The background features a stylized illustration. On the left, a sun with radiating lines is partially obscured by a white wavy pattern representing water. To the right, there are several trees of different shapes and sizes. In the lower right quadrant, three fish are depicted swimming. The entire scene is rendered in a halftone or dithered style.

**An Identification Guide
to the Nymphal Mayflies
(Order EPHEMEROPTERA)
of British Columbia**

March 1996

Copyright



Resources Inventory Committee

STATEMENT LIMITING THE LIABILITY OF THE PROVINCE

The entire risk of loss, personal injury, or damages of any kind, as a result of using the information and procedures contained in these materials, including the print and/or workshop materials, is with the user. Although the Province of British Columbia has used considerable efforts in preparing the materials for use in the province of British Columbia, the Province of British Columbia does not warrant the accuracy, completeness or effectiveness of the information and procedures contained in the materials. In no event will the Province of British Columbia be liable for damages of any kind arising out of the use of the materials.

Government Publications Centre

Phone: (250) 387-3309 or

Toll-free: 1-800-663-6105

Fax: (250) 387-0388

www.publications.gov.bc.ca

An Identification Guide to the Nymphal Mayflies
(Order EPHEMEROPTERA) of British Columbia

by Karen M. Needham

March 1996

© The Province of British Columbia
Published by the
Resources Inventory Committee

Canadian Cataloguing in Publication Data

Needham, Karen Merrie, 1963-

An identification guide to the nymphal mayflies
(order Ephemeroptera) of British Columbia [computer
file]

Available through the Internet.
Issued also in printed format on demand.
Includes bibliographical references.
ISBN 0-7726-3881-0

1. Mayflies - British Columbia - Identification.
I. Resources Inventory Committee (Canada)
II. Title.

QL505.2.C3N43 1999 595.7'34'09711 C99-960161-X

Additional Copies of this publication can be purchased from:

Government Publications Centre

Phone: (250) 387-3309 or

Toll free: 1-800-663-6105

Fax: (250) 387-0388

www.publications.gov.bc.ca

ACKNOWLEDGEMENTS

I gratefully acknowledge Dr. G.G.E. Scudder for initially sparking my interest in aquatic insects, and for his continuous support and encouragement throughout my entomological career, this publication being no exception. I would also like to thank Launi Lucas: illustrator, layout design artist, and overall calming influence. And finally, thanks goes to my father, who always encouraged me to bring friends into our house when I was growing up, even if they were of the six-legged variety, and to my sister, who supported my "hobby" with a smile from a safe distance.

This publication was made possible by funding from the Resource Inventory Committee, with the assistance of Rick Nordin, B.C. Ministry of the Environment, Land and Parks, Water Branch, Victoria.

TABLE OF CONTENTS

INTRODUCTION AND FIGURES 1-5.....	1
FAMILIES AND GENERA OF B.C. EPHEMEROPTERA RECORDED TO DATE.....	11
PICTORIAL KEYS	
KEY TO FAMILIES Order Ephemeroptera	12
KEYS TO GENERA Family Baetidae	15
Family Ephemerellidae.....	16
Family Ephemeridae.....	17
Family Heptageniidae	18
Family Letophlebiidae	20
Family Siphonuridae.....	21
TABLES AND FIGURES 6-14.....	22
GLOSSARY.....	72
REFERENCES	
TAXONOMIC INDEX TO FAMILIES AND GENERA	

INTRODUCTION

The mayflies, Order Ephemeroptera, are primitive insects with two winged adult stages and several aquatic nymphal stages. Adults are easily identified by their bristle-like antennae, upright wings containing many wing veins, the presence of two or three tails extending from the posterior end, and their fragile nature (Figure 1). Nymphs can also be identified by the presence of two or three long tails at the end of the abdomen. In addition, nymphs have paired gills associated with some of their abdominal segments, and their tarsal claws are single rather than double (Figure 2). Two tails, double tarsal claws, and gills associated with the thorax rather than the abdomen are characteristics of stonefly nymphs, which superficially resemble mayfly nymphs and may sometimes be confused with them (Figure 3).

This publication will enable the user to identify the recorded mayfly nymphs of British Columbia to family and genus, with the aid of pictorial keys. Also included are short synopses of each family and genus in B.C., a glossary of taxonomic terms, and a reference list for further studies.

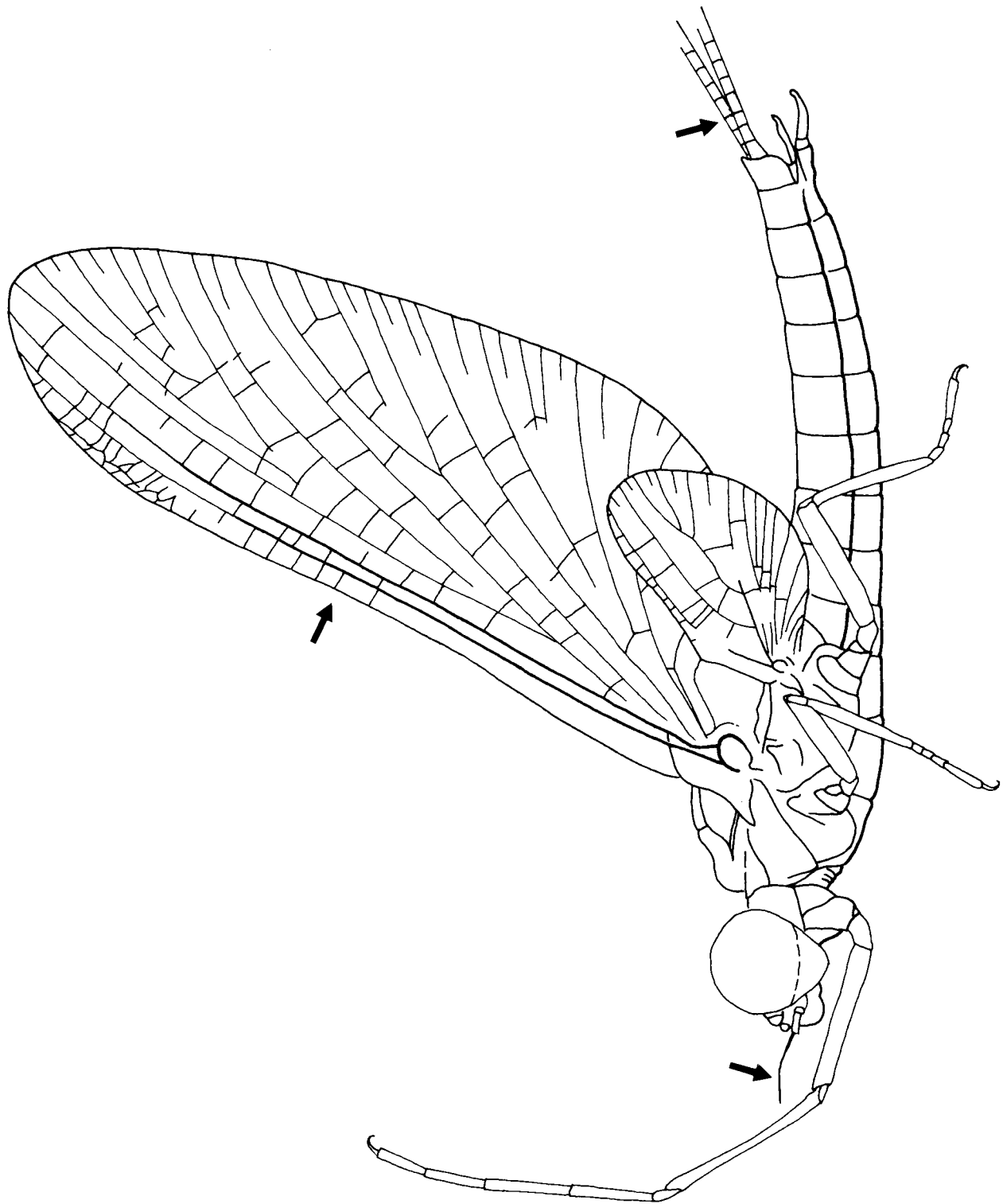


Figure 1. Mayfly adult

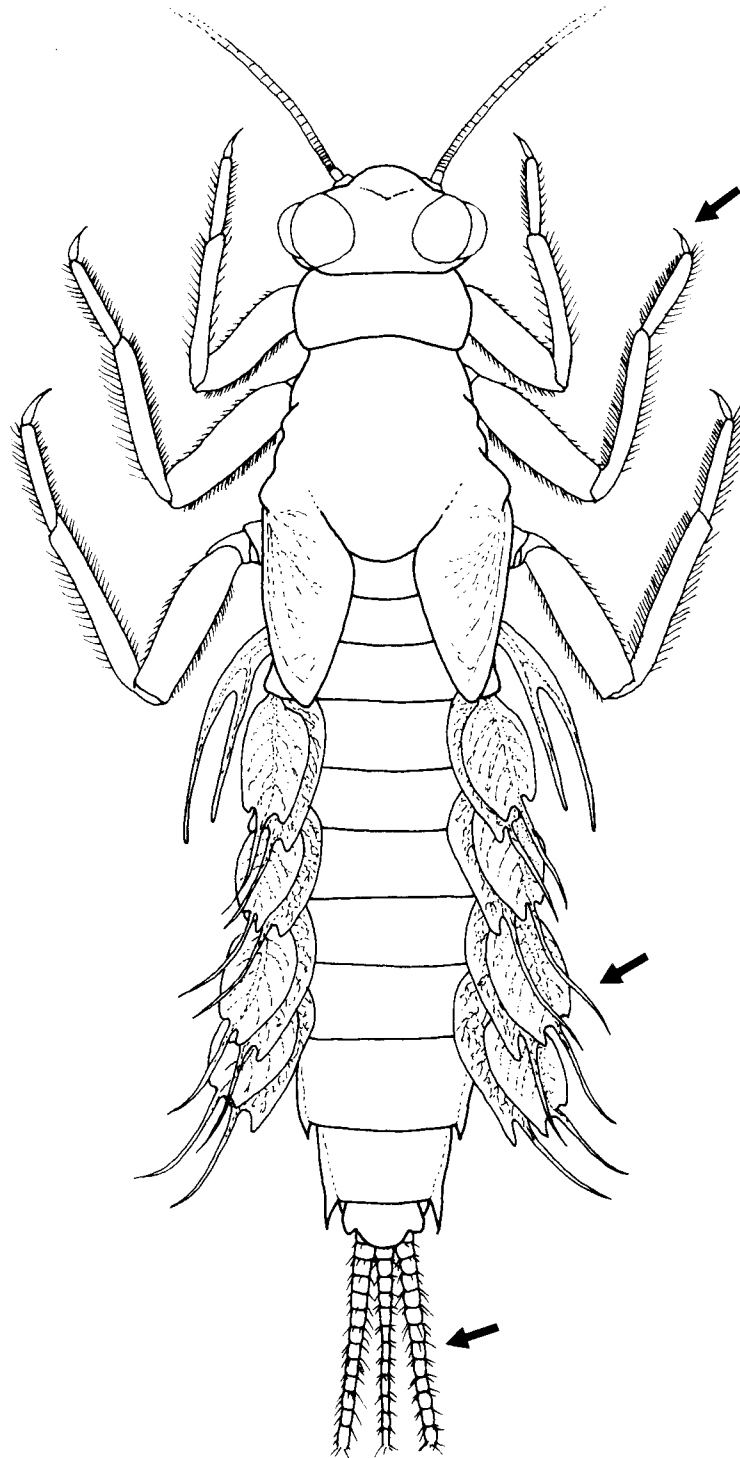


Figure 2. Mayfly nymph

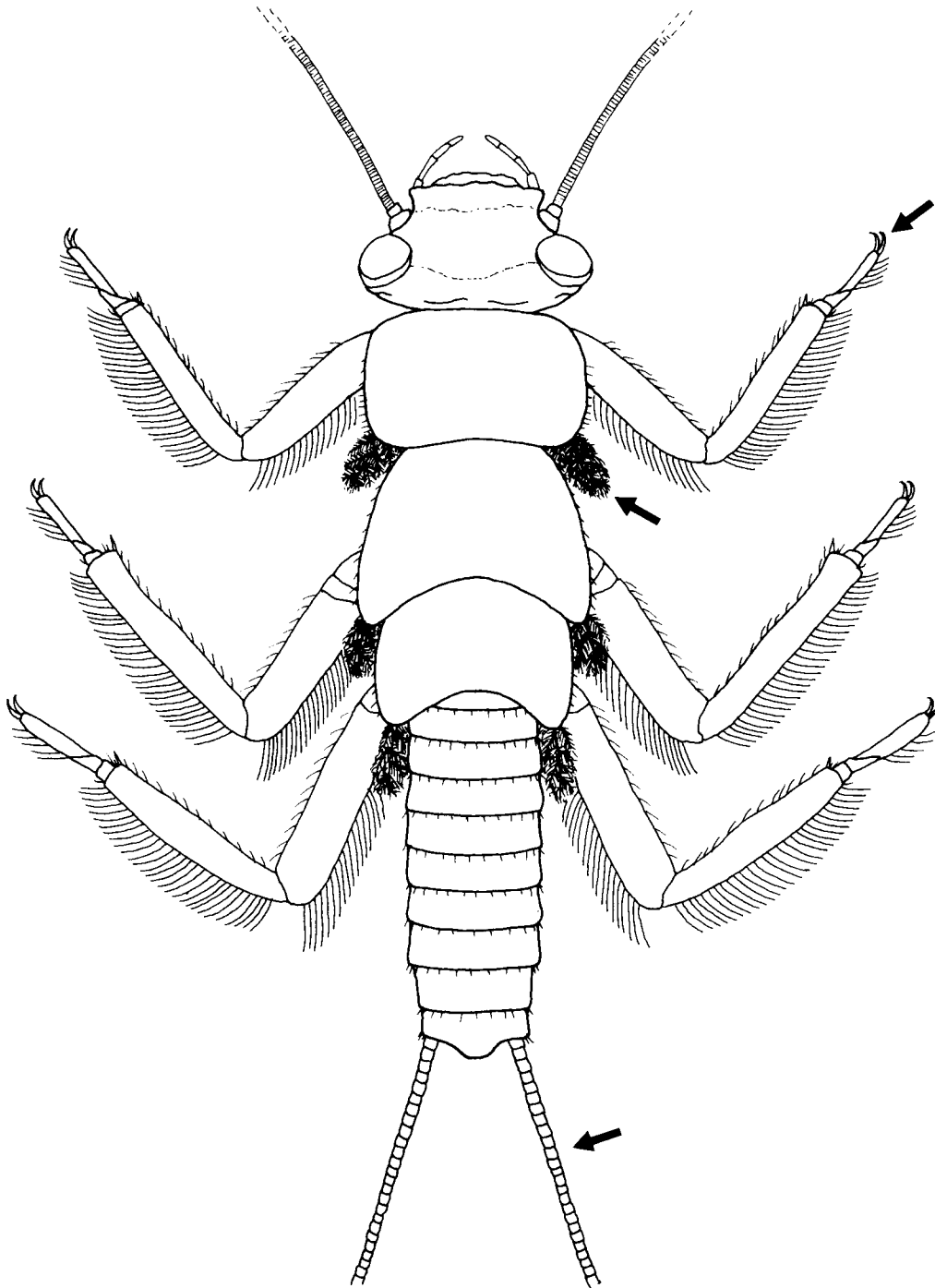


Figure 3. Stonefly nymph

ADULTS

Mayfly adults usually have four wings; the front pair is always much larger than the hind pair, which is sometimes completely absent. These wings cannot be folded over the abdomen when the insect is at rest, giving the adult insect its characteristic profile.

The presence of two winged adult stages is unique among the insects. The first of these stages is known as the subimago, and can be readily distinguished from the second stage by the presence of hairs on the wings and sometimes on the body, making them appear dull. The subimago is non-flying, non-reproductive, and short-lived. The second winged stage is the imago, which has completely clear, shiny wings and is capable of reproduction. It may also be short-lived (a few hours to a few days), or it may survive up to several weeks.

Mayflies are very poor fliers; the two or three tails at the end of the abdomen in the adult are thought to act as stabilizers during flight. Adults in both stages have non-functional, strongly reduced mouthparts, so they cannot feed.

NYMPHS

Mayfly nymphs vary greatly in general body shape owing to their many different lifestyles. All live in freshwater, but some are burrowers, possessing large mandibular tusks for digging, and feathery abdominal gills for creating a water current through their underground burrows. Others live underneath stones in fast-flowing streams and rivers; these have flattened heads and bodies, and widespread legs for clinging. Still others are slender and elongate, adapted for crawling on the surface or through vegetation. These mobile nymphs have cylindrical bodies and long legs for holding their bodies up off the ground. All of these nymphal types are well-camouflaged against the background, and are therefore difficult to spot in their natural habitat.

Most mayfly nymphs are omnivores, browsing for tiny plants and animals on the surfaces of rocks or underwater plants. Feeding habits of many are not known, but it appears that a few at least are true carnivores.

The abdominal gills possessed by mayfly nymphs are used for obtaining both oxygen and salts from the water. Oxygen can be taken up across the gill surface itself, or across the general body surface from the water currents created by the movement of the gills. Maintaining a body concentration high in salts is difficult for freshwater animals, so gills of mayfly nymphs are covered in special cells, known as chloride cells, that aid in salt uptake in dilute waters. Gills vary greatly in shape and size between mayfly species, so are an excellent taxonomic character when trying to identify individuals within this Order.

LIFE CYCLE

Because mayfly adults are short-lived and are poor fliers, mating swarms have been observed in many species. Adults emerge simultaneously in large numbers and males then congregate to make the females' job of finding them easier. When a female enters this mating swarm, she is approached by a male from underneath. He grasps her thorax with his front legs, and then attempts to copulate with her by curving the end of his abdomen upwards, grasping her abdomen with his forceps, and inserting his penes into her oviducal openings. Sometimes these joined couples sink to the ground; other times they remain in flight during copulation. The female then flies off to find water in which to lay her eggs. Eggs can be laid on the surface of the water singly or in clumps, after which they sink to the bottom. However, females of a few species actually crawl under the water on submerged vegetation and lay their eggs directly on the surface of some submerged object.

Eggs of most species hatch within a few weeks. Nymphs then undergo several molts, growing larger with each successive stage. Nymphs may live a few weeks, a few months, or a few years, depending on the species. Water temperature plays a large role in the speed of nymphal development.

The final nymphal instar is easily identified by the presence of wing pads on its thorax. This nymph floats to the surface by filling its midgut with air. Emergence to the subimago may occur just under the surface of the water, on the surface of the water, out of the water on a floating object or on the shore. Large numbers of sexually immature subimagos are often seen floating on the surface of the water while their wings expand and their skeletons harden. The hairs covering their wings and bodies are thought to provide waterproofing for the subimagos at this vulnerable time.

The molt to imago may occur within a few minutes in some species, or may take up to 48 hours in others. During this time, the subimago rests on vegetation, rocks, or walls, and rarely attempts flight. The sexually mature imagos of most species emerge synchronously, usually near dusk, and immediately begin the process of mating. In the Pacific Northwest, where winters are mild, adult emergence occurs throughout the year.

COLLECTING AND PRESERVING MAYFLIES

Mayfly nymphs can be collected by using an aquatic net with a fairly fine mesh. Place the net near the bottom of a stream or river, and then disturb the substratum or turn over some rocks just upstream from it. The disturbed mayflies will drift downstream into the awaiting net. An aquatic net can also be moved gently over submerged vegetation to disturb and capture mayflies clinging there. After each sweep, the net should be inverted and washed into a shallow, light-coloured pan, where the insects can easily be seen. Be sure to check for nymphs clinging to vegetation and debris in the pan. Remove each specimen from the pan and place it in a vial of its own, labelled with the date, collecting locale, and collector's name. If additional information is available, such as water temperature, air temperature, weather conditions, or altitude, this should be recorded in a field note book and cross-referenced to each specimen.

Adult mayflies are best collected using an aerial net. This can be swept through the air above a water body, or it can be used to gently sweep the vegetation near the water's edge, where subimagos or imagos may be resting. Again, place each specimen in a vial of its own and record all of the pertinent collecting data.

Both nymphs and adults should be preserved in 70% ethyl alcohol to prevent drying, and so that the specimens can easily be examined at a later date. Glass dram vials with lids that prevent alcohol evaporation are excellent for this.

EXTERNAL MORPHOLOGY OF MATURE NYMPHS

The external structures of a generalized mature mayfly nymph are illustrated in Figure 4. An enlarged view of the mouthparts of this nymph are illustrated in Figure 5. These features will aid in the use of the taxonomic keys to follow. Presence of wing pads on the meso- and metathorax identify a nymph as mature. The thorax also bears three pairs of legs, one on each thoracic segment. The abdomen of mayflies consists of 10 segments. Begin numbering these segments by counting forward from the 10th abdominal segment. Some of these segments will contain gills, which may be located dorsally, ventrally, or laterally. At the posterior end of the abdomen are caudal filaments of varying lengths; usually there are two lateral caudal filaments and one middle caudal filament.

USING THE KEYS

Begin by identifying your specimen to family using the key located on pages 12-14. Once you have placed your specimen in a mayfly family, turn to the appropriate family key (pages 15-21) and use this to identify your specimen to genus. Four families in British Columbia have only one representative genus; these are indicated on the Key to Families (pages 12-14). Using the keys involves making a series of choices. Eventually, these choices will lead you to the end of a pathway where the specimen is then identified to either family or genus. Taxonomic characters chosen for the keys are those that were deemed easiest to recognize, and are illustrated wherever appropriate. Within each block of text in the keys, lower case letters in brackets refer to the illustrations directly below that block of text. Illustrations are by Launi Lucas, and are redrawn after Edmunds *et al.* (1976), Clifford (1991), and Merritt and Cummins (1996).

Once you have identified your specimen to family or genus, you may wish to compare its overall features with the whole animal illustrations and with the more complete list of taxonomic characters located in the tables following the pictorial keys (pages 22-71). Here, you will also find specific information about distribution, habitat, habits, and miscellaneous facts for each British Columbia family and genus within the Order Ephemeroptera. A glossary of terms is available beginning on page 72 to further aid you in the use of the keys. A bibliography to other keys, more in-depth taxonomic information, and the biology and ecology of mayflies can be found at the end of this publication.

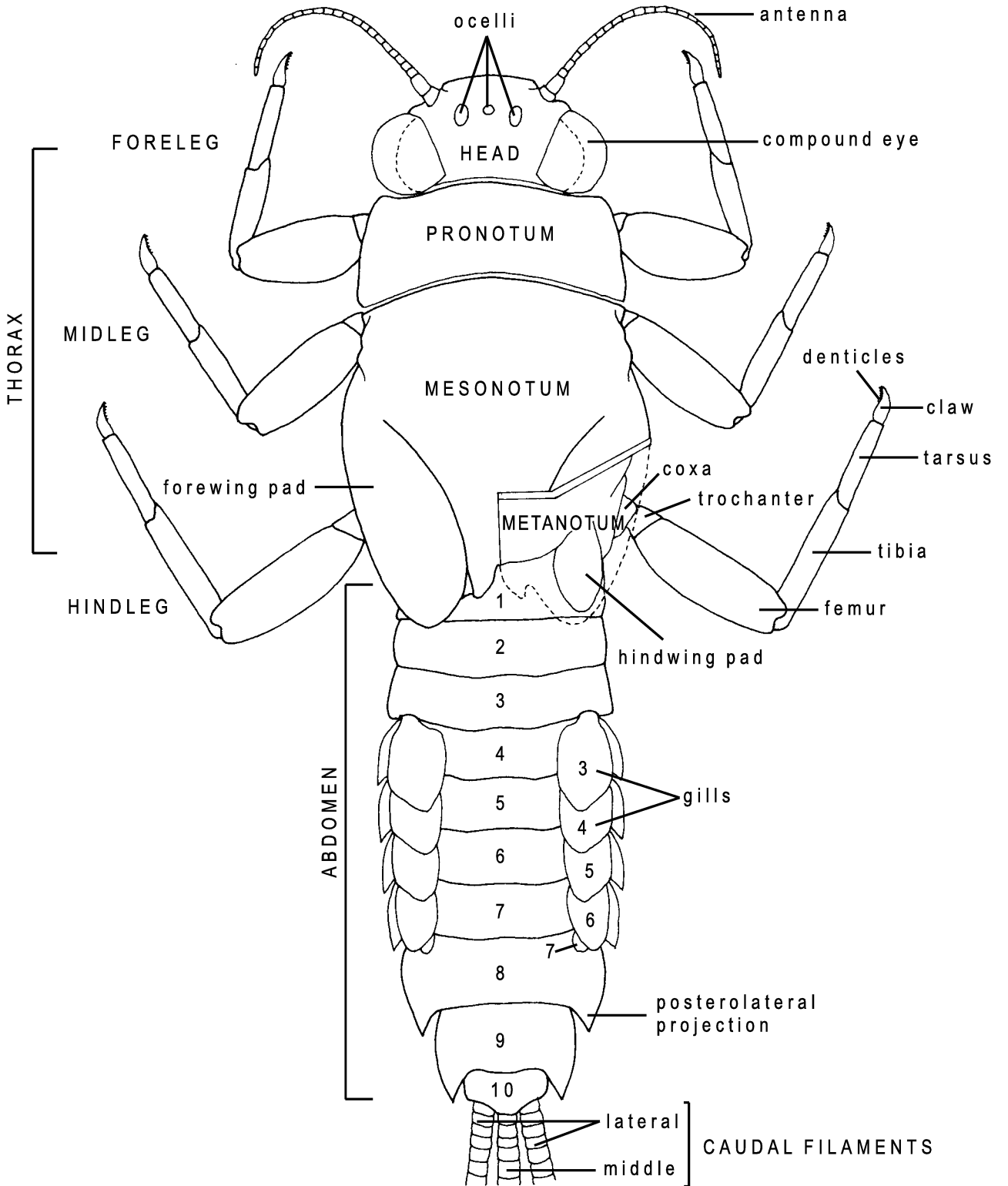


Figure 4. Mayfly nymph - external features

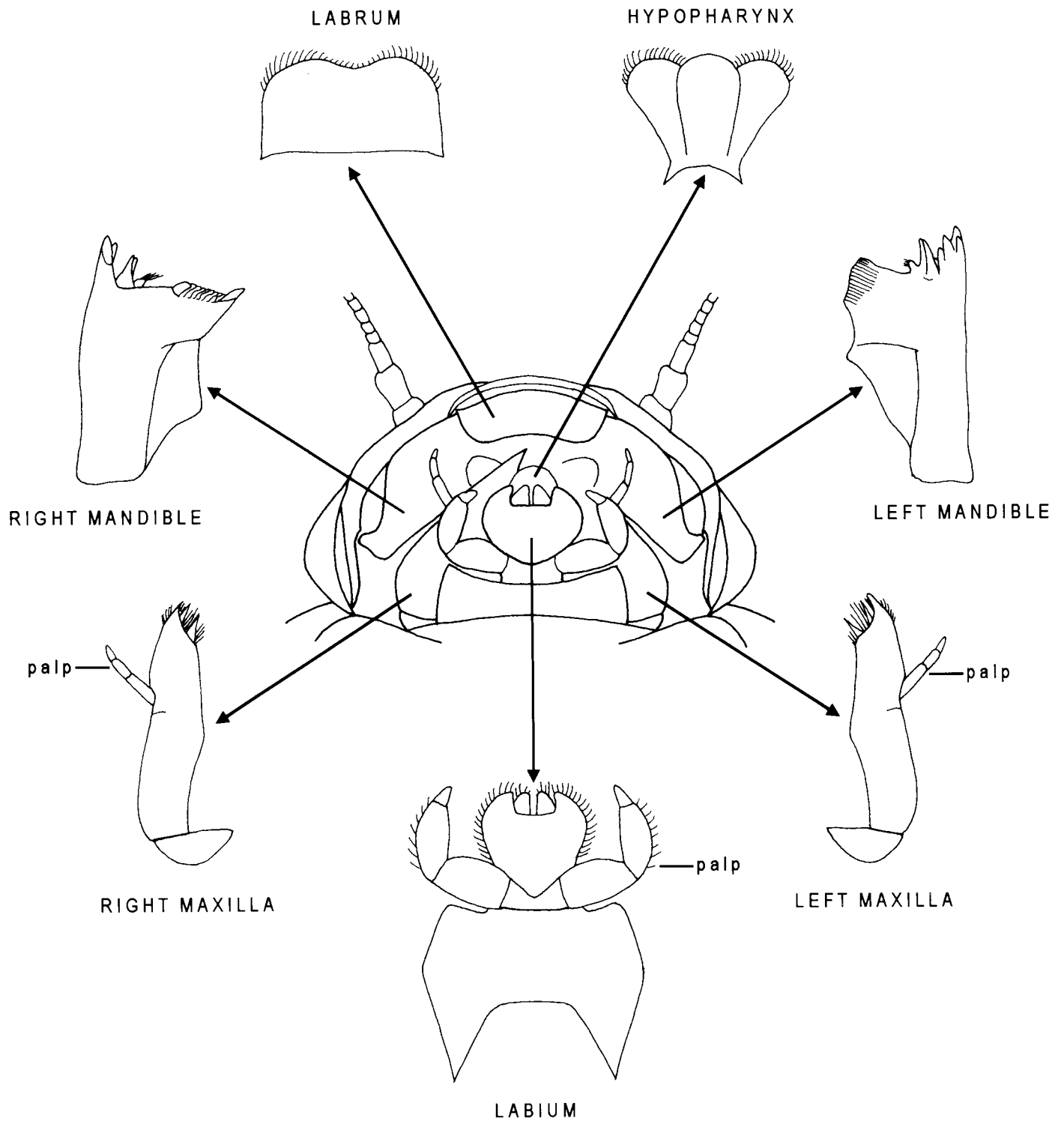


Figure 5. Mayfly nymph - mouthparts (ventral view)

**FAMILIES AND GENERA OF B.C. EPHEMEROPTERA
RECORDED TO DATE**

Family Ameletidae

Ameletus Eaton

Family Baetidae

Acentrella Bengtsson*Baetis* Leach*Callibaetis* Eaton*Centroptilum* Eaton*Dipheter* Waltz and McCafferty*Proclleon* Bengtsson

Family Caenidae

Caenis Stephens

Family Ephemerellidae

Attenella Edmunds*Caudatella* Edmunds*Drunella* Needham*Ephemerella* Walsh*Eurylophella* Tiensuu*Serratella* Edmunds*Timpanoga* Needham

Family Ephemeridae

Ephemera Linnaeus*Hexagenia* Walsh

Family Heptageniidae

Cinygma Eaton*Cinygmula* McDunnough*Epeorus* Eaton*Heptagenia* Walsh*Ironodes* Traver*Nixe* Flowers*Rhithrogena* Eaton*Stenonema* Traver

Family Leptophlebiidae

Leptophlebia Westwood*Paraleptophlebia* Lestage

Family Metretopodidae

Metretopus Eaton

Family Siphonuridae

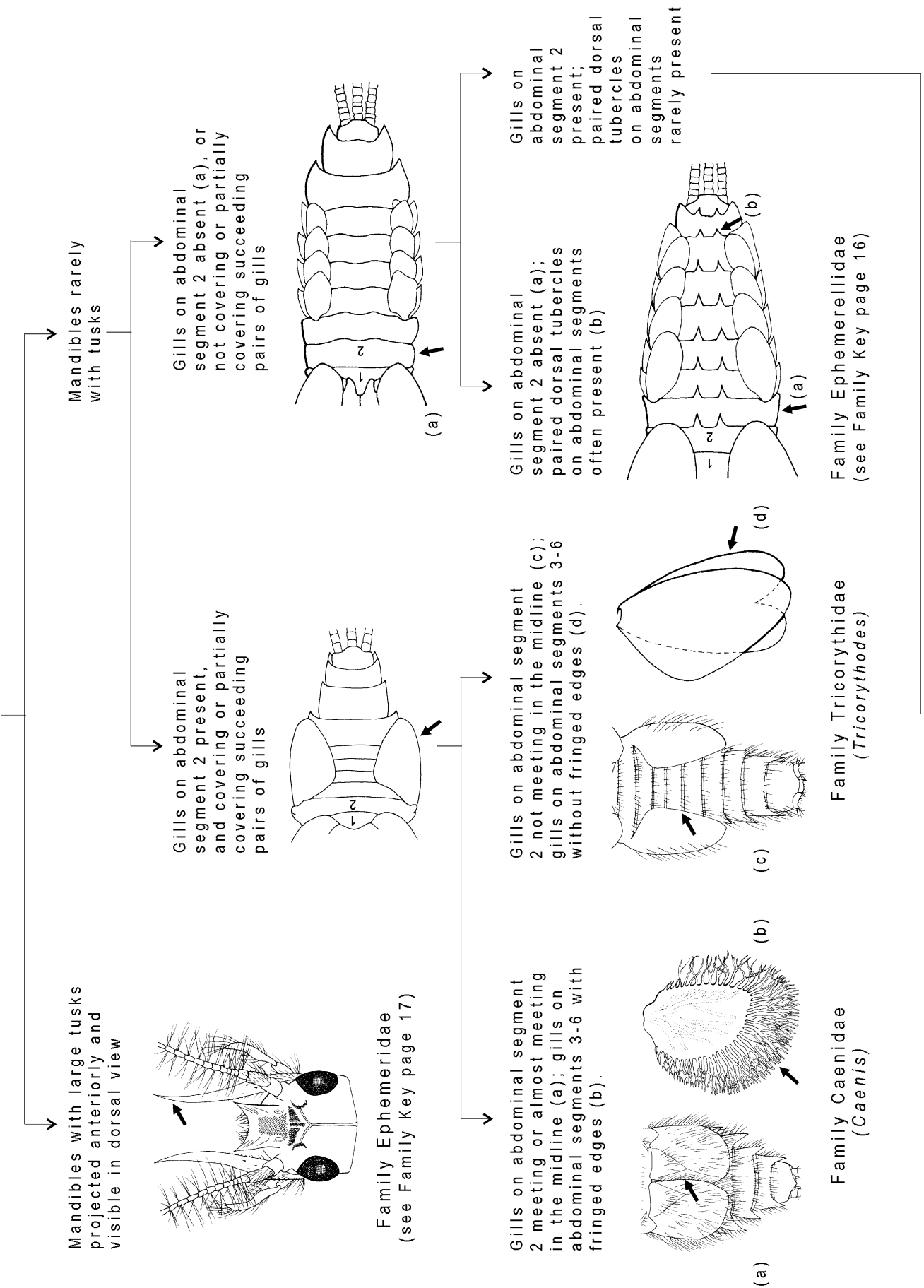
Parameletus Bengtsson*Siphonurus* Eaton

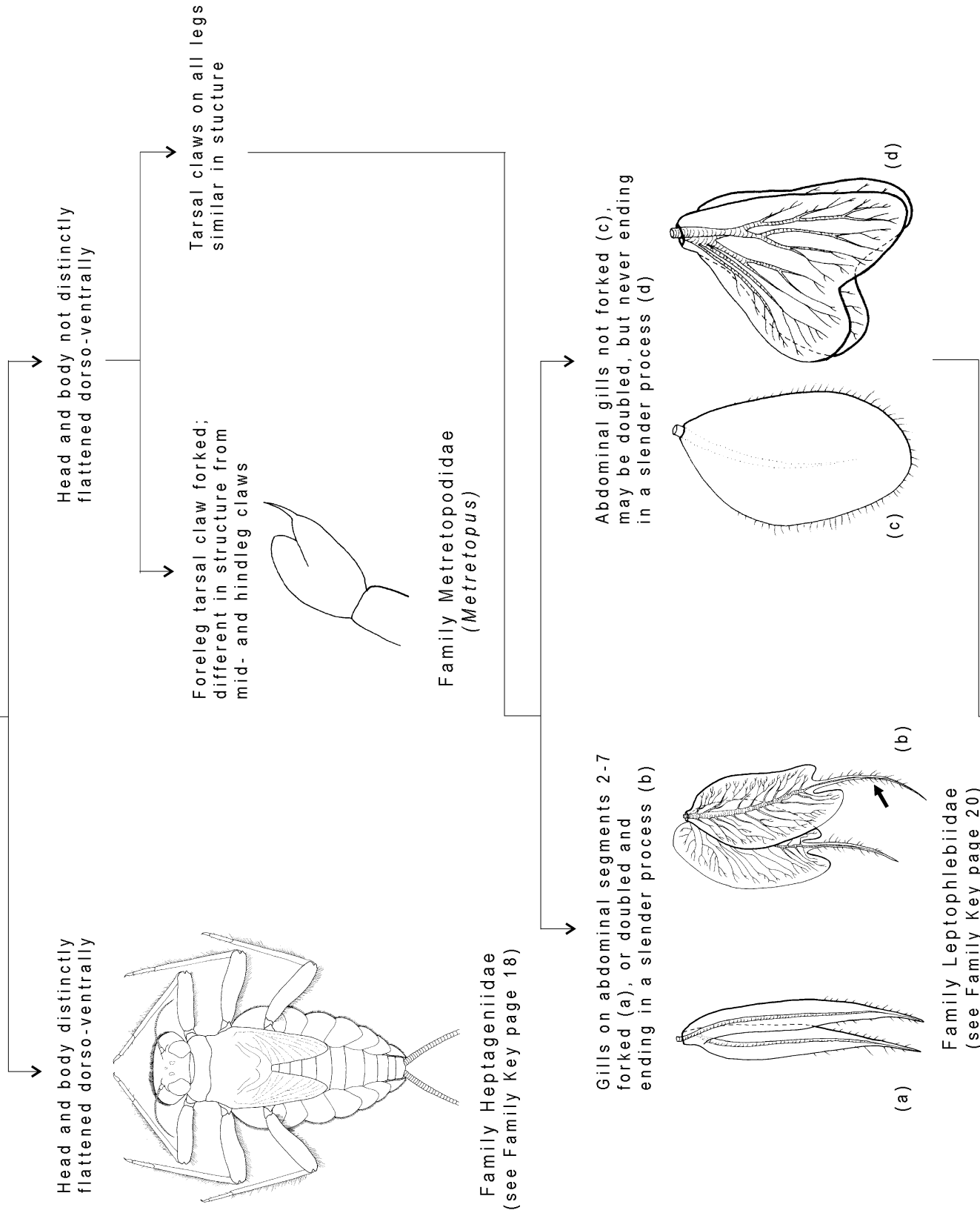
Family Tricorythidae

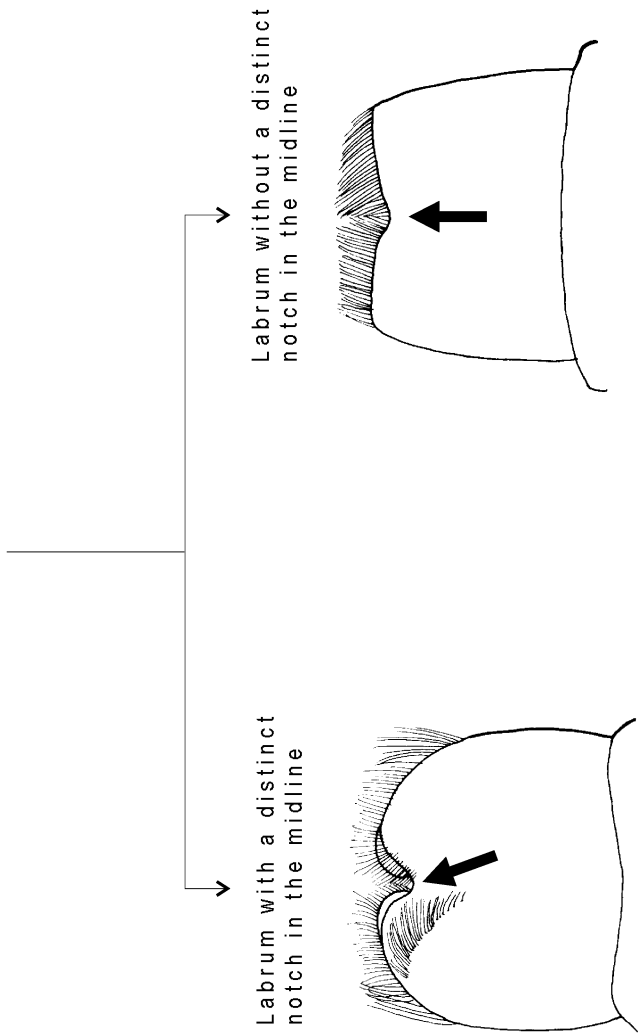
Tricorythodes Ulmer

In total: 10 families
31 genera

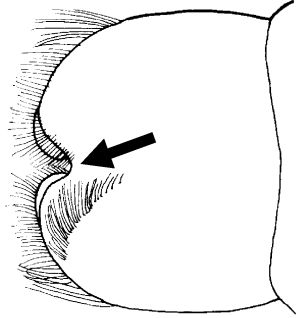
Order EPHEMEROPTERA



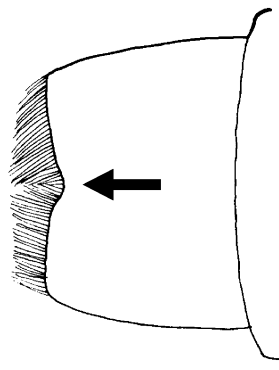




Labrum with a distinct notch in the midline

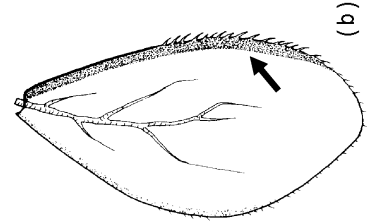
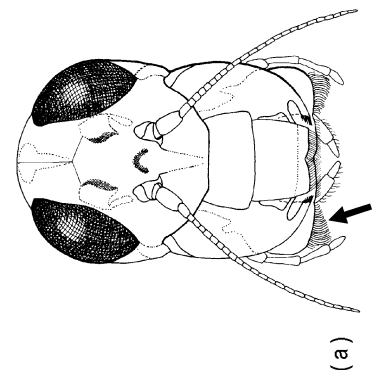


Labrum without a distinct notch in the midline

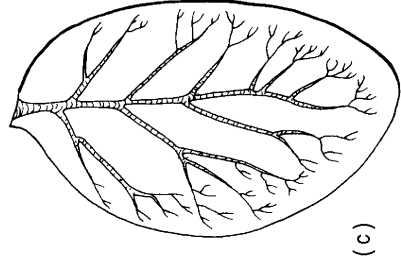


Family Baetidae
(see Family Key page 15)

Maxilla with a fringed bottom edge (a); each gill with a sclerotized band along its outer edge (b)



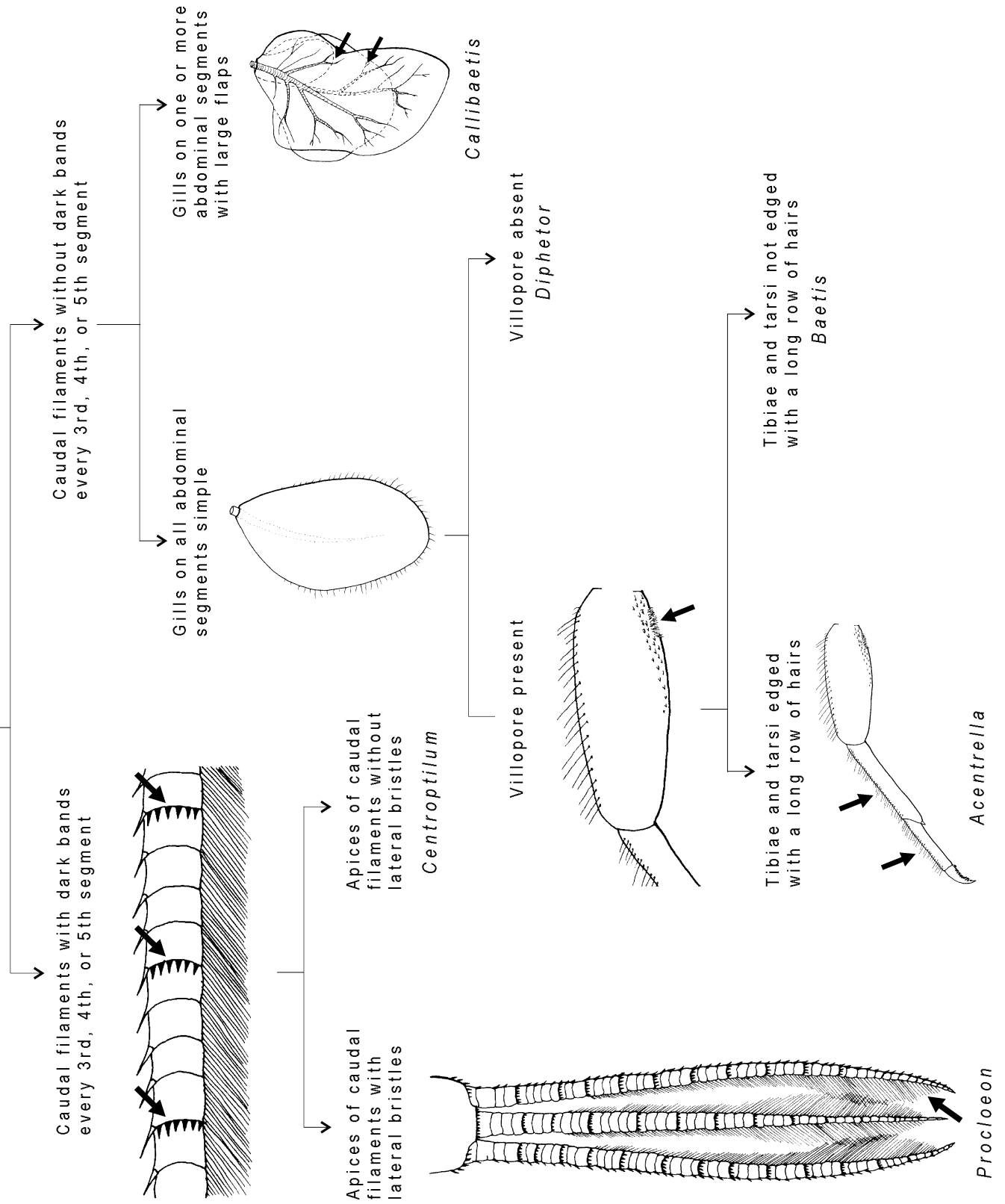
Maxilla without a fringed bottom edge; gills variable (c)



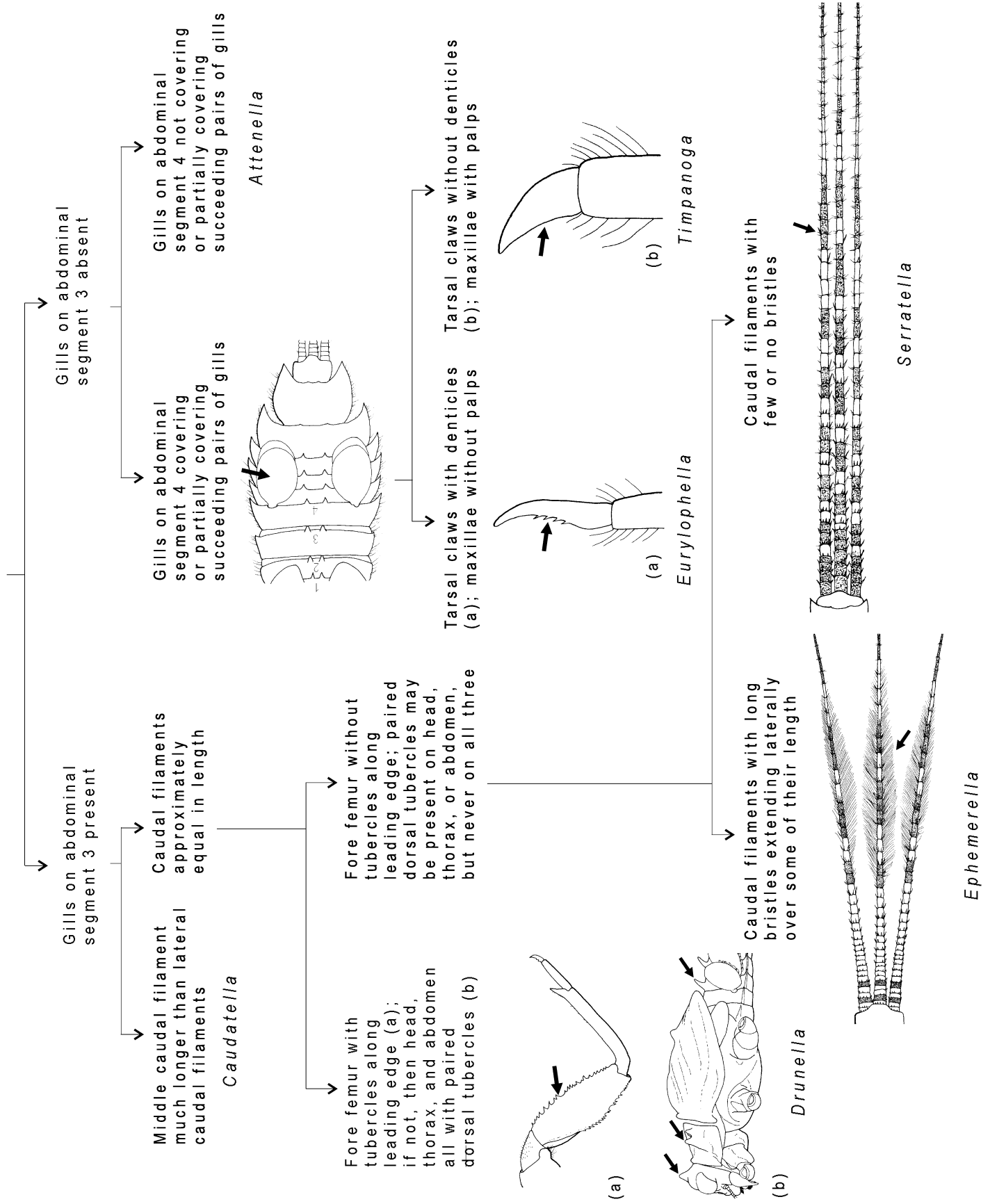
Family Ameletidae
(*Ameletus*)

Family Siphonuridae
(see Family Key page 21)

Family Baetidae

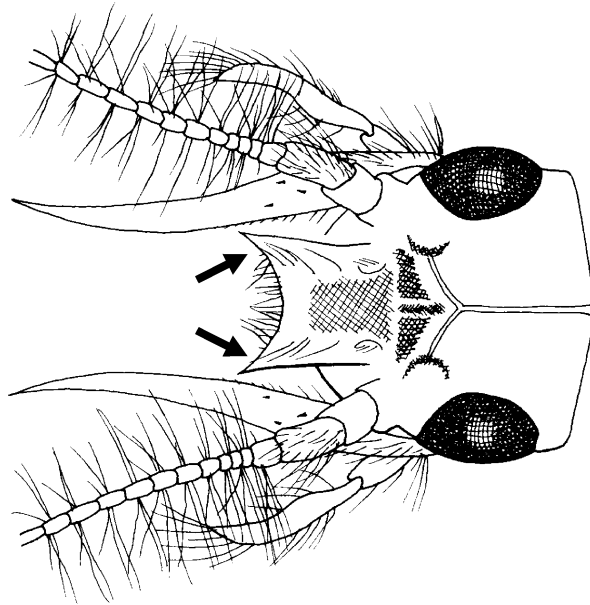


Family Ephemereidae



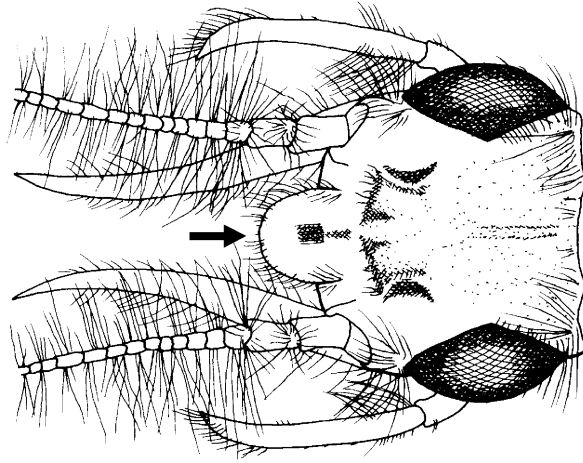
Family Ephemeridae

Head with a bifid frontal process



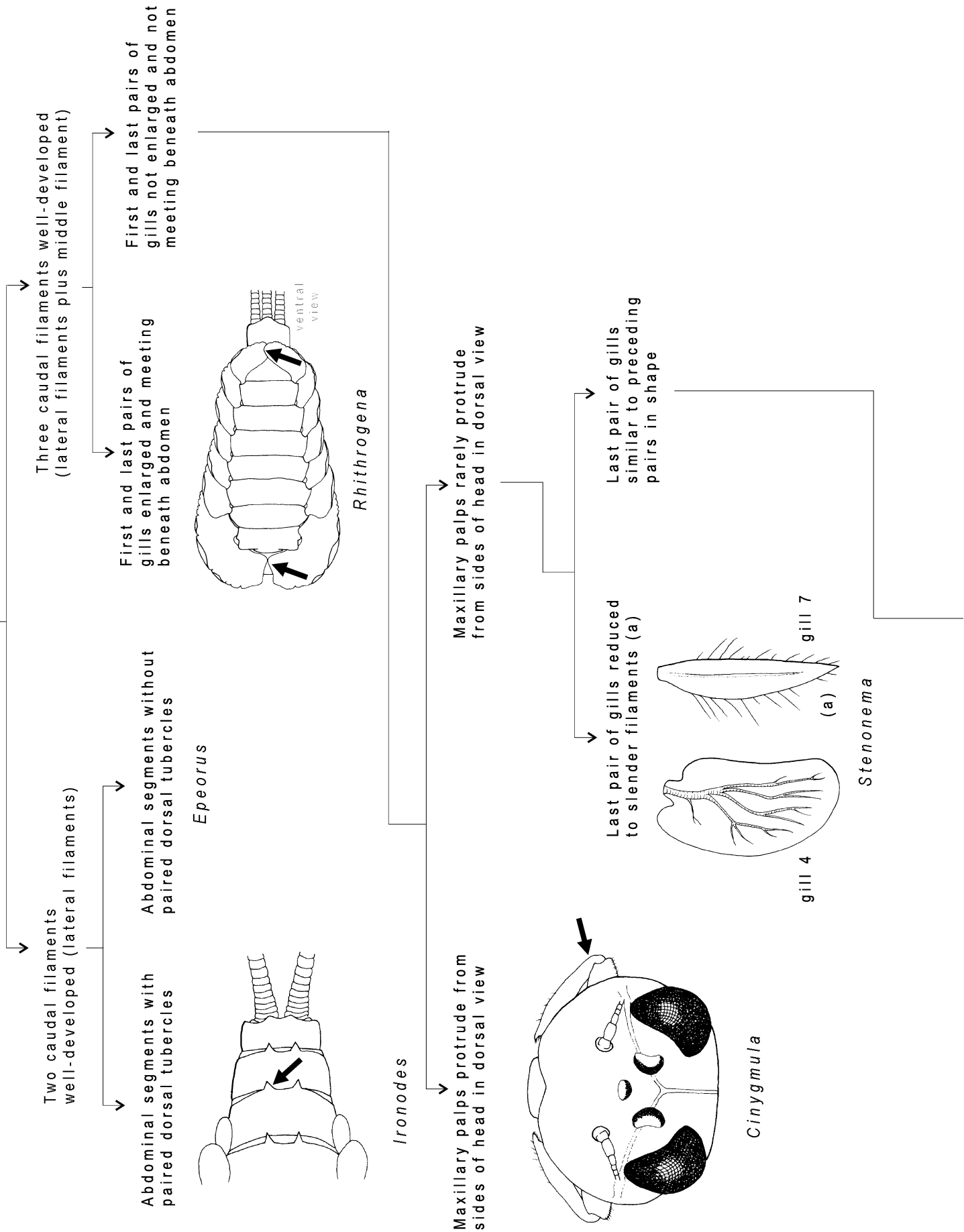
Ephemera

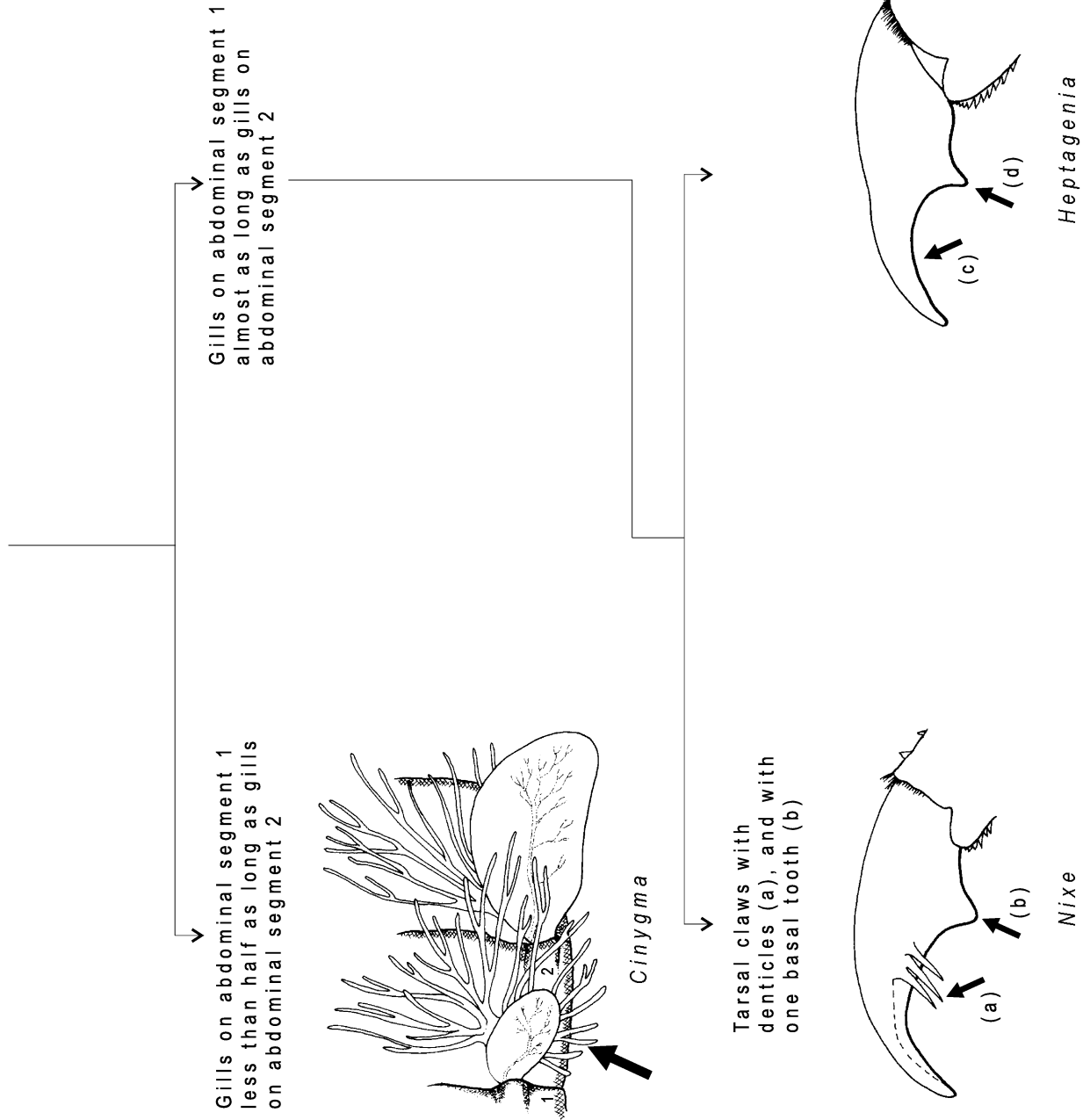
Head with a rounded frontal process



Hexagenia

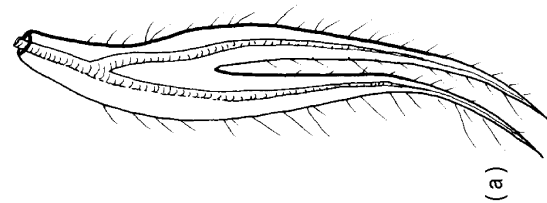
Family Heptageniidae





Family Leptophlebiidae

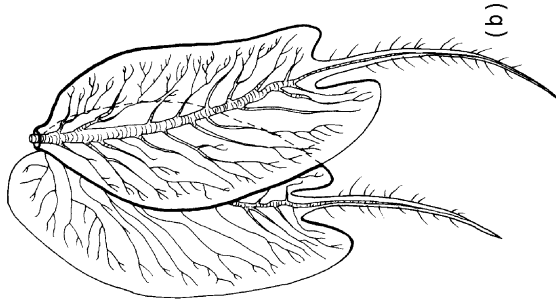
Gills on abdominal segment 1 much narrower (a) than gills on abdominal segments 2-7 (b)



(a)

gill 1

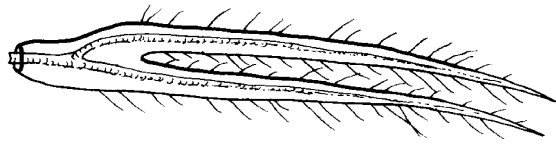
Leptophlebia



(b)

gill 4

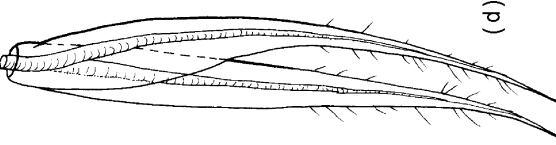
Gills on abdominal segment 1 not much narrower (c) than gills on abdominal segments 2-7 (d)



(c)

gill 1

Paraleptophlebia

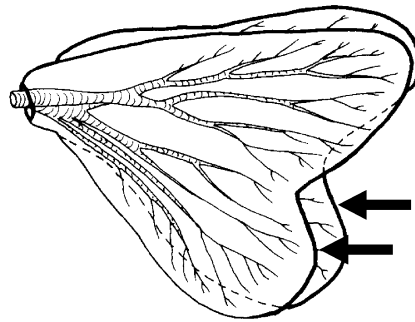


(d)

gill 4

Family Siphonuridae

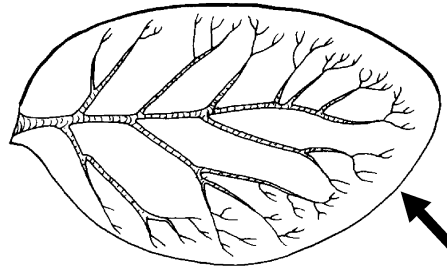
Gills on abdominal segments
1 and 2 with double lamellae



gill 2

Siphonurus

Gills on abdominal segments
1 and 2 with single lamellae



gill 2

Parameletus

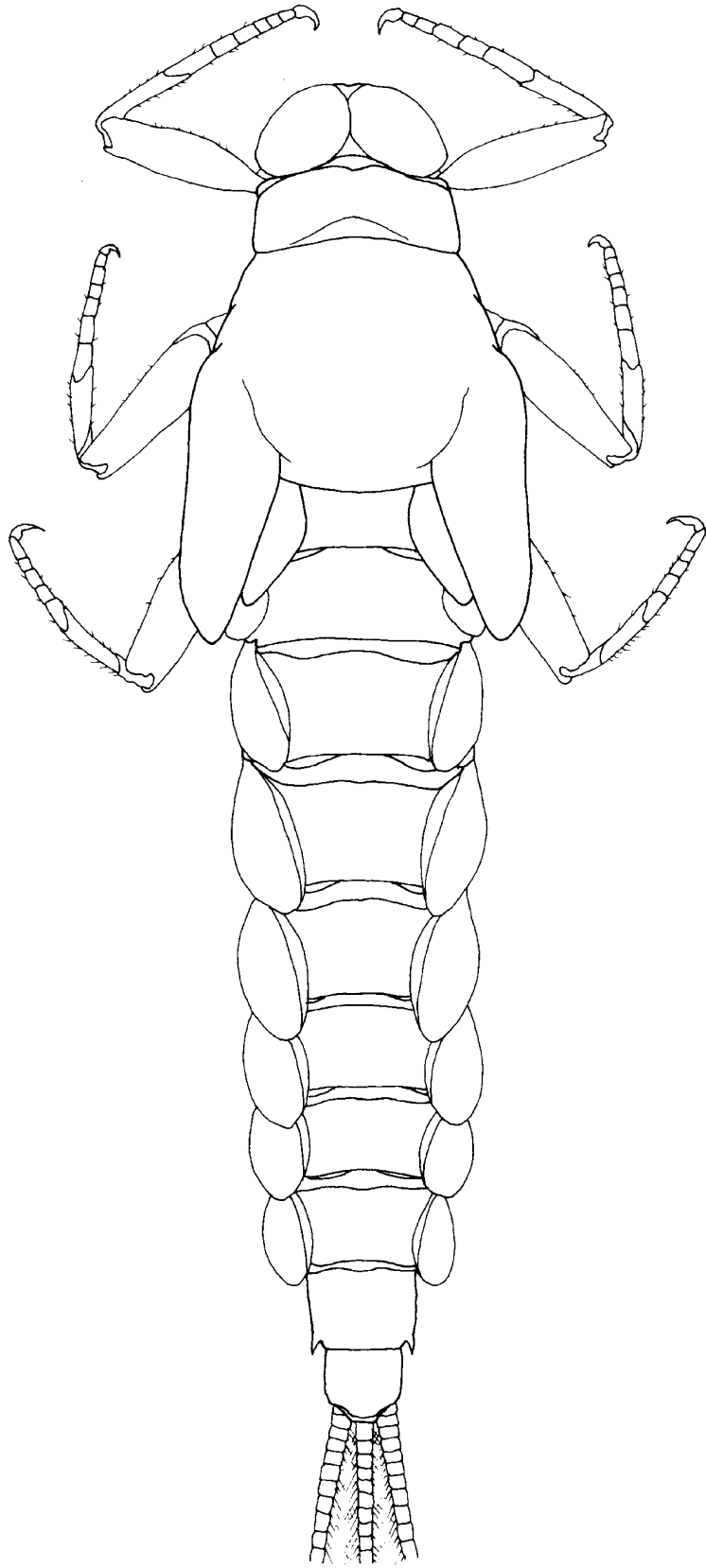


Figure 6. Family Ameletidae - *Ameletus* sp. nymph

FAMILY AMELETIDAE	
TAXONOMIC CHARACTERS	Labrum without a distinct notch in the midline; mandibles rarely with tusks; maxilla with a fringed bottom edge; tarsal claws on all legs similar in structure; gills on abdominal segment 2 present; abdominal gills not forked; each gill with a sclerotized band along its outer edge; paired dorsal tubercles on abdominal segments rarely present; head and body not distinctly flattened dorso-ventrally
DISTRIBUTION IN NORTH AMERICA	In the west from southern California to northern Alaska, Yukon, and the NWT; in the east from South Carolina to Quebec; absent in the central part of the continent from the Gulf of Mexico through the Great Plains to Hudson Bay
TOTAL NUMBER OF GENERA IN N.A.	1
TOTAL NUMBER OF GENERA IN B.C.	1
TOTAL NUMBER OF SPECIES IN N.A.	32
TOTAL NUMBER OF SPECIES IN B.C.	12

GENUS <i>AMELETUS</i>	
TAXONOMIC CHARACTERS	Tarsal claws without denticles; gills on all abdominal segments single and oval; gills on abdominal segment 1 half as small as gills on abdominal segments 3-5; caudal filaments much shorter than abdomen, and with dark bands and intersegmental bristles along their entire length
HABITAT	Among pebbles, vegetation, or debris of small, fast-flowing streams in mountainous areas
HABIT	Swimming or clinging
FEEDING METHOD	Collecting-gathering or scraping
COMMENTS	Extremely strong swimmers; some species can be found occupying tiny rivulets
SPECIES RECORDED IN B.C. TO DATE	<i>celer</i> , <i>cooki</i> , <i>oregonensis</i> , <i>pritchardi</i> , <i>shepherdi</i> , <i>similior</i> , <i>sparsatus</i> *, <i>suffusus</i> , <i>validus</i> , <i>vancouverensis</i> , <i>velox</i> , <i>vernalis</i>

* A potentially rare and endangered species, known at present only from the South Okanagan (Scudder 1994).

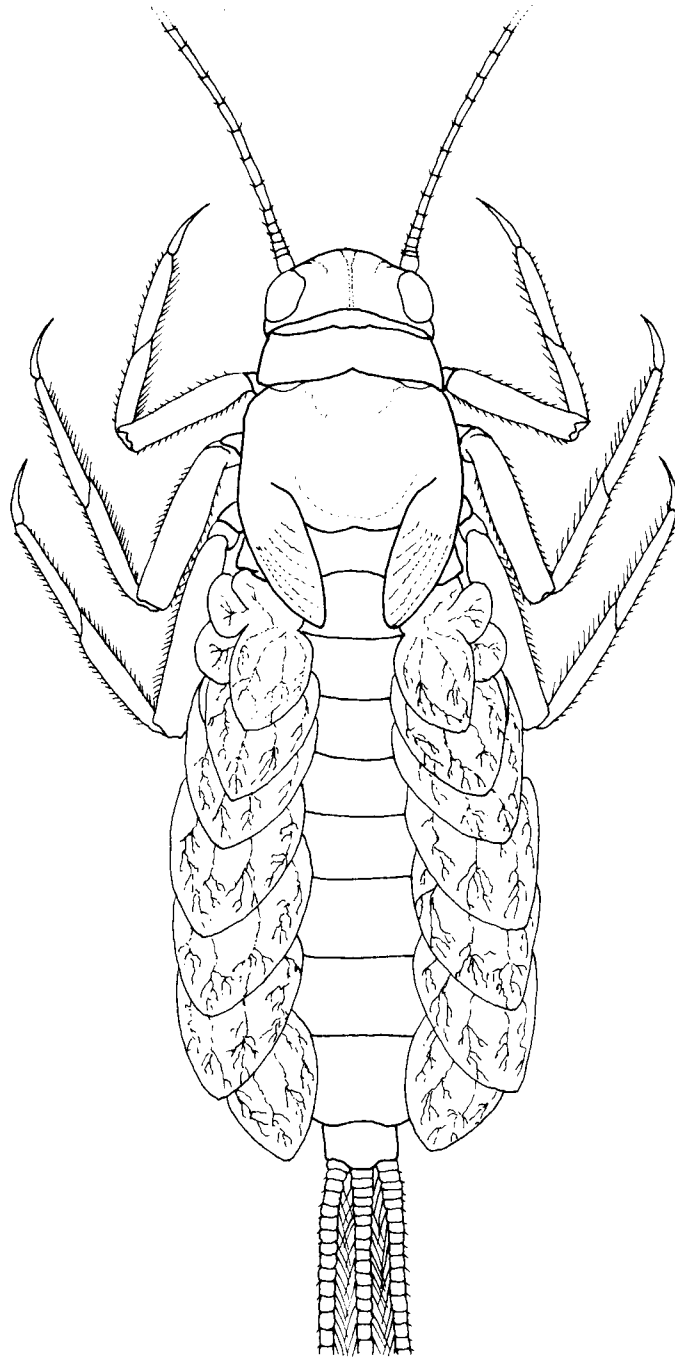


Figure 7. Family Baetidae - *Callibaetis* sp. nymph

FAMILY BAETIDAE	
TAXONOMIC CHARACTERS	Labrum with a distinct notch in the midline; mandibles rarely with tusks; tarsal claws on all legs similar in structure; gills on abdominal segment 2 present; abdominal gills not forked, may be doubled, but never ending in a slender process; paired dorsal tubercles on abdominal segments rarely present; head and body not distinctly flattened dorso-ventrally
DISTRIBUTION IN NORTH AMERICA	Widespread
TOTAL NUMBER OF GENERA IN N.A.	18
TOTAL NUMBER OF GENERA IN B.C.	6
TOTAL NUMBER OF SPECIES IN N.A.	130
TOTAL NUMBER OF SPECIES IN B.C.	14

GENUS <i>ACENTRELLA</i>	
TAXONOMIC CHARACTERS	Prothorax with oblique stripes; villopore present; femurs, tibiae, and tarsi edged with a long row of hairs; abdominal segments with paired dorsal spots; gills on all abdominal segments simple; caudal filaments without dark bands every 3rd, 4th, or 5th segment; middle caudal filament less than five segments long; body dorso-ventrally flattened
HABITAT	Among deep riffles and rapids of fast-flowing waters with rocky bottoms
HABIT	Swimming or clinging
FEEDING METHOD	Collecting-gathering
COMMENTS	All species formerly in <i>Pseudocloeon</i> or <i>Baetis</i>
SPECIES RECORDED IN B.C. TO DATE	<i>insignificans</i> , <i>turbida</i>

GENUS <i>BAETIS</i>	
TAXONOMIC CHARACTERS	Villopore present; tibiae and tarsi not edged with a long row of hairs, although femurs may have one; gills on all abdominal segments simple; caudal filaments without dark bands every 3rd, 4th, or 5th segment; body cylindrical
HABITAT	Among vegetation or in riffles of shallow, flowing waters; along shorelines of lakes
HABIT	Swimming, climbing, or clinging
FEEDING METHOD	Collecting-gathering or scraping
COMMENTS	Some species an important component of stream drift
SPECIES RECORDED IN B.C. TO DATE	<i>bicaudatus</i> , <i>moffati</i> , <i>parallelus</i> *, <i>persecutus</i> , <i>tricaudatus</i>

* A potentially rare and endangered species, known at present only from the South Okanagan (Scudder 1994).

GENUS <i>CALLIBAETIS</i>	
TAXONOMIC CHARACTERS	Hind wing pads present in mature nymphs; tarsal claws with a double row of tiny denticles; gills on one or more abdominal segments with large flaps; caudal filaments without dark bands every 3rd, 4th, or 5th segment
HABITAT	Among vegetation or on the bottom of still waters
HABIT	Swimming or clinging
FEEDING METHOD	Collecting-gathering
COMMENTS	Tolerant of a wide range of water temperatures and acidities
SPECIES RECORDED IN B.C. TO DATE	<i>americanus</i>

GENUS <i>CENTROPTILUM</i>	
TAXONOMIC CHARACTERS	Tarsal claws shorter than length of tarsi; gills on all abdominal segments simple; caudal filaments with dark bands every 3rd, 4th, or 5th segment; apices of caudal filaments without lateral bristles
HABITAT	On sandy bottoms of slow or quiet waters
HABIT	Swimming or clinging
FEEDING METHOD	Collecting-gathering or scraping
COMMENTS	Many species now placed in <i>Procloeon</i>
SPECIES RECORDED IN B.C. TO DATE	<i>bifurcatum</i>

GENUS <i>DIPHETOR</i>	
TAXONOMIC CHARACTERS	Villopore absent; gills absent from abdominal segment 1; gills on abdominal segments 2-7 simple; caudal filaments without dark bands every 3rd, 4th, or 5th segment
HABITAT	Among vegetation of shallow, flowing waters
HABIT	Swimming or clinging
FEEDING METHOD	Unknown
COMMENTS	One species, <i>D. hageni</i> , is obligately parthenogenetic
SPECIES RECORDED IN B.C. TO DATE	<i>hageni</i>

GENUS <i>PROCLOEON</i>	
TAXONOMIC CHARACTERS	Tarsal claws shorter than length of tarsi; gills on all abdominal segments simple, although gills on abdominal segment 1 may have a dorsal flap; caudal filaments with dark bands every 3rd, 4th, or 5th segment; apices of caudal filaments with lateral bristles
HABITAT	Among vegetation of slow-flowing streams, lakes, or ponds
HABIT	Swimming or clinging
FEEDING METHOD	Collecting-gathering or scraping
COMMENTS	Many species formerly placed in <i>Cloeon</i> or <i>Centroptilum</i>
SPECIES RECORDED IN B.C. TO DATE	<i>album, bellum, conturbatum, implicatum</i>

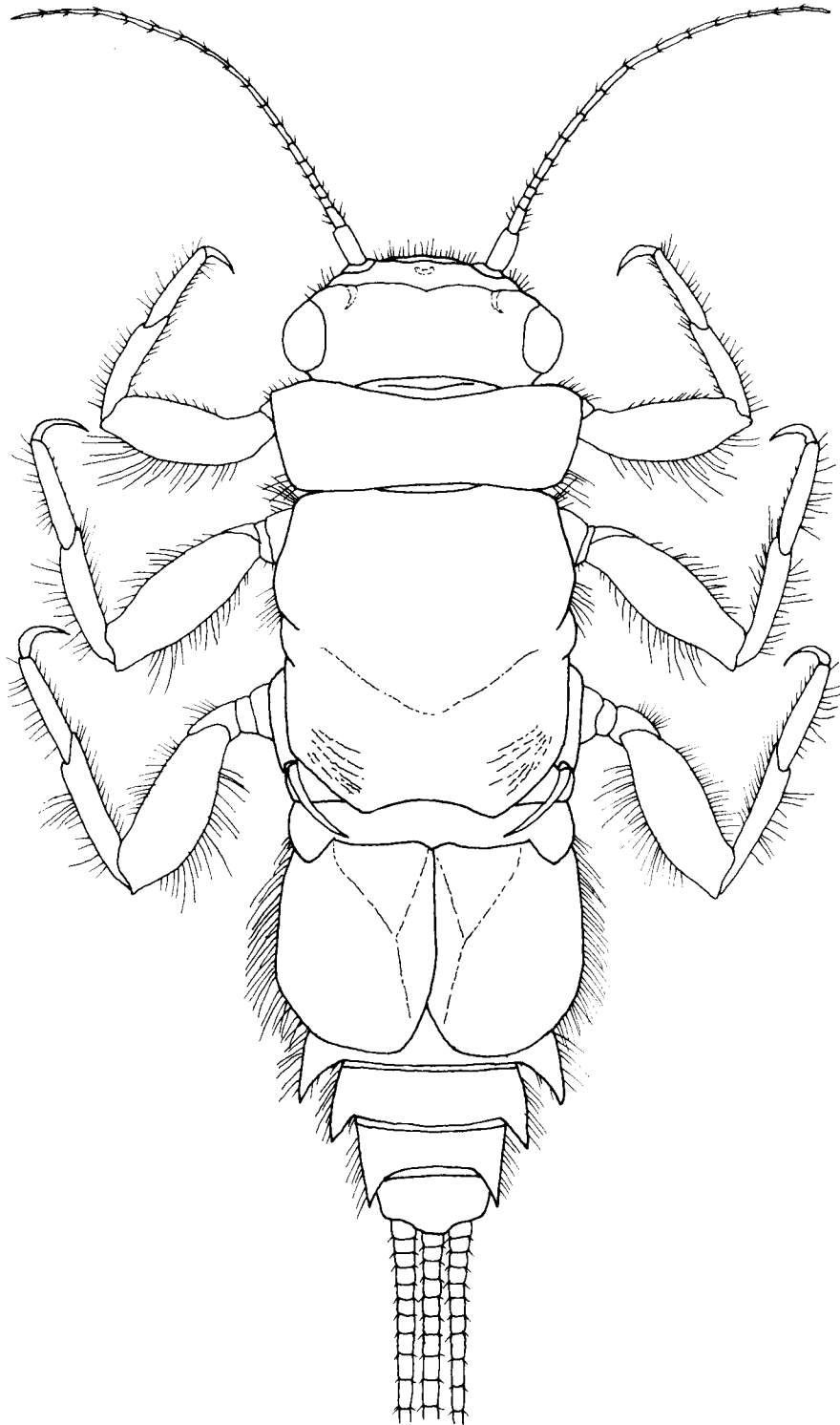


Figure 8. Family Caenidae - *Caenis* sp. nymph

FAMILY CAENIDAE	
TAXONOMIC CHARACTERS	Mandibles rarely with tusks; hind wing pads absent in mature nymphs; gills on abdominal segment 2 covering or partially covering succeeding pairs of gills and meeting or almost meeting in the midline, but never fused; gills on abdominal segments 3-6 with fringed edges
DISTRIBUTION IN NORTH AMERICA	Widespread
TOTAL NUMBER OF GENERA IN N.A.	4
TOTAL NUMBER OF GENERA IN B.C.	1
TOTAL NUMBER OF SPECIES IN N.A.	26
TOTAL NUMBER OF SPECIES IN B.C.	1

GENUS <i>CAENIS</i>	
TAXONOMIC CHARACTERS	Labial palps and maxillary palps three-segmented; fore tibia and tarsus edged with a row of spines; gills on abdominal segment 2 with fringed edges; middle abdominal segments with prominent posterolateral projections
HABITAT	Among debris or vegetation of slow-moving or stagnant waters
HABIT	Sprawling or climbing
FEEDING METHOD	Collecting-gathering or scraping
COMMENTS	Some species pollution-tolerant; some species positively phototactic
SPECIES RECORDED IN B.C. TO DATE	<i>simulans</i>

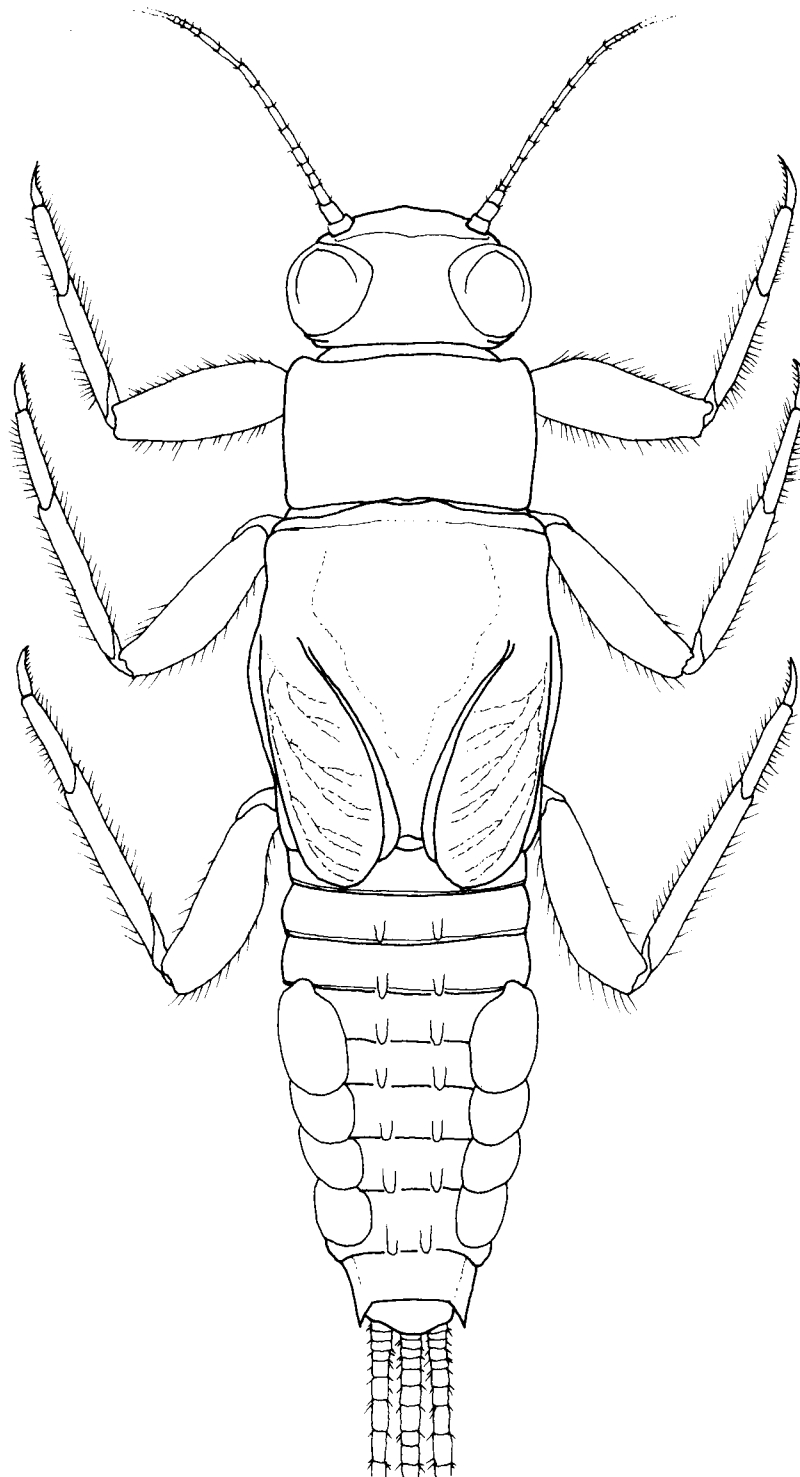


Figure 9. Family Ephemerellidae - *Serratella* sp. nymph

FAMILY EPHEMERELLIDAE	
TAXONOMIC CHARACTERS	Mandibles rarely with tusks; gills on abdominal segment 1 rudimentary or absent; gills on abdominal segment 2 absent; gills on abdominal segment 3 present or absent; abdominal gills with double lamellae; paired dorsal tubercles on abdominal segments often present
DISTRIBUTION IN NORTH AMERICA	Widespread
TOTAL NUMBER OF GENERA IN N.A.	8
TOTAL NUMBER OF GENERA IN B.C.	7
TOTAL NUMBER OF SPECIES IN N.A.	90
TOTAL NUMBER OF SPECIES IN B.C.	18

GENUS <i>ATTENELLA</i>	
TAXONOMIC CHARACTERS	Tarsal claws with denticles; gills on abdominal segment 3 absent; gills on abdominal segment 4 not covering or partially covering succeeding pairs of gills; paired dorsal tubercles on abdominal segments present
HABITAT	Among vegetation or on the bottoms of streams and rivers
HABIT	Clinging
FEEDING METHOD	Collecting-gathering
COMMENTS	Disjunct populations in both western and eastern North America
SPECIES RECORDED IN B.C. TO DATE	<i>margarita</i>

GENUS CAUDATELLA	
TAXONOMIC CHARACTERS	Gills on abdominal segment 3 present; paired dorsal tubercles on abdominal segments present; middle caudal filament much longer than lateral caudal filaments
HABITAT	In rock crevices of mountain streams
HABIT	Clinging
FEEDING METHOD	Collecting-gathering or scraping
COMMENTS	Most species have a narrow range of environmental tolerances
SPECIES RECORDED IN B.C. TO DATE	<i>heterocaudata heterocaudata, hystrix, jacobi</i>

GENUS <i>DRUNELLA</i>	
TAXONOMIC CHARACTERS	Fore femur with tubercles along leading edge; if not, then head, thorax, and abdomen all with paired dorsal tubercles, or ventral surface of abdomen modified into a disc of long hairs for attachment to the substratum; gills on abdominal segment 3 present; caudal filaments approximately equal in length
HABITAT	Attached to rocks or other substrates of rivers
HABIT	Clinging or sprawling
FEEDING METHOD	Scraping or predation
COMMENTS	The only predaceous Ephemerellidae are in this genus
SPECIES RECORDED IN B.C. TO DATE	<i>coloradensis</i> , <i>doddsi</i> , <i>flavilinea</i> , <i>grandis flavitincta</i> , <i>grandis ingens</i> , <i>pelosa</i> , <i>spinifera</i>

GENUS <i>EPHEMERELLA</i>	
TAXONOMIC CHARACTERS	Maxillary palps well-developed; fore femur without tubercles along leading edge; paired dorsal tubercles may be present on head, thorax, or abdomen, but never on all three; gills on abdominal segment 3 present; caudal filaments approximately equal in length; caudal filaments with long bristles extending laterally over some of their length
HABITAT	Attached to rocks or vegetation of streams and rivers
HABIT	Clinging or swimming
FEEDING METHOD	Collecting-gathering or scraping
COMMENTS	Swim awkwardly, using lateral undulations of the body
SPECIES RECORDED IN B.C. TO DATE	<i>aurivillii</i> , <i>inermis</i> , <i>infrequens</i>

GENUS <i>EURYLOPHELLA</i>	
TAXONOMIC CHARACTERS	Maxillae without palps; tarsal claws with denticles; gills on abdominal segment 3 absent; gills on abdominal segment 4 covering or partially covering succeeding pairs of gills; dorsal tubercles on abdominal segments present
HABITAT	Attached to rocks or vegetation of flowing or standing waters
HABIT	Clinging or sprawling
FEEDING METHOD	Collecting-gathering
COMMENTS	Disjunct populations in both western and eastern North America
SPECIES RECORDED IN B.C. TO DATE	<i>lodi</i>

GENUS <i>SERRATELLA</i>	
TAXONOMIC CHARACTERS	Maxillary palps reduced or absent; fore femur without tubercles along leading edge; paired dorsal tubercles may be present on head, thorax, or abdomen, but never on all three; gills on abdominal segment 3 present; caudal filaments approximately equal in length; caudal filaments with few or no bristles intersegmentally, but with whorls of spines at each segmental division
HABITAT	Attached to rocks, vegetation, or substrates of streams and rivers
HABIT	Clinging
FEEDING METHOD	Collecting-gathering
COMMENTS	One species, <i>S. tibialis</i> , with mating swarms up to fifty feet off the ground
SPECIES RECORDED IN B.C. TO DATE	<i>teresa</i> , <i>tibialis</i>

GENUS <i>TIMPANOGA</i>	
TAXONOMIC CHARACTERS	Maxillae with palps; tarsal claws without denticles; gills on abdominal segment 3 absent; gills on abdominal segment 4 covering or partially covering succeeding pairs of gills; abdominal segments with prominent posterolateral projections; head and body flattened dorso-ventrally
HABITAT	Attached to rocks of large, fast-flowing mountain streams
HABIT	Clinging or sprawling
FEEDING METHOD	Collecting-gathering
COMMENTS	Disjunct populations in both western and eastern North America
SPECIES RECORDED IN B.C. TO DATE	<i>hecuba hecuba</i>

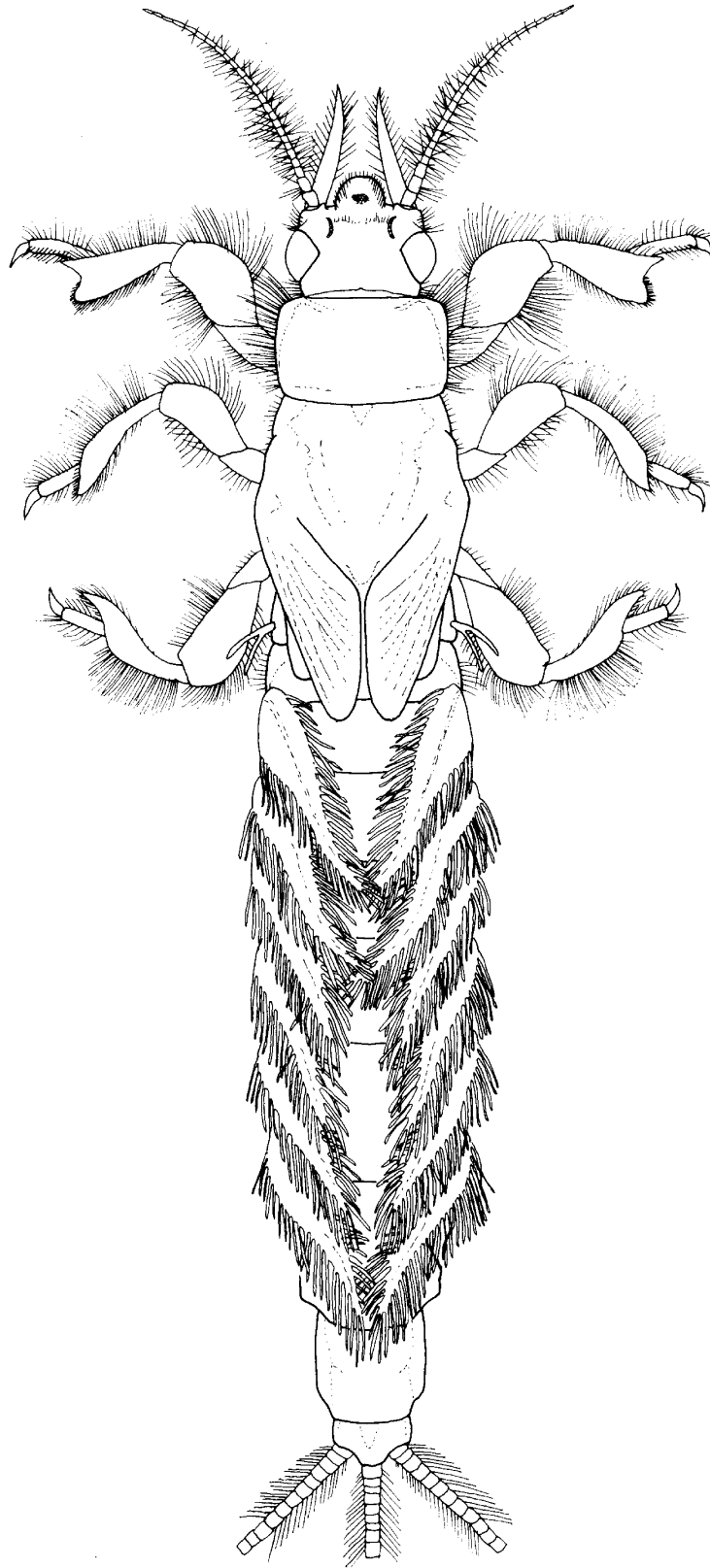


Figure 10. Family Ephemeridae - *Hexagenia limbata* nymph

FAMILY EPHEMERIDAE	
TAXONOMIC CHARACTERS	Mandibles with large tusks projected anteriorly and visible in dorsal view; apex of hind tibia pointed; gills on abdominal segments 2-7 forked and with fringed edges
DISTRIBUTION IN NORTH AMERICA	Widespread
TOTAL NUMBER OF GENERA IN N.A.	4
TOTAL NUMBER OF GENERA IN B.C.	2
TOTAL NUMBER OF SPECIES IN N.A.	15
TOTAL NUMBER OF SPECIES IN B.C.	2

GENUS <i>EPHEMERA</i>	
TAXONOMIC CHARACTERS	Head with a bifid frontal process; mandibular tusks with hairs and spines near base; antennae with whorls of long hairs along most of their length
HABITAT	Hard, large-particle substrates of streams and lakes
HABIT	Burrowing
FEEDING METHOD	Collecting-gathering, filtering, or predation
COMMENTS	Negatively phototactic
SPECIES RECORDED IN B.C. TO DATE	<i>simulans</i>

GENUS <i>HEXAGENIA</i>	
TAXONOMIC CHARACTERS	Head with a rounded frontal process; mandibular tusks with hairs along their entire length; antennae with whorls of long hairs along most of their length; gills on abdominal segment 1 very small
HABITAT	Soft, fine-particle substrates of streams and lakes
HABIT	Burrowing
FEEDING METHOD	Collecting-gathering or filtering
COMMENTS	Live in U-shaped burrows; negatively phototactic and positively geotropic
SPECIES RECORDED IN B.C. TO DATE	<i>limbata</i>

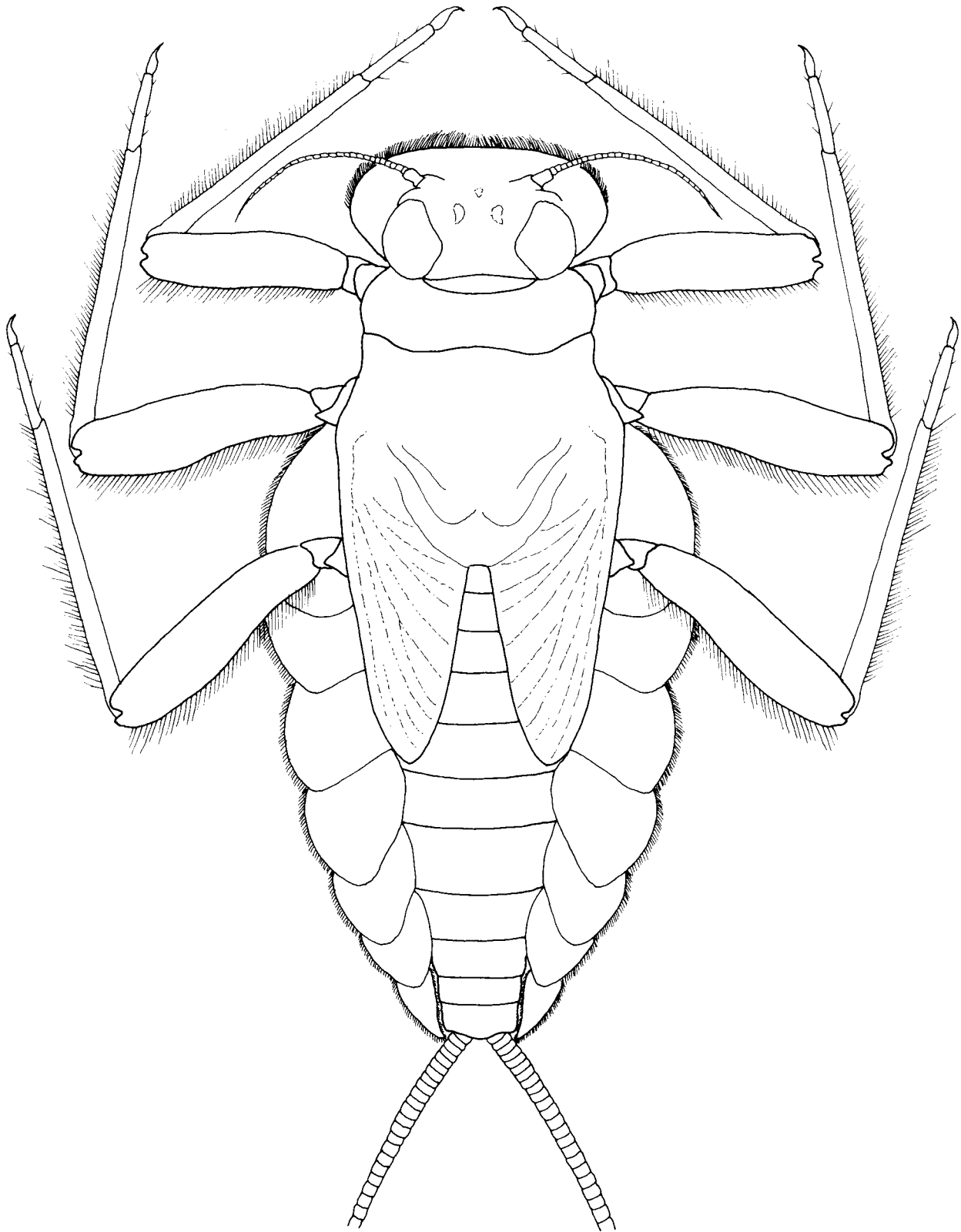


Figure 11. Family Heptageniidae - *Epeorus longimanus* nymph

FAMILY HEPTAGENIIDAE	
TAXONOMIC CHARACTERS	Mandibles rarely with tusks; tarsal claws much shorter than length of tarsi; gills on abdominal segment 2 present; abdominal gills with single lamellae; paired dorsal tubercles on abdominal segments rarely present; head and body distinctly flattened dorso-ventrally
DISTRIBUTION IN NORTH AMERICA	Widespread
TOTAL NUMBER OF GENERA IN N.A.	14
TOTAL NUMBER OF GENERA IN B.C.	8
TOTAL NUMBER OF SPECIES IN N.A.	126
TOTAL NUMBER OF SPECIES IN B.C.	23

GENUS <i>CINYGMA</i>	
TAXONOMIC CHARACTERS	Maxillary palps rarely protrude from sides of head in dorsal view; labrum narrowing from base to outer edge; first and last pairs of gills not enlarged and not meeting beneath abdomen; gills on abdominal segment 1 less than half as long as gills on abdominal segment 2; last pair of gills similar to preceding pairs in shape; three caudal filaments well-developed (lateral filaments plus middle filament)
HABITAT	Attached to wood debris in fast-flowing waters of low-elevation coastal streams
HABIT	Clinging
FEEDING METHOD	Scraping or collecting-gathering
COMMENTS	Found only in western North America
SPECIES RECORDED IN B.C. TO DATE	<i>integrum</i>

GENUS <i>CINYGMULA</i>	
TAXONOMIC CHARACTERS	Maxillary palps protrude from sides of head in dorsal view; front margin of head with a distinct notch in the midline; first and last pairs of gills not enlarged and not meeting beneath abdomen; three caudal filaments well-developed (lateral filaments plus middle filament)
HABITAT	Attached to the undersides of stones in mountain streams
HABIT	Clinging
FEEDING METHOD	Scraping or collecting-gathering
COMMENTS	Some species live at the bases of waterfalls
SPECIES RECORDED IN B.C. TO DATE	<i>gartrelli</i> , <i>kootenai</i> , <i>mimus</i> , <i>par</i> , <i>ramaleyi</i> , <i>uniformis</i>

GENUS <i>EPEORUS</i>	
TAXONOMIC CHARACTERS	Abdominal gills flat and plate-like, some with gills forming a ventral disc for attachment to the substratum; abdominal segments without paired dorsal tubercles; two caudal filaments well-developed (lateral filaments)
HABITAT	Attached to solid objects in shallow, fast-flowing mountain streams
HABIT	Clinging
FEEDING METHOD	Collecting-gathering or scraping
COMMENTS	Two subgenera in North America: <i>Epeorus (Iron)</i> with pale gills and <i>Epeorus (Ironopsis)</i> with dark gills
SPECIES RECORDED IN B.C. TO DATE	<i>albertae</i> , <i>deceptivus</i> , <i>dulciana</i> , <i>grandis</i> , <i>longimanus</i> , <i>nitidus</i> , <i>permangus</i>

GENUS <i>HEPTAGENIA</i>	
TAXONOMIC CHARACTERS	Maxillary palps rarely protrude from sides of head in dorsal view; labrum the same width from base to outer edge; tarsal claws without denticles, but with one basal tooth; first and last pairs of gills not enlarged and not meeting beneath abdomen; gills on abdominal segment 1 almost as long as gills on abdominal segment 2; last pair of gills similar to preceding pairs in shape; three caudal filaments well-developed (lateral filaments plus middle filament)
HABITAT	Attached to the undersides of stones or debris in fast-flowing rivers and streams
HABIT	Clinging or swimming
FEEDING METHOD	Scraping or collecting-gathering
COMMENTS	Active, agile mayflies
SPECIES RECORDED IN B.C. TO DATE	<i>elegantula</i> *, <i>solitaria</i>

* A potentially rare and endangered species, known at present only from the South Okanagan (Scudder 1994).

GENUS <i>IRONODES</i>	
TAXONOMIC CHARACTERS	Tarsal claws with three or more denticles near their tips, but no teeth; abdominal segments with paired dorsal tubercles; two caudal filaments well-developed (lateral filaments)
HABITAT	Attached to the undersides of rocks or debris in fast-flowing waters
HABIT	Clinging
FEEDING METHOD	Scraping or collecting-gathering
COMMENTS	Found only in western North America; uncommon
SPECIES RECORDED IN B.C. TO DATE	<i>flavipennis</i>

GENUS <i>NIXE</i>	
TAXONOMIC CHARACTERS	Maxillary palps rarely protrude from sides of head in dorsal view; head narrower than pronotum; tarsal claws with denticles, and with one basal tooth; first and last pairs of gills not enlarged and not meeting beneath abdomen; gills on abdominal segment 1 almost as long as gills on abdominal segment 2; last pair of gills similar to preceding pairs in shape; three caudal filaments well-developed (lateral filaments plus middle filament)
HABITAT	Attached to rocks or vegetation in streams and rivers
HABIT	Clinging
FEEDING METHOD	Scraping or collecting-gathering
COMMENTS	All species formerly placed in <i>Heptagenia</i>
SPECIES RECORDED IN B.C. TO DATE	<i>(Akkarion) simplicioides</i>

GENUS <i>RHITHROGENA</i>	
TAXONOMIC CHARACTERS	Front margin of head with a distinct notch in the midline; first and last pairs of gills enlarged and meeting beneath abdomen; three caudal filaments well-developed (lateral filaments plus middle filament)
HABITAT	Attached to stones in fast-flowing waters
HABIT	Clinging
FEEDING METHOD	Collecting-gathering or scraping
COMMENTS	Difficult to remove from surfaces to which they cling
SPECIES RECORDED IN B.C. TO DATE	<i>hageni, morrisoni, robusta, virilis</i>

GENUS <i>STENONEMA</i>	
TAXONOMIC CHARACTERS	Maxillary palps rarely protrude from sides of head in dorsal view; first and last pairs of gills not enlarged and not meeting beneath abdomen; last pair of gills reduced to slender filaments; abdominal segments with prominent posterolateral projections; three caudal filaments well-developed (lateral filaments plus middle filament)
HABITAT	Attached to rocks or vegetation in slow- to medium-flowing sandy rivers and streams
HABIT	Clinging
FEEDING METHOD	Scraping or collecting-gathering
COMMENTS	<i>S. terminatum</i> is the only western species within this genus
SPECIES RECORDED IN B.C. TO DATE	<i>terminatum</i>

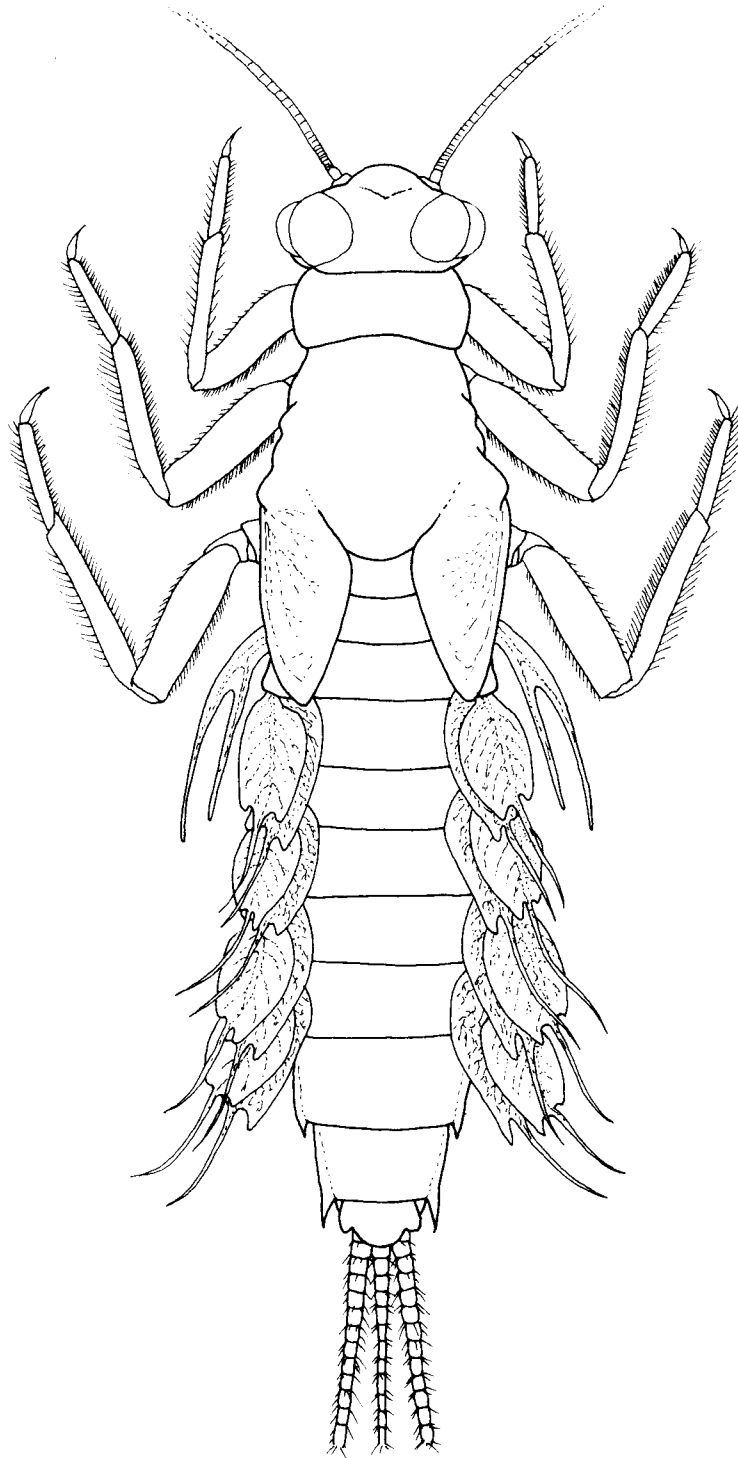


Figure 12. Family Leptophlebiidae - *Leptophlebia cupida* nymph

FAMILY LEPTOPHLEBIIDAE	
TAXONOMIC CHARACTERS	Mandibles rarely with tusks (exception: some <i>Paraleptophlebia</i> spp.); maxilla with a fringed bottom edge; tarsal claws on all legs similar in structure; gills on abdominal segment 2 present; gills on abdominal segments 2-7 forked or doubled and ending in a slender process; paired dorsal tubercles on abdominal segments rarely present; head and body not distinctly flattened dorso-ventrally
DISTRIBUTION IN NORTH AMERICA	Widespread
TOTAL NUMBER OF GENERA IN N.A.	9
TOTAL NUMBER OF GENERA IN B.C.	2
TOTAL NUMBER OF SPECIES IN N.A.	72
TOTAL NUMBER OF SPECIES IN B.C.	11

GENUS <i>LEPTOPHLEBIA</i>	
TAXONOMIC CHARACTERS	Tarsal claws with ventral denticles; gills on abdominal segment 1 forked, and much narrower than gills on abdominal segments 2-7, which are doubled and ending in a slender process
HABITAT	Quiet areas of lakes, ponds, or streams
HABIT	Swimming, clinging, or sprawling
FEEDING METHOD	Collecting-gathering
COMMENTS	Large surface area of gills an adaptation for low oxygen waters
SPECIES RECORDED IN B.C. TO DATE	<i>cupida</i> , <i>gravastella</i> *, <i>nebulosa</i>

* A potentially rare and endangered species, known at present only from the South Okanagan (Scudder 1994).

GENUS <i>PARALEPTOPHLEBIA</i>	
TAXONOMIC CHARACTERS	Tarsal claws with fine denticles; gills on abdominal segment 1 forked, but not much narrower than gills on abdominal segments 2-7, which are also forked; abdominal segments with rows of small spines along their posterior margins
HABITAT	Among gravel or vegetation of fast-flowing streams and rivers
HABIT	Swimming, clinging, or sprawling
FEEDING METHOD	Collecting-gathering or shredding
COMMENTS	Some species hide in cracks and crevices on the undersides of rocks
SPECIES RECORDED IN B.C. TO DATE	<i>bicornuta</i> , <i>debilis</i> , <i>gregalis</i> , <i>heteronea</i> , <i>memorialis</i> , <i>rufivenosa</i> , <i>temporalis</i> , <i>vaciva</i>

FAMILY METRETOPODIDAE	
TAXONOMIC CHARACTERS	Mandibles rarely with tusks; foreleg tarsal claw forked, different in structure from mid- and hindleg claws; all legs with tarsi longer than tibiae; gills on abdominal segment 2 present; paired dorsal tubercles on abdominal segments rarely present; head and body not distinctly flattened dorso-ventrally
DISTRIBUTION IN NORTH AMERICA	Alaska; Canada; Central, Northeastern, and Southeastern U.S.A.
TOTAL NUMBER OF GENERA IN N.A.	2
TOTAL NUMBER OF GENERA IN B.C.	1
TOTAL NUMBER OF SPECIES IN N.A.	8
TOTAL NUMBER OF SPECIES IN B.C.	1

GENUS <i>METRETOPUS</i>	
TAXONOMIC CHARACTERS	Foreleg tarsal claws edged with spines; gills on all abdominal segments single; gills on abdominal segment 4 with several spines along outer edge
HABITAT	Among vegetation of slow-moving streams
HABIT	Swimming or clinging
FEEDING METHOD	Unknown
COMMENTS	Extremely rare
SPECIES RECORDED IN B.C. TO DATE	<i>borealis</i>

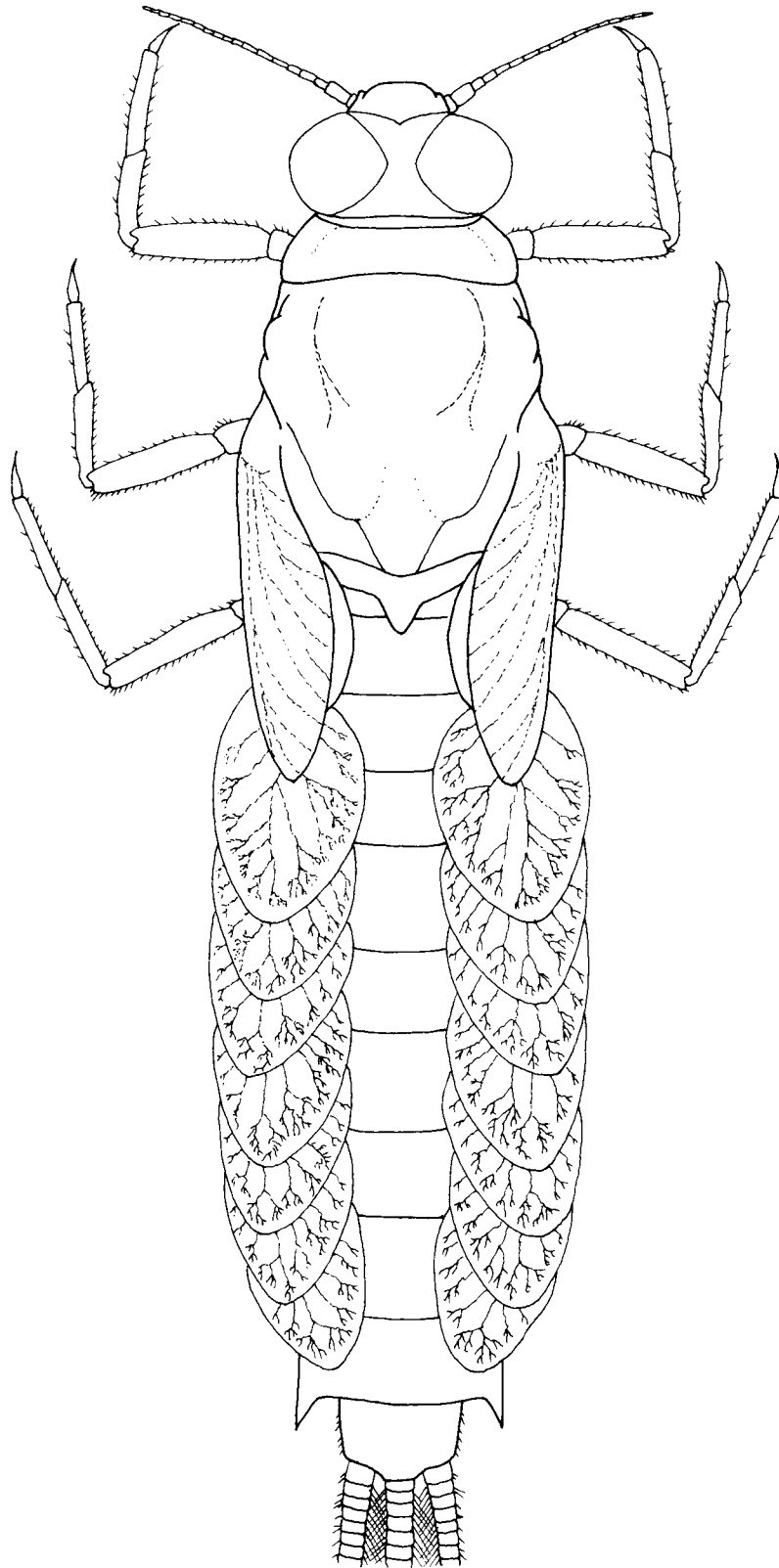


Figure 13. Family Siphonuridae - *Parametetus columbiae* nymph

FAMILY SIPHLONURIDAE	
TAXONOMIC CHARACTERS	Labrum without a distinct notch in the midline; mandibles rarely with tusks; maxilla without a fringed bottom edge; antennae short; tarsal claws on all legs similar in structure; abdominal gills not forked, may be doubled, but never ending in a slender process; gills on abdominal segment 2 present; paired dorsal tubercles on abdominal segments rarely present; head and body not distinctly flattened dorso-ventrally
DISTRIBUTION IN NORTH AMERICA	Widespread
TOTAL NUMBER OF GENERA IN N.A.	4
TOTAL NUMBER OF GENERA IN B.C.	2
TOTAL NUMBER OF SPECIES IN N.A.	25
TOTAL NUMBER OF SPECIES IN B.C.	4

GENUS <i>PARAMELETUS</i>	
TAXONOMIC CHARACTERS	Labial palps with pincer-like ends; gills on abdominal segments 1 and 2 with single lamellae; abdominal segments with prominent posterolateral projections
HABITAT	Quiet waters of swamps and forest pools
HABIT	Swimming or climbing
FEEDING METHOD	Unknown
COMMENTS	Uncommon
SPECIES RECORDED IN B.C. TO DATE	<i>columbiae</i>

GENUS <i>SIPHLONURUS</i>	
TAXONOMIC CHARACTERS	Gills on abdominal segments 1 and 2 with double lamellae; abdominal segments with prominent posterolateral projections
HABITAT	Among vegetation in quiet areas of ponds or streams
HABIT	Swimming or climbing
FEEDING METHOD	Collecting-gathering, scraping, shredding, or predation
COMMENTS	Some species can be found in small, stagnant pools
SPECIES RECORDED IN B.C. TO DATE	<i>autumnalis</i> , <i>columbianus</i> , <i>occidentalis</i>

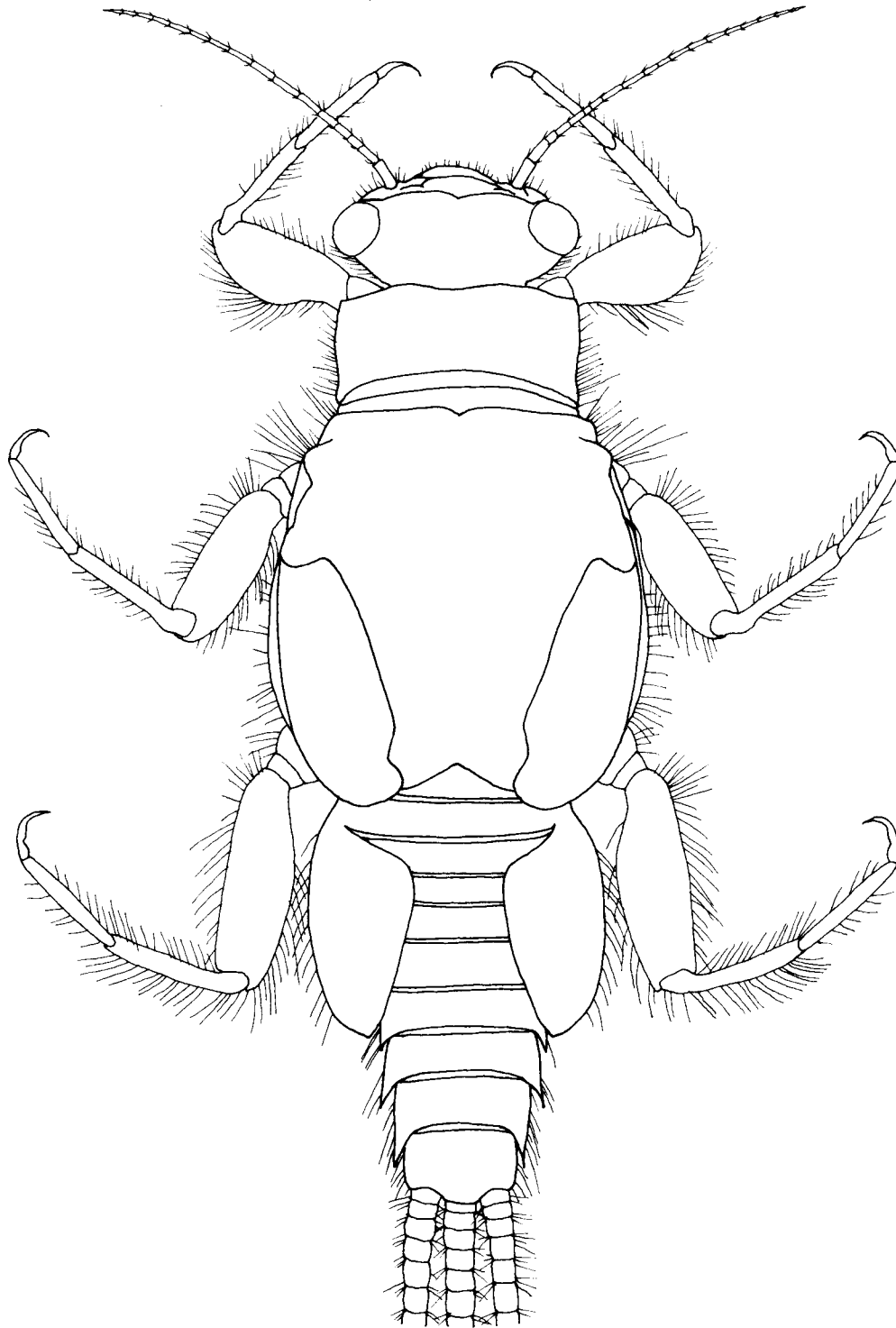


Figure 14. Family Tricorythidae - *Tricorythodes* sp. nymph

FAMILY TRICORYTHIDAE	
TAXONOMIC CHARACTERS	Mandibles rarely with tusks; gills on abdominal segment 2 covering or partially covering succeeding pairs of gills, but not meeting in the midline; gills on abdominal segments 3-6 without fringed edges and simple or bilobed
DISTRIBUTION IN NORTH AMERICA	Widespread
TOTAL NUMBER OF GENERA IN N.A.	2
TOTAL NUMBER OF GENERA IN B.C.	1
TOTAL NUMBER OF SPECIES IN N.A.	24
TOTAL NUMBER OF SPECIES IN B.C.	1

GENUS <i>TRICORYTHODES</i>	
TAXONOMIC CHARACTERS	Hind wing pads absent in mature nymphs; fore femur with a transverse band of long hairs; tarsal claws long, with hooked ends
HABITAT	Silted areas of streams and rivers
HABIT	Sprawling or clinging
FEEDING METHOD	Collecting-gathering
COMMENTS	Massive swarms common
SPECIES RECORDED IN B.C. TO DATE	<i>minutus</i>

GLOSSARY

- abdomen** - the posterior region of an insect's body
- antennae** - a pair of segmented projections from the anterior region of an insect's head; sensory function
- apex** (pl., **apices**) - any part of a structure furthest away from the body
- apical** - farthest from the body
- basal** - closest to the body
- base** - any part of a structure closest to the body
- bifid** - coming to two distinct points
- bristle** - a stiff, short, blunt hair
- carnivore** - an animal that feeds exclusively on other animals
- caudal filaments** - segmented projections from the posterior of an insect's abdomen; outer two are known as lateral caudal filaments and inner one is known as middle caudal filament; sensory function
- compound eyes** - image-forming eyes on the lateral surface of an insect's head
- coxa** (pl., **coxae**) - the first segment of an insect's leg, counting from the base out
- denticles** - small, tooth-like projections from the inner surface of an insect's tarsal claw
- disjunct** - separated
- dorsal** - the upper surface of an insect's body
- femur** - the third segment of an insect's leg, counting from the base out
- forceps** - clasping projections from the posterior of an adult male mayfly's abdomen; used for holding onto the female during mating
- forelegs** - the anterior pair of legs; projecting from an insect's prothorax
- forewing pad** - developing forewing located on a mature nymph's mesonotum
- frontal process** - an anterior projection from the anterior surface of an insect's head
- geotropic** - responding to gravity
- gills** - flattened or filamentous projections from a mayfly nymph's abdominal segments; used for respiration
- head** - the anterior region of an insect's body
- hindlegs** - the posterior pair of legs; projecting from an insect's metathorax
- hingwing pad** - developing hindwing located on a mature nymph's metanotum
- hypopharynx** - an insect's "tongue"; used for manipulating food in the mouth
- imago** - the second adult stage of a mayfly; has wings and is capable of reproduction
- instar** - any life stage between a molt; ex. nymphal instar
- labium** - the part which forms the "lower lip" of an insect's mouth; with palps for sensing and manipulating food into the mouth
- labrum** - the part which forms the "upper lip" of an insect's mouth; used to prevent food from falling out of the mouth
- lamella** (pl., **lamellae**) - each separate component of an insect's gill
- lateral** - the left and right sides of an insect's body
- mandibles** - mouthparts with a serrated edge for chewing food
- maxillae** - mouthparts with palps for sensing and manipulating food into the mouth

- mesonotum** - the dorsal surface of an insect's mesothorax
- mesothorax** - the middle segment of an insect's thorax
- metanotum** - the dorsal surface of an insect's metathorax
- metathorax** - the posterior segment of an insect's thorax
- midlegs** - the middle pair of legs; projecting from an insect's mesothorax
- molt** - the shedding of an insect's exoskeleton; allows for growth during the immature stages of an insect's life cycle
- nymph** - the immature stage of an insect; lacks functional wings and reproductive structures
- obligately parthenogenic** - reproduces by asexual means only
- oblique** - at an angle
- ocelli** - light-sensitive eyes on the dorsal surface of an insect's head, usually between the compound eyes
- omnivore** - an animal that feeds on both plant and animal material
- oviducal openings** - external openings to the paired oviducts of an adult female mayfly
- phototactic** - responding to light
- posterolateral projections** - posterior projections from the posterior sides of an insect's abdominal segments
- pronotum** - the dorsal surface of an insect's prothorax
- prothorax** - the anterior segment of an insect's thorax
- sclerotized** - thickened and hardened
- spine** - a thick, thorn-like projection
- subimago** - the first adult stage of a mayfly; has wings but is not capable of reproduction
- substrate** - the surface on which an insect lives
- substratum** (pl., **substrata**) - any object attached to or situated upon the bottom of a water body; ex. aquatic plants or rocks
- synchronously** - occurring at the same time
- tarsal claw** - a small projection from the apical end of the tarsus of an insect's leg
- tarsus** (pl., **tarsi**) - the fifth segment of an insect's leg, counting from the base out
- thorax** - the middle region of an insect's body
- tibia** (pl., **tibiae**) - the fourth segment of an insect's leg, counting from the base out
- tooth** - a short, pointed projection from an appendage
- transverse** - from side to side
- trochanter** - the second segment of an insect's leg, counting from the base out
- tubercle** - a small knob-like or rounded projection
- undulations** - wavy motions
- ventral** - the lower surface of an insect's body
- villopore** - a ventral patch of stiff hairs at the base of the femur of a mayfly's foreleg

REFERENCES

- Alba-Tercedor, J., and J. Flannagan. 1995. Two new Canadian species of the genus *Tricorythodes* Ulmer, with additional studies on other North American species (Insecta, Ephemeroptera: Leptohephyidae). *Can. J. Zool.* 73: 1588-1598.
- Allen, R.K., and G.F. Edmunds, Jr. 1959. A revision of the genus *Ephemerella* (Ephemeroptera: Ephemerellidae) I. The subgenus *Timpanoga*. *Can. Ent.* 91(1): 51-58.
- Allen, R.K., and G.F. Edmunds, Jr. 1961a. A revision of the genus *Ephemerella* (Ephemeroptera: Ephemerellidae) II. The subgenus *Caudatella*. *Ann. Ent. Soc. Am.* 54(4): 603-612.
- Allen, R.K., and G.F. Edmunds, Jr. 1961b. A revision of the genus *Ephemerella* (Ephemeroptera: Ephemerellidae) III. The subgenus *Attenuatella*. *J. Kansas Ent. Soc.* 34(4): 161-173.
- Allen, R.K., and G.F. Edmunds, Jr. 1962a. A revision of the genus *Ephemerella* (Ephemeroptera: Ephemerellidae) IV. The subgenus *Dannella*. *J. Kansas Ent. Soc.* 35(3): 333-338.
- Allen, R.K., and G.F. Edmunds, Jr. 1962b. A revision of the genus *Ephemerella* (Ephemeroptera: Ephemerellidae) V. The subgenus *Drunella*. *Misc. Publ. Ent. Soc. Am.* 3: 147-179.
- Allen, R.K., and G.F. Edmunds, Jr. 1963a. A revision of the genus *Ephemerella* (Ephemeroptera: Ephemerellidae) VI. The subgenus *Serratella*. *Ann. Ent. Soc. Am.* 56(5): 583-600.
- Allen, R.K., and G.F. Edmunds, Jr. 1963b. A revision of the genus *Ephemerella* (Ephemeroptera: Ephemerellidae) VII. The subgenus *Eurylophella*. *Can. Ent.* 95(6): 597-623.
- Allen, R.K., and G.F. Edmunds, Jr. 1965. A revision of the genus *Ephemerella* (Ephemeroptera: Ephemerellidae) VIII. The subgenus *Ephemerella*. *Misc. Publ. Ent. Soc. Am.* 4: 243-282.
- Bednarik, A.F., and W.P. McCafferty. 1979. Biosystematic revision of the genus *Stenonema* (Ephemeroptera: Heptageniidae). *Can. Bull. Fish. Aq. Sci.* 201: 1-73.
- Berner, L., and M.L. Pescador. 1988. The mayflies of Florida (rev. ed.). University Presses of Florida, Gainesville, USA. 415 pp.
- Campbell, I.C. (ed.). 1990. Mayflies and stoneflies: life histories and biology. Kluwer Academic Publishers, Dordrecht, The Netherlands. 366 pp.
- Clifford, H.F. 1991. Aquatic invertebrates of Alberta. University of Alberta Press, Edmonton, Canada. 538 pp.
- Corkum, L.D., and J.J.H. Ciborowski (eds.). 1995. Current directions in research on Ephemeroptera. Canadian Scholars' Press Incorporated, Toronto, Canada. 478 pp.

- Eaton, A.E. 1901. Ephemeridae collected by Herr E. Strand in South and Arctic Norway. Ent. Month. Mag. 37: 252-255.
- Edmunds, G.F., Jr. 1959. Subgeneric groups within the mayfly genus *Ephemerella* (Ephemeroptera: Ephemerellidae). Ann. Ent. Soc. Am. 52(5): 543-547.
- Edmunds, G.F., Jr. 1988. The mayfly subimago. Ann. Rev. Ent. 33: 509-529.
- Edmunds, G.F., Jr., and R.K. Allen. 1957. A checklist of the Ephemeroptera of North America north of Mexico. Ann. Ent. Soc. Am. 50(4): 317-324.
- Edmunds, G.F., Jr., S.L. Jensen, and L. Berner. 1976. The mayflies of North and Central America. University of Minnesota Press, Minneapolis, USA. 330 pp.
- Flowers, R.W. 1980. Two new genera of Nearctic Heptageniidae (Ephemeroptera). Fla. Ent. 63(3): 296-307.
- Harker, J. 1989. Naturalists' Handbook 13: Mayflies. Richmond Publishing Company Limited, Slough, England. 56 pp.
- McCafferty, W.P. 1981. Aquatic entomology. Science Books International, Boston, USA. 448 pp.
- McCafferty, W.P., and G.F. Edmunds, Jr. 1979. The higher classification of the Ephemeroptera and its evolutionary basis. Ann. Ent. Soc. Am. 72(1): 5-12.
- McCafferty, W.P., and R.D. Waltz. 1990. Revisionary synopsis of the Baetidae (Ephemeroptera) of North and Middle America. Trans. Am. Ent. Soc. 116(4): 769-799.
- McCafferty, W.P., M.J. Wible, and R.D. Waltz. 1994. Systematics and biology of *Acentrella turbida* (McDunnough) (Ephemeroptera: Baetidae). Pan-Pacific Ent. 70(4): 301-308.
- Merritt, R.W., and K.W. Cummins (eds.). 1984. An introduction to the aquatic insects of North America (2nd ed.). Kendall/Hunt Publishing Company, Dubuque, USA. 722 pp.
- Merritt, R.W., and K.W. Cummins (eds.). 1996. An introduction to the aquatic insects of North America (3rd ed.). Kendall/Hunt Publishing Company, Dubuque, USA. 862 pp.
- Schaefer, C.W. 1975. The mayfly subimago: a possible explanation. Ann. Ent. Soc. Am. 68(1): 183.
- Scudder, G.G.E. 1975. An annotated checklist of the Ephemeroptera (Insecta) of British Columbia. Syesis 8: 311-315.
- Scudder, G.G.E. 1994. An annotated systematic list of the potentially rare and endangered freshwater and terrestrial invertebrates in British Columbia. Entomol. Soc. Brit. Columbia, Occasional Paper 2: 1-92.

Usinger, R.L. (ed.). 1956. Aquatic insects of California. University of California Press, Berkeley, USA. 508 pp.

Wigle, M.J., and H.V. Thommasen. 1990. Ephemeroptera of the Bella Coola and Owikeno Lake watersheds, British Columbia Central Coast. J. Entomol. Soc. Brit. Columbia 87: 7-15.

Zloty, J. 1996. A revision of the Nearctic *Ameletus* mayflies based on adult males, with descriptions of seven new species (Ephemeroptera: Ameletidae). Can. Ent. 128:293-346.

TAXONOMIC INDEX TO FAMILIES AND GENERA

<i>Acentrella</i>	11, 15, 27	<i>Heptagenia</i>	11, 19, 54, 56
AMELETIDAE.....	11, 14, 22, 23	HEPTAGENIIDAE.....	11, 13, 49, 50
<i>Ameletus</i>	11, 14, 24, 65	<i>Hexagenia</i>	11, 17, 45, 48
<i>Attenella</i>	11, 16, 38	<i>Ironodes</i>	11, 18, 55
BAETIDAE.....	11, 14, 25, 26	<i>Leptophlebia</i>	11, 20, 59, 61
<i>Baetis</i>	11, 15, 27, 28	LEPTOPHLEBIIDAE.....	11, 13, 59, 60
<i>Callibaetis</i>	11, 15, 25, 29	METRETOPODIDAE	11, 13, 63
CAENIDAE.....	11, 12, 33, 34	<i>Metretopus</i>	11, 13, 64
<i>Caenis</i>	11, 12, 33, 35	<i>Nixe</i>	11, 19, 56
<i>Caudatella</i>	11, 16, 39	<i>Paraleptophlebia</i>	11, 20, 62
<i>Centroptilum</i>	11, 15, 30, 32	<i>Parameletus</i>	11, 21, 22, 67
<i>Cinygma</i>	11, 19, 51	<i>Procloeon</i>	11, 15, 30, 32
<i>Cinygmula</i>	11, 18, 52	<i>Pseudocloeon</i>	27
<i>Cloeon</i>	32	<i>Rhithrogena</i>	11, 18, 57
<i>Dipheter</i>	11, 15, 31	<i>Serratella</i>	11, 16, 36, 43
<i>Drunella</i>	11, 16, 40	SIPHLONURIDAE	11, 14, 65, 66
<i>Epeorus</i>	11, 18, 49, 53	<i>Siphonurus</i>	11, 21, 68
<i>Ephemera</i>	11, 17, 47	<i>Stenonema</i>	11, 18, 58
<i>Ephemerella</i>	11, 16, 41	<i>Timpanoga</i>	11, 16, 44
EPHEMERELLIDAE	11, 12, 36, 37	TRICORYTHIDAE	11, 12, 69, 70
EPHEMERIDAE	11, 12, 45, 46	<i>Tricorythodes</i>	11, 12, 69, 71
<i>Eurylophella</i>	11, 16, 42		

Queen's Printer for British Columbia©
Victoria

768000552