 to November 1.

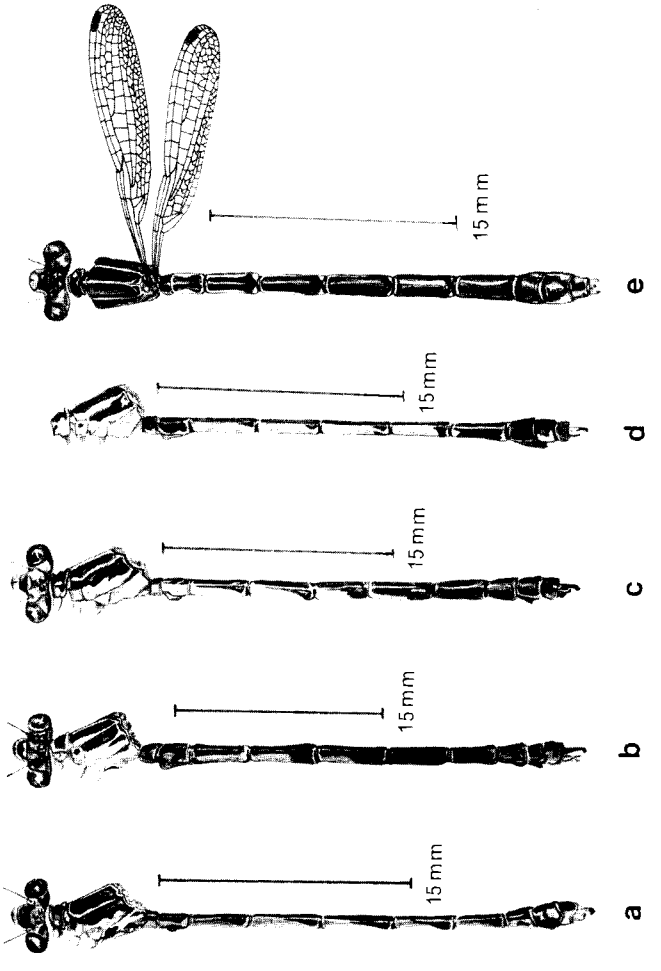


Fig. 37. Adults of the genus *Lestes:* **a**, *L. congener* ♂ (lateral); **b**, *L. disjunctus* ♂ (lateral); **c**, *L. dryas* ♂ (lateral); **d**, *L. unguiculatus* ♂ (lateral); **e**, *L. unguiculatus* ♀ (dorsal) (wings not to scale).

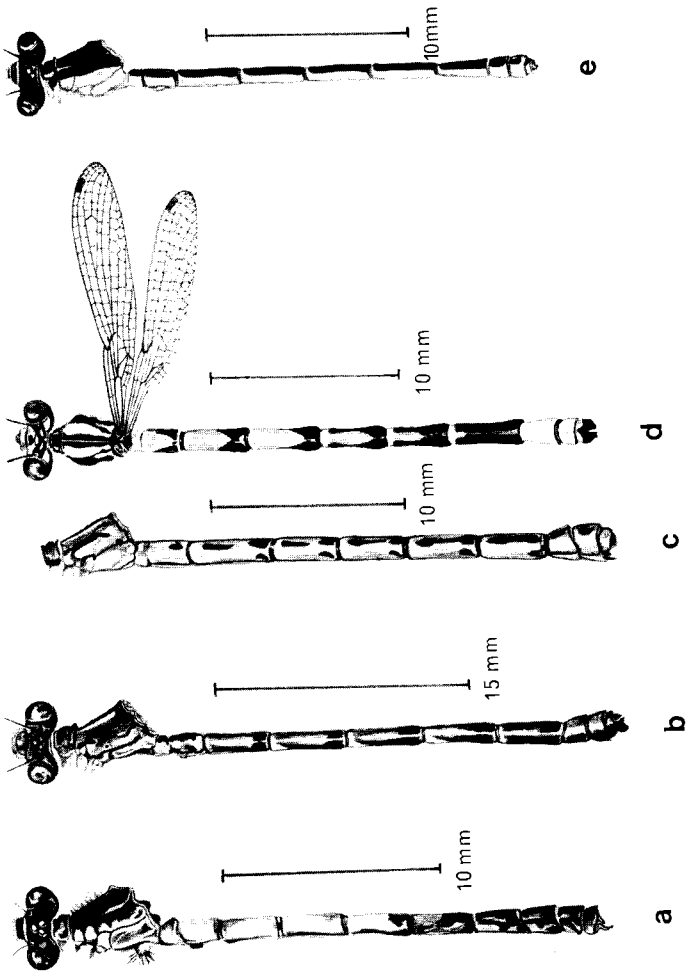


Fig. 38. Selected adults of the genera *Amphiagrion, Argia,* and *Nehalennia;* **a**, *Amphiagrion abbreviatum* ♂ (lateral); **b**, *Argia emma* ♂ (lateral); **c**, *A. vivida* ♀, (lateral); **d**, *A. vivida* ♂ (dorsal) (wings not to scale); **e**, *Nehalennia irene* ♂ (lateral).

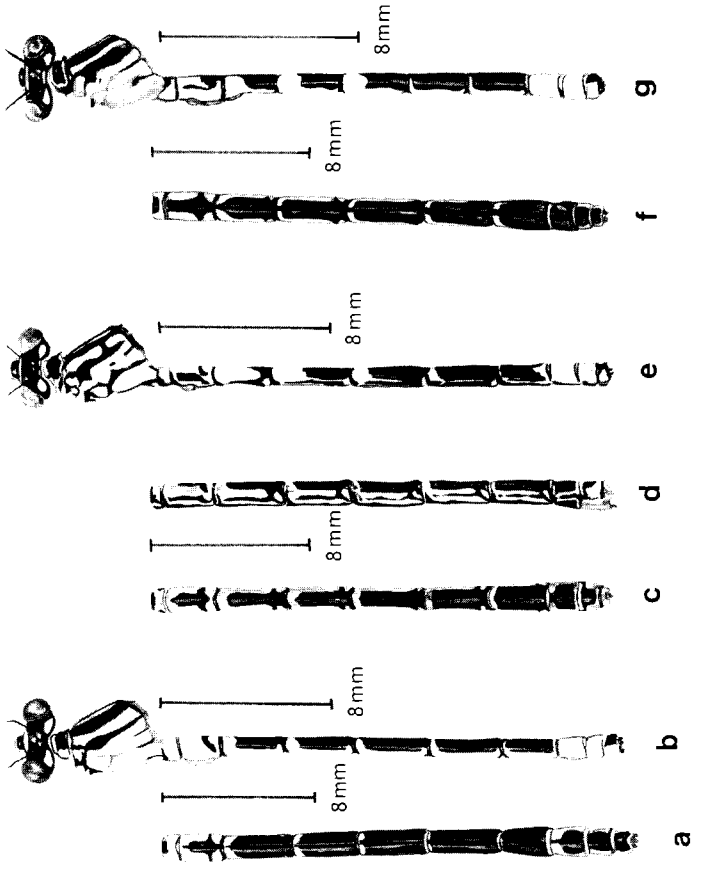


Fig. 39. Adults of the genus *Cœnagrion:* **a**, *C. angulatum* ♀ (dorsal); **b**, *C. angulatum* ♂ (lateral); **c**, *C. interrogatum* ♀ (dorsal); **d**, *C. interrogatum* ♀ (lateral); **e**, *C. interrogatum* ♂ (lateral); **f**, *C. resolutum* ♀ (dorsal); **g**, *C. resolutum* ♂ (lateral).

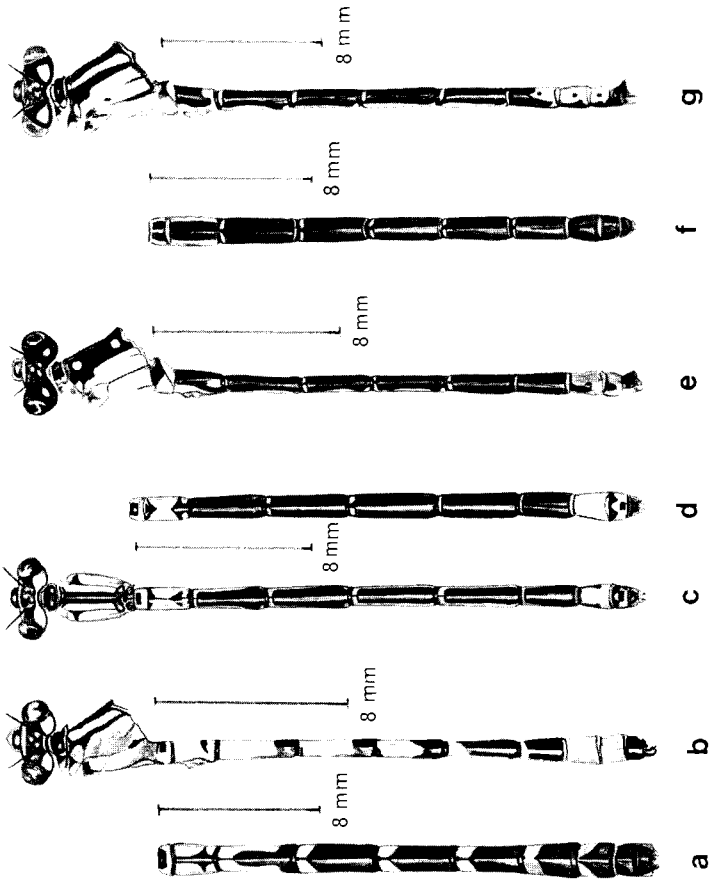


Fig. 40. Selected adults of the genera *Enallagma* and *Ischnura:* **a**, *E. cyathigerum* ♀ (dorsal); **b**, *E. cyathigerum* ♂ (lateral); **c**, *I. damula,* heterochromatic ♀ (dorsal); **d**, *I. damula,* homeochromatic ♀ (dorsal); **e**, *I. damula* ♂ (lateral); **f**, *I. erratica* ♀ (dorsal); **g**, *I. erratica* ♂ (lateral).

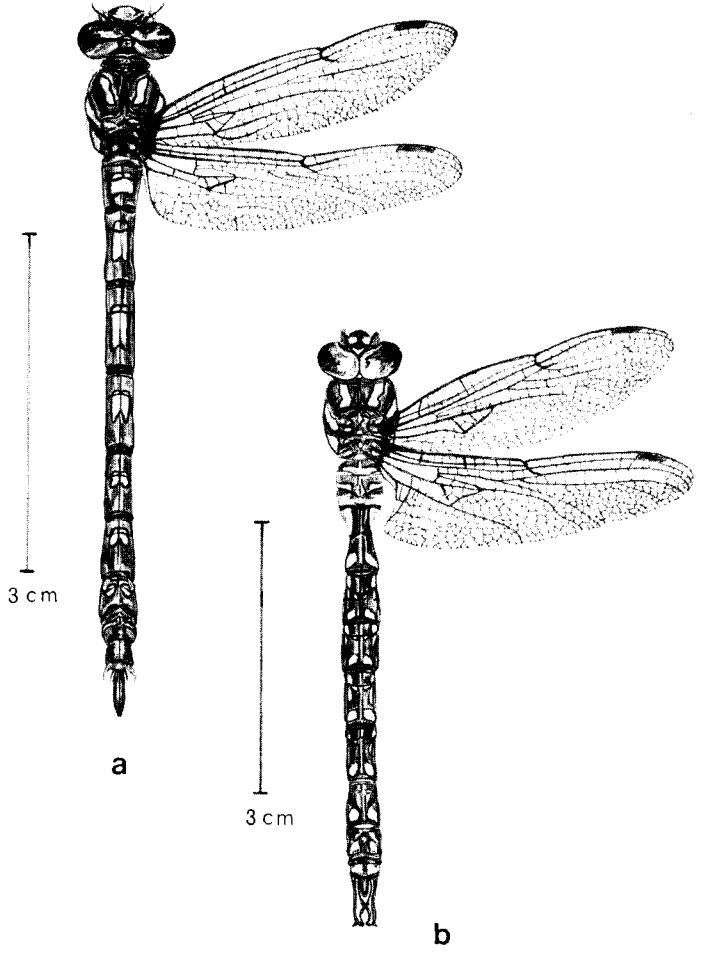


Fig. 41. **a**, *Cordulegaster dorsalis* ♀ (dorsal); **b**, *Æshna constricta* ♂ (dorsal) (wings not to scale).

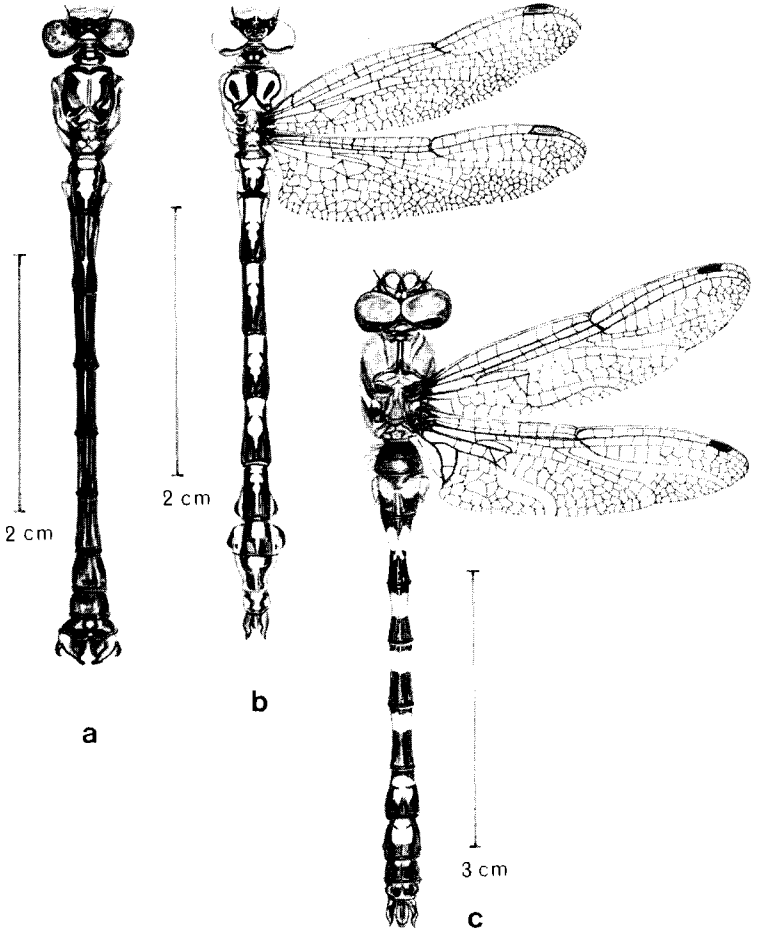


Fig. 42. **a**, *Octogomphus specularis* ♂ (dorsal); **b**, *Ophiogomphus severus* ♂ (dorsal); **c**, *Macromia magnifica* ♂ (dorsal) (wings not to scale).

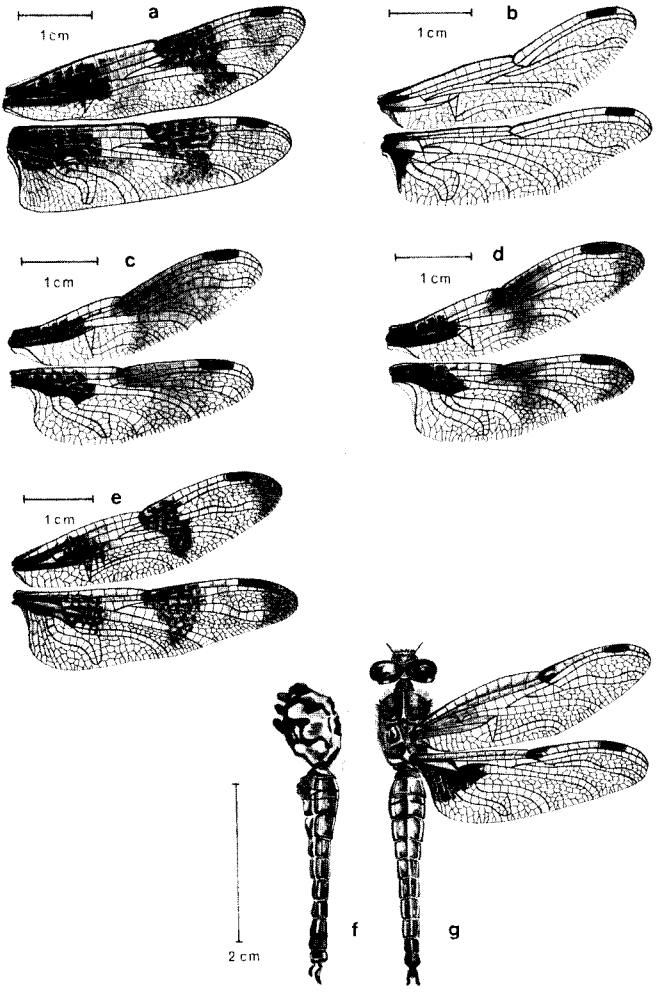


Fig. 43. Wings of the genus *Libellula:* **a**, *L forensis;* **b**, *L. julia;* **c**, *L. lydia* ♂; **d**, *L. lydia* ♀; **e**, *L. pulchella;* **f**, *L. quadrimaculata* ♂ (lateral); **g**, *L. quadrimaculata* ♂ (dorsal).

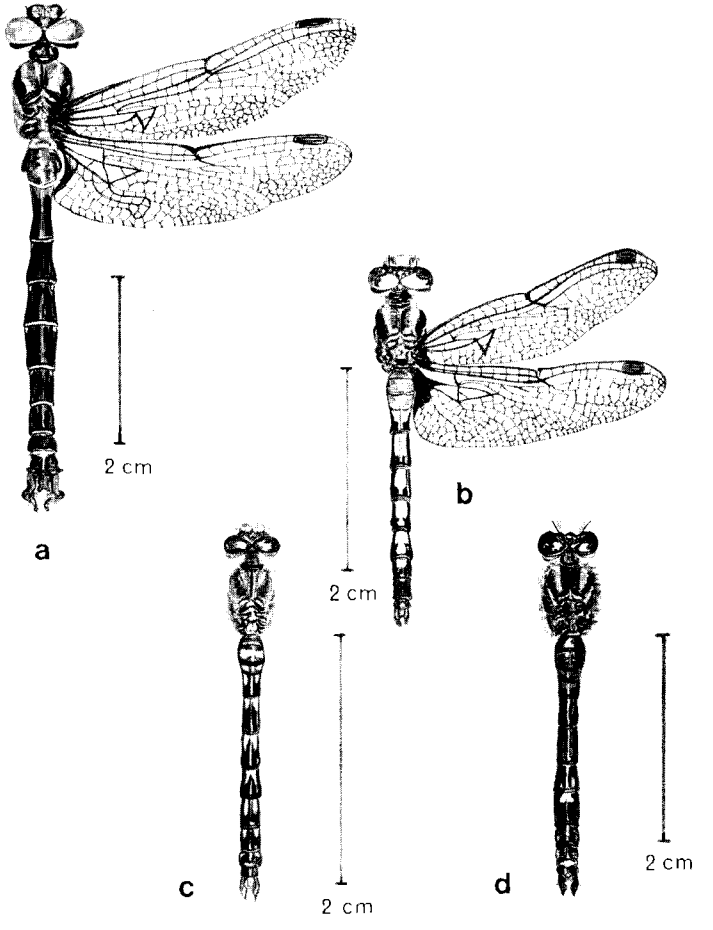


Fig. 44. **a**, *Somatochlora cingulata* ♂ (dorsal); **b**, *Leucorrhinia borealis* ♂ (dorsal); **c**, *Sympetrum danæ* ♂, teneral (dorsal); **d**, *L. intacta* ♂ (dorsal) (wings not to scale).

EXPLANATION OF LETTERS APPEARING ON ILLUSTRATIONS IN KEYS

a1, a2, etc.	abdominal segments
aa	anal appendage
adc	abdominal dorsal carina
al	anal loop
alc	abdominal lateral carina
alm	anterior lamina
alp	apex of labial palp
an	antenodal crossvein
ans	antenodal seta
ant	antenna
Arc	arculus
asp	anterior supracoxal process
at	anal triangle
bh	burrowing hook
bp	basal plate
C	costa
ce	cercus
cl	clypeus
co	compound eye
cu2	second cubital vein
cx1	procoxa
cx2	mesocoxa
cx3	metacoxa
dh	dorsal hook
dn	dorsal nodus
em2	mesepimeron
em3	metepimeron
ep	epiproct
es2	mesepisternum
es3	metepisternum
f	frons
fcs	fronto-clypeal suture
fe2	mesofemur
fe3	metafemur
fr	frame
fw	forewing
fwc	forewing case
gv	genital valve
h	head
ha	hamulus
hf	hamular fold
hp	hamular process
hw	hindwing
hwc	hindwing case
1A	anal vein
IR2, etc.	radial intercalary veins
ia	inferior appendage
ib	inner branch
is	interpleural suture
l	labrum
la	labium
lc	laterial carina
lcl	lateral caudal lamella
lo	lateral ocellus
lp	labial palp
lpl	lateral plate
ls	lateral spine
lsp	laminar spine
m	mandible
MA	anterior media
mb	membranule
mc	median carina
mcl	median caudal lamella
mes	mesothorax
met	metathorax
mg	male genitalia
mh	movable hook
ml	mesostigmal lamina
mo	median ocellus
mx	maxilla
N	nodus
nl	nodal line
ob	outer branch
oc	occiput
ov	ovipositor
pm	prementum
pms	premental seta*
pn	postnodal crossvein
pns	postnodal seta
pos	postocular spot
pp	paraproct

* Counts of setæ refer to the number on *one* side of the midline.

pro	prothorax	st	stylus
ps	palpal seta	T	triangle
psp	posterior supracoxal process	ta2	mesotarsus
		ta3	metatarsus
Pt	pterostigma	tb	trachial branch
R1, R2, etc.	branches of radius	tdc	thoracic dorsal carina
R & M	radius and media	ti2	mesotibia
ra	ramus of median carina	ti3	metatibia
Rs	radial sector	tr2	mesotrochanter
Rspl	radial supplement	tr3	metatrochanter
s2	mesopleural sulcus	ts	T-spot
s3	metapleural sulcus	v	vertex
sa	superior appendage	vl	vulvar lamina
Sc	subcosta	vn	ventral nodus
sp2	mesothoracic spiracle	vs	vulvar spine
sp3	metathoracic spiracle	xv	cubito-anal crossvein

GLOSSARY

abdomen—the elongate, posterior part of an insect; in dragonflies consisting of 10 visible segments and appendages derived from an eleventh.

abdominal dorsal carina—the ridge running along the mid-dorsal line of the abdominal segments.

abdominal lateral carina—the ridge on each side of the abdominal segments.

accessory genitalia—the unique apparatus on the venter of the second abdominal segment of the male dragonfly functioning in the transfer of sperm to the female.

acute—ending in a point.

anal appendages—the structures, excluding the ovipositor, projecting from the end of the dragonfly abdomen.

anal loop—a series of cells near the base of the hindwing of some Anisoptera; in more advanced forms, these cells form a foot-shaped loop.

anal triangle—a triangular group of cells at the posterior angle of the base of the hindwing in some male Anisoptera.

antennæ (singular, *antenna*)—the pair of short, hair-like sensory organs located in front of the compound eyes.

antenodal setæ—hairs arising basally to the nodus on the edge of a caudal lamella.

anterior—the front; towards the front.

anterior lamina—part of the framework of the accessory genitalia.

apex (*apical*)—the part of a structure farthest from the main body mass.

arculus—an important crossvein near the base of the wing of a dragonfly.

austral—southern; of southern origin. In the Life Zone concept, the Austral Zone includes much of North America south of Canada; its western portion is termed the Sonoran Zone.

axis—centre line.

base (*basal*)—the part of a structure closest to the main body mass.

basal plate—part of the structure supporting the ovipositor.

bifid—divided, by a cleft, into two parts.

bilobate—divided into two lobes.

boreal—northern; of northern origin.

caudal lamella (plural, *lamellæ*)—one of three leaf-like structures at the end of the abdomen of a Zygopteran larva.

cell—in the insect wing, a space bounded by veins.

cerci (singular, *cercus*)—lateral appendages between the epiproct and paraprocts of larvæ, becoming the superior appendages of the adult.

clypeus—the part of the face between the frons and the labrum.

compound eyes—the large insect eyes composed of thousands of closely packed, individual, light-sensitive structures.

copulation—the act of mating.

costa—the strengthened, leading-edge of the wing.

coxa (plural, *coxæ*)—the leg base joined to the thorax.

crossvein—a secondary, strengthening vein transverse to the main longitudinal veins in the wings.

dorsal (*dorsum*)—above; the upper side.

dorsal hook—a projection on the mid-dorsal line of an abdominal segment found in many Anisopteran larvæ.

emergence—the transformation of a dragonfly larva into an adult.

entire—without lobes or teeth.

epimeron (plural, *epimera*)—the posterior of the two main lateral plates of a thoracic segment.

epiproct—the dorsal anal appendage of Anisopteran larvæ, equivalent to the median caudal lamella of the Zygoptera.

episternum (plural, *episterna*)—the anterior of the two main lateral plates of a thoracic segment. The mesepisterna of dragonflies appear dorsally, anterior to the wings.

exuvia (plural, *exuviæ*)—the larval skin remaining after the ermergence of the adult.

femur (plural, *femora*)—the largest leg segment.

frame—the inner ridge-like edge of the mesostigmal lamina.

frons—the dorsal part of the dragonfly face ventral and anterior to the antennæ.

fronto-clypeal suture—the groove separating the frons from the clypeus.

genital valves—structures sheathing the ovipositor.

hamular fold/process—parts of the anterior hamulus important in the classification of the genus *Æshna*.

hamulus (plural, *hamuli*)—a clasping structure composing part of the accessory genitalia of male dragonflies.

inferior appendage—the ventral anal appendage of the adult male dragonfly; two appear in the Zygoptera, one in the Anisoptera.

inner/outer branch—divisions of the posterior hamulus important in the identification of the Libellulidæ.

instar—one of the stages in the growth of a larva, each separated by a moult.

interpleural suture—the line of fusion between the mesothorax and metathorax.

labial palp—in the Odonata larva, one of a pair of grasping appendages attached to the end of the labium.

labium—the posterior, fused pair of insect mouthparts, modified in the dragonfly larva to form a hinged, grasping organ.

labrum—the "upper lip" anterior to the chewing mouthparts.

laminar spines—pointed processes on the anterior lamina.

larva (plural, *larvæ*)—the aquatic immature stage of the dragonfly; also called nymph or naiad.

lateral—pertaining to the side of a structure; away from the middle.

lateral spine—a posteriorly projecting point on the abdominal lateral carinæ of some larvæ.

mandibles—the pair of strong, toothed, chewing mouthparts.

maxillæ (singular, *maxilla*)—the pair of spiny mouthparts between the mandibles and labium.

median—in the middle.

mes(o)—a prefix indentifying structures associated with the mesothorax, the second thoracic segment, bearing the forewings and middle legs.

mesostigmal laminæ (singular, *lamina*)—complex plates on the dorsal anterior margin of the mesothorax in female Zygoptera. These structures are engaged by the male anal appendages in the tandem position.

met(a)—a prefix identifying structures associated with the metathorax, the third thoracic segment, bearing the hindwings and hindlegs.

movable hook—a sharp spine at the apex of the labial palp.

nodal line—a line, sometimes joint-like, joining the dorsal nodus and ventral nodus of a caudal lamella.

nodus—in the Odonata, a crossvein thickened into a joint-like structure in the middle of the leading edge of the wing. Also the point on the edge of a caudal lamella where an abrupt change in seta type occurs.

occiput—the top of the head between the compound eyes and the back of the head.

ocellus (plural, *ocelli*)—one of the three simple eyes on the vertex.

ovate—egg-shaped.

oviposition—the egg-laying process carried out by the female, either alone or in conjunction with the male.

ovipositor—the pointed structure possessed by some female dragonflies used to place eggs in plants or other material.

palpal setæ—hair-like spines on the labial palp.

paraproct—one of the pair of ventral anal appendages of Anisopteran larvæ, equivalent to the lateral caudal lamellæ of Zygoptera.

pleural sulcus (plural, *sulci*)—the groove between an episternum and an epimeron.

posterior—the rear; towards the rear.

premental setæ—hair-like spines on the prementum, usually present in two lateral groups.

prementum—in the dragonfly larva the anterior half of the hinged labium to which are attached the labial palps.

postnodal setæ—hairs arising apically to the nodus on the edge of a caudal lamella.

postocular spots—spots located behind the compound eyes in certain Zygoptera.

pro—a prefix identifying structures associated with the prothorax, the first thoracic segment, bearing the front legs.

process—a projection.

pruinose—covered with a bluish-white, powdery "bloom".

pterostigma (plural, *pterostigmata*)—a thickened area, usually dark, on the leading edge of the dragonfly wing near the tip.

pterothorax—the enlarged, wing-bearing part of the thorax, consisting of the fused mesothoracic and metathoracic segments.

rami (singular, *ramus*)—fan-shaped, diverging halves of the thoracic dorsal carina posterior to the mesostigmal laminæ.

rectum—the posterior end of the gut; in Anisoptera larvæ it is lined with gills.

segment—a regular division of a part, e.g., a ring of the abdomen.

seta (plural, *setæ*)—a hairlike bristle.

sphagnum bog—a marshy area dominated by *Sphagnum* mosses and in which there is an accumulation of much undecomposed organic material, usually acidic.

spiracle—the segmental opening of the tracheal system.

styli (singular, *stylus*)—sensory projections at the apices of the genital valves.

superior appendages—the pair of dorsal anal appendages of the adult male dragonfly.

supracoxal process—a bifid projection dorsal to the procoxa in *Æshna* larvæ.

tandem position—the position attained prior to copulation, or during oviposition, when the male grasps the female by the head or thorax with the anal appendages.

tarsus (plural, *tarsi*)—the apical leg segment, secondarily divided into usually three parts and bearing terminal claws.

teneral—a newly emerged adult dragonfly before the body has fully hardened.

thoracic dorsal carina—the ridge along the dorsal midline of the thorax between the two mesepisterna.

thorax—the part of an insect's body between the head and abdomen, consisting of three segments bearing the wings and legs.

tibia (plural, *tibiæ*)—the long, slender leg segment between the femur and tarsus.

tooth—a short, pointed projection.

tracheæ (singular, *trachea*)—a network of tiny tubes transporting air into the tissues of an insect.

triangle—a large triangular cell in the venation of the Anisopteran wing.

trifid—divided into three lobes or points.

Transition Zone—in the Life Zone concept, a zone between the Austral Zone of southern latitudes and low elevations and the Canadian Zone of more northerly latitudes and higher elevations. It is represented in British Columbia by the dry Interior and the southern Georgia Strait region.

trochanter—a small leg segment between the coxa and femur.

truncate—cut off more or less squarely at the tip.

T-spot—a dark T-shaped mark on the frons of some species.

tubercle—a small knob.

undulate—wavy.

vein—a rib in the network supporting the membranous wings of insects.

ventral (*venter*)—below; the underside.

vertex—the part of the head between the frons and the compound eyes.

vestigial—reduced to a trace.

vulvar lamina—a female Anisopteran structure derived from the ovipositor and forming a flap or scoop behind the genital opening on abdominal segment 8.

vulvar spine—a ventral process on abdominal segment 8 of some female Zygoptera.

wing cases—the developing wings of dragonfly larvæ.

wing venation—the arrangement of insect wing veins.

REFERENCES

BARBEAU, M. 1929. Totem poles of the Gitksan, Upper Skeena River, British Columbia. Nat. Mus. of Can. Anthro. Ser. No. 12, Bull. 61, Ottawa.

BOAS, F. 1927. Primitive Art. Institute For Sammenlignende Kulturforskning, Oslo.

COOK, P. P., and A. L. ANTONELLI. 1969. The nymph of *Amphiagrion abbreviatum*. Ann. Ent. Soc. Amer. 62:264.

CORBET, P. S. 1962. A Biology of Dragonflies. Witherby, London.

CORBET, P. S., C. LONGFIELD, and N. W. MOORE. 1960. Dragonflies. Collins, London.

COWAN, I. McT., and C. J. GUIGUET. 1956. The Mammals of British Columbia. B.C.P.M. Handbk. No. 11, Victoria.

GARRISON, R. W. 1976. Multivariate analysis of geographic variation in *Libellula luctuosa* Burmeister (Odonata: Libellulidæ). Pan-Pac. Entomol. 52:181–203.

KENNEDY, C. H. 1915. Notes on the life history and ecology of the dragonflies (Odonata) of Washington and Oregon. Proc. U.S. Nat. Mus. 49:259–345.

——— 1917. Notes on the life history and ecology of the dragonflies (Odonata) of central California and Nevada. Proc. U.S. Nat. Mus. 52:483–635.

KRAJINA, V. J. 1965. Biogeoclimatic zones and classification of British Columbia. Ecology of Western North America 1:1–17. University of British Columbia, Vancouver.

MUNRO, J. A., and I. McT. COWAN. 1947. A Review of the Bird Fauna of British Columbia. B.C.P.M. Spec. Publ. No. 2, Victoria.

MUSSER, J. R. 1962. Dragonfly Nymphs of Utah (Odonata: Anisoptera). University of Utah Biological Series 12(6): 1–71.

NEEDHAM, J. G., and H. B. HEYWOOD. 1929. A handbook of the dragonflies of North America. C. C. Thomas, Springfield.

NEEDHAM, J. G., and M. J. WESTFALL. 1955. A manual of the dragonflies of North America (Anisoptera) including the Greater Antilles and the Provinces of the Mexican border. University of California Press, Berkeley.

PAULSON, D. R. 1970. A list of the Odonata of Washington with additions to and deletions from the State List. The Pan-Pac. Entomol. 46:194–198.

SCUDDER, G. G. E., R. A. CANNINGS, and K. M. STUART. 1976. An annotated checklist of the Odonata (Insecta) of British Columbia. Syesis 9:143–162.

SVIHLA, A. 1958. The nymph of *Tanypteryx hageni* Selys (Odonata). Ent. News 69:261–266.

——— 1959. Life history of *Tanypteryx hageni* Selys (Odonata). Trans. Amer. Ent. Soc. 85:219–232.

WALKER, E. M. 1927. The Odonata of the Canadian Cordillera. Bull. Prov. Mus. Nat. Hist., Victoria.

——— 1953. The Odonata of Canada and Alaska. Vol. 1. University of Toronto Press, Toronto.

——— 1958. The Odonata of Canada and Alaska. Vol. 2. University of Toronto Press, Toronto.

WALKER, E. M., and P. S. CORBET. 1975. The Odonata of Canada and Alaska. Vol. 3. University of Toronto Press, Toronto.

WHITEHOUSE, F. C. 1941. British Columbia dragonflies (Odonata) with notes on distribution and habits. Amer. Midl. Nat. 26:488–557.

INDEX TO SPECIES TREATED

(Other names and synonyms shown in *italics*)