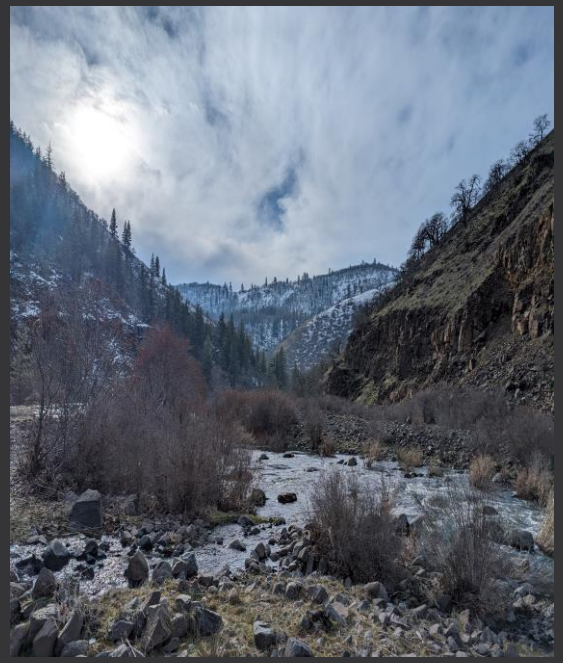
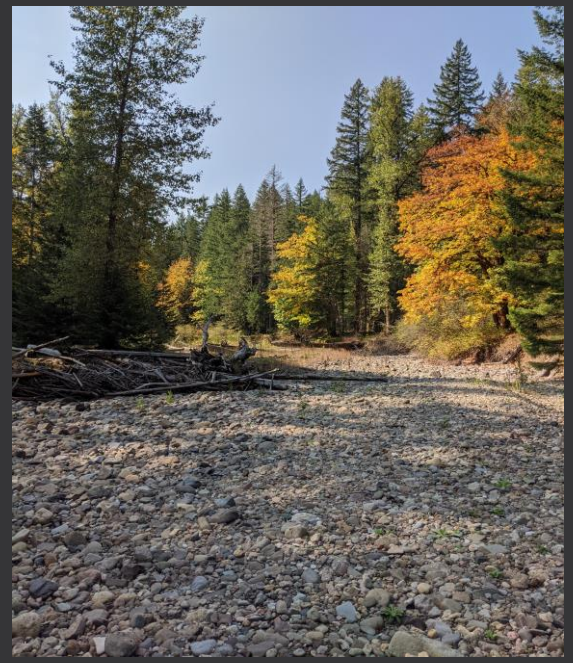
EPA United States Environmental Protection Agency

US Army Corps of Engineers

Pacific Northwest Streamflow Duration Assessment Method: Presence of aquatic macroinvertebrates, six or more mayflies, perennial indicator taxa





Virtual Training

2024

The SDAM PNW is based on 5 indicators:

All indicators are measured in the **field**

In recommended order of data collection

1. Presence of aquatic macroinvertebrates
2. Presence of 6 or more Ephemeroptera (mayflies)
3. Presence of perennial indicator taxa
4. Wetland plants in or near streambed
5. Slope

Aquatic macroinvertebrate indicators

And 2 "single indicators":

Can conduct concurrently with macroinvertebrate search

1. Presence of one or more fish
2. Presence of one or more aquatic life stages of certain herpetofauna

Aquatic macroinvertebrate indicators

- Measured with a 15-minute search in at least 6 locations that represent all habitat types.
- Do not differentiate between live organisms and non-living material (cases, shed skins, etc.). All are counted for these metrics.
- Ignore terrestrial life-stages or species.
- Use of field guides is recommended if not familiar with common types of aquatic macroinvertebrates, especially to discern aquatic vs. terrestrial taxa or life stages.

Aquatic macroinvertebrate indicators

- These metrics are **responses** to streamflow duration
  - Presence of aquatic macroinvertebrates
  - Presence of 6 or more mayflies
  - Presence of perennial indicator taxa
- Presence/abundance associated with **longer** streamflow duration

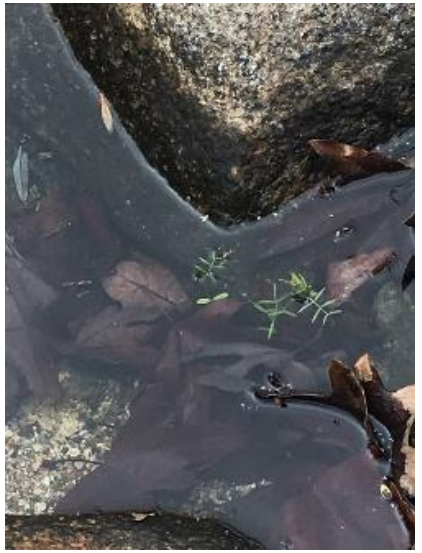
In crews of two

- This is one of the most time-consuming steps in the assessment.
- After the reach-length has been established, one person can collect, while the other starts the sorting and identification.

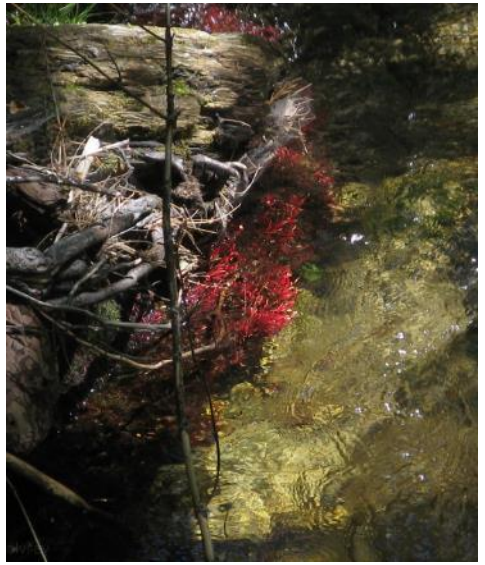
Target all habitat types

Riffles

Pools



Leaf packs



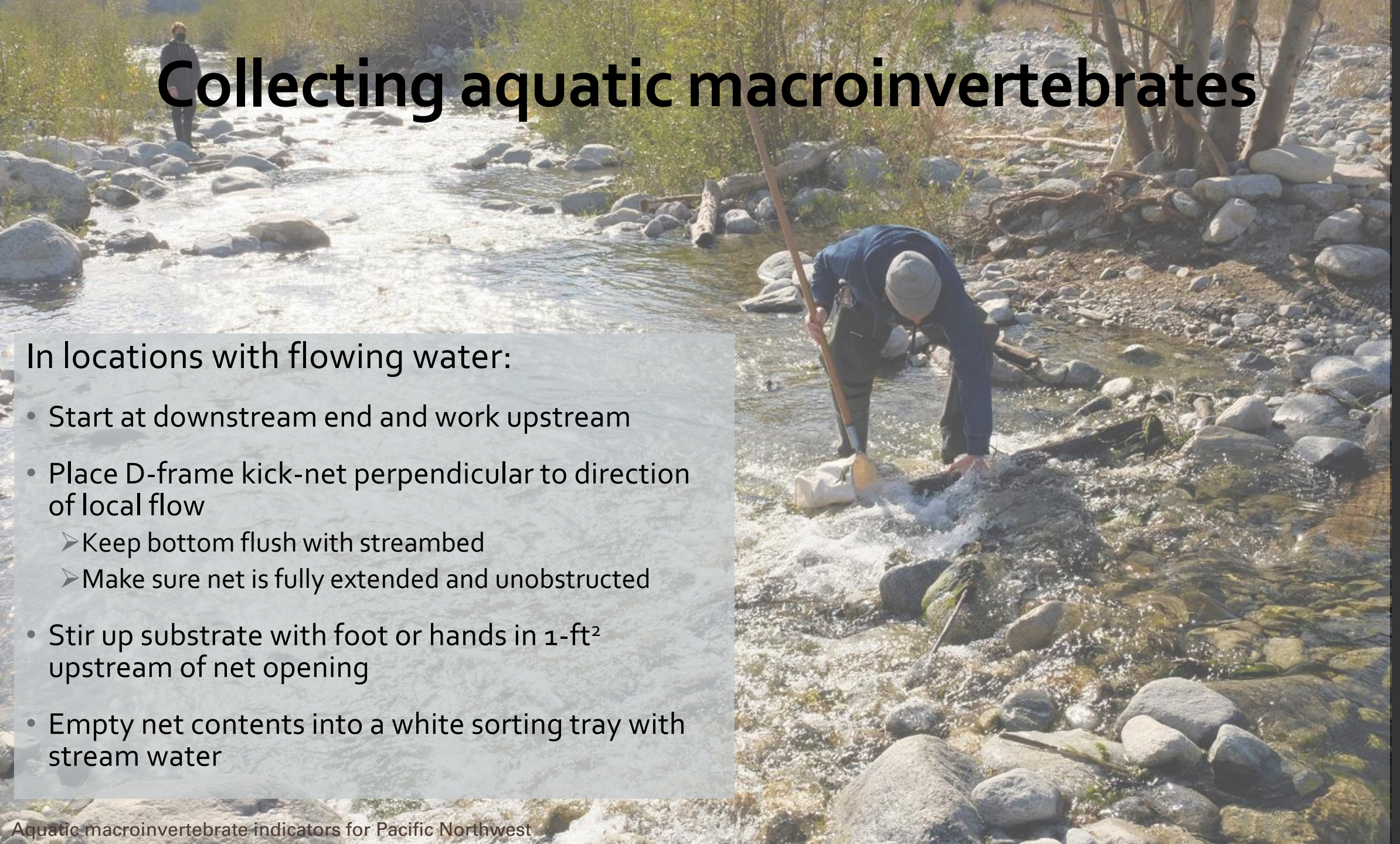
Tree roots

Woody jams

Undercut banks

Use the appropriate method for the conditions

Collecting aquatic macroinvertebrates



In locations with flowing water:

- Start at downstream end and work upstream
- Place D-frame kick-net perpendicular to direction of local flow
  - Keep bottom flush with streambed
  - Make sure net is fully extended and unobstructed
- Stir up substrate with foot or hands in 1-ft^2 upstream of net opening
- Empty net contents into a white sorting tray with stream water

Collecting aquatic macroinvertebrates

In locations with still water:

- Place net in water
- Kick up substrate
- Rapidly move net through water, sweeping up suspended invertebrates and material they may be clinging to

Collecting aquatic macroinvertebrates

In woody jams, root mats, and undercut banks:

- Jab with a D-frame net

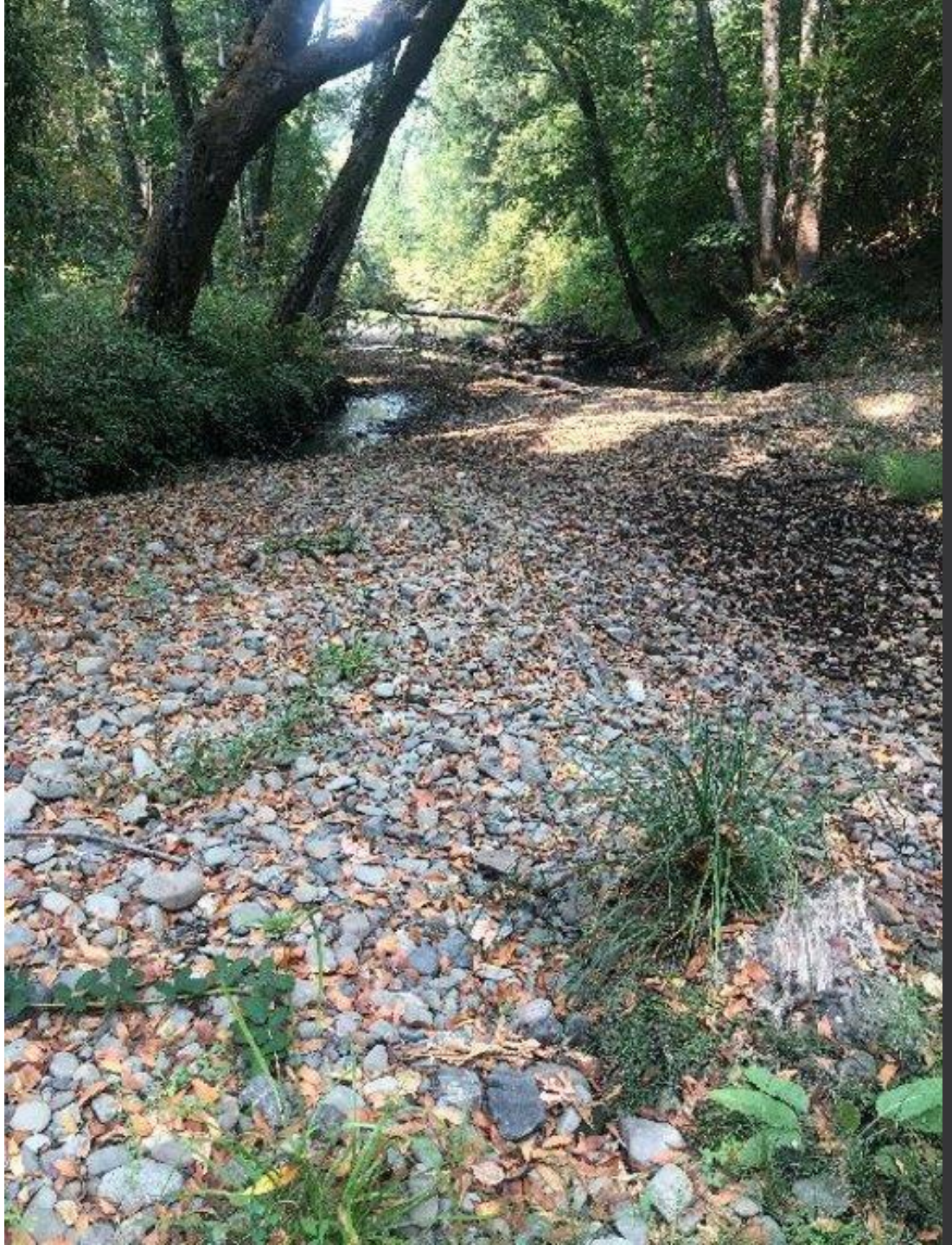
Collecting aquatic macroinvertebrates

- Pick up and examine large cobbles or other substrate
- "Clingers" will be evident; for example, heptageniid mayflies are flattened and will often be found clinging to rocks.

In partially dry and dry streams

- Look for areas where water may have persisted; focus on remaining wetted habitats, if they exist
- Turn over cobbles and boulders in areas where water likely persisted longer (dry streams)
- Look at streamside vegetation or large boulders for shed skins or cases


Shed larval skins (exuviae)



Living aquatic invertebrates can be found in dry streams!

Photo credit: Michael Bogan

Ignore terrestrial lifestages

Field versus lab identification of invertebrate samples

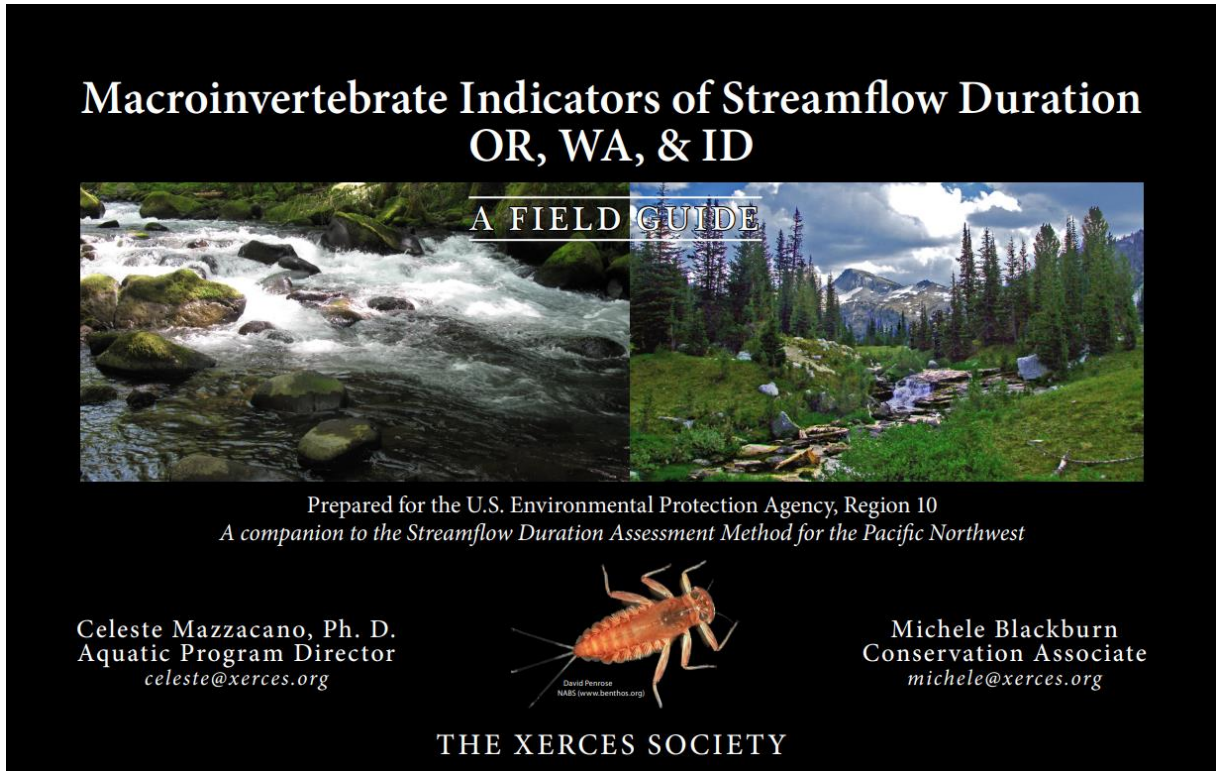
- Both are acceptable
- When relying on field identifications:
  - Ensure at least one crew member is adequately trained
  - Retain voucher specimens where possible to confirm identifications (quality photos may also be helpful)
  - Use hand lenses or field scope, if available
- Lab identification is an option
  - Field crews may not have necessary expertise
  - Higher confidence in identifications
  - Samples may be re-evaluated by expert taxonomists
  - Save time in the field

Pick the approach that best suits the skills and capacity of your field crew!

Field sorting and identification

- Remove and ID aquatic invertebrates
  - **One of more aquatic macroinvertebrates**?
  - **6 individuals of Ephemeroptera taxa?**
  - **One or more perennial indicator taxa**?
- Feather-weight forceps, eye-droppers can help.
- Macroinvertebrates are easier to observe in a white-backed tray.
- Be patient: Some macroinvertebrates will start moving and become obvious.
- Search for macroinvertebrates clinging to the net as well.
- Recommend collecting specimens to confirm identifications, if possible.

Macroinvertebrate identification

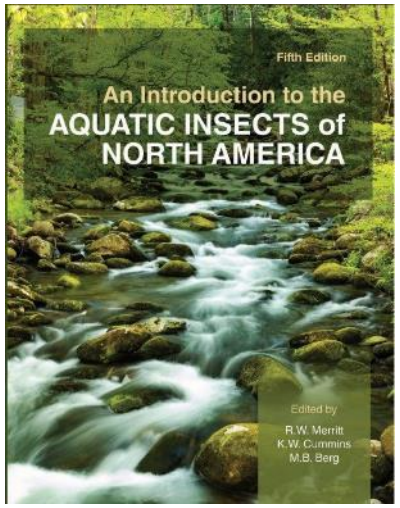


Developed specifically for the SDAM PNW, field guide includes:

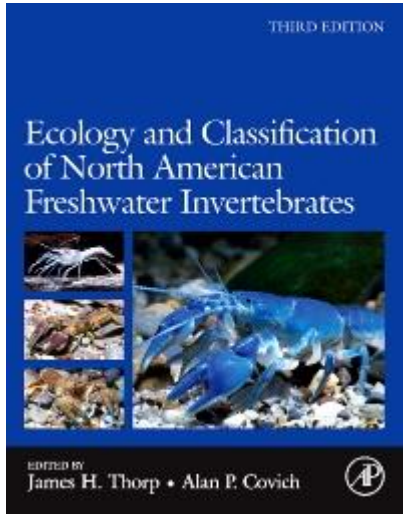
- Taxa representative of common and readily visible groups of species in the Pacific Northwest.
- Taxa identified as perennial streamflow duration indicators.
- General information on the identification, habitat, and regional distribution of each group.
- Entire organism photos, close-ups, and highlights of diagnostic features.

Books to help learn identifications

Keys for identification

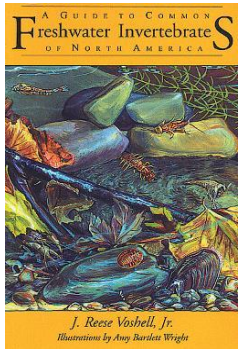


- Merritt, Cummins and Berg's *An introduction to Aquatic Insects of North America*

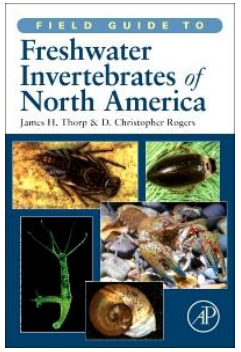


- Thorp and Covich's *Ecology and Classification of North American Freshwater Invertebrates*

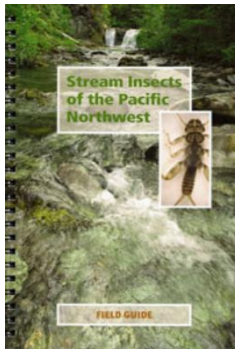
Field guides



- Voshell's *A guide to common freshwater invertebrates of North America*



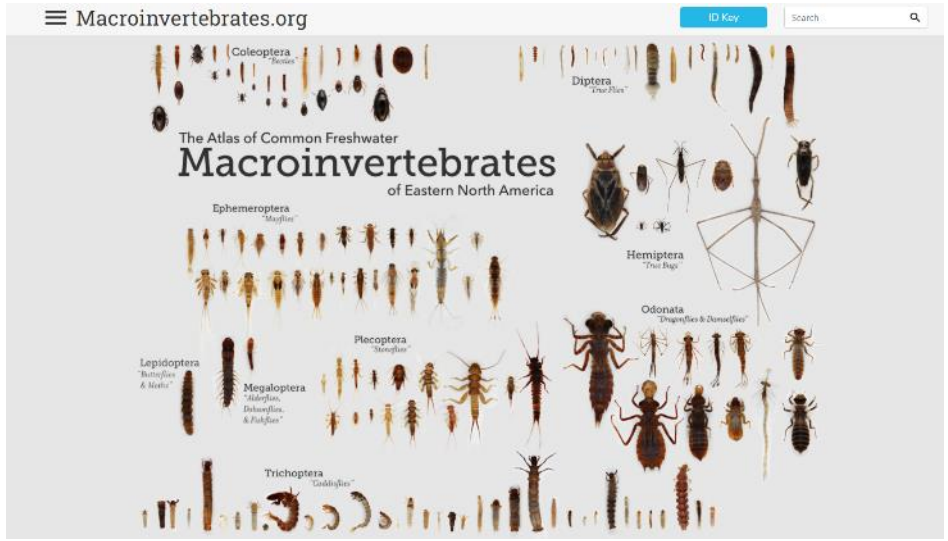
- Thorp and Rogers' *Field guide to freshwater invertebrates of North America*



- Edward's *Stream insects of the Pacific Northwest*

Other resources for invertebrate identification

Online resources



- Macroinvertebrates.org is for the eastern U.S., but will work for western insect taxa

Professional societies offer workshops:

- The Xerces Society
- The Society for Freshwater Science

XERCES SOCIETY for Invertebrate Conservation

Society *for* Freshwater Science

Aquatic macroinvertebrate taxa

Includes the range of macroinvertebrates typically associated with stream habitats:

- **E**phemeroptera (mayflies)
- **P**lecoptera (stoneflies)
- **T**richoptera (caddisflies)

Ephemeroptera larva
Image credit: Dieter Tracev

Plecoptera larva
Tracev Saxbv

Trichoptera larva
Tracev Saxbv

Field-based identification is relatively easy with a little training.

Image Credit: Integration and Application Network
https://ian.umces.edu/

Aquatic macroinvertebrate taxa

Includes the range of macroinvertebrates typically associated with stream habitats:

- Odonata (dragonflies, damselflies)
- Megaloptera (dobsonflies, alderflies)
- Diptera (true flies)

common skimmer dragonfly

dobsonsfly

cranefly

- Coleoptera (aquatic beetles)
- Mollusca (snails, clams)
- Astacoidea (crayfish)

riffle beetle

Juga sp.

crayfish

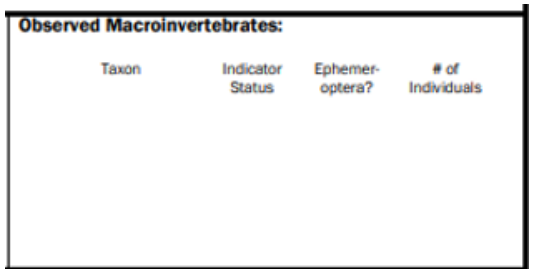
Image Credit: Xerces Society

Aquatic macroinvertebrate taxa

Does NOT include Culicidae (mosquito) larvae/pupae!

Image Credit: UNH Center for Freshwater Biology
https://cfb.unh.edu/Vernal_Pool_Page/html/Organisms

Record on the field form



1. Are there aquatic macroinvertebrates in the assessment reach? If at least one macroinvertebrate (or macroinvertebrate shell, casing, or exuviae) is present, the answer is "yes."*

Indicators			
	1. Are aquatic macroinvertebrates present?	☐ Yes	☐ No
	2. Are 6 or more individuals of the Order Ephemeroptera present?	☐ Yes	☐ No
	3. Are perennial indicator taxa present? (refer to Table 1)	☐ Yes	☐ No
	4. Are FACW, OBL, or SAV plants present? (Within ½ channel width)	☐ Yes	☐ No
	5. What is the slope? (In percent, measured for the valley, not the stream)	_____ %	

*If the ONLY macroinvertebrate present is mosquito larvae (an ephemeral indicator taxon), the answer is "no."

Mayflies

- Gills on sides of abdomen
- Two or three tail-like filaments (cerci)
  - Most have 3
  - Some species have 2
  - May be broken off or missing
- One tarsal claw at end of each leg
- Wingpads evident on mature larvae
- Many have a minnow-like appearance
  - Actively swim like fish in your sorting tray

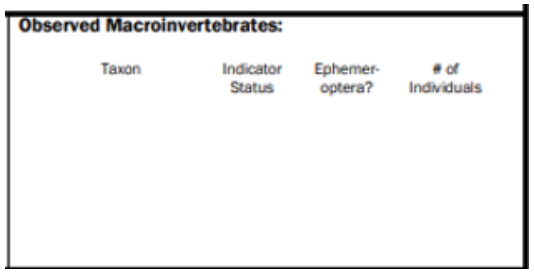
CA DFW Digital Reference Library

Mayflies

- Many have a flattened appearance
- Typically found clinging to undersides of cobbles (not freely swimming)

CA DFW Digital Reference Library

Record on the field form



Observed Macroinvertebrates:

Taxon	Indicator Status	Ephemer-optera?	# of Individuals

2. Are 6 or more individuals of the Order Ephemeroptera present in the assessment reach? If at least 6 Ephemeroptera are present, the answer is "yes."

Indicators			
	1. Are aquatic macroinvertebrates present?	☐ Yes	☐ No
	2. Are 6 or more individuals of the Order Ephemeroptera present?	☐ Yes	☐ No
	3. Are perennial indicator taxa present? (refer to Table 1)	☐ Yes	☐ No
	4. Are FACW, OBL, or SAV plants present? (Within ½ channel width)	☐ Yes	☐ No
	5. What is the slope? (In percent, measured for the valley, not the stream)	_____ %	

Perennial indicator families

- 13 families of aquatic invertebrates were identified as indicators of perennial streamflow
  - They are typically found in perennial reaches, although they may sometimes occur in adjacent nonperennial reaches and in intermittent reaches with longer flow durations
- Several are easy to identify in the field, but others take training and practice
- The Xerces Society Field Guide, Macroinvertebrate Indicators of Streamflow Duration developed for the SDAM PNW, includes a photo guide to each family

This training video will provide an overview of what's required for the protocol, *not* a complete training course of identification of these families in the field.

Perennial indicator families

Lifestage	Order	Family	Common name
ANY	Mollusca: Gastropoda	Pleuroceridae	*Juga* spp.
	Mollusca: Bivalvia	Margaritiferida	Freshwater pearl mussels
		Unionidae	Unionid mussels
Larvae/pupae	Trichoptera (caddisflies)	Philopotamidae	Finger-net caddisflies
		Hydropsychidae	Net-spinning caddisflies
		Rhyacophilidae	Free-living caddisflies
		Glossosomatidae	Saddle case-maker caddisflies
Nymphs	Plecoptera (stoneflies)	Pteronarcyidae	Giant stoneflies
		Perlidae	Golden stoneflies
Larvae	Coleoptera (beetles)	Elmidae	Riffle beetles
		Psephenidae	Water pennies
Larvae/nymphs	Odonata	Gomphidae	Clubtail dragonflies
		Cordulegastridae	Spiketail dragonflies; biddies

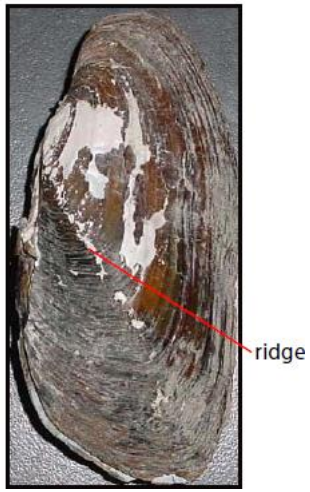
Perennial indicator mollusks

Gastropoda, Pleuroceridae
(*Juga* spp.)

Source: Xerces Society

Bivalvia, Unionidae
(freshwater mussels)

Anodonata spp.



Gonidea angulata

Bivalvia, Margaritiferidae
(freshwater pearl mussels)

Caddisflies

- Soft abdomen with gills along ventral side
- Head and thorax is partly or fully hardened (sclerotized)
- C-shaped body
- Anal hooks at end of abdomen
- Many live in cases made of silk and other material.
  - Pebbles
  - Leaves or needles

CA DFW Digital Reference Library

Caddisflies

Diversity of case types

All images from CA DFW Digital Reference Library, except where noted

Caddisflies

- Net-spinners build permanent silk retreats on cobbles, boulders, and other large substrate
- Look for pebbles stuck to cobbles with silk—there's often a bug inside!

Perennial indicator caddisflies

Stoneflies

- Gills along thorax
- Wingpads evident
- Two (never 3) cerci
- Two tarsal claws
- Often found clinging to cobbles and other large substrate

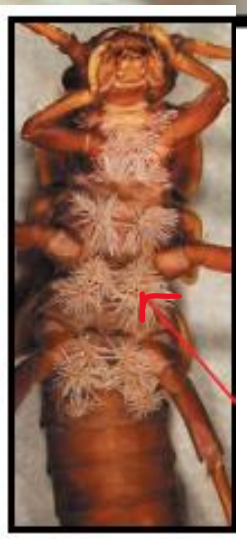
Stoneflies

- Some have a roach-like appearance
- Some are more slender and elongated

CA DFW Digital Reference Library

Perennial indicator stoneflies

Pteronarcyidae
(giant stoneflies)



Source: Xerces Society

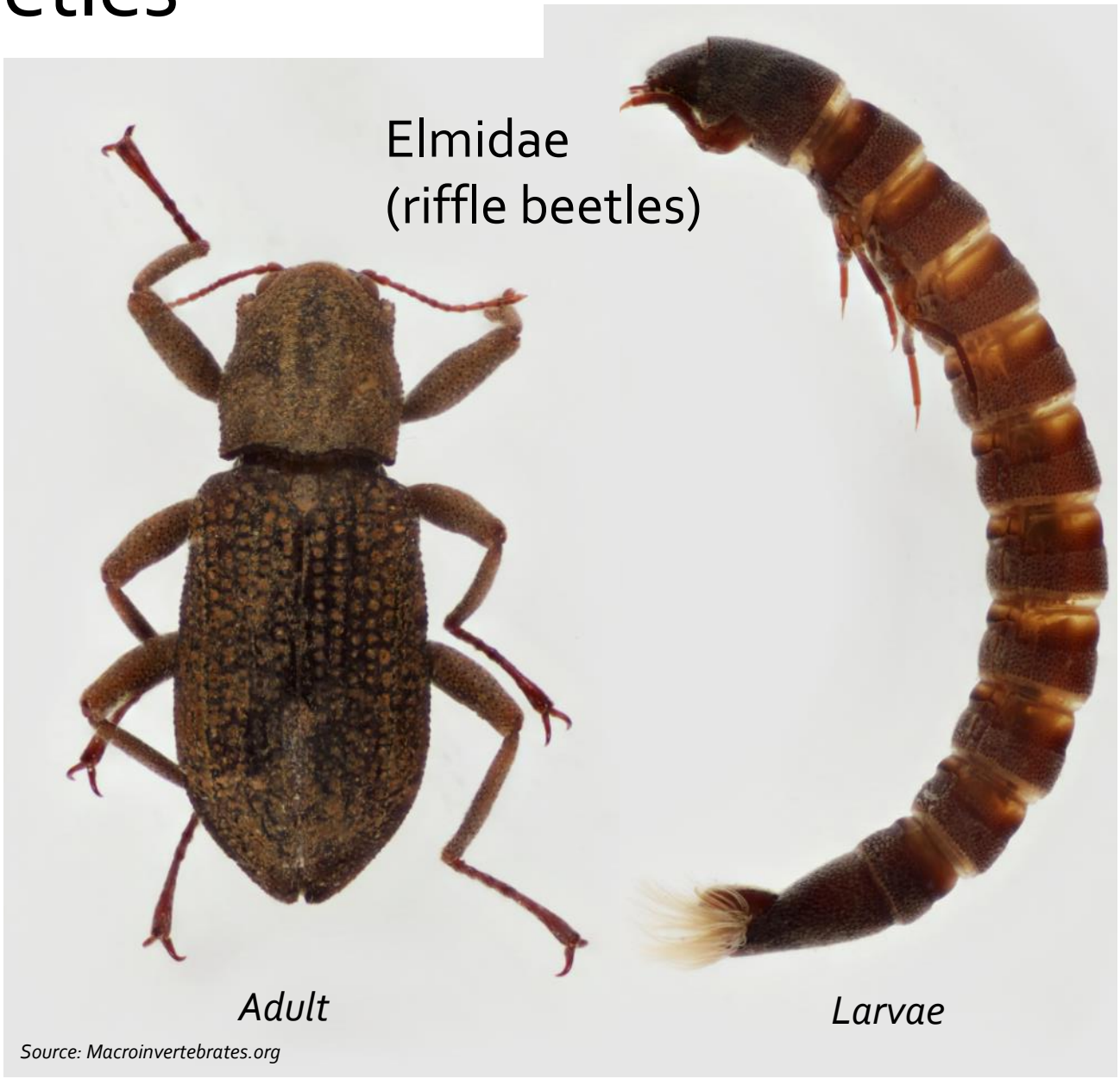
Source: CA. Department of Fish and Wildlife

Perennial indicator beetles

Psephenidae
(water pennies)

Source: Xerces Society

Elmidae
(riffle beetles)



Source: Macroinvertebrates.org

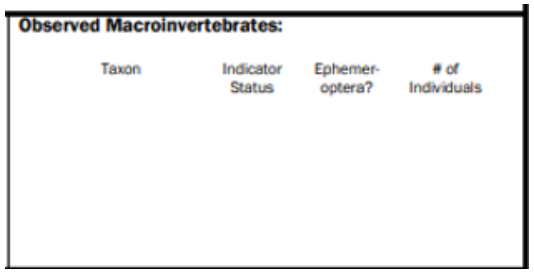
Perennial indicator dragonflies

Gomphidae
(clubtail dragonflies)

Cordulegastridae
(spiketail dragonflies; biddies)

Source: Xerces Society

Record on the field form



3. Are there perennial indicators taxa in the assessment reach? If at least one individual (or shell, casing, or exuviae) are present, the answer is "yes."

Indicators			
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	3. Are perennial indicator taxa present? (refer to Table 1)	☐ Yes	☐ No
	4. Are FACW, OBL, or SAV plants present? (Within ½ channel width)	☐ Yes	☐ No
	5. What is the slope? (In percent, measured for the valley, not the stream)	_____ %	

Knowledge check!

True or false: No aquatic macroinvertebrates will be found in a dry reach.

A. TRUE

B. FALSE

Count individuals or evidence of aquatic macroinvertebrates you observe in a dry reach, whether living or dead. The most common evidence may be caddisfly casings or snail shells.

Knowledge check!

When is sampling for aquatic macroinvertebrates complete?

A. When you've collected at least 100 individuals

B. After you've collected from the richest habitats

C. After you've collected from 6 locations over 15 minutes

D. Immediately, in a dry reach

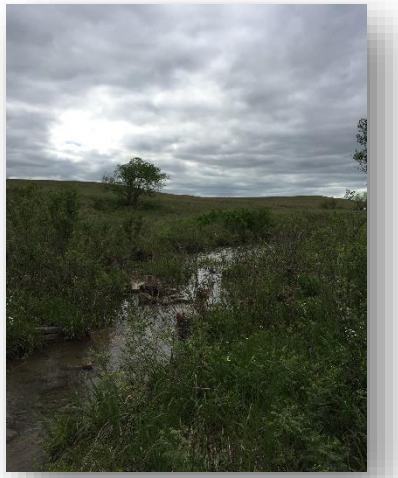
Sampling is complete after at least 6 locations have been sampled over 15 minutes of searching.

Knowledge check!

Which of these insect orders contain families that are indicators of perennial flow for the Pacific Northwest SDAM? Select all that apply.

A. Coleoptera (beetles)
B. Diptera (flies)
C. Hemiptera (true bugs)
D. Odonata (dragonflies, damselflies)
E. Ephemeroptera (mayflies)
F. Plecoptera (stoneflies)
G. Trichoptera (caddisflies)

2 beetle families, 2 dragonfly families, 2 stonefly families, and 4 caddisfly families are treated as perennial indicators in the Pacific Northwest SDAM.


For more information about SDAMs, visit:

https://www.epa.gov/streamflow-duration-assessment