Taxonomic Laboratory Protocol for Stream Macroinvertebrates Collected by the Washington State Department of Ecology

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Introduction

The Washington Department of Ecology (Ecology) is engaged in collection and storage of biological data from Washington State's surface waters. Biological data collection is, in part, intended to be used for delineating temporal and spatial distribution patterns as well as establishing biocriteria. The long term program goal is to develop a diagnostic tool for determining the condition and source of degradation in the state's aquatic systems.

Ecology's aquatic invertebrate biological assessment program and other related monitoring programs in the agency consist of several components: field collection, sample processing, organism identification, data storage/analysis, and interpretation of results. Protocols that standardize methods for each component help assure consistent and comparable results between projects. Standardized field collection protocols and sample processing protocols have already been described in other Ecology quality assurance project plans (Merritt, 1994; Plotnikoff, 1994).

The taxonomic laboratory protocol provides guidance for consistent aquatic macroinvertebrate (invertebrate) identifications. Consistency between taxonomists and between projects enhances comparability of taxonomic effort.

Standard Taxonomic Effort

A standard taxonomic effort for aquatic invertebrate identification is outlined. Effort expended in identification depends on quality of taxonomic keys, time taken to identify a taxon, and specimen condition. Aquatic insect taxonomy is primarily based on treatment of adult male characters. Reliable species identification is impossible unless larval characters have been completely described for an entire genus. Usually, the adult males confirm a species.

Taxonomic group, family, or genus identifications are appropriate for most taxa. Many of the keys depend on morphological descriptions for late instar specimens. These late instars must often be in excellent condition following collection from the stream.

The following list contains taxa names previously reported in the scientific literature and can be reliably identified. To use this list, specimens are identified to the lowest taxonomic level indicated. If the specimen is not listed, then the next highest taxonomic level is reported.

Aquatic Invertebrates

EPHEMEROPTERA (genus - Merritt and Cummins, 1996; Edmunds *et al.,* 1976; select northwestern species - Jensen, 1966)

Ameletidae - *Ameletus*
Ametropodidae - *Ametropus*
Baetidae
    Acentrella (species-McCafferty *et al.,* 1994)

*insignificans (*formerly in *Baetis)*
*turbida (*formerly in *Pseudocloeon)*
Baetis (species-Morihara and McCafferty, 1979)
bicaudatus
bicaudatus/tricaudatus
tricaudatus
Centroptilum
Callibaetis
Diphetor hageni (previously known as *Baetis hageni*) (McCafferty and Waltz, 1990)
Baetiscidae - *Baetisca columbiana*
Caenidae (genus)
Caenis
Ephemerellidae
Attenella (species-Allen and Edmunds, 1961a)
delantala
margarita
Caudatella (species-Allen and Edmunds, 1961b)
cascadia
edmundsi
heterocaudata
hystrix
orestes
Drunella (species-Allen and Edmunds, 1962)
coloradensis/flavilinea
doddsi
grandis
grandis/spinifera
spinifera
Ephemerella (species-Allen and Edmunds, 1965)
alleni
aurivillii
inermis/infrequens complex (if early instars*)*
Serratella (species-Allen and Edmunds, 1963a)
teresa
tibialis
Eurylophella lodi (species-Allen and Edmunds, 1963b)
Timpanoga hecuba (species-Allen and Edmunds, 1959)
Ephemeridae
Ephemera
Hexagenia
Heptageniidae
Cinygmula
Cinygma
Epeorus (species-Edmunds and Allen, 1964)
albertae

deceptivus
grandis
longimanus
Ironodes (Merritt and Cummins, 1996)
Heptagenia
Heptagenia/Nixe
Rithrogena
Nixe
Isonychiidae
I*sonychia*
Leptophlebiidae
Choroterpes
Leptophlebia
Paraleptophlebia spp.
bicornuta
Siphlonuridae
Siphlonurus
Tricorythidae
Tricorythodes minutus

ODONATA (family-Merritt and Cummins, 1996)

Aeschnidae
Aeschna
Anax
Calopterygidae
Calopteryx
Hetaerina
Coenagrionidae
Argia
Enallagma/Ischnura
Zoniagrion
Libellulidae
Corduliidae
Corduliinae (subfamily-Merritt and Cummins, 1996)
Macromiinae (subfamily-Merritt and Cummins, 1996)
Macromia
Cordulegastridae
Cordulegaster
Gomphidae
Octogomphus
Ophiogomphus
Lestidae
Macromiidae
Macromia

PLECOPTERA (genus-Stewart and Stark, 1988; species - Baumann *et al.*, 1977)

Capniidae
Chloroperlidae
- *Kathroperla perdita*
- *Paraperla*
- *Sweltsa* grp.

Leuctridae
- *Megaleuctra*
- *Moselia*

Nemouridae
- *Amphinemura*
- *Malenka*
- *Ostrocerca*
- *Podmosta*
- *Prostoia*
- *Soyedina*
- *Visoka cataractae*
- *Zapada* (Baumann *et al.*, 1977)
  - *columbiana*
  - *cinctipes*
  - *frigida*
  - Oregonensis grp.

Peltoperlidae (Stark and Stewart, 1981)
- *Sierraperla*
- *Soliperla* (Stark, 1983)
- *Yoraperla* (species-Stark and Nelson, 1994)
  - *brevis*
  - *mariana*
  - *siletz*
  - *nigrisoma*

Perlidae
- *Calineuria californica*
- *Claassenia sabulosa*
- *Doroneuria*
- *Hesperoperla pacifica*

Perlodidae
- Perlodidae early instar
- *Calliperla luctuosa*
- *Cascadoperla trictura* (Szczytko and Stewart, 1979)
- *Cultus*
- *Frisonia picticeps*
- *Isoperla* (Szczytko and Stewart, 1979)
- *Kogotus nonus*
- *Megarcys*

Perlinodes aureus
Osobenus yakimae
Rickera sorpta
Setvena tibialis
Skwala
Pteronarcyidae
Pteronarcella
Pteronarcys californica
princeps
dorsata
Taeniopterygidae
Taeniopteryx

MEGALOPTERA (family/genus-Merritt and Cummins, 1996)

Corydalidae
Sialidae
Sialis

NEUROPTERA (family/genus-Merritt and Cummins, 1996)

Sisyridae
Climacia
Sisyra

TRICHOPTERA (genus-Wiggins, 1996; Merritt and Cummins, 1996)

Brachycentridae (Wiggins, 1965)
Amiocentrus aspilus
Brachycentrus (species-Flint, 1984)
americanus
occidentalis
Eobrachycentrus gelida
Micrasema
Oligoplectrum echo
Calamoceratidae
Heteroplectron californicum
Helicopsychidae
Helicopsyche borealis
Hydropsychidae
Hydrophychinae (genus-Wiggins, 1996)
Cheumatopsyche
Hydropsyche
Arctopsychinae (genus-Wiggins, 1996)
Arctopsyche grandis

Parapsyche (species-Givens and Smith, 1980)
almota
elsis
Hydroptilidae
Agraylea
Hydroptila
Ochrotrichia
Oxyethira
Neotrichia
Palaeagapetus
Glossosomatidae
Anagapetus
Agapetus
Glossosoma
Protoptila
Lepidostomatidae
Lepidostoma (species-Weaver, 1988)
Leptoceridae
Ceraclea
Mystacides
Nectopsyche
Oecetis (Floyd, 1995)
Triaenodes
Limnephilidae
Allocosmoecus partitus
Apatania
Asynarchus
Chyranda centralis
Clistoronia
Clostoeca disjuncta
Cryptochia
Desmona bethula
Dicosmoecus (species-Wiggins and Richardson, 1982)
atripes
gilvipes
Ecclisomyia
Ecclisocosmoecus seylla
Eocosmoecus (species-Wiggins and Richardson, 1989)
s*chmidi*
frontalis
Goera archaon
Halesochila taylori
Hesperophylax
Homophylax
Hydatophylox hesperus

Imania
Lepania cascadia
Lenarchus
Limnephilus (Ruiter, 1995)
Moselyana comosa
Onocosmoecus
Pedomoecus sierra
Philocasca
Psychoglypha
subborealis
bella
Phryganeidae
Agrypnia
Banksiola
Phryganea
Ptilostomis
Philopotamidae
Chimarra
Dolophilodes
Wormaldia
Polycentropodidae
Polycentropus
Nyctiophylax
Psychomyiidae
Psychomyia
Tinodes
Rhyacophilidae
Himalopsyche phryganea
Rhyacophila (species group-Wold, 1974; Anderson, 1976; Smith, 1968; Smith, unpublished 1995)
Angelita grp.
Alberta grp
Betteni grp.
malkini
Brunnea grp.
Coloradensis grp.
Ecosa grp.
ecosa
Grandis grp.
grandis
Hyalinata grp.
Lieftincki grp.
arnaudi
Nevadensis grp. (Smith, 1985)

Oreta grp.
oreta
Rotunda grp.
Sibirica grp.
blarina
narvae
*pellisa (*Rocky Mountains*)*
*valuma (*maritime*)*
Vagrita grp.
Vemna grp.
Viquaea grp
Verrula grp.
Vofixa grp.
Uenoidae
Farula
Neophylax (species-Vineyard and Wiggins, 1987)
occidentalis
rickeri
splendens
Neothremma
Oligophlebodes

LEPIDOPTERA (family/genus-Merritt and Cummins, 1996)

Pyralidae
Petrophila

COLEOPTERA (family/genus-Merritt and Cummins, 1996; Usinger, 1956)

Amphizoidae
Amphizoa
Dryopidae
Helichus
Dytiscidae
Elmidae (adults and larvae to genus; Brown, 1972)
Ampumixis dispar
Cleptelmis
Heterlimnius
Lara avara
Microcylloepus
Narpus concolor
Optioservus
Ordobrevia nubifera
Zaitzevia

Gyrinidae
- *Dineutus*
- *Gyrinus*
- *Gyretes*

Haliplidae
- *Byrchius*
- *Haliplus*
- *Peltodytes*

Hydrophilidae
- *Berosus*

Psephenidae
- *Acneus*
- *Decranopselaphus*
- *Psephenus*
- *Eubrianax edwardsi*

DIPTERA (family/genus-Merritt and Cummins, 1996; McAlpine *et al.*,1981 and 1987)

Athericidae
- *Atherix*

Blephariceridae

Ceratopogonidae
- Ceratopogoninae
- Forcipomyiinae

Chironomidae

Deuterophlebiidae
- *Deuterophlebia*

Dixidae
- *Meringodixa*
- *Dixella*
- *Dixa*

Dolichopodidae

Empididae
- *Chelifera*
- *Clinocera*
- *Hemerodromia*
- *Oreogeton*
- *Wiedemannia*

Ephydridae

Muscidae
- *Limnophora*

Nyphomyiidae

Pelecorhynchidae
- *Glutops*

Psychodidae
Psychoda
Pericoma
Maruina

Ptychopteridae
Ptychoptera
Bittacomorpha
Sciomyzidae
Simuliidae
Stratiomyidae
Syrphidae
Thaumaleidae
Thaumalea
Tabanidae
Tanyderidae
Protanyderus
Tipulidae
Antocha
Dicranota
Hesperoconopa
Pedicia
Hexatoma
Limnophila
Limonia
Tipula
Ormosia
Rhabdomastix

For other invertebrate taxa, use Pennak (1977 and 1989) or Thorp and Covich (1992) as general guides.

Phylum: Arthropoda

Class: Crustacea

AMPHIPODA (genus-Holsinger, 1972)

Gammarus
Hyallela azteca

COPEPODA (order)

ISOPODA (order)

OSTRACODA (order)

DECAPODA (genus-Hobbs, 1972)
Pacifasticus

Phylum: Mollusca

Class: Pelecypoda (bivalves)

PELECYPODA (family/genus-Burch, 1972))
Sphaeriidae
Unionidae
Margaritiferidae
Magaritifera
Corbiculidae
Corbicula

Class: Gastropoda (snails, limpets)

GASTROPODA (family/genus-Pennak, 1978; Burch, 1982)
Ancylidae
Ferrissia
Lymnaeidae
Physidae
Physella
Valvatidae
Hydrobiidae
Fluminicola
Planorbidae
Pleuroceridae
Juga

NON INSECTS (flatworms, leeches, horsehair worms, earthworms, roundworms)

TURBELLARIA (class)

HIRUDINEA (Klemm, 1972)
Helobdella stagnalis

NEMATODA (order)

NEMATOMORPHA (order)

OLIGOCHAETA (class)

NON INSECTS (freshwater sponges, hydroids)

PORIFERA (phylum)

HYDRA (order)

NON INSECTS (water mites)

ACARI

Key Identification Characters

Identification of aquatic insects is done with physical descriptions. Our program uses those physical descriptors that have been reported in the published literature and other features of aquatic insects that have regional application. The sometimes lengthy path for identification of taxa can be circumvented by using fewer, but consistent characters, that have been extracted from large identification keys.

Availability of these condensed physical descriptions for aquatic insect taxa is intended to accomplish three goals:

- expedite aquatic invertebrate identification,
- maintain consistent identification, and
- provide guidance for less-experienced taxonomists.

The narratives for taxa identification are arranged according to order and where possible, family. Specialty keys are listed for genera or species when available.

Ephemeroptera

Recommended keys for this order are Merritt and Cummins (1996), Edmunds *et al*. (1976) and Jensen (1965), a Master's Thesis.

Ameletidae

Ameletidae has one genus, *Ameletus*, which is not identified to species. *Ameletus* was moved from the family Siphlonuridae.

Baetiscidae

Baetisca columbiana is the only known Baetiscidae found in Washington.

Baetidae

Most specimens should be identified to genus and, if in good condition, identified to species. Three genera are commonly found in lotic waters: *Baetis*, *Acentrella*, and *Diphetor*. *Baetis* has two species that are often collected, *B. bicaudatus* and *B. tricaudatus*. The appropriate key for baetid species is Morihara and McCafferty (1979).

Acentrella is a two-tailed baetid that has a dense dorsal row of setae from the femur to the tarsal claw (*insignificans*) or is missing hind wing pads (*turbida*). All other baetids have a row of setae on the femur, but sparse on the tibial and tarsal segments. Revised species descriptions and keys can be found in McCafferty *et al.* (1994).

Diphetor hageni, a monotypic genus, was formerly called *B. hageni*. Gills on segments 1-7 is the key characteristic for this species.

Centroptilum and *Callibaetis* are common in lentic conditions and slow moving streams and rivers.

Ephemerellidae

Ephemerellidae is represented by many genera, all of which can be identified to species. Examples of genera include *Attenella, Caudatella, Drunella, Ephemerella, Eurylophella, Serratella, and Timpanoga.* Keys to species for these genera are as follows: Allen and Edmunds (1961a), (1961b), (1962), (1963a and b), (1965), and Jensen (1975).

Attenella is represented by *A. margarita* and *A. delantala* and can be distinguished by the occurrence of light-colored gills on segments 4-7.

Two species of *Ephemerella* are commonly found (*E. inermis* and *E. infrequens*) but are hard to separate and should be called *E. inermis/infrequens*. *Ephemerella* and *Serratella* are occasionally difficult to separate with small specimens or if cerci are missing.

Eurylophella is represented by one previously known species in Washington, *E. lodi*. This genus is not commonly collected.

The last genus, *Timpanoga*, is monotypic. This genus is distinguished by the flared lateral abdominal tergites.

Heptageniidae

All taxa in the heptageniid family can be identified to genus. The following taxa are always identified to genus: *Cinygmula* (no species keys available), *Cinygma* (no species keys available), *Heptagenia, Rithrogena, Ironodes* and *Nixe*. *Epeorus* should be identified to species. Jensen (1965) is available for species descriptions and identifications.

Epeorus is identified to species with Edmunds and Allen (1964) or Jensen (1965). One species, late instar *E. longimanus,* has a dark macula on the dorsal surface of each femur that helps distinguish it from other species.

Siphlonuridae

Siphlonuridae has one representative, *Siphlonurus,* which should not be identified beyond genus.

Leptophlebiidae

The family Leptophlebiidae is represented by one common genus, *Paraleptophlebia,* and two uncommon genera: *Leptophlebia* and *Choroterpes*. Loss of gills makes species identification for *Paraleptophlebia spp*. difficult and further identification is not recommended other than for *P. bicornuta*. The presence of tusks makes *P. bicornuta* easily identifiable.

Caenidae, Tricorythidae, Ephemeridae, Ametropodidae, Oligoneuriidae

These families have local distributions and can be confidently identified to genus. Reliable keys for the species have not been provided. *Tricorythodes minutus* is the only species from the family Tricorythidae that has been currently identified in Washington.

Odonata

Identification of odonates should be made to family with keys provided in Merritt and Cummins (1996). A microscope with higher magnification is often needed to confirm morphological features. Early instar larvae cannot be reliably identified. This is a large order with many representatives in Washington. Representatives of the families Aeschnidae, Calopterygidae, Coenagrionidae, Corduliidae, Cordulegastridae, Gomphidae, and Lestidae are present in Washington.

Plecoptera

Family and generic descriptions are found in Stewart and Stark (1988). General species keys are found in Baumann *et al*. (1977). Other keys detailing genera and species are reported in the text.

Capniidae

The stonefly family Capniidae is identified to the family level. Late-instars can be identified to genus to advance knowledge of state distributions.

Leuctridae

Leuctridae should be identified to the family level except for one taxon, *Moselia infuscata.* Large specimens in good condition should be identified to genus for contribution to state distributional records.

Nemouridae

The family is represented by many genera including: *Amphinemura*, *Lednia*, *Malenka*, *Nemoura*, *Podmosta*, *Prostoia*, *Soyedina*, *Ostrocerca*, *Visoka*, and *Zapada*. *Visoka cataractae* is a monotypic genus and is the only nemourid with submental gills. *Zapada* is represented by several species (Baumann *et al., 1*977). *Podmosta*, *Prostoia*, *Soyedina*, and *Ostrocerca* have local distributions. *Podmosta* is found in cold headwater streams while *Prostoia* is found in warm, large streams.

The two genera, *Amphinemura* and *Malenka*, are difficult to separate because of highly branched anterior thoracic gills. *Malenka* is the most common genus found west of the Cascades and has uneven gill filament lengths with an occasional single branch. Submental gills on *Amphinemura spp.* do not branch and are all the same length. The distribution of *Amphinemura* in Washington is uncertain.

Zapada is represented by six known species in Washington with only four that are common (*Z. Oregonensis* grp., *Z. columbiana*, *Z. cinctipes* and *Z. frigida*). *Z. frigida* is uncommon but has a widespread distribution and is recognized by gill lengths of 12-15 times longer than the width. *Z. cinctipes* has anterior thoracic gills that branch up to 4 or 5 times and is the most prevalent nemourid. We are unaware of existing keys for the aquatic stage of *Z. haysi* and *Z. cordillera* (*Z.* Oregonensis grp.).

Taeniopterygidae

Three genera are represented in the family Taeniopterygidae in Washington of which only *Taeniopteryx* can be identified past family. The presence of a dorsal fringe of fine silky hairs on the cercal segments of *Doddsia occidentalis* separates this genus from *Taenionema* in mature nymphs. *Doddsia* is a monotypic genus. *Taeniopteryx* has single coxal gills.

Chloroperlidae

For the family Chloroperlidae, only *Sweltsa*, *Kathroperla perdita*, and *Paraperla* should be identified to the generic level. *Sweltsa* has thick depressed black hair on all thoracic sterna. All other taxa are identified to the family level. Mature specimens in good condition can be identified to genus. *Kathroperla perdita* and *Paraperla frontalis* have eyes set forward of the head's midline and are usually light colored nymphs. *K. perdita* has semiquadrate lacinia and *P. frontalis* has a subtriangular lacinia (Stewart and Stark, 1988).

Peltoperlidae

Peltoperlidae, or the roach-like stoneflies, are represented by two genera in Washington, *Soliperla* and *Yoraperla* (an important note, *S. fenderi* is on the U.S. Fish and Wildlife's threatened species list). *Yoraperla* has double supracoxal gills, no spots present on the abdominal terga and a transverse row of stout bristles on the anterodorsal surface of the femora. Patterns on the abdominal terga may not be consistent among individual nymphs. Species descriptions and keys for *Yoraperla* can be found in Stark and Nelson (1994). *Yoraperla* is represented by four species: *Y. brevis*, *Y. mariana*, *Y. siletz*, and *Y. nigrisoma*. *Y. mariana* is commonly found in the Cascades range and *Y. brevis* is common in the Northern Rockies range. The remaining species are found in southern Cascade range streams of Washington (south of Mt. Rainier).

Perlidae

The family Perlidae is represented by four taxa in Washington. Two of these are monotypic: *Calineuria californica* and *Claassenia sabulosa*. Identification of the perlid stoneflies can be done with Stewart and Stark (1988). *Hesperoperla pacifica* is the only perlid with anal gills and a keyhole pattern on the dorsal part of the head. *C. sabulosa* can be separated from the rest of the perlids by a uniform, continuous spinule row on the postocciput. Probably the most common perlid, *C. californica*, is distinguished from *Doroneuria* by lacking a dorsal, medial fringe of hairs.

Perlodidae

The family Perlodidae has several monotypic genera including *Calliperla luctuosa*, *Cacadoperla trictura*, *Frisonia picticeps*, *Perlinodes aureus*, *Osobenus yakimae*, and *Rickera sorpta*. Two genera that apparently have single species representatives in Washington are: *Kogotus nonus* and *Setvena bradleyi*. Other commonly collected genera are *Isogenoides*, *Isoperla*, *Megarcys*, *Skwala*, and *Cultus*. Speciation of *Isoperla* is possible with Szczytko and Stewart (1979), but require mature nymphs in good condition. We recommend *Isoperla* be identified to genus. Most early instar perlodids are difficult to identify to genus and should be called “Perlodidae-early instar”.

Pteronarcyidae

Pteronarcyiidae are the only stoneflies with filamentous gills present on the abdomen. Three species of *Pteronarcys* are present including *P. princeps, dorsata and californica.*. *Pteronarcys* has pairs of gill tufts on the ventral side of the first two abdominal segments. *Pteronarcella* has pairs of gill tufts on the ventral side of the first three abdominal segments. Early instar *Pteronarcella* are hard to speciate so it is recommended to leave at genus.

Megaloptera

Generic identification using Merritt and Cummins (1996) is recommended for taxa of this order.

Sialidae

Sialidae is represented by one genus, *Sialis*. Single gill filaments arise laterally from each abdominal segment and from the posterior of the abdomen.

Corydalidae

At least five genera have been identified in Washington, but taxonomic effort should be to family. Most corydalids are found west of the Cascade Range. Additional distributions may be throughout the lower Columbia River tributaries and in the upper Yakima River drainage.

Neuroptera

Neuroptera is a unique order with aquatic representatives living in freshwater sponges. Two genera are known to occur: *Climacia* and *Sisyra*. Identifications should be to the genus level.

Trichoptera

Descriptions and keys to families and genera can be found in Wiggins (1996) and Merritt and Cummins (1996).

Brachycentridae

The brachycentrid family is represented by five genera: *Brachycentrus, Amiocentrus aspilus* (monotypic), *Eobrachycentrus gelidae* (monotypic), *Micrasema*, and *Oligoplectrum*. *Brachycentrus* can be identified to species (Flint, 1984). Two species of *Brachycentrus* are known to be present in Washington: *B. americanus* and *B. occidentalis*. *B. americanus* has two major setae on venter of abdominal segment 1 (ab1) and *B. occidentalis* four major setae present on the ventre of ab1. *B. americanus* has an anterolateral carina above each compound eye.

Micrasema and *Amiocentrus* occasionally occur together and care should be taken in separating the two genera. *Micrasema* has numerous mesonotal sa1 setae and the posterior opening of the case has a clover shape. *Amiocentrus* has only one mesonotal sa1 seta and the posterior opening of the case is circular.

Calamoceratidae

One genus, *Heteroplectron*, is known to be represented in Washington. *H. californicum*, the only species of *Heteroplectron* in the western United States, is unique in that it hollows out twigs as a case.

Glossosomatidae

Glossosomatidae has four known genera that occur in Washington: *Glossosoma*, *Anagapetus*, *Agapetus,* and *Protoptila*. *Glossosoma* and *Anagapetus* are the most common taxa and occasionally co-occur. Excision of the pronotum by the fore coxae consistently separates the two genera and can be difficult to identify in early instar larvae. *Glossosoma's* pronotum is excised one-third its lateral width from the anterior and *Anagapetus's* pronotum is excised two-thirds this distance. The Glossosomatidae should be identified to genus.

Helicopsychidae

Helicopsyche is the genus frequently found in the Northwest. Reliable species keys are unavailable. The case for this genus is coiled, much like that of a snail, and is distinctive. Therefore, we use *H. borealis* as a valid scientific name for this common taxon.

Hydroptilidae

At least six genera of Hydroptilidae are found in Washington: *Agraylea*, *Hydroptila*, *Ochrotrichia*, *Oxyethira*, and *Neotrichia*. Identifications should be made to the generic level.

Hydropsychidae

The Hydropsychidae are a complex group and sometimes difficult to identify in larval form. However, four genera of Hydropsychidae are found in Washington and are easily identified. These genera are: *Hydropsyche*, *Cheumatopsyche*, *Arctopsyche,* and *Parapsyche*. *Hydropsyche* is the most common taxon in this family but *Ceratopsyche* has been lowered to subgenus status (Wiggins, 1996). Older taxonomic keys for this family report *Ceratopsyche* as a distinct genus (e.g., Merritt and Cummins, 1984) or prefer the name retained as a distinct genus until further worldwide taxonomic work is completed (Merritt and Cummins, 1996). *Hydropsyche* and *Cheumatopsyche* belong to the subfamily Hydropsychinae (Wiggins, 1996). Further information for the *Hydropsyche morosa* group can be found in Schefter and Wiggins (1986).

Arctopsyche and *Parapsyche,* are placed in the subfamily Arctopsychinae, and can be identified by using Givens and Smith (1980). *Arctopsyche grandis* is the only known species present in this genus throughout Washington. A distinguishing feature is the light colored longitudinal stripe on its head. There are two species of *Parapsyche: P. elsis* and *P. almota*. *P. elsis* can be confused with *A. grandis* if the ventral apotome is the only character examined (tapering ventral apotome). Long scale hairs on the abdominal sa2 and sa3 positions are used to positively identify *Parapsyche. P. almota* has a parallel sided ventral apotome.

Leptoceridae

Leptoceridae is commonly found in lentic waters and is identified to genus. Five genera have been identified in Washington: *Ceraclea, Mystacides, Nectopsyche, Oecetis* and *Triaenodes*. Small specimens make generic identifications difficult.

Lepidostomatidae

One genus, *Lepidostoma,* exists in the western United States. Lepidostomatids are the only Trichopteran with the antennae located next to the eye. Specimens with cases present and in good condition can be identified to species or species group with Weaver (1988). Immature instars build small, slightly curved cases constructed of sand grains. Careful examination of antennae location confirms their identity.

Limnephilidae

There are twenty-six genera from this family known in Washington State. Of these, *Dicosmosecus* and *Eocosmoecus* can be consistently identified to species (Wiggins, 1982; Wiggins and Richardson, 1989). Genera with one known species in Washington include: *Ecclisocosmoecus scylla, Goera archaon*, and *Hydatophylax hesperus*. Monotypic taxa include: *Allocosmoecus partitus, Chyranda centralis, Clostoeca disjuncta, Desmona bethula, Halesochila taylori, Lepania cascadia,* and *Pedomoecus sierra*.

Philopotamidae

All three North American genera occur in Washington: *Chimarra, Dolophilodes,* and *Wormaldia*. *Chimarra* is uncommon. Identifications should be made to genus. Mature larvae are easily distinguished from related families by the absence of a sclerotized plate on the dorsum of abdominal segment IX and a T-shaped membranous labrum (sometimes withdrawn).

Phryganeidae

Four genera are known to occur in Washington (*Agrypnia, Banksiola, Phryganea,* and *Ptilostomis*). Reliable species keys are unavailable.

Polycentropodidae and Psychomyiidae

Each of these families has two genera distributed in Washington. Association of genera with family are as follows: Polycentropodidae: *Polycentropus* and *Nyctiophylax;* and Psychomyiidae: *Psychomyia* and *Tinodes*. The distinct head patterns of these two families help identify them from most rhyacophilids and philopotamids.

Rhyacophilidae

Rhyacophilidae should be identified to species or species groups with Wold (1974). Schmid (1970), Smith (unpublished), and Anderson (1976) provide descriptions of all taxa and can be used as a cross-reference. There are 16 known species groups recognized in Washington and 27 North American species.

Uenoidae

Three genera represent the Uenoidae family: *Farula*, *Neothremma,* and *Neophylax*. Species identification for *Neophylax* can be done with Vineyard (1986). Three species of *Neophylax* are readily identified: *N. occidentalis*, *N. rickeri,* and *N. splendens*.

Lepidoptera

Identification of the aquatic Lepidoptera can be done with Merritt and Cummins (1996). The family Pyralidae is represented in the state by one common taxon, *Petrophila*. There are many uncommon taxa and should be identified if present. It is important to watch for incidental collection of terrestrials that have been incorporated into the sample.

Coleoptera

Larvae and adult keys for generic identification are found in Merritt and Cummins (1996). Species keys for select families of adults can be found in Brown (1972) and Hatch (1953 and 1965).

Amphizoidae

One genus is found in Washington: *Amphizoa*

Dryopidae

From distributional information, one species of Dryopidae can be found in Washington. *Helichus striatus* can be identified using Brown (1972). More recently, the new genus *Postelichus* has been derived from original descriptions of *Helichus*. Merritt and Cummins (1996) provides a key for adult dryopids.

Dytiscidae and Hydrophilidae

These two families have numerous representatives in Washington. Identifications can be made to genus using Merritt and Cummins (1996) or Usinger (1956). Most taxa should be identified to the family level.

Elmidae

Larval and adult Elmidae should be identified to genus using Brown (1972). *Ampumixis dispar* and *Narpus concolor* are representatives for each of these genera in Washington. Additionally, *Cleptelmis, Heterlimnius, Microcylloepus,* and *Ordobrevia nubifera* have been collected in the state. Several species from two genera have records of occurrence in Washington: *Lara avara, L. gehring*i (considered a synonym of *L. avara*), *Optioservus quadrimaculatus, O. divergens, O. seriatus,* and *O. pecosensis.* Generic identification of *Optioservus* is adequate. Other than *Ordobrevia,* all genera are common.

Gyrinidae, Haliplidae Psephenidae

Generic level identifications for this family are appropriate. Gyrinidae has at least three genera in the state: *Dineutus, Gyrinus,* and *Gyretes*; and Haliplidae has at least three genera: *Brychius, Haliplus,* and *Peltodytes*. Psephenidae has three representatives in Washington: *Acneus oregonensis, Eubrianax edwardsi* and *Psephenus falli*. *Dicranopselaphus* is an uncommon genus of Psephenidae.

Diptera

Two important taxonomic keys are used for identifications of dipterans. Merritt and Cummins (1996) and McAlpine *et al.* (1981,1987, and 1989) provide sufficient information to identify most dipterans to family or genus.

Athericidae

Atherix is the only genus identified for Washington collections.

Blephariceridae

All five North American genera: *Agathon, Bibiocephala, Blepharicera, Dioptopsis,* and *Philorus* are distributed in Washington but should not be identified past family.

Ceratopogonidae, Chironomidae, and Simuliidae

These three families constitute a large portion, of the total taxa and abundance of invertebrate stream biota. Consistent keys to northwestern taxa have not yet been developed for general use with Ceratopogonidae. Currently, genus and species identifications of Chironomidae and Simuliidae require regional taxonomic expertise. Unless the objectives of a study require finer taxonomic detail, identification to family is adequate.

Dixidae

Three genera are found in Washington which include *Meringodixa*, *Dixella*, and *Dixa*. Identifications to genus are straightforward.

Empididae

Chelifera, Clinocera, Hemerodromia, Oreogeton, and *Wiedemannia* are all found in Washington. Empidids should be identified to genus. *Chelifera* and *Clinocera* are most common.

Psychodidae

Psychodidae has three genera commonly found in Washington: *Psychoda, Pericoma,* and *Maruina*. All should be identified to the genus level.

Ptychopteridae

Two genera, *Ptychoptera* and *Bittacomorpha*, are probably found in Washington.

Tipulidae

At least 10 genera from this family are commonly found in Washington: *Antocha, Dicranota, Hesperoconopa, Pedicia, Hexatoma, Limnophila, Limonia, Tipula, Ormosia,* and *Rhabdomastix*. Genera in this family can be difficult to identify. Two genera, *Hexatoma* and *Limnophila,* can be hard to separate. *Hexatoma* usually has dark pigmentation on the inside of each anal lobe. *Limnophila* does not have the dark pigment lines on the anal lobes, but instead are densely covered with short hairs. *Dicranota* may have the first pair of prolegs drawn up into the body and can be mistaken for *Pedicia*.

Dolichopodidae, Ephydridae, , Nyphomyiidae, Scathophagidae, Sciomyzidae, Stratiomyidae, and Syrphidae

These families have fewer representatives among the aquatic fauna of moving waters. Most of these families do not have reliable keys for generic identification. Family level identifications are appropriate.

Non-Insect Taxa

All non-insect taxa should be identified to the recommended standard taxonomic level with either Pennak (1978) or Thorp and Covich (1991).

Storage and Verification Procedures

Specific storage techniques and verification procedures of the invertebrate collection are required for each Ecology project. The invertebrates in samples from each project are identified, a reference collection consisting of all taxa in a sample is made, and all rare or uncommon species are kept for verification. Ecology maintains a state voucher collection at the headquarters building in Olympia, Washington. The collection contains representative taxa from each region of the state. New specimens are added to the collection from successive projects when:

- the specimen is in better condition than those in the voucher collection,
- the specimen represents some variation of a morphological characteristic, or
- the taxon has not yet been vouchered.

Storage of identified benthic macroinvertebrate samples is required for 5 years. A longer period of storage for project materials is recommended if space is available (e.g., a museum).

The voucher collection serves several project requirements. First, examples of taxa are provided from several geographic regions of the state, which can assist regional taxonomists with identifications. Second, valid identifications satisfy quality assurance performance objectives. Third, the material is available to qualified researchers to advance the knowledge of aquatic sciences. All specimens should be confirmed by established regional or national experts.

Archival Protocols

Archival procedures require the use of databases, consistent labeling procedures, and reliable storage materials. Recording information in electronic form allows access to information quickly. Also, a large body of information can be stored and organized in this form. As taxa revisions occur, information stored in electronic form can be efficiently revised.

Labels document the origin and identification of each taxon. Material for labels should be reliable in retaining information relating to each specimen. Paper used for specimen storage should be acid free, thirty pound linen stock. If labels are hand-written, black india ink is required. All labels are placed inside the sample container. The ink should dry thoroughly before placement in alcohol to alleviate smudging. Alcohol-proof pens (disposable) will also work and can be found in most office supply stores. Laser printed labels are used to save time, but stability of this ink type in alcohol is unknown. Back-up labels are recommended in addition to the primary label if laser printers are used. Label format is complete with the following information:

Location (State, County)	Elevation
Water Body Collected	Date
Latitude and Longitude	Collector/Project

Specimens should be stored in 70% alcohol and should not have more than one part specimen to four parts of alcohol. Storage in borosilicate glass vials with polyvinyl caps is required to

minimize alcohol evaporation. It is imperative to annually check collections for loose caps and to refill those vials low in preservative. These can then be placed in glass jars with polyvinyl lids for long-term storage and organization.

Taxonomic Accuracy

The agency's biological monitoring program seeks to provide high quality, relevant data for regulatory decision-making. Building the biological assessment program on a strong base will provide confidence in using the conclusions drawn from stream biology. A strong basic program begins with consistency and accuracy in field collection and laboratory analysis.

Identification of aquatic insects from samples should be consistent and accurate. Taxonomic literature is available for the well-studied orders of aquatic insects and, therefore, is revised frequently. A large biological monitoring program would not produce consistent temporal information if literature used for laboratory analysis changed between years. Standard literature is identified for continual use until the database review period is due (every five years; corresponds with one cycle of Ecology's Watershed Planning Program where all drainages in the state have been evaluated). Retention of vouchered specimens will allow for taxonomic corrections whenever literature revisions occur.

Changes in taxonomic keys that provide reliable descriptions of a species are incorporated into the laboratory analysis routine. Taxa name changes that emerge from taxonomic revisions are incorporated into the laboratory continually. The most effective means in maintaining consistency of identification is to provide standard information for completing laboratory analysis.

Taxonomic Literature

The biological monitoring program maintains a library of taxonomic information for benthic macroinvertebrates. New literature is periodically added to the list. Key publications are marked to indicate standard works that are used for identifying taxa. Other publications included in the list are used as background information for confirming initial identifications, distribution, and ecological information.

Standardizing Identifications

Monitoring stream biology and interpreting the data rely mostly on use of established biological literature. Little time is spent learning detailed information about a single group of organisms and laboratory identifications are done for a variety of taxonomic groups. We rely on individuals who have considerable experience with single groups of aquatic insects to provide literature and guidance. This guidance standardizes how each analyst identifies organisms and reduces misinterpretations from the taxonomic literature. Also, when regional literature is used and is not widely available, we request the author's interpretation so that misconceptions are eliminated.

Continuing Development

Additional maintenance of the taxonomic protocol ensures accuracy of any taxonomic work conducted in our benthic laboratory. We anticipate continued evaluations of the current taxonomic literature and its ability to assist in expedient sample processing. Elaboration and development of larval descriptions for the more difficult groups to identify will eventually be incorporated. Finally, description of the biology for important aquatic taxa will be compiled and used for interpreting sample data.

Periodic Taxonomic Reviews

Revision of taxonomic literature is a continuous process. This document is intended to provide consistency and accuracy in laboratory sample identifications. Revisions of this laboratory identification protocol will occur periodically and incorporate new literature.

The Chironomidae (midges)

We currently do not expend much effort in identifying the Chironomidae taxa. Many of our surveys have indicated the importance of scrutinizing more closely this group of aquatic organisms. Compilation of a regional taxonomic key for larvae of Pacific Northwest streams would be useful.

Wiederholm (1983) and Merritt and Cummins (1996) provide extensive keys for larvae of the holarctic region. Other available keys focus on subfamilies or tribes of the Chironomidae. A collection of relevant literature to Pacific Northwest streams can be made to conduct detailed work with this family (Clark, 1996).

The Biology of Key Species

Although not a complete record, existing information of biology for the aquatic invertebrate taxa has great interpretive value. The appearance or disappearance of taxa from site survey comparison can be relavant when determining stream quality. Compilation of brief descriptions for species biology such as that found in Wisseman (1996) is useful during analysis of data. Biological notes are also helpful when identifying difficult taxa.

Glossary of Terms (Couplets and Words)

(from Torre-Bueno, 1989)

abdomen - the third or posterior, major division of the insect body.
abdominal segment - one of the annular subdivisions of the abdominal segment.
abdominal terga- dorsal sclerite of the abdomen.
adults- a fully grown, sexually mature insect; the final stage in the arthropod life cycle.
anterodorsal surface- in front and on top of a structure.
anterolateral carina - an elevated ridge located anteriorly and to the side.
benthic macroinvertebrates - bottom-dwelling organisms (invertebrates) in running or standing water that are not smaller than 0.595 mm in size.
cercus - (pl. cerci) an appendage of the last abdominal segment; tails
cercal segments - subdivisions of the cerci.
coxa - (pl. coxae) the basal segment of the leg, by means of which it is articulated to the body.
excision - a notch or other cut-out part.
femur - (pl. femora) the third, and usually the stoutest segment of the leg, articulated to the body through the trochanter and coxa and bearing the tibia at it distal end.
forecoxa - coxa of the front leg.
generic level - (s. genus) an assemblage of species agreeing in some character or series of characters; a category for a taxon including one species or a group of species, presumably of common phylogenetic origin.
gill filaments -a special, variously formed respiratory organ, by means of which they get dissolved oxygen from the water.
gular - (gula) the fused lower ends of the postocciput forming a ventral plate (the "chin" sclerite).
instars - stage between molts in the nymph or larva.
larva - (pl. larvae) a young wingless insect which hatches from the egg in an early stage of morphological development and differs fundamentally in form from the adult. This stage is often more difficult to identify.
lacinia - the inner lobe of the maxilla, a blade.
local distribution - not distributed throughout the whole region, but in small distinct populations.
macula - a spot or mark.
maxilla - second pair of jaws in insects with chewing mouthparts.
middle filament - of the three cerci of a mayfly, it would be the middle or second cerci.
monotypic - containing but one immediately subordinate taxon, as a genus containing but one species, or a species containing but one subspecies.
morphological - relating to form and structure.
nymphs - see larva.
postocciput - the extreme posterior rim of the cranium behind the postoccipital suture.
proleg - any process or appendage that serves the purpose of, but in not homologous with, a leg.
pronotum - the upper and dorsal part of the prothorax.
sa1, sa2, sa3 - sclerite positions on the second or third dorsal thoracic surfaces. Sclerite positions begin with the pair (sa1) forward and most closely appressed along the mid-dorsal line.

sclerite - any plate of the body wall bounded by membrane or sutures.
semiquadrate - approximating a four-sided shape.
seta - (pl. setae) a sclerotized hairlike projection.
species - an aggregation of individuals alike in appearance and structure, mating freely and producing young that themselves mate freely and bear fertile offspring resembling each other and their parents.
specific level - pertaining to the species level.
spinule - a small spine.
sternum - (pl. sterna) the entire ventral division of any segment.
submental gills - the proximal division of the postmentum, by means of which the labium is attached to the head (gills on the lower "chin").
subtriangular - an elongated triangular shape.
supracoxal gills - gills located on top of the coxae.
supraorbital - situated above the eye.
tarsal claw - claws at the apex of the leg.
tarsus - the leg segment attached too the apex of the tibia.
taxa - any taxonomic unit, whether named or not, including its subordinate taxa and individuals.
taxonomic - relating to classification.
taxonomic key - tabulation of characters of species, genera, etc., serving to identify taxa.
terga - (pl. tergite) a dorsal sclerite or part of a segment.
thoracic gills - gills belonging to the middle portion of the body between the head and abdomen consisting of 3 segments (prothorax, mesothorax and metathorax).
tibia - the fourth segment of the leg, between the femur and the tarsal segments.
ventral apotome - gular sclerite of the head capsule.

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