EPA United States Environmental Protection Agency

US Army Corps of Engineers

ERDC

Arid West and Western Mountains Streamflow Duration Assessment Methods: Aquatic macroinvertebrate indicators

Video Training

2025

The Arid West (AW) and Western Mountains (WM) SDAMs are based on 11 indicators:

All indicators are measured in the **field**

7 are shared by both SDAMs, plus:

- One only used in AW SDAM
- Three only used in WM SDAM

In recommended order of data collection

1. Bankfull channel width
2. **Aquatic macroinvertebrate indicators**
   - **Abundance of Ephemeroptera, Plecoptera, and Trichoptera (Western Mountains only)**
   - **Abundance of perennial indicator taxa**
4. Slope
5. Shading (WM only)
6. Number of hydrophytic plant species
7. Prevalence of rooted upland plants in the streambed
8. Algal cover (AW only)
9. Differences in vegetation
10. Riffle-pool sequence
11. Particle size or stream substrate sorting (WM only)

Aquatic macroinvertebrate indicators

- Both AW and WM SDAMs use aquatic macro.
- 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 this metric.
- 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.

Macroinvertebrates.org

Aquatic macroinvertebrate indicators

- Both metrics used in the western SDAMs are **responses** to streamflow duration
  - Abundance of mayflies, stoneflies, and caddisflies
  - Abundance of perennial indicator taxa
- Higher abundances are associated with **longer** streamflow duration
- Used alone, not a great determinant of streamflow duration. These taxa are sometimes found in non-perennial streams, though less often and typically in lower numbers.

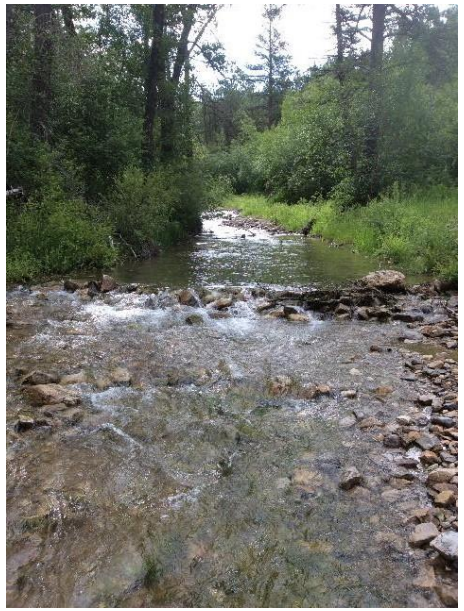
Macroinvertebrates.org

Collection in the reach

In crews of two or more

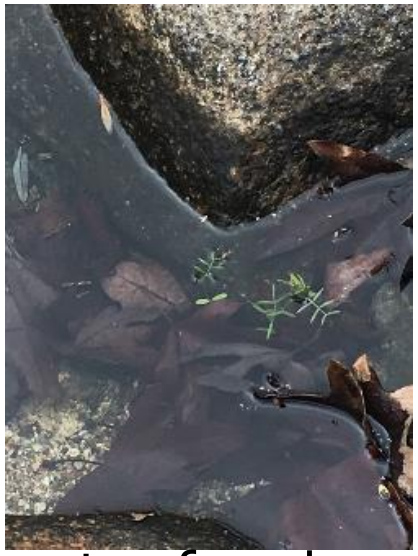
- This is one of the most time-consuming steps in the assessment
- After the reach-length has been established, one person can collect, sort, and identify aquatic macroinvertebrates while another evaluates other indicators.

Target all habitat types

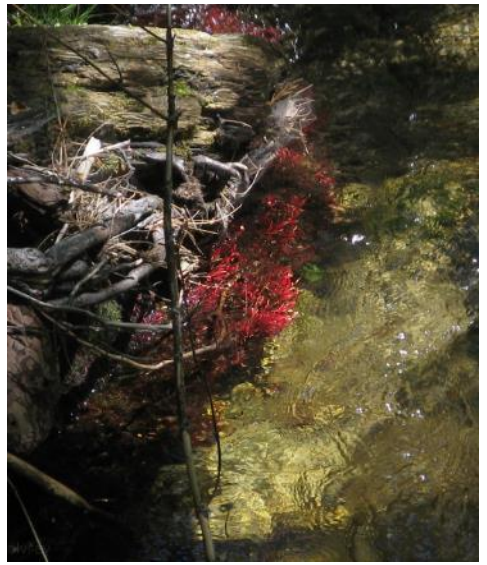


Riffles

Pools



Leaf packs



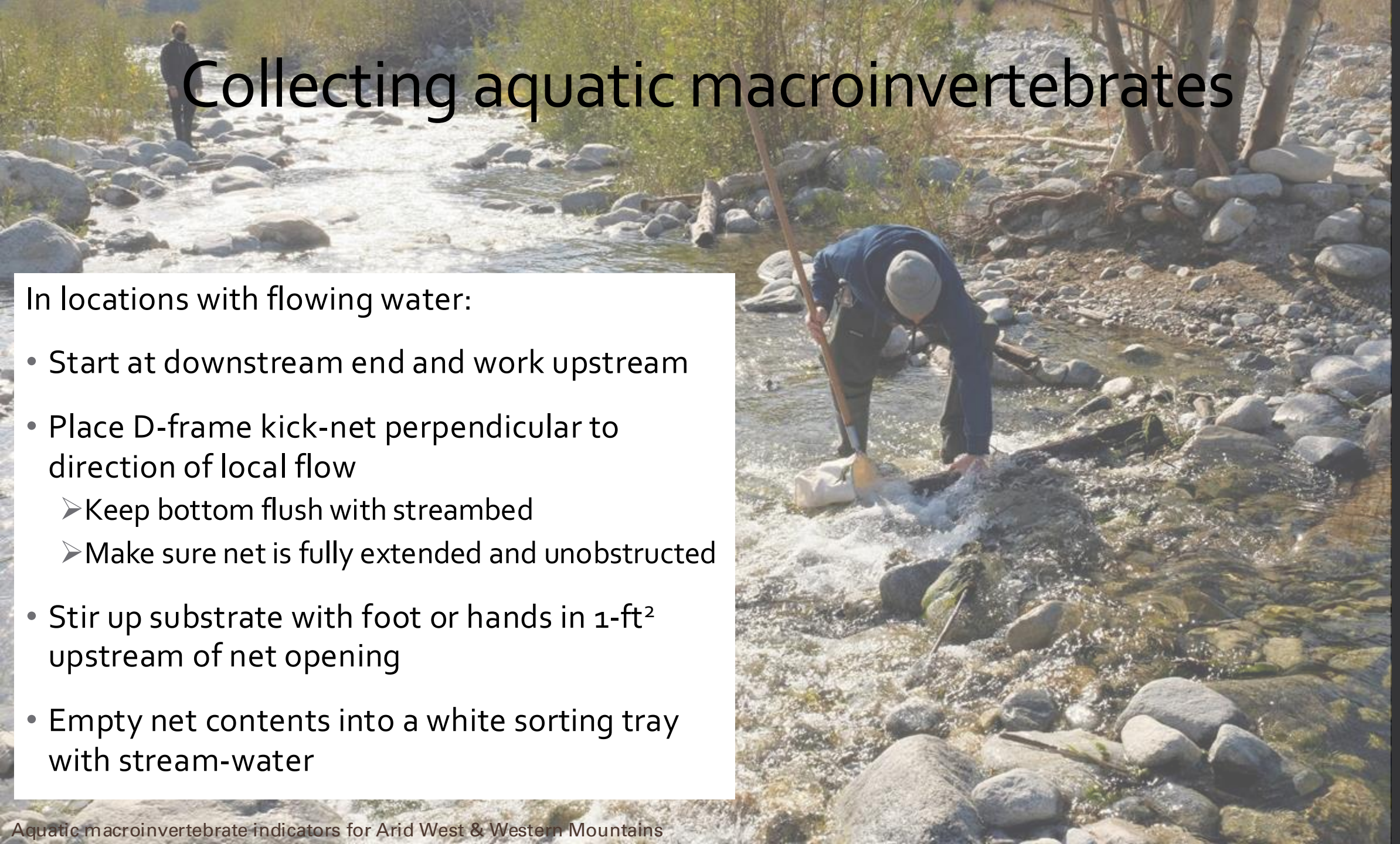
Tree roots

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

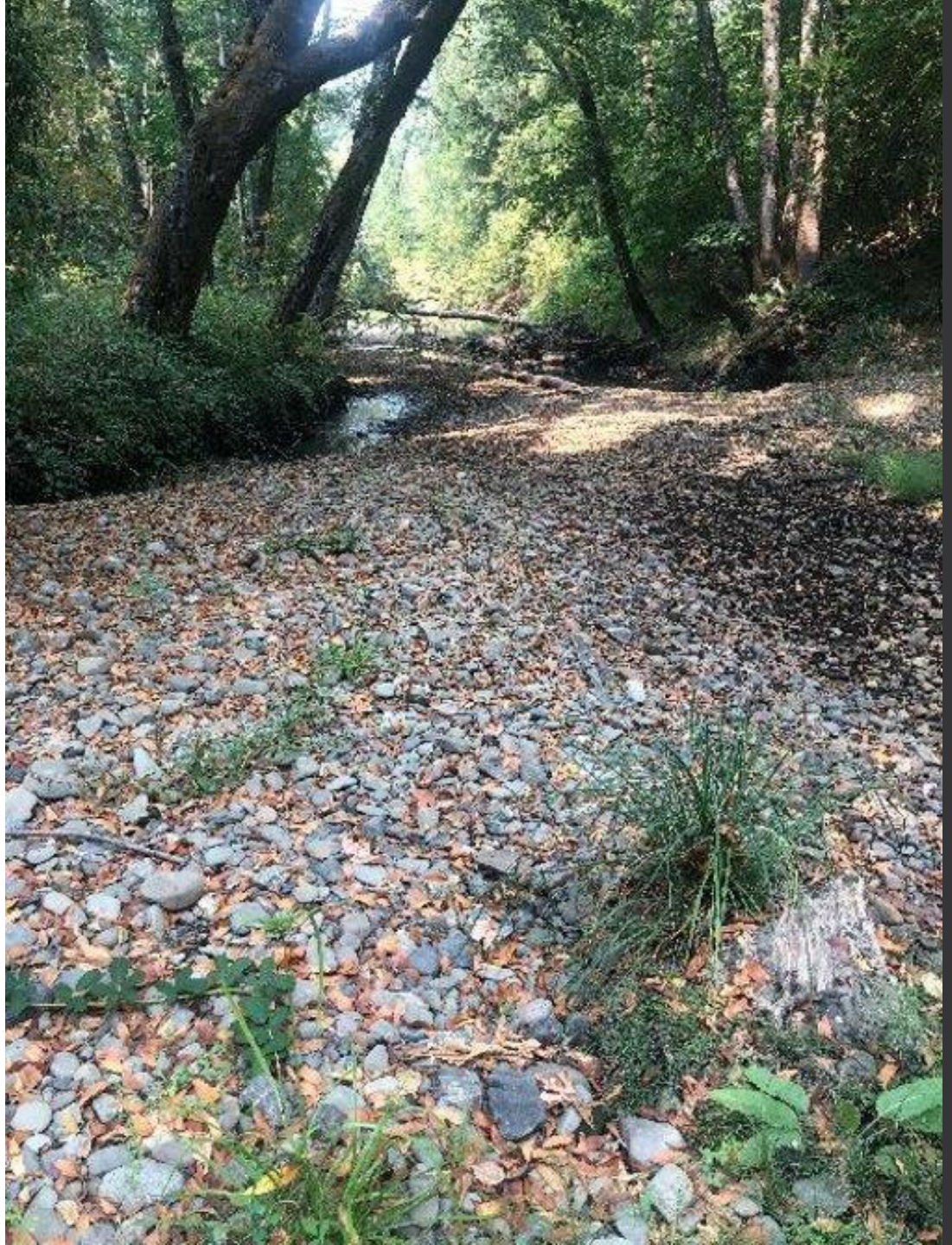
- Pick up and examine large cobbles or other substrate
- "Clingers" will be evident; for example, heptageniid mayflies are flattened and will often be found clinging to rocks.

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)

Caddisfly cases



Living aquatic invertebrates can be found in dry streams!

Photo credit: Michael Bogan

Neohermes is a long-lived specialist in intermittent streams.

Ignore terrestrial lifestages

Field versus lab processing 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 processing is sometimes a better option
  - Field crews may not have necessary expertise
  - Higher confidence in identifications, abundance
  - Samples may be re-evaluated by expert taxonomists
  - Save time in the field

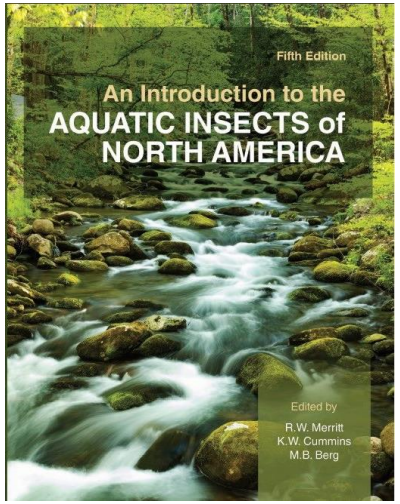
Pick the approach that best suits the skills and capacity of your field crew!

Field sorting and identification

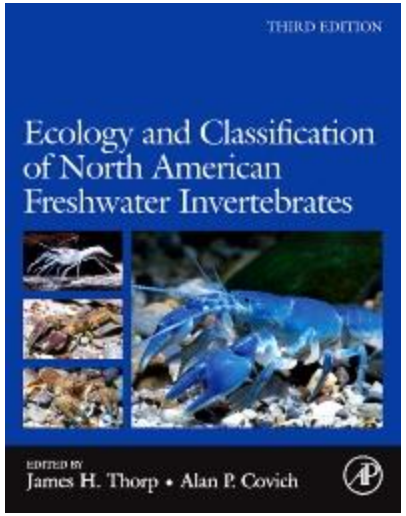
- Remove, tally, and ID aquatic invertebrates
- Count up to **11 individuals** per taxon
- Feather-weight forceps, eye-droppers can help
- Macroinvertebrates are easier to observe in a white-backed tray.
- Be patient: Some macroinvertebrates will start moving and become obvious.
- Search for macroinvertebrates clinging to the net as well.
- Recommend collecting specimens to confirm identifications, if possible.

Books to help learn identifications

Keys for lab identification

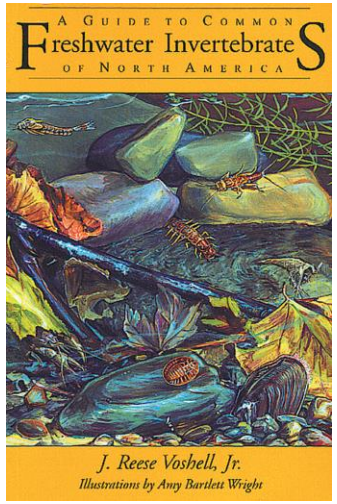


- Merritt, Cummins and Berg's *An introduction to Aquatic Insects of North America*

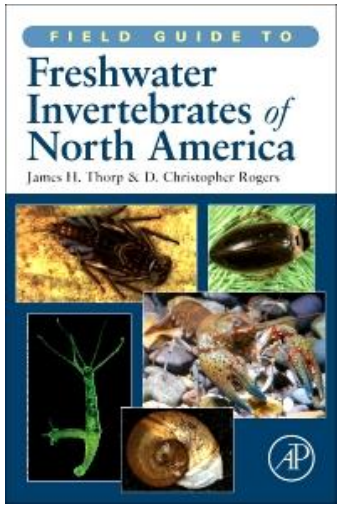


- Thorp and Covich's *Ecology and Classification of North American Freshwater Invertebrates*

Field guides



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

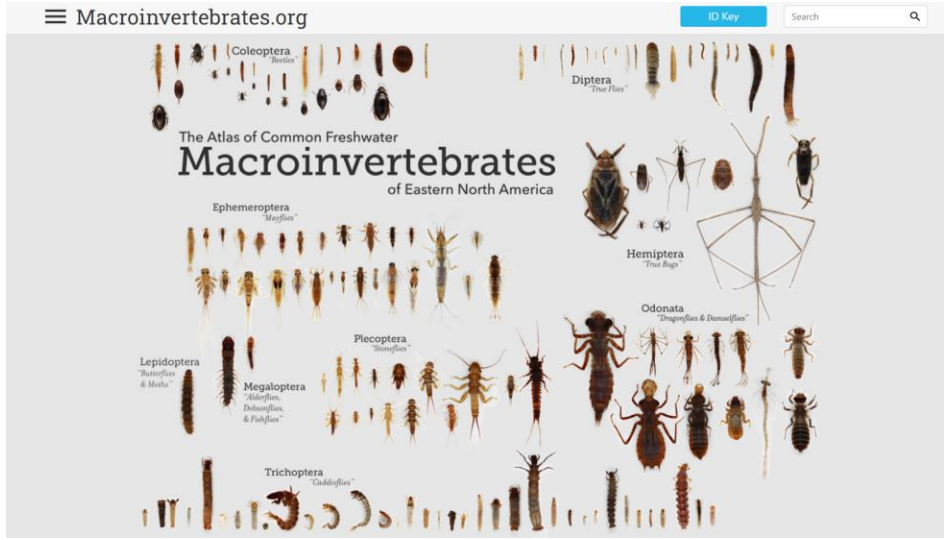


- Thorp and Rogers' *Field guide to freshwater invertebrates of North America"*

Plus several more!

Other resources for invertebrate identification

Online resources



- Macroinvertebrates.org is for the eastern U.S., but will work for western insect taxa
- Colorado Division of Wildlife has an online field guide to freshwater mollusks

Professional societies offer workshops:

- The Southwest Association of Freshwater Invertebrate Taxonomists (SAFIT)
- The Xerces Society
- The Society for Freshwater Science

Identify EPT taxa

Abundance of these three insect orders is an indicator for the Western Mountains SDAM, and is a necessary step to calculate indicators for both SDAMs

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

Ephemeroptera larva
Image credit: Dieter Tracev

Plecoptera larva
Tracev Saxby

Trichoptera larva
Tracev Saxby

Field-based identification is relatively easy with a little training

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

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

Mayflies

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

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

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

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!

Non-EPT look-alikes

- Similarities are superficial
- Hand lens or microscope may help learn to recognize differences

Record on the field form: Abundance of EPT (WM only)

Every taxon should be enumerated up to **11** individuals per family.

Add up the total number of EPT individuals.

2. Aquatic macroinvertebrates: Abundance of Ephemeroptera, Plecoptera, and Trichoptera (WM only)

Determine total abundance of individuals in the orders of Ephemeroptera, Plecoptera, and Trichoptera (EPT), such that no one family counts for more than 11 individuals in the total:

Mark the appropriate box for the number of EPT individuals observed.

- ☐ No EPT detected
- ☐ 1 to 4 EPT individuals
- ☐ 5 to 9 EPT individuals
- ☐ 10 to 19 EPT individuals
- ☐ 20 or more EPT individuals

Notes on abundance of EPT indicator:

Abundance of Ephemeroptera, Plecoptera, and Trichoptera for Western Mountains

Perennial indicator families (AW and WM)

- 11 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 durations
- Several are easy to identify in the field, but others take training and practice
- User manual appendix includes a photo guide to each family, as well as non-indicator look-alikes.

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

Perennial indicator families

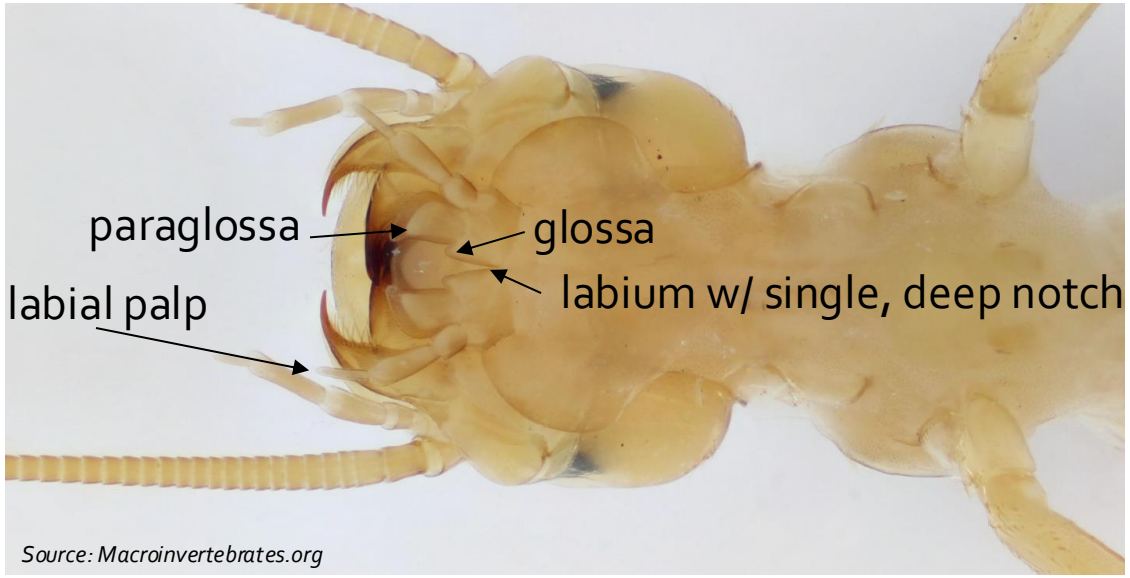
Order	Family	Common name
Ephemeroptera (mayflies)	Ephemerellidae	Spiny crawler mayflies
	Heptageniidae	Flathead mayflies
	Leptohyphidae	Little stout crawler mayflies
	Leptophlebiidae	Prong-gilled mayflies
Plecoptera (stoneflies)	Chloroperlidae	Green stoneflies
	Perlidae	Common stoneflies
Trichoptera (caddisflies)	Brachycentridae	Humpless casemaker caddisflies
	Glossosomatidae	Saddle casemaker caddisflies
	Hydropsychidae	Common net-spinner caddisflies
	Rhyacophilidae	Free-living caddisflies
Coleoptera (beetles)	Elmidae	Riffle beetles

Perennial indicator families for Arid West & Western Mountains

Perennial indicator mayflies

Perennial indicator families for Arid West & Western Mountains

Perennial indicator stoneflies



Perennial indicator families for Arid West & Western Mountains

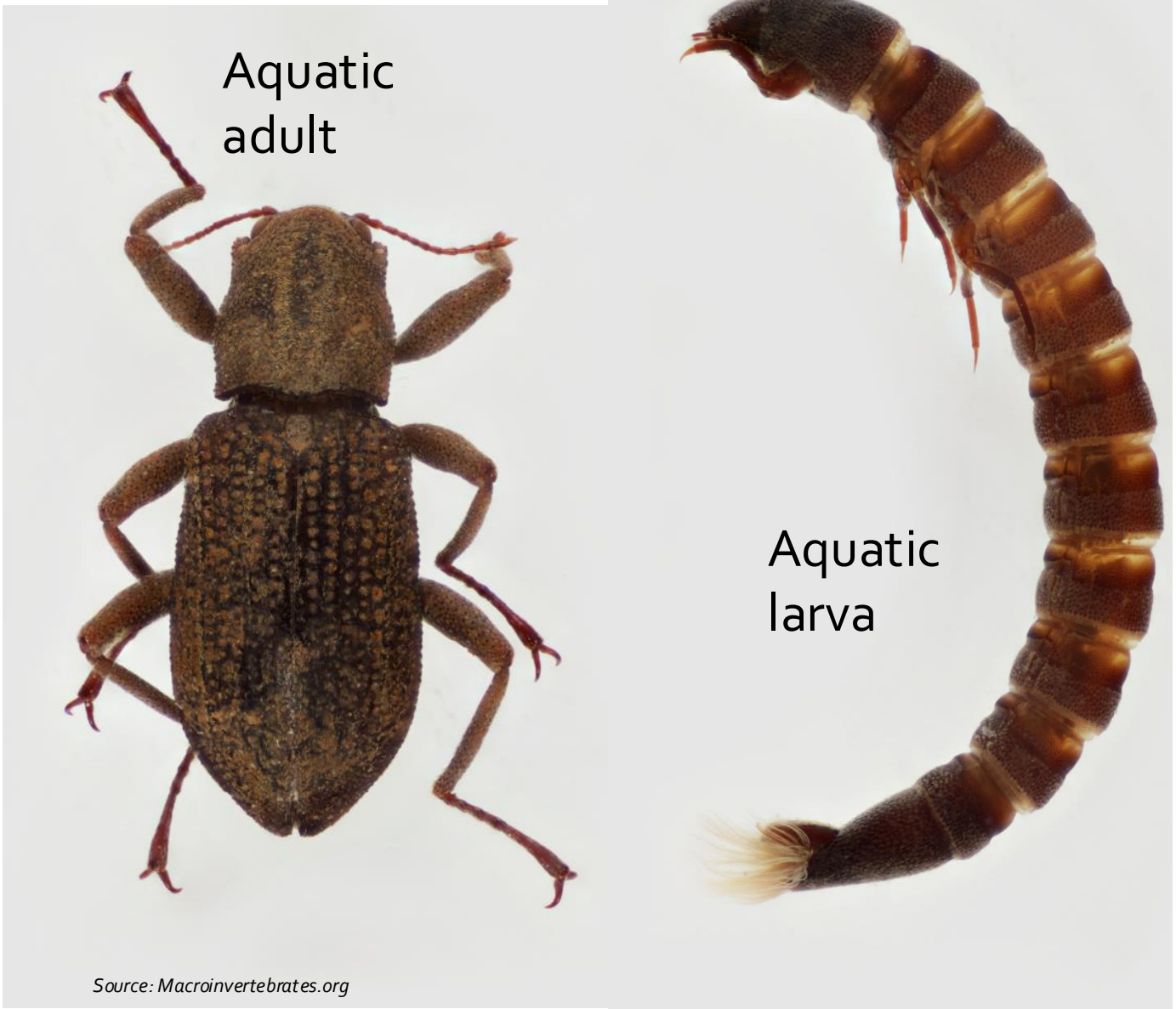
Perennial indicator caddisflies

Glossosomatidae (saddle casemakers)

Perennial indicator families for Arid West & Western Mountains

Perennial indicator beetles

Elmidae
(riffle beetles)



Record on the field form

Every taxon should be enumerated up to **11** individuals.

Add up the total number of individuals in perennial indicator families.

3. Aquatic macroinvertebrates: Abundance of perennial indicator taxa

Determine total abundance of individuals in perennial indicator families listed below, such that no one family counts for more than 11 individuals in the total.

Ephemeroptera	Plecoptera	Trichoptera	Coleoptera
Ephemerellidae (spiny crawler mayflies)	Chloroperlidae (green stoneflies)	Brachycentridae (humpless casemakers)	Elmidae (riffle beetles)
Heptageniidae (flathead mayflies)	Perlidae (common stoneflies)	Glossosomatidae (saddle casemakers)	
Leptohyphyidae (little stout crawler mayflies)		Hydropsychidae (common netspinners)	
Leptophlebiidae (prong-gilled mayflies)		Rhyacophilidae (free-living caddisflies)	

Mark the appropriate box for the number of perennial indicator individuals observed.

☐ No perennial indicator taxa detected
☐ 1 to 4 perennial indicator individuals
☐ 5 to 9 perennial indicator individuals
☐ 10 to 19 perennial indicator individuals
☐ 20 or more perennial indicator individuals

Check if applicable: ☐ No aquatic macroinvertebrates in assessment area

Notes on perennial indicator taxa:

Perennial indicator families for Arid West & Western Mountains

Knowledge check!

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

A. TRUE

B. FALSE

False: Count individuals or evidence of aquatic macroinvertebrates you observe in a dry reach, whether living or dead. The most common evidence may be things like 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 the following insects are "EPT" taxa? Select all that apply.

A, B, D, G, I, and M are EPT taxa

A

Ephemeroptera: Ameletidae

B

Plecoptera: Chloroperlidae

C

Megaloptera: Corydalidae

D

Trichoptera: Brachycentridae

E

Diptera: Dixidae

F

Coleoptera: Elmidae

G

Ephemeroptera: Caenidae

H

Diptera: Culicidae

I

Trichoptera: Lepidostomatidae

J

Diptera: Simuliidae

K

Diptera: Tabanidae

L

Coleoptera: Dytiscidae

M

Trichoptera: Uenoidae

N

Hemiptera: Notonectidae

O

Odonata: Coenagrionidae

Photos are from the Digital Reference Library of California Benthic Invertebrates maintained by the Aquatic Bioassessment Lab of the California Department of Fish and Wildlife

Knowledge check!

True or false: Perennial indicator taxa exclusively inhabit perennial reaches.

A. TRUE

B. FALSE

False: Perennial indicator taxa are more frequently found at perennial reaches, but some also occur at non-perennial reaches

Knowledge check!

Which of these insect orders contain families that are indicators of perennial flow for the Arid West and Western Mountain SDAMs?

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

One beetle family, 4 mayfly families, 2 stonefly families, and 4 caddisfly families are treated as perennial indicators in the AW and WM SDAMs

BONUS: Can you name any?

Beetles:	Elmidae
Mayflies:	Ephemerellidae, Heptageniidae, Leptohyphidae, Leptophlebiidae
Stoneflies:	Chloroperlidae, Perlidae
Caddisflies:	Brachycentridae, Glossosomatidae, Hydropsychidae, Rhyacophilidae

For more information about SDAMs:

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