Compendium of Recommended Keys for British Columbia Freshwater Organisms: Part 1

Freshwater Keys
Executive Summary

This document identifies taxonomic keys which are useful for the identification of British Columbian freshwater organisms. This information was gathered from existing publications and from contacting experts on individual groups. All the keys should be readily available from scientific publishing houses and major university or research libraries. There are a few keys listed which are less readily available, but which are very useful if copies can be obtained.

Due to the time constraints on this project, experts were not contacted for every group. This document should be reviewed by experts on each of the major taxonomic groups and revised as necessary.

Findings:

The following table outlines the major works available for each group. North American keys which are suitable for Canada are listed only as keys for Canada:

<table>
<thead>
<tr>
<th>Taxonomic Group</th>
<th>Key for B.C.</th>
<th>Checklist for B.C. (P=partial)</th>
<th>Key for Canada (N.A.)= North American Key</th>
<th>Checklist for Canada (P=partial)</th>
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<tr>
<td>Kingdom Monera</td>
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<tr>
<td>Bacteria</td>
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<tr>
<td>Cyanobacteria</td>
<td></td>
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<tr>
<td>(“Blue-green algae”)</td>
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<tr>
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<td>Algae</td>
<td>Stein &amp; Borden 1979</td>
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<td>Aquatic Plants</td>
<td>Warrington 1995</td>
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<tr>
<td>Sponges</td>
<td>Frost 1991</td>
<td></td>
<td>(P) Ricciardi &amp; Reiswig 1993</td>
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### Taxonomic Group

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<tr>
<td>Hydrozoans</td>
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<td>(P) Adshead, Mackie &amp; Paetkau 1963</td>
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<td>Kolasa 1991</td>
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<td>Gastrotrichs</td>
<td></td>
<td>Strayer &amp; Hummon 1991</td>
<td>Brunson 1959</td>
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<td>Rotifers</td>
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<td>Wallace &amp; Snell 1991</td>
<td>Edmondson 1959</td>
<td>Chengalath &amp; Koste 1987</td>
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<td></td>
<td></td>
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<td>Poinar 1991</td>
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<td></td>
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<td>Poinar 1991</td>
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<td></td>
<td>Burch 1982</td>
<td>Clarke 1981</td>
<td>LaRoque 1953</td>
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<td>Burch 1975</td>
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<td>Klemm 1985</td>
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<td>Merritt &amp; Cummins 1996</td>
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<td>Scudder 1971a &amp; b (Gerridae)</td>
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<td>Hungerford 1948 (Corixidae)</td>
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<td>Merritt &amp; Cummins 1996; Ross 1937 (N.A.)</td>
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<td>Wiggins 1977 to be updated 1996</td>
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<tr>
<td>Mosquitoes</td>
<td>Belton &amp; Belton 1981</td>
<td>Wood et al. 1979</td>
<td>Wood et al. 1979</td>
<td></td>
</tr>
<tr>
<td>Crane flies</td>
<td>(P) Spencer 1948</td>
<td></td>
<td></td>
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<tr>
<td>Fairy shrimp; tadpole shrimp &amp; clam shrimp</td>
<td>Belk 1975 Edmondson 1959</td>
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<td>Hartland-Rowe 1965</td>
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<td>Copepods</td>
<td>Sandercock &amp; Scudder 1996 (Calanoid)</td>
<td>Carl 1940</td>
<td>Williamson 1991 (N.A.)</td>
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<tr>
<td>Brine Shrimp (Mysids)</td>
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<td>Covich &amp; Thorp 1991 (N.A.)</td>
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<td>Amphipods</td>
<td>(P) Saunders 1933</td>
<td>Covich &amp; Thorp 1991</td>
<td>Bousfield 1958</td>
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<td>Isopods</td>
<td></td>
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<td>Shrimps &amp; Crayfishes</td>
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<td>Orchard, S. <em>in Cannings &amp; Harcombe (eds)</em> 1990</td>
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</table>
The above summary table demonstrates that keys, and even species lists, are lacking for most freshwater organisms in B.C. In particular, there are no keys specific to Canadian Cyanobacteria, algae, hydrozoans or aquatic arachnids. Many keys presently in use for other groups are North American keys. Keys for British Columbia are lacking for all groups except the aquatic plants, mayflies, dragonflies, butterflies, blackflies, cladocerans, copepods, ostracods and fish. The fish key was completed only two years ago; the zooplankton and mayfly keys are being completed in the next few months and the black fly key is two years away. These gaps must be filled if aquatic inventory and biodiversity studies are to be successful in B.C.

The number of keys itemized in this document is indicative of the complexity of taxonomic study. Most taxonomists spend years, even decades, learning the organisms, the literature and the ecosystems in which the organisms are found. This is not a science that can be performed by amateurs. Incorrect identification of organisms will lead to confusion, poor interpretation of the inventory data and, ultimately, poor decisions regarding the protection and management of aquatic ecosystems. In a recent document entitled Systematics: an Impending Crisis (1995) Dr. Ian Efford states “Correct identification is vital to the protection of our natural resources, our health, and our environment. Furthermore, identification of pests and diseases must be accurate and timely if we are to sustain the mainstay of our economy- that is our forest, fisheries and agricultural resources.” Taxonomic keys for all of B.C.’s aquatic organisms are therefore essential.

**Recommendations:**

1. Resources should first be focused on groups for which Canadian keys do not exist.
Freshwater Keys

2. New keys for B.C. organisms must be written by experienced taxonomists. These individuals have the background knowledge, literature collections and contacts with other taxonomists which are vital to producing good keys.

3. Experts throughout North America must be contacted before new works are commissioned to ensure that other similar keys are not in production or that a major taxonomic revision of the group is not forthcoming.

4. A central database should be created into which all taxonomic information can be entered and updated as systematics change.

5. Quality control for biological data is essential. A central repository for specimens is necessary so that identifications can be verified in the future. This could include digitized photographs with dimensions and descriptions of organisms and site information. Funds should be provided for care of the specimens by the individual submitting them when they are submitted to the repository. This repository must provide for the long term storage (many decades) of these specimens.

6. Consideration should be given to producing interactive computerized “expert” systems, simultaneously with keys for B.C. organisms, so that the accuracy of identifications by non-specialists can be improved.
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<td>Class Aves (Birds)</td>
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<td>Order Gaviiformes (loons, grebes)</td>
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<tr>
<td></td>
<td>Order Charadriiformes (plovers, sandpipers, stilts)</td>
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<td></td>
<td>Order Ciconiiformes (herons, storks, ibises)</td>
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<td>Order Ciconiiformes (pelicans)</td>
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<td>Order Pelicaniformes (pelicans)</td>
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<td></td>
<td>Order Procellariiformes (albatrosses, petrels)</td>
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<td></td>
<td>Order Pelecaniformes (pelicans, cormorants, shags)</td>
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<td>Order Sphenisciformes (penguins)</td>
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<td>Order Carinata (ducks, geese)</td>
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<td>Family Astacidae (freshwater shrimps)</td>
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<td><strong>Superclass Branchiopoda</strong></td>
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<td>Family Dikerogammaridae (dikerogammarids)</td>
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<td>Order Cladocera (brine shrimps)</td>
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The Compendium of Recommended Keys for British Columbia Freshwater Organisms:

Part 1: Freshwater Keys.

Part 2: Taxonomic Bibliography of Literature pertaining to the Freshwater Organisms of British Columbia.

Part 3: Classification Scheme of Freshwater Organisms

How to Use This Compendium and Guide:

These keys follow the taxonomic classification schemes generally accepted by the scientific community. (For classification of each phylum (to family) see Part 3: Classification Scheme). In some cases it is necessary to use a new key for each order. In other cases a key to the class is sufficient. Only groups for which literature has been located are listed. Each major group heading is followed by explanatory notes. If a key for B.C. exists, it is listed first, followed by:

2. checklist for B.C.
3. endangered status of the group in B.C.*
4. key for Canada
5. checklist for Canada
6. key for North America
7. checklist for North America
8. key for the world
9. other relevant literature.

*Note: Item 3, the endangered status of the group in B.C., refers to those organisms listed by Scudder (1994) as rare or endangered. Scudder notes that some organisms may be listed as rare simply because few collections have been made in B.C., not because there are few organisms in the province. These organisms are not listed as “rare or endangered” by either the Federal or Provincial government at this time. (**=endemic to B.C., *=B.C. only in Canada, but recorded elsewhere in North America)

Where possible the International Standard Book/Serial Number (IBSN/ISSN) or Library of Congress Card Catalogue number (LOCCC number) is provided to aid the reader in obtaining a copy of the document.

Please note that this is not a comprehensive list. Furthermore, this document is subject to updates as more literature becomes available and/or amendments to the classification schemes are made.
Introduction

There is a vast number of freshwater organisms in North America. It is estimated that invertebrates alone number more than 10,000 species. In order to understand these organisms and their relationship to one another, it is necessary to classify and name them in a systematic manner. This is the role of the disciplines called taxonomy and systematics.

Taxonomic classification schemes are ever-changing. As new organisms are discovered and as we gain new insight into known species, we rename and regroup them to better reflect their similarities and differences. There are two very similar systems of arranging organisms into groups, or ranks; one for plants and one for animals. The system used to rank plants, and the rules for doing so, are outlined in the International Code of Botanical Nomenclature. Similarly, the International Code of Zoological Nomenclature sets out the rules for naming and classifying animals. The botanical and zoological ranks and their endings are outlined below (those most commonly used are indicated in bold print).

<table>
<thead>
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<th>Botanical Ranks</th>
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<td>Class</td>
<td>Class</td>
</tr>
<tr>
<td></td>
<td>Cohort</td>
</tr>
<tr>
<td>Order (-ales)</td>
<td>Order</td>
</tr>
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<td>Family (-idae)</td>
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<tr>
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<td>Subfamily (-inae)</td>
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<td>Tribe (-ini)</td>
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<tr>
<td>Species</td>
<td>Species</td>
</tr>
<tr>
<td>Variety</td>
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</tbody>
</table>

Many ranks have unique endings which act as a code to indicate its level i.e. a rank which ends in “-idae” can immediately be recognized as a zoological family name. The two part, or binomial, Latin name which is assigned to an organism consists of the Genus name first, which is capitalized, followed by the species name, which is not capitalized e.g. *Daphnia pulex*. Both names are either italicized or underlined. If the organism can be identified to Genus, but not to species, this is indicated by writing the Genus name followed by "sp." e.g. *Daphnia sp.*
There is considerable debate among taxonomists regarding the number of kingdoms into which all organisms should be classified. The most widely accepted classification scheme uses five kingdoms. In increasing order of complexity, they are: Monera (the bacteria), Protista, Fungi, Plantae and Animalia. Certain groups of organisms, such as the algae, do not lend themselves to neat classification systems, but have characteristics of more than one kingdom. In other cases, organisms previously known as a single class or family are now split into many different classes or families, but are still widely referred to by a common “catch-all” term which bears no relationship to the present classification scheme. The terms “protozoa” and “cladocera” are two such terms. For the purposes of this document, organisms are grouped according to the classification schemes outlined in the following documents:


Plants: Aquatic plants other than the algae are not subdivided here. See Warrington, 1995.


The taxonomic keys which are recommended in this document are most often general keys, that is, they are intended for use by the non-specialist. This said, for many groups it is nearly impossible to identify an organism to species, or even to genus, without highly specialized expertise. The keys are therefore not always easy to use, not because they are poorly written, but because the group of organisms is so complex. When using a key, it is important not to “force an organism to fit” a given description. Where possible, use a different key that may use clearer terms. It is advisable to contact an expert in the field to confirm an identification.
Recommended Keys and Checklists for B.C Freshwater Organisms:

Kingdom MONERA

The distribution of bacteria is not treated in the same manner as other organisms. Keys for B.C. and Canada are not practical and therefore do not exist. The taxonomy of bacteria has been completely revised in recent decades and for this reason up-to-date taxonomic keys are essential.

Bacteria, unlike many other organisms, are not classified by morphological characteristics alone. Their physiology, biochemistry and fatty acid profiles are all essential to a correct identification. These techniques are certainly beyond the resources of all but a few specialized labs. One exception are the large cyanobacteria. This group is often treated as part of the algae, especially in older texts, but modern evidence suggests that they are in fact more bacterial than algal in nature.

Recommended Key for Bacterial Identification:


Phylum CYANOBACTERIA


Kingdom PROTISTA

Protozoa

Protozoa are defined as: "Unicellular or colonial eukaryotes that are heterotrophic" (Thorp and Covich, 1991).


Kingdom FUNGI

No checklists or keys are known to exist for B.C. or Canada.

**Status:** unknown

**Keys to fungi of the world:**


*This illustrated key has numerous line drawings.*


Kingdom PLANTAE

The aquatic plants of British Columbia have been recently catalogued. A complete set of keys and checklists are contained in:


See bibliography for an extensive list of literature pertaining to aquatic plants in B.C.

Algae

The algae are a nebulous group of organisms, the members of which belong to many different phyla and in fact to different kingdoms. In the new book: The Freshwater Algae, Their Microscopic World Explored (1995), John Lund states "...at the algal level there is no distinction between the plant and animal kingdoms. Most algae are plants but some are animals and in between there is a considerable number of algae with both plant and animal characteristics. Some of these algae are more like plants than animals, other more like animals than plants and there is every gradation between the two." Therefore, with the exception of the blue-green algae (Cyanobacteria) which are treated under bacteria, all algal groups will be dealt with here, under the Kingdom Plantae.

The identification of algae often requires the use of literature from all over the globe. In addition to English, much of the literature is in German, some is in French and a few volumes are in Polish. Many of these keys have been reprinted, in spite of their age, because they are so useful. Higher taxonomic reclassification rarely affects the genus and species names of algae, so many old texts are still in use. The texts listed here are the major works in common use. There are many more books, particularly regional floras, not listed here. An excellent source of phycological literature is: Balogh Scientific Books, 1911 North Duncan Road, Champaign Illinois 61821 USA. Phone: 1(217) 355 9331 FAX: 1(217) 355 9413 e-mail: balogh@balogh.com.

Keys to the Algae of B.C.:

No keys exist which are specific to the algae of B.C. Some papers which illustrate species of B.C. are listed under their appropriate heading.

Checklist of the Algae of B.C.:


Freshwater Keys


This checklist is a compilation of the previous three with additions.

General keys to the algae of North America:


This text provides details of algal classification and contains many family and genus keys.


General keys to the freshwater algae of the world:


Fritsch, F.E. The structure and reproduction of the algae Vol. 1

Fritsch, F.E. The structure and reproduction of the algae Vol. II


Division CHLOROPHYTA


Order CHLOROCOCCALES

Freshwater Keys

Order ULOTTRICHALES


Order SPAHEROPLEALES


Order CHAETOPHORALES


Order TRENTEPOHLIALES


Order OEDOGONIALES


Order ULVALES


Order CLADOPHORALES


Order SIPHONOCLADALES

Order ZYNEMATALES (Conjugales)


Family DESMIDACEAE (Desmids)

Key to Desmids of North America:


Keys to Desmids of the world:


This book covers desmids with worldwide distribution.


Family ZYNEMATAECEAE


Division CHAROPHYTA (stoneworts)


See Also Aquatic Plants

Division EUGLENOPHYTA


Class EUGLENOPHYCEAE

Order EUGLENALES


Division PHAEOPHYTA (Brown algae)


Brown algae are very rare in freshwater. Only six genera have been recorded:

- Heribaudiella
- Sphacelaria
- Pseudobodanella
- Lithoderma
- Pleurocladia lacustris
- Porterinema fluvatilis

Division CHRYSOPHYTA

Class CHRYSOPHYCEAE

Class XANTHOPHYCEAE


Class BACILLARIOPHYCEAE (diatoms)

Literature pertaining to the freshwater diatoms of British Columbia:


Keys to Diatoms of North America:


Freshwater Keys


Keys to diatoms of the world:


This book is indispensable for describing the features of the diatom frustule which allow for identification.


Cleve-Euler, A. Key to Diatoms of Sweden & Findland. Centricae; Pennatae. Monoraphideae, Biraphideae I (Amphora, Navicula spp).


Foged, N. Freshwater Diatoms from Spitsbergen II. Summary. III.

Foged, N. Freshwater Diatoms from Spitsbergen.

Foged, N. Freshwater Diatoms from Spitsbergen I. Taxonomy.


**Division PYRRHOPHYTA**


**Division RHODOPHYTA**


**Subclass FLORIDIOPHYCIDAE**

Division CRYPTOPHYTA


Kingdom ANIMALIA: Subkingdom PARAZOA

Phylum PORIFERA (Sponges)

Class DEMOSPONGIAE

Family SPONGILLIDAE

No checklists or keys are known to exist for B.C.

Status: None of the sponges that occur in B.C. are considered rare or endangered.

Key to freshwater sponges of Eastern Canada:


No checklist is known to exist for Canada.

Key to freshwater sponges of North America:


Key to freshwater sponges of the world:

Kingdom ANIMALIA: Subkingdom EUMETAZOA

Phylum CNIDARIA (also called Coelenterata)

Class HYDROZOA (hydras)

No checklists or keys are known to exist for B.C.

Status: None of the hydrozoans that occur in B.C. are considered rare or endangered.

One paper is known which describes hydrozoan species from western Canada:


Key to the Hydrozoans of North America:


Phylum PLATYHELMINTHES (Flatworms)

Status: None of the flatworms that occur in B.C. are considered rare or endangered (Scudder, 1994).

Class TURBELLARIA (free-living)

The term “microturbellarians” (microflatworms) includes Turbellarian orders other than Tricladida.

No checklists or keys are known to exist for B.C. or Canada.

Key to the Turbellarians of North America:


Key to the Turbellarians of the World:


Order TRICLADIDA (planarians)

No checklists or keys are known to exist for B.C. or Canada.
The identification of most planarians to species requires examination of serial sections; therefore, identification only to the Genus level is more common.

Key to Planarians of North America:


Phylum NEMERTEA (proboscis worms)

No checklists or keys are known to exist for B.C. or Canada.

Status: None of the species known to North America have been identified from British Columbia.

Key to the Nemerteans of North America:


** Three freshwater North American species are keyed by Kolasa; however, none of these species have been recorded in B.C. In the instance that a nemertean is found which cannot be keyed using Kolasa (1991), the following world-wide keys should be used:

Key to the Nemerteans of the world:


Phylum GASTROTRICHA

No checklists or keys are known to exist for B.C. or Canada.

Status: These organisms are very difficult to identify to species. As a result, little research has been done on these organisms in B.C.. None of the gastrotrichs that occur here are believed to be rare or endangered.

Key to the Genera of Gastrotrichs in North America:

Phylum ROTIFERA (wheel animals)

The rotifers are a vast group and can be very complicated to identify. Persistence and patience are needed to key these organisms to Genus.

No checklists or keys are known to exist for B.C.

Status: Eighty-two named species of rotifers are reported from B.C. Of these, 13 are found only in B.C. None of the rotifers that occur in B.C. are considered rare or endangered.

No key is known to exist for Canada.

Pictoral key to Common Genera of Rotifers in Alberta:

Clifford, H.F. 1991. Aquatic Invertebrates of Alberta. The University of Alberta Press. 538 pp. ISBN 0-88864-233-4 cloth, are very clear and cover the common Genera. This is a good place to start, as there are numerous species in North America and the larger keys may be confusing.

Checklists of the Rotifers of Canada:


Key to Families of Rotifers in North America:


This key is very comprehensive, but too detailed and technical for those without prior expertise in this group. Some of the simpler line drawings are helpful.

Key to Genera of Rotifers in North America:


This key is also very detailed. In general, the terms are more straightforward than those in Wallace and Snell (1991).

Keys to Rotifers of the world:


Ten additional volumes on Rotifers are forthcoming from Academic Press. See bibliography.

Phylum NEMATODA (unsegmented worms)

No checklists or keys are known to exist for B.C. or Canada.

Status: Very little information is available on the nematodes of B.C., therefore no attempt can be made to assess rarity (Scudder, 1994).

Key to the Nematodes of North America:


This key does not include all freshwater genera.

Phylum NEMATOMORPHA (horsehair worms)

No checklists or keys are known to exist for B.C. or Canada.

Status: None of the freshwater horsehair worms recorded from B.C. appear to be rare or endangered (Scudder, 1994).
Key to the Genera of Nematomorpha in North America:

ISBN# 0-12-690645-9.

Phylum MOLLUSCA

No checklists or keys are known to exist for B.C..

Status: Threatened and endangered freshwater molluscs in Western North America are listed in:
Taylor, D.W. 1970. Western freshwater molluscs. Malacologica. 10: 33-34. he does not list any species as threatened in British Columbia (c. 1970); however, two species which are found in B.C., Physella columbiana and P. virginea, are listed as rare and endangered in the U.S.

Six species or subspecies which may be endangered in B.C. are listed in:
Clarke, A.H. 1976. Endangered freshwater molluscs of northwestern North America. Bulletin of the American Malacological Union Inc. 1976: 18-19. Also, Physella wrightii, a tadpole snail found only in a small portion of the Liard Hot Springs is first mentioned by Clarke (1976) and was later described by Te and Clark (1985). It is considered both rare and endangered.

As of 1994, Scudder notes that 13 freshwater species may be rare and endangered: *Flumnicola virens (Lea), *Juga plicifera (Lea), Acroloxus coloradensis (Henderson), *Fisherola nuttalli (Haldeman), Fossaria truncatula (Müller), *Physella columbiana (Hemphill), P. hordacea (Lea), P. lordi (Baird), P. propinqua nuttalli (Lea), P. virginea (Gould), **P. wrightii Te & Clarke.

The history of collectors and collections of non-marine Molluscs in British Columbia:


Key to the Molluscs of Canada:


Most recent checklist of Canadian Molluscs:


*According to Scudder (1994) the nomenclature of this checklist is now out of date. Nomenclature currently follows Turgeon et al.:

Keys to the North American freshwater molluscs:


Class GASTROPODA (snails)

Pictoral key to the families of gastropods in Alberta:


This key is very useful for the pulmonate snails, since it includes all five families recorded in North America. It includes only two families of prosobranch snails out of the ten known from North America.

Key to Gastropods in North America:


Class BIVALVIA (mussels and clams)

Key to the Bivalves of North America:


Superfamily UNIONACEA

Family UNIONIDAE

Status: One species of Unionacean clam is believed to be rare and possibly endangered in B.C.:

*Gonidea angulata* (Lea)

Key to the Unionacean Clams of North America:

Phylum ANELLIDA

Class POLYCHAETA

No checklists or keys are known to exist for B.C. or Canada.

**Status:** Three species of polychaete worms have been recorded in freshwater in British Columbia. None is considered rare or endangered (Scudder, 1994).

**Key to Polychaetes in North America:**


Class OLIGOCHAETA (aquatic earthworms)

No checklists or keys are known to exist for B.C. though Brinkhurst (1978) contains distribution records.

**Status:** None of the freshwater species in B.C. are considered rare or endangered (Scudder, 1994)

**Key to the families of Oligochaetes in Alberta:**


*This key is very clear and outlines the principal differences between families.*

**Key to the Oligochaetes of northwestern Canada:**


**Key and Checklist to the Oligochaetes in Canada:**


**Keys to the North American Oligochaetes:**


Keys to the Oligochaetes of the world:


Class BRANCHIOBDELLIDA (crayfish parasites)

No checklists or keys are known to exist for B.C. or Canada.

Status: unknown.

Key to the Branchiobdellids of North America:


Class HIRUDINOIDEA (leeches)

No checklists or keys are known to exist for B.C.

Status: There are presently twenty known species of leeches in B.C. They are listed by Davies (1991) Madill (1985) and Oosthusien and Davies (1993). Five species may be considered rare in B.C. (Scudder, 1994): Batracobdella picta (Verrill), Marvinmeyeria lucida (Moore), Theromyzon tessulatum (Muller) Piscicola punctata (Verrill) *Dina anoculata Moore.

Pictoral key to the three orders and four families of Leeches in Alberta:


This key is extremely clear and should be sufficient for all the most common leeches in B.C. It includes colour photographs which are very helpful.
Freshwater Keys

Checklist of the Leeches in Canada:


Keys to the Leeches of North America:


Keys to the Leeches of the world:


Phylum TARDIGRADA (water bears)

No keys are known to exist for B.C. or Canada.
Partial checklists of Tardigrades in B.C.:


Status: There are currently 49 species of tardigrades which have been reported from B.C., three of which are believed to be endemic: **Isohypsibius woodsae Kathman; **Platicrista cheleusis Kathman; **Pseudodiphascon arrowsmithii Kathman and Nelson.

No keys or checklists are known to exist for Canada.

Key to the Genera of Tardigrades in North America:


Key to the Tardigrades of Britain:


In spite of the fact that it is written for Britain, his key is useful since many tardigrades have a worldwide distribution (Clifford, 1991).

Phylum BRYOZOA

No keys or checklists are known to exist for B.C. Canada.

Status: None of the bryozoans found in B.C. are considered rare or endangered (Scudder, 1994).

Key to the Bryozoans of North America:


Phylum ARTHROPODA

Subphylum CHELICERATA

Class ARACHNIDA

Order ARANEAE (spiders)

No keys are known to exist for B.C. or Canada.

Checklists of spiders in B.C.:


Family PISAURIDAE (fishing and nursery-web spiders)


Subclass ACARI (mites and ticks)

Order ACARIFORMES

No keys or checklists are known to exist for B.C. or Canada.

Status: Twelve species of water mites are considered to be rare and perhaps endangered (Scudder, 1994). They are listed under their respective family headings below.

Family TYDEIDAE

One endemic species of this family is considered rare and perhaps endangered: **Meyerella marshalli Andre

Family ACALYPTONOTIDAE

One species of this family is considered rare and perhaps endangered: *Acalyptonus pacificus Smith

Family ANISITSIELLIDAE

Two species of this family are considered rare and perhaps endangered: *Bandakiopsis fonticola Smith and *Cookacarus columbiensis Barr.

Family NEOACARIDAE

One species of this family is considered rare and perhaps endangered: *Neoacarus occidentalis Cook
Family ATHIENEMANNIIDAE

One species of this family is considered rare and perhaps endangered: *Chelomideopsis brunsoni* (Cook).

Family ATURIDAE

One species of this family is considered rare and perhaps endangered: *Lethaxona oregonensis* Cook.

Family HYDRYPHANTIDAE

Three species of this family are considered rare and perhaps endangered, one is endemic to B.C.: *Cowichania interstitialis* Smith, **Tadjikothyas sp.n.** and *Tartarothyas sp.n.*

Family MOMONIIDAE

One species of this family is considered rare and perhaps endangered: *Cyclomomonia andrewsi* Smith.

Family UNIONICOLIDAE

One endemic species of this family is considered rare and perhaps endangered: **Koenikea sp.n.**

Key to families of freshwater mites in North America:


Suborder ORIBATIDA

Checklist of 43 described species of oribatid mites in B.C.:


Catalogue of the Oribatid mite Species of North America:


Key to families of Oribatid mites in North America:

Key to Genera of Oribatid mites in North America:


Class INSECTA

Many insects collected in freshwater are found in the larval stage. Only very few experts can identify larvae to species and then often only by rearing the larvae to the adult stage. Often, larvae can only be identified to Genus, and most frequently only to family. Detailed keys to species may serve only to confuse rather than clarify and may lead to incorrect identifications which appear to be more precise than they are. With this in mind, a general key is recommend for field work, while monographs and more detailed papers should be used only by experts in the field.

General key to the aquatic insects of North America:


This volume updates the classification of many aquatic insects and should be considered the definitive reference for classification matters.

General key to the aquatic insects of Vancouver Island:


Order COLLEMBOLA (springtails)

No keys are known to exist for B.C. or Canada.

Preliminary checklist of the Collembola of B.C:


Status: Ten species of Collembola are currently considered rare and endemic to B.C. None of these belong to the families Poduridae or Sminthuridae, which are primarily aquatic.

Pictoral key to the aquatic families of Collembola:


Key to the Collembola of North America:

Order EPHEMEROPTERA (mayflies)

Note: the order Ephemeroptera has recently been revised by Merritt and Cummins (1996). Please refer to this volume for up-to-date classification.

Key to the Mayflies of B.C.:

A key to the Mayflies of B.C. is currently in preparation by Ms. Karen Needham at the University of British Columbia. It is expected to be available in April 1996.

Checklist of the Mayflies of B.C.:


Pictoral key to the Mayflies of Alberta:


This key is very clear and has excellent line drawings. Caution should be exercised when using this key, since species not included in it may occur in B.C.

Recent additions to the B.C. checklist:


Status: Four British Columbian species have a very restricted distribution and may be considered rare and endangered (Scudder, 1994): *Baetes parallelus* Banks, *Heptagenia elegantula* (Eaton), *Leptophlebia gravastella* (Eaton) and *Ameletus sparsatus* McDunnough.

Checklist of the mayflies of North America:


Keys to the mayflies of North America:

Merritt, R and Cummins


**Freshwater Keys**

*This key is quite old and somewhat outdated.*

**Order ODONATA (dragonflies and damselflies)**

The dragonflies and damselflies in B.C. have been well studied. Both a checklist and a key for B.C. species were written in 1977:

**Monograph of (key to) the Odonata of B.C.:**


**Checklist of the Odonata of B.C.:**


**Pictoral key to the families of Odonata in Alberta:**


**Monographs of the Odonata of Canada and Alaska:**


**Order PLECOPTERA (stoneflies)**

**Keys to the Stoneflies of British Columbia:**

A key to the Plecoptera of Alaska and Northwest Canada by Dr. Ken Stewart of the University of North Texas at Denton and Dr. Mark Oswood of the University of Alaska is currently in progress. This book will cover all of British Columbia, Alberta, the Yukon, the Northwest Territories and Alaska. It is to be published by the University of Alaska Press. The anticipated date of publication is spring 1997.
Dr. Ken Stewart also has a book chapter in press with the Biological Survey of Canada. This book will cover Yukon insects and will therefore be useful for northern B.C. Neither the exact title nor the release date is known at this time.


This publication is useful for western and perhaps central B.C., but does not cover stoneflies of the coastal ranges.

Checklist of the Stoneflies of B.C.:


Status: There are 125 species of stoneflies recorded from British Columbia. Three are endemic (**) and an additional 22 are rare and may be considered endangered (Scudder, 1994):

**Bolshecapnia gregsoni (Ricker), Bolshecapnia milami (Nebeker and Gaufin), Bolshecapnia rogozera (Ricker), Bolshecapnia sasquatchi (Ricker), Bolshecapnia spenceri (Ricker), Capnia cheama Ricker, Capnia nearctica Banks, *Capnia elongata Claassen, Capnia petilia Jewett, Capnia pileata Jewett, Capnia sextuberculata Jewett, **Isocapnia fraseri Ricker, Isocapnia vedderensis (Ricker), Megaleuctra spectabilis Neave, *Soyedina interrupta (Claassen), Alloperla medveda Ricker, *Haploperla chinualna (Ricker), *Yoroperla mariana (Ricker), *Cascadoperla trictura (Hoppe), Isoperla transmarina (Newman), Arcynopteryx compacta (McLachlan), Setvena tibialis (Banks), *Cultus tostonus (Ricker), *Osobenus yakimae (Hoppe), Isogenoides elongatus (Hagen).

Pictoral key to the families of Stoneflies of Alberta (North America):


Illustrated key to the immature stages (Generic level) of Stoneflies in North America:


This book includes 244 illustrations, new family and generic keys as well as a complete species list for North America.

Keys to the Stoneflies of North America:

**Freshwater Keys**


**Key to the Stoneflies of the world:**


**Order HEMIPTERA (true bugs)**

No checklists or keys are known to exist for the whole of the aquatic Hemiptera of B.C. or Canada. Checklists of individual families are listed under their respective subheadings.

**Status:** unknown

**Pictoral key to eight families of Hemiptera in Alberta:**


*This key covers the Corixidae, Notonectidae, Belostomatidae, Gerridae, Veliidae, Mesoveliidae, Saldidae and Hebridae. Keys to Genera found in Alberta are also included.*

**Key to the Hemiptera of North America:**


*Supplemental literature is listed under individual family headings.*

**Family BELOSTOMATIDAE (giant water bugs)**

**Family CORIXIDAE (water boatmen)**


**Family GERRIDAE (water striders)**


**Family HEBRIDAE (velvet water bugs)**


**Family MESOVELIIDAE (water treaders)**

**Family NOTONECTIDAE (back swimmers)**


**Family SALSIDAE (shore bugs)**

**Family VELIIDAE (broad-shouldered water striders)**

Order MEGALOPTERA

See also: NEUROPTERA

No keys or checklists are known to exist for B.C.:

**Records of species from B.C.:**


**Status:** Very little information is available of the Megaloptera of B.C.; however two species of the family Sialidae may be rare and endangered in B.C.

**Family SIALIDAE (fishflies)**

Two species of fishflies may be rare and endangered in B.C.: Sialis hamata Ross and Sialis velata Ross (Scudder, 1994).

**Key to the Fishflies of North America:**

Order NEUROPTERA

Checklist of the Neuroptera of B.C.


*This list includes insects which are now placed in the orders Megaloptera and Raphidioptera.

Status: Twenty neuropteroid species (includes the orders Megaloptera Raphidioptera and Neuroptera) in B.C. may be rare and endangered; of these only two species are aquatic (see SIALIDAE above).

Family SISYRIDAE (spongilla-flies)

Key to the Spongilla-flies of North America:


Order LEPIDOPTERA (aquatic moths)

A great deal of information is available on the terrestrial moths and butterflies of B.C. but very little information exists on the aquatic forms. The publications listed here may include aquatic species in their treatment of the entire order.

Key to the butterflies of Mount Revelstoke and Glacier National Park:


Checklist of the Lepidoptera of B.C.:

Guppy, C.S. and J.H. Shepard. unpublished. C.S. Guppy may be reached at the Ministry of Environment, Lands and Parks, Quesnel, B.C.

A checklist of the moths of B.C. is currently in preparation by J.H. Shepard of Nelson, B.C.

Status: Sixty-one butterflies and moths are listed as rare and potentially endangered in B.C. Only one species (Family Noctuidae) is known to be semi-aquatic by this author; however others may also be semi-aquatic (see Scudder, 1994).

Checklist of the Lepidoptera of North America:

Family NOCTUIDAE

One marsh species of this family is considered rare and perhaps endangered: *Apamea maxima* (Dyar) (Scudder, 1994)

Order TRICHOPTERA (caddisflies)

Checklist of the Caddisflies of B.C.:


Status: There are four species of caddisflies endemic to British Columbia. Seventy other species have been recorded from only a single locality, so are probably not rare. The four endemic species are: **Limnephilus chilcotinensis** Nimmo, *Psychoglypha* sp.n. **Rhyacophila perplana** Ross & Spencer, **R. unimaculata** Denning.

Pictorial key to the Caddisflies of Alberta:


*This key has an excellent description of the morphological features of caddisflies. It includes 15 of the twenty families in North America.*

Key to Caddisflies of North America:


Order COLEOPTERA (beetles)

Status: There are currently 114 rare and possibly endangered beetle species and subspecies in B.C. Of these at least three are aquatic: *Amphizoa striata* Van Dyke, *Agabinus glabrellus* (Motschulsky), *Agabinus sculpturellus* Zimmerman. There are 16 Curculionid beetles which are rare in B.C.- some of these beetles may also be considered aquatic (see Scudder, 1994).

Catalogue of the Beetles of Canada and Alaska:

Freshwater Keys

Keys to the Beetles of the Pacific Northwest:

A Checklist of the Beetles of North and Central America and the West Indies:

Though some terrestrial beetles have been covered, none of the aquatic beetle families have been thoroughly monographed recently.

Keys to North American Beetles:


Order DIPTERA (true flies)

No checklists is known to exist for the whole of the Diptera of B.C. or Canada.

Key to Diptera of Canada:

Status: At present, a checklist for British Columbian Diptera does not exist; however, Scudder (1994) lists 76 species which may be rare or endangered. His list was constructed in consultation with many experts on B.C dipteran fauna. Of the rare/endangered species listed by Scudder, 25 are aquatic. They are listed under their respective family headings below.

Suborder NEMATOCERA

Family BLEPHARICERIDAE (net-winged midges)

Family CERATOPOGONIDAE (= Heleidae, biting midges)

Family CHAOBORIDAE (phantom midges)

Key to the Chaoboridae of the world:


Family CHIRONOMIDAE (= Tendipedidae, midges)

Seven species of Chironomids are believed to be rare or endangered in B.C, all of which are endemic to B.C.:

**Chironomus vancouveri** Michailova and Fischer, **Doithrix hamiltoni** Saether and Sublette, **Heterotanytarsus perennis** Saether, **Odontomesa lutospora** (Garrett), **Parachaetocladius hirtipectus** Saether, **Pseudosmittia setavenna** Saether, **Skeutzia inopinata** Reiss.

Partial Checklist of Chironomids of Canada:


Catalog of Chironomids of North America:


Key to Chironomids of the world:


The above two keys are reportedly very good, but difficult to use.

Family CULICIDAE (mosquitoes)

Checklist of the Mosquitoes of B.C.:

**Freshwater Keys**

**Status:** There are five species of mosquitoes in Canada which have been recorded only in B.C. Two of these have a very restricted distribution. Scudder (1994) suggests that the following species warrant further study: *Aedes hendersonii* Cockerell, *Aedes nevadensis* Chapman & Barr, *Aedes nigripes* (Zetterstedt) and *Culiseta minnesotae* Barr.

**Key to the Mosquitoes of Canada:**


**Key to Mosquitoes of North America:**


**Family DEUTEROPHLEBIIDAE (mountain midges)**

**Status:** One species, *Deuterophlebia personata* Courtney is rare in B.C. The rarity of this species may be an artifact of lack of collecting rather than scarcity of the insect (Scudder, 1994).

**Key to the Mountain midges of North America:**


**Family DIXIDAE (dixid midges)**

**Family NYMPHOMYIIDAE**

**Family PSYCHODIDAE (moth flies)**

**Family PTYCHOPTERA (= Lirioidae, phantom crane flies)**

**Family SIMULIIDAE (black flies)**

Black flies are a very difficult group to identify to species. Often two groups of reproductively isolated species will appear identical in external appearance. Chromosomal examination is then required to distinguish them. There are no cytological keys for B.C. and many species are as yet undescribed (Currie, pers. comm.). Only experts should attempt black fly identification to species.

**Key to the Black flies of B.C.:**

Dr. Doug Currie of the Royal Ontario Museum together with Dr. Peter Adler (Clemson University) and Dr. Monty Wood (Agriculture Canada) are currently completing a key to the blackflies of North America. This volume will contain keys and figures for all 290 North American species including the 60+ species known from B.C. It is expected to be available in 1998.
No keys or checklists are known to exist which pertain directly to B.C. black flies.

See bibliography for references pertaining to records of B.C. Genera and Species.

**Status:** Six species of black flies are considered rare or endangered in B.C.; three of these are endemic to B.C.: *Parasimulium furcatum* Malloch, **Prosimulium constrictistylum** Peterson, **Prosimulium woodorum** Peterson, **Prosimulium n.sp. near fulvum** (Coquillett), *Simulium n.sp.1 near pugetense* (Dyar and Shannon), *Simulium n.sp.2 near virgatum* Coquillett (Scudder, 1994).

**Keys to the immature stages of most Black flies in B.C.:**


**Keys to Black flies of Canada:**


- **Family TANYDERIDAE** (primitive crane flies)
- **Family THAUMALEIDAE** (solitary midges)
- **Family TIPULIDAE** (crane flies)

**A preliminary checklist of Tipulidae of B.C.:**


**Status:** At present, seven species of crane flies are rare or endangered in B.C. Five of these are endemic to B.C.: *Chionea macnabeana* Alexander, *Tipula imbellis* Alexander, **Phalacroceria vancouverensis** Alexander, **Limonia suffusca** (Garrett), **Phyllolabis bryantiana** Alexander, **Limnophila columbiana** Alexander, **Limnophila lobifera** Alexander (Scudder, 1994).
Suborder BRACHYCERA

Family TABANIDAE (deer flies and horse flies)

No checklists or keys are known to exist for B.C.

Status: Sixty-one species have been recorded in B.C. Sixteen of these are not found elsewhere in Canada and of these sixteen, five are believed to be rare (Scudder, 1994): *Chrysops coloradensis* Bigot, *Chrysops surdus* Osten Sacken, *Hybomitra aasa* Philip, *Tabanus laticeps* Hine, *Tabanus punctifer* Osten Sacken.

Key to Canadian Deer flies and Horse flies:


Subphylum CRUSTACEA

An annotated checklist of the freshwater crustacea of B.C. is in preparation by Dr. Geoff Scudder at the University of British Columbia.

Status: None of the planktonic crustacea in B.C. are believed to be rare or endangered.

Class BRANCHIOPODA

Key to the Branchipoda (Cladocera) of B.C.:


Partial checklists of the Branchipoda of B.C.:


Checklist of Branchipoda of Canada:


Keys to the Branchiopoda of North America:


*This key is the most up-to-date; however, Brooks (1959) is still highly regarded and useful.*


Keys to the Branchiopoda of the World:


Order ANOSTRACA (fairy shrimp)

Checklist of the Anostraca in Canada

Keys to the Anostraca of North America:

Order NOTOSTRACA (tadpole shrimp)

Order CONCHOSTRACA (clam shrimp)

Class MAXILLOPODA

Subclass BRANCHIURA (fish lice)

Argulus (only genus)

Subclass COPEPODA (copepods)

Key to the Copepod species of B.C.:
A monograph of the Calanoid Copepods of British Columbia is in preparation by Dr. Gail Sandercock and Dr. Geoff Scudder at the University of British Columbia. It is expected to be complete in April 1996.

Partial checklist of Copepoda in B.C.:
Key to the Copepods of North America:


Class OSTRACODA (seed shrimp)

Key to the Ostracodes of B.C.:

A key to the ostracodes of British Columbia is currently in preparation by Gordon Green, Curator of Invertebrates at the Royal B.C. Museum.

Checklist of the Ostracodes in B.C.:


Status: None of the Ostracodes in B.C. are believed to be rare or endangered.

Keys to the Ostracodes of Canada:


Please see bibliography for additional references on Canadian Ostracodes.
Class MALACOSTRACA

Superorder PERACARIDA

Order MYSIDACEA (opossum shrimp)

No keys are known to exist for B.C. or Canada.

Status: unknown.

Key to the Genera of Mysids of North America:


Order AMPHIPODA (scuds)

No keys are known to exist for B.C.

Checklist of the Amphipods of B.C.:


Additions to the checklist:


**Status:** Three species of freshwater Amphipods, which are all endemic to B.C., are thought to be at risk: *Ramellogammarus vancouverensis* Bousfield, *Stygobromus quatsinensis* Holsinger & Shaw, *Paramoera carlottensis* Bousfield.

**Key to the freshwater Amphipods of North America:**


**Checklist of the freshwater Amphipods of North America:**


**Order ISOPODA (aquatic sow bugs)**

No checklists or keys are known to exist for B.C. or Canada

**Status:** Six species of Isopods in B.C. are believed to be at risk, though only one species is a freshwater form: *Caecidotea occidentalis* (Williams).

**A key to the Genera of Isopods of North America:**


Further details of the ispod genus Asellus are contained in:


**Superorder EUCARIIDA**

**Order DECAPODA (freshwater shrimps and crayfishes)**

No checklists or keys are known to exist for B.C. or Canada.

**Keys to North American Shrimps and Crayfishes:**

Phylum CHORDATA

Subphylum VERTEBRATA

The vertebrates of British Columbia have been well catalogued. A complete list of species (to 1988) is contained in:


Class MAMMALIA (Mammals)

Checklist of the Mammals of B.C:


Class REPTILIA (Reptiles)

Checklist of the Reptiles of B.C:


Class AVES (Birds)

Checklist of the Birds of B.C:

Class AMPHIBIA (Amphibians)

Checklist of the Amphibians of B.C:


Class CYCLOSTOMATA (Hagfishes and Lampreys)

Class OSTEICHTHYS (Bony fishes)

Key to the Freshwater Fishes of British Columbia:
McPhail, J.D. and R. Carveth. 1996. Field Key to the Freshwater Fishes of British Columbia. Fish museum, Department of Zoology, University of British Columbia.

Checklist of the Freshwater Fishes of B.C: