Species Interactions in Small Streams

A summary of the research being conducted
by the Novak Lab in the McDonald-Dunn forest

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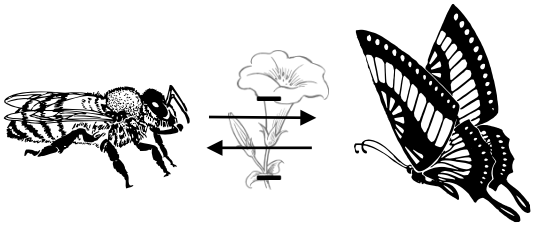
The Novak Lab

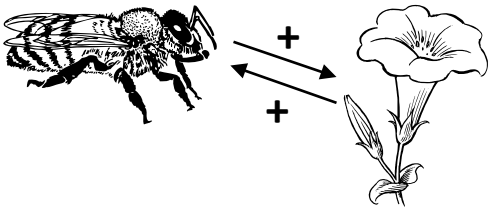
In our lab we study species interactions and their effects on individuals, communities, and ecosystems. Our work focuses on freshwater streams and the marine intertidal, the data of which we integrate into mathematical models to gain generality.

What are species interactions, and what makes them interesting?

Within an ecosystem individual organisms are continually interacting with each other. These interactions may be beneficial, harmful, or neutral to the individuals involved.



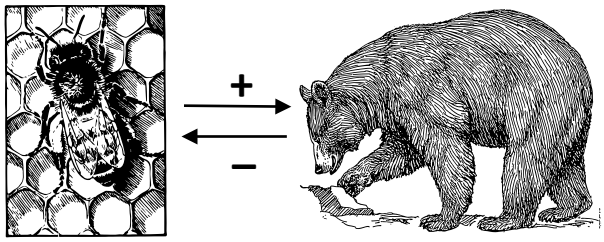
Interactions



Competition
Both individuals have a negative effect on each other

Predation
One individual benefits at the expense of another

Facilitation
One or both individuals benefit with no harm to either



Interactions between individuals are elemental components of a functioning ecosystem. When we observe interactions, we often find that individuals of one species will interact with individuals of another species in a repeated and predictable manner.

The cumulative effects of these repeated and predictable interactions are powerful enough to structure the distribution and abundance of species within a community. Sometimes the effects are so strong that they shape whole ecosystems.

The Novak Lab

Research in McDonald-Dunn forest

We are currently examining the effects of species interactions within the McDonald-Dunn forest. This research is focused on interactions occurring in the streams within the forest. These streams are home to four ”large” predators: reticulate sculpin, cutthroat trout, Pacific giant salamanders, and signal crayfish. The streams also host an impressive diversity of aquatic invertebrates. A species list compiled by OSU Professor emeritus Norm Anderson catalogued over 200 species of aquatic invertebrates that had been identified within Berry Creek (in the Dunn Forest).

Our research examines interactions between the ”large” predators and their prey. The first step to exploring these interactions is to conduct surveys within the creeks and document:

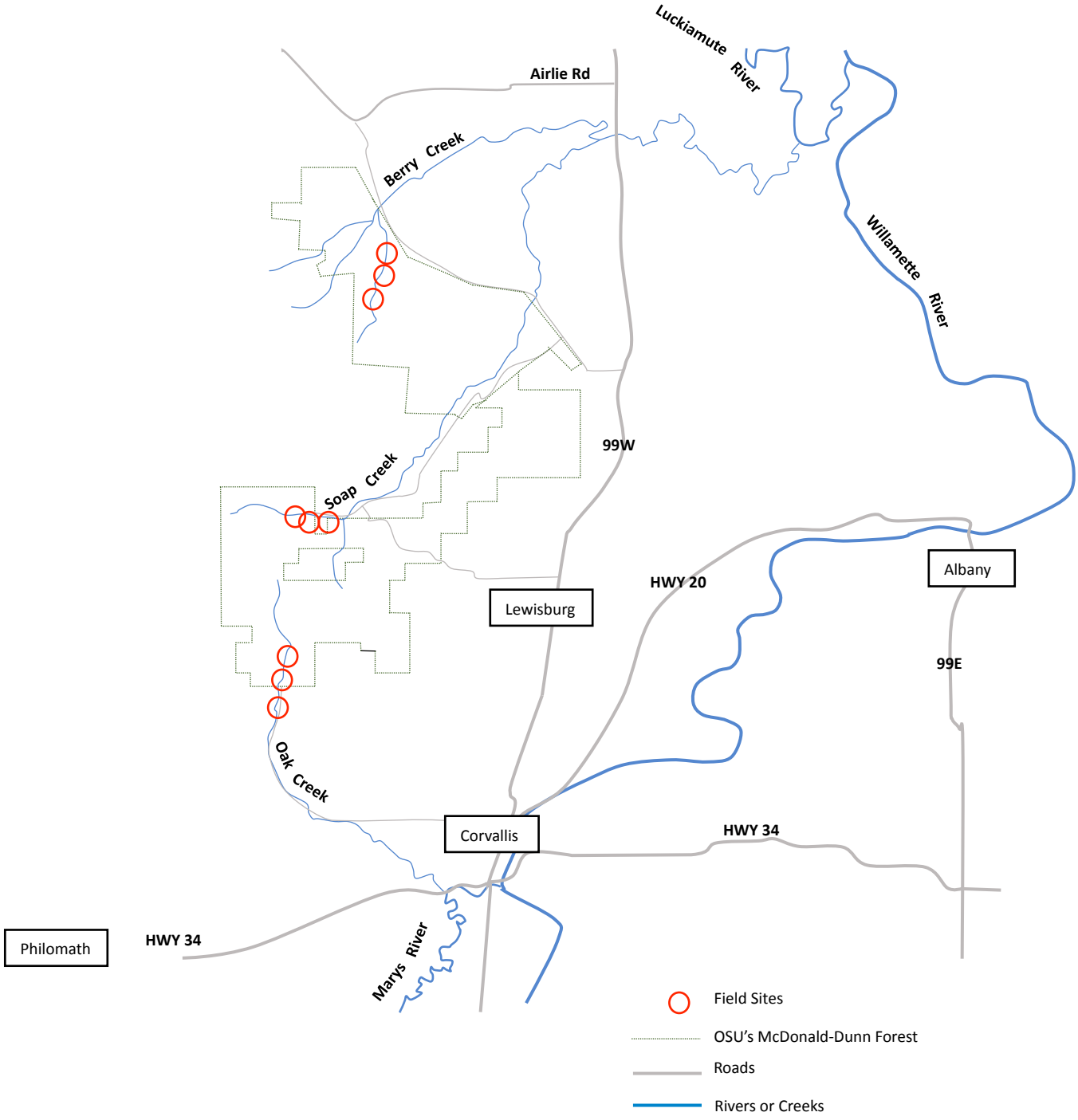
- Abundance of predators
- Abundance of prey
- Diets of predators

These surveys are conducted at 9 sites within the McDonald-Dunn forest:

- 3 sites in Soap Creek
- 3 sites in Berry Creek
- 3 sites in Oak Creek

Field sites

Sites used by the Novak Lab to conduct stream research in the McDonald-Dunn forest



Methods

How do we collect data on species interactions?

The mathematical models we use to understand the effects of species interactions require us to have estimates of density (abundance per unit area) of predators and their prey. Additionally, we need to know what prey species the predators are eating. In short, we need to count all the predators and prey in a section of stream and ask the predators what they had for lunch and how fast they're eating.

To count fish, salamanders, and crayfish we first have to catch them. We use a backpack electrofisher to momentarily stun the fish so that we can scoop them up in nets before they swim away. Once we catch them they are transferred to aerated buckets where they are given a light dose of anesthetic. The anesthetic relaxes them, allowing us to flush their stomachs with water and collect all the food they have recently eaten. When the fish recover from the anesthetic they are returned to the stream. Because this process is non-lethal, we're able to collect very useful data with minimal impacts to the ecosystem.

To survey the aquatic invertebrates (the bugs) we use a device called a Surber sampler. A Surber sampler is a 1 ft. by 1 ft. square frame with a net attached to one side. When placed in the creek the water flows over the frame and into the net. Using our hands, we move the rocks and gravel around within the frame and "rinse" them into the current. As we do so, any bugs that are attached come off and drift into the net. When we're done "rinsing" the rocks, we take all the bugs out of the net and preserve them in alcohol. They are then taken back to the lab where we can put them under a microscope to identify them.

Results

What are we finding?

Overall, Berry, Oak, and Soap creeks have very similar communities of species.

Sculpin, trout, salamanders, crayfish, and brook lamprey were present in all streams. At each creek we surveyed approximately 450 feet of stream (3 sites x 150 ft. each per creek) and caught:

	Sculpin	Trout	Salamanders	Crayfish	Lamprey
Berry	554	198	15	11	11
Oak	639	115	47	17	49
Soap	953	204	50	22	7

Pacific giant salamander

Reticulate sculpin

Brook lamprey

Cutthroat trout

Signal crayfish

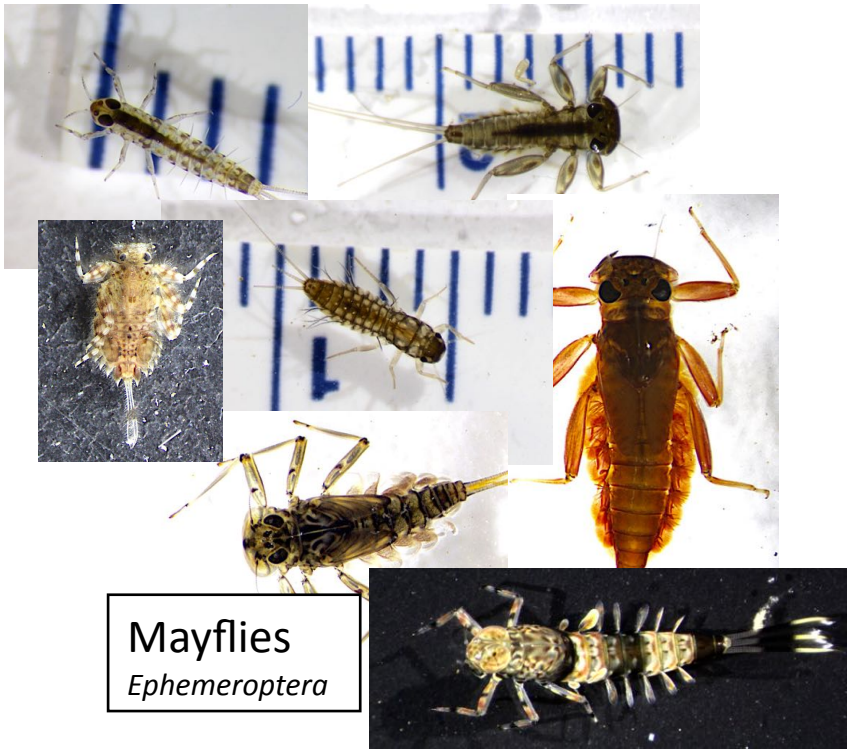
Aquatic inverts of McDonald-Dunn

Bugs we have found in our samples

To date, we have identified 12 Orders of aquatic invertebrates in our samples. Within these Orders there are over 50 identifiable Families. These 50 families could possibly represent well over 100 different species.

Kingdom
Phylum
Class
Order
Family
Genus
Species

Stoneflies
Plecoptera



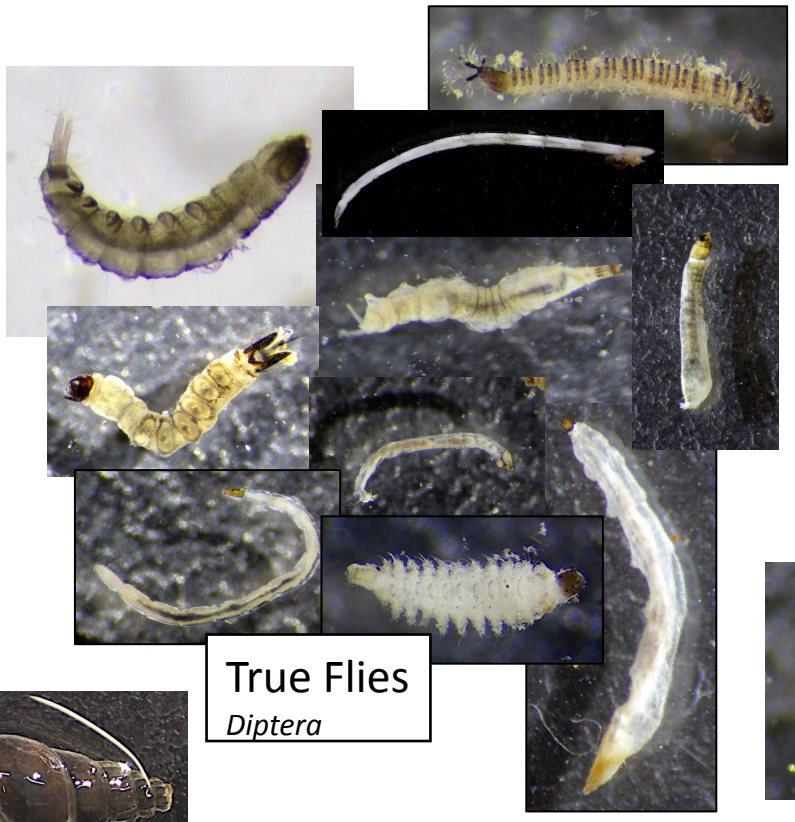
Mayflies
Ephemeroptera

Caddisflies
Trichoptera

Riffle Beetles
Coleoptera

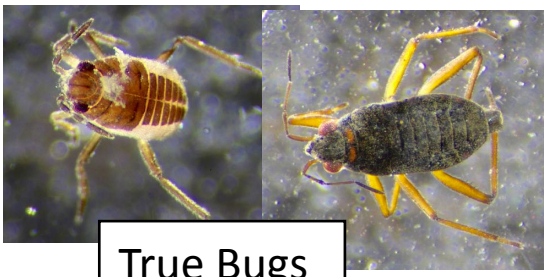
Aquatic Inverts of McDonald-Dunn

Bugs we have found in our samples



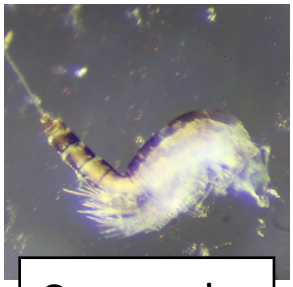
True Flies
Diptera

Alderflies
Megaloptera



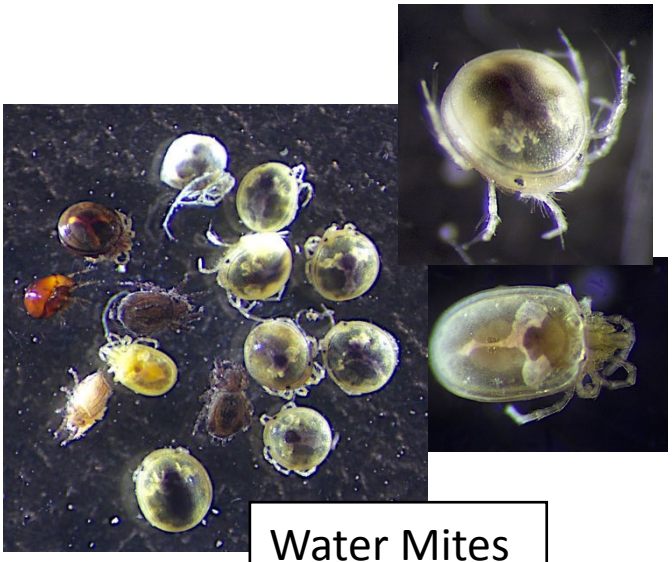
True Bugs
Hemitptera

Snails
Achatinoidae



Copepods
Harpacticoida

Ostracods
Ostracoda



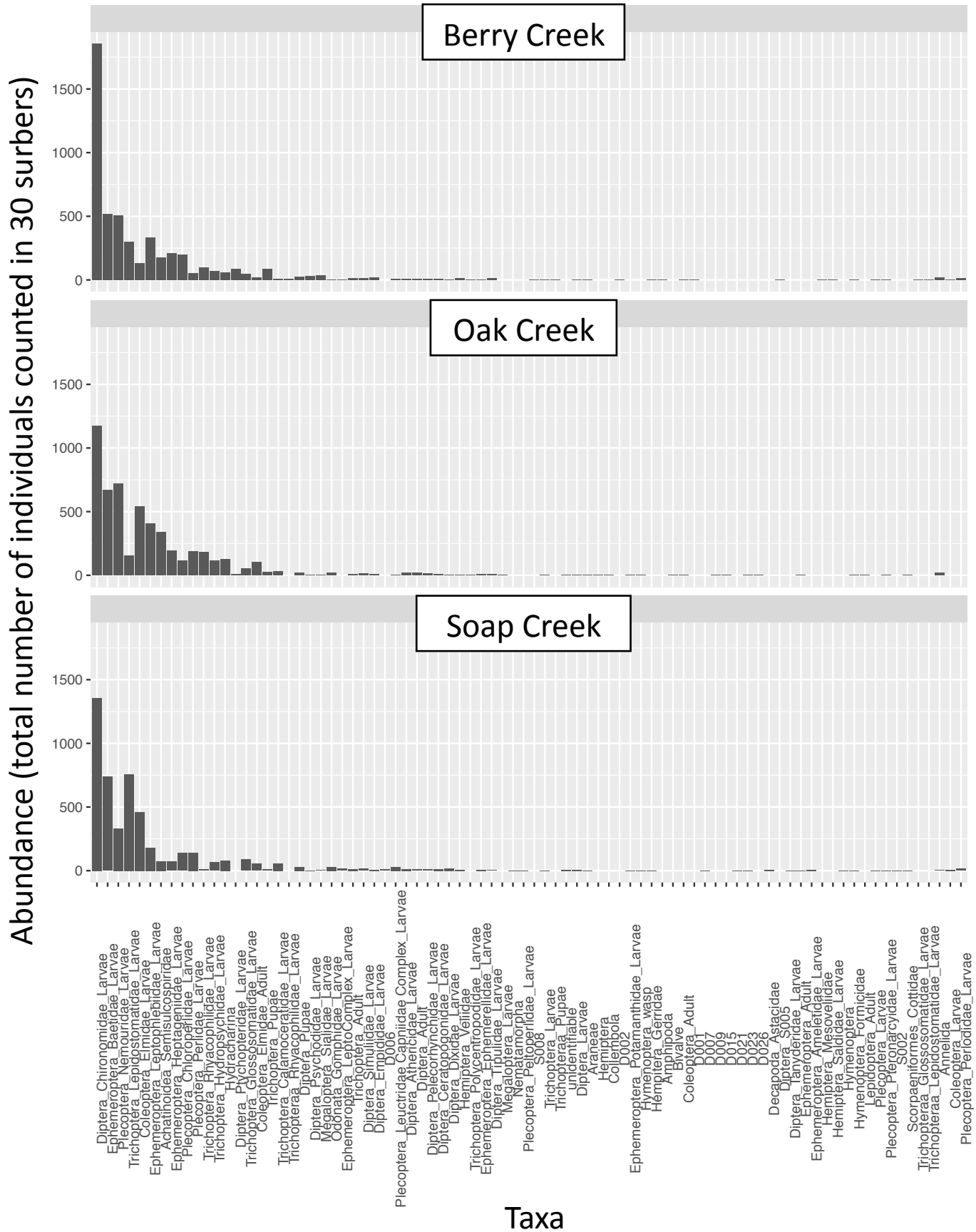
Water Mites
Hydracarina

Springtails
Collembola

Aquatic inverts of McDonald-Dunn

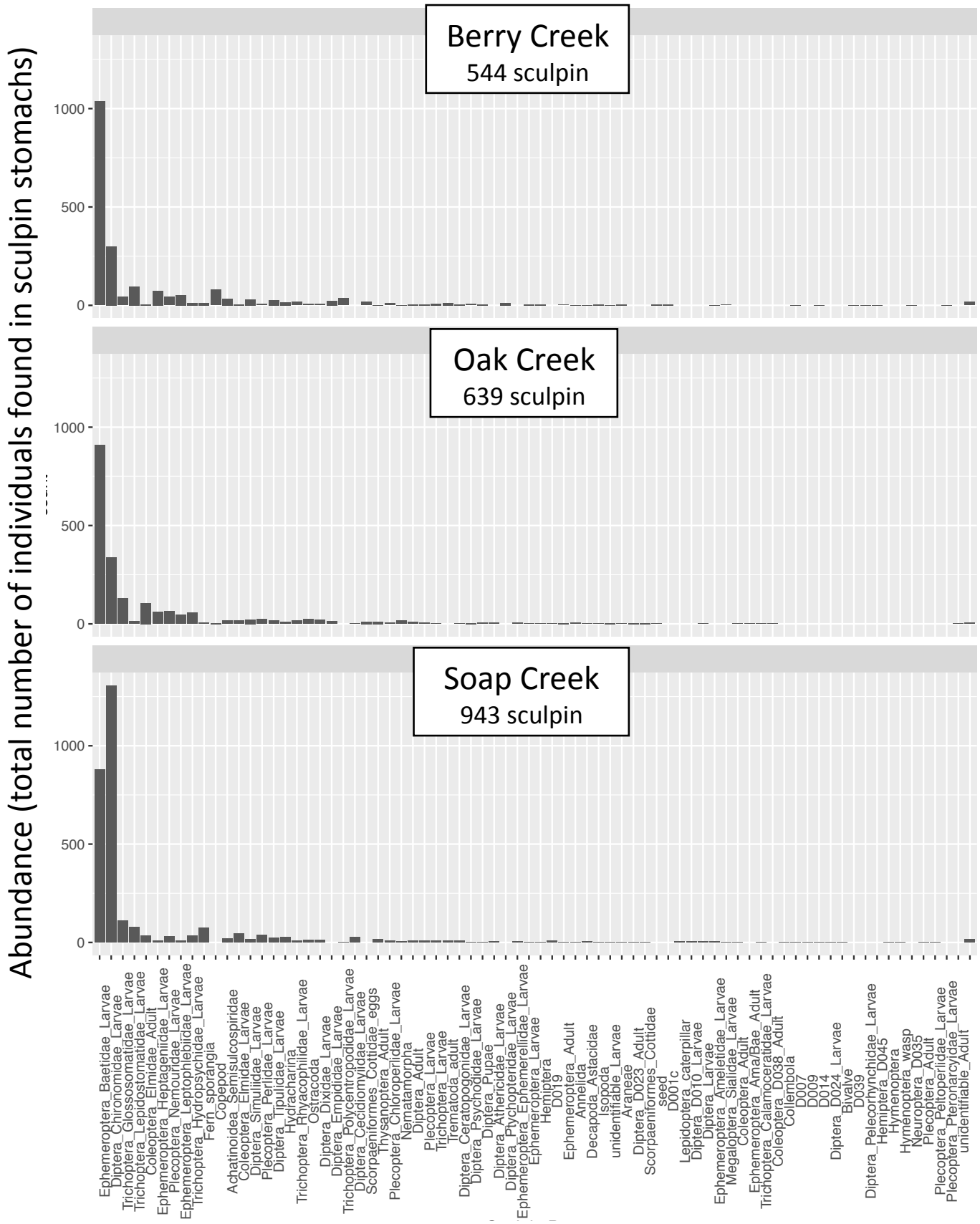
Abundance of bugs in Berry, Oak, and Soap creeks

The relative abundance of taxa in the three creeks. Midges, small stoneflies, mayflies, riffle beetles, and caddisflies are the most abundant taxa. Codes represent unidentified species.



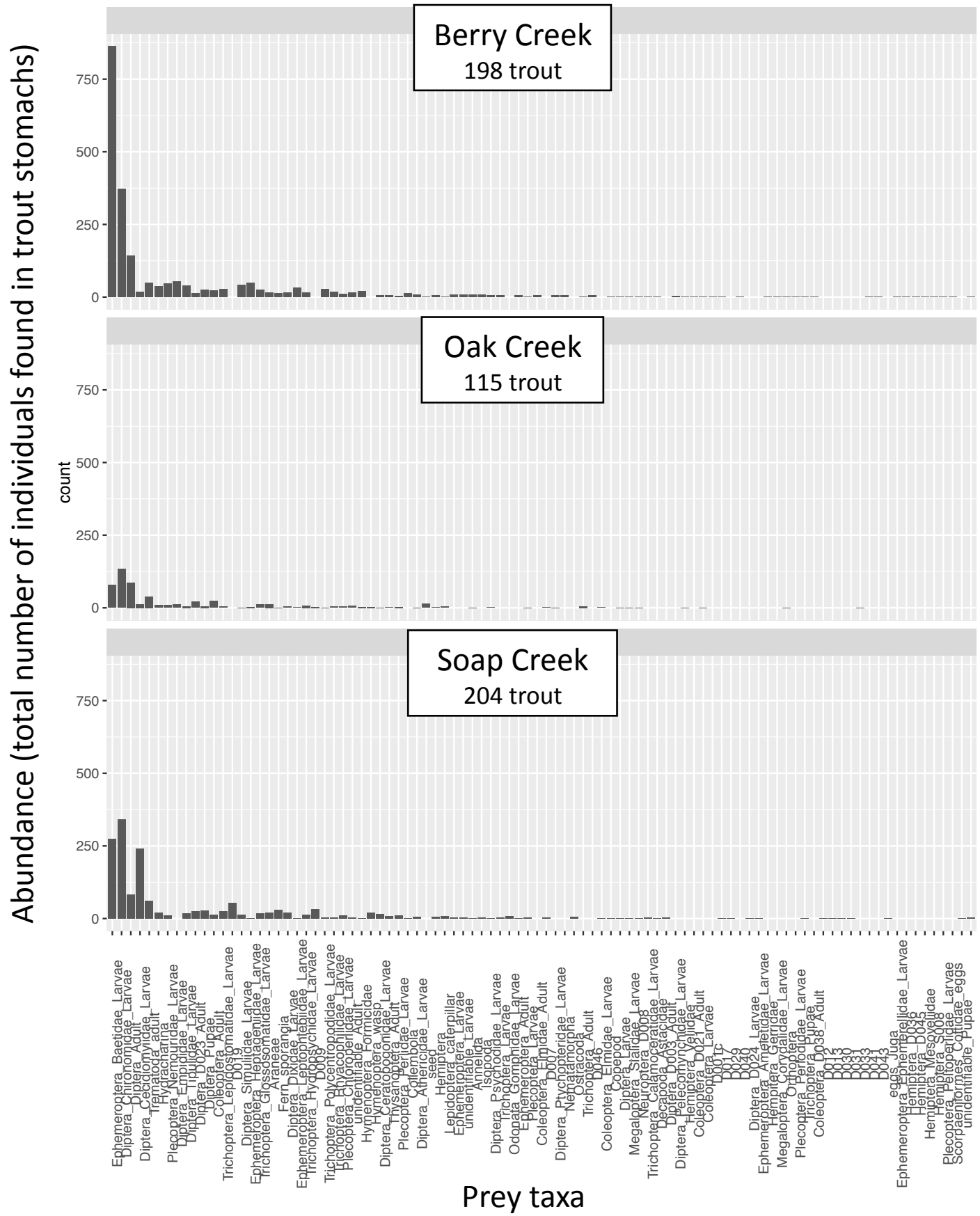
Reticulate sculpin diets

The relative abundance of prey found in sculpin stomachs. Sculpin are eating mostly aquatic invertebrates, preying heavily on midges and small mayflies.



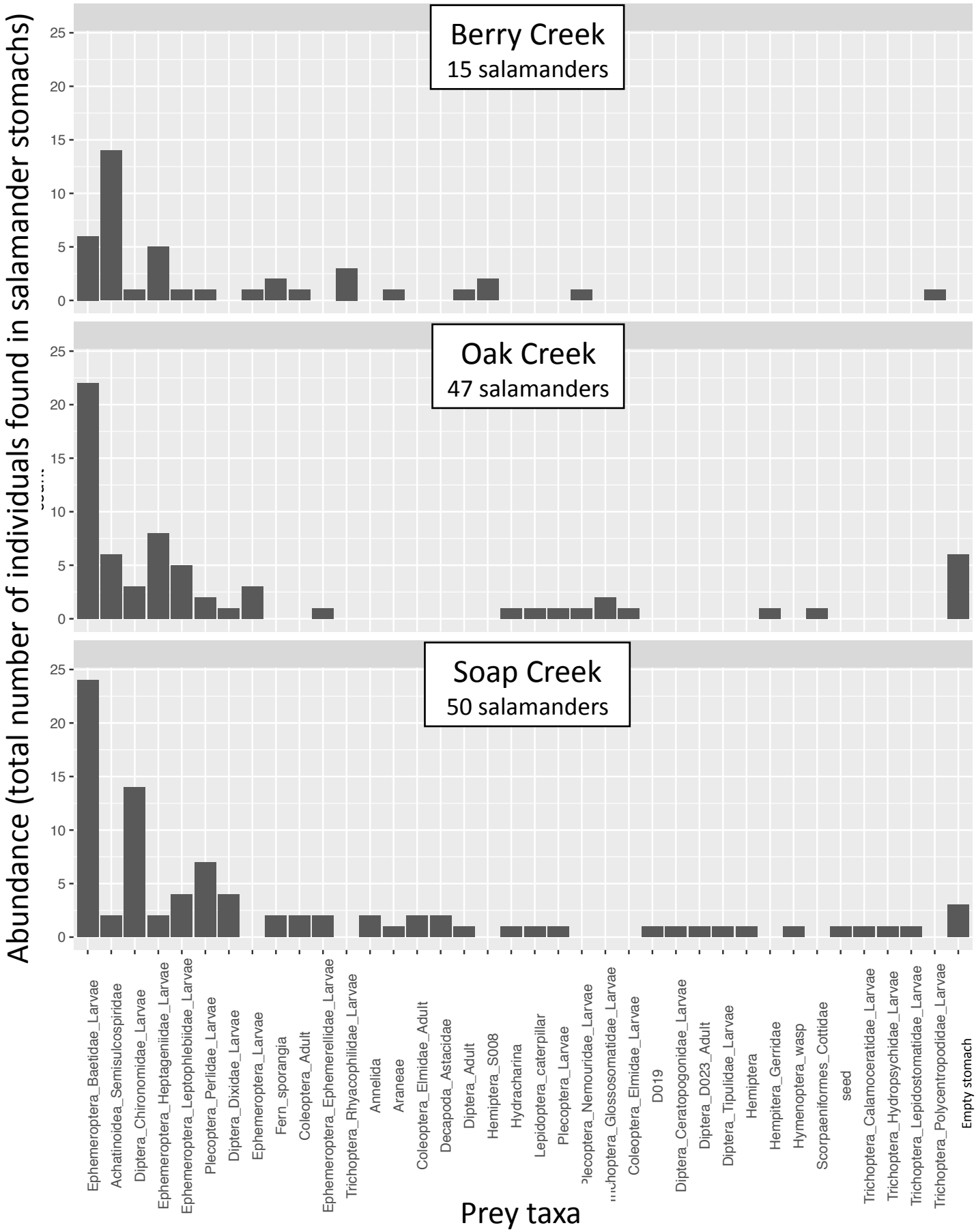
Cutthroat trout diets

The relative abundance of prey found in trout stomachs. Trout are eating caddis, midges, and mayflies, along with a number of terrestrial insects that fall in the streams.



Pacific Giant Salamander Diets

The relative abundance of prey found in salamander stomachs. Salamanders are eating mayflies, snails, midges, and an assortment of other taxa.

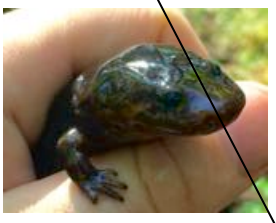


Simplified food web for McDonald-Dunn streams

Using the data we've collected we can put together a "food web" for our sites. This simplified food web shows which species are linked as predators and prey.

Leaves and Detritus

Terrestrial Insects

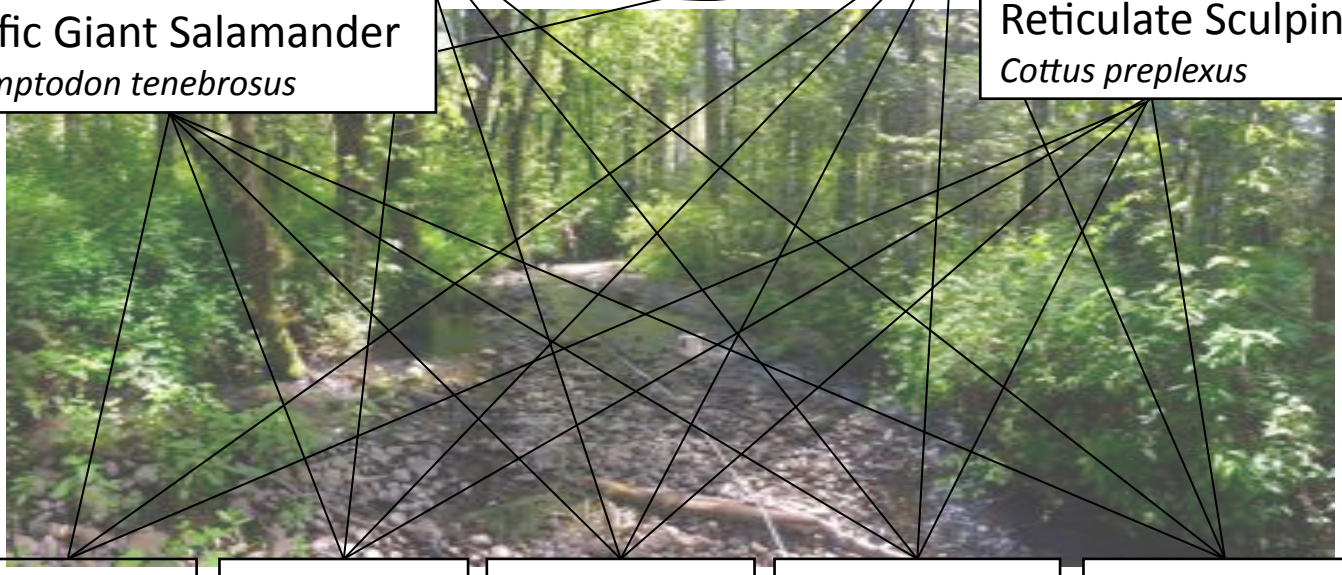


Coastal Cutthroat Trout
Oncorhynchus clarkii

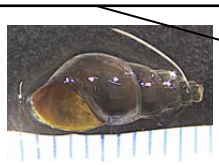
Signal Crayfish
Pacifastacus leniusculus

Pacific Giant Salamander
Dicamptodon tenebrosus

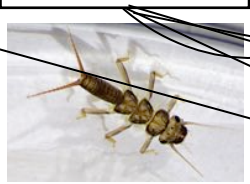
Reticulate Sculpin
Cottus preplexus



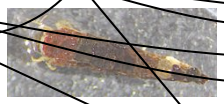
Snails
Juga spp.



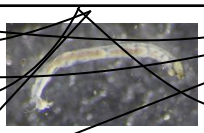
Stoneflies
Plecoptera



Caddisflies
Trichoptera



True Flies
Diptera



Mayflies
Ephemeroptera

Western Brook Lamprey
Lampetra richardsonii

Algae and Detritus

What's next?

As we gather more data and observations at these sites we can begin to examine the dynamic aspects of species interactions as they take place in the streams of the McDonald-Dunn forest. By combining our surveys with field and laboratory experiments, we can start to answer some questions like:

- How strong are the interactions between predators and their prey in these streams? Do predators have a large effect on the size of prey populations?
- How do the predators in this system interact with each other? Do interactions between predators indirectly change their interactions with prey species?
- Are there any interactions that are sufficiently strong to control processes of interest at the ecosystem level?

In addition to providing insight about species interactions, the research we are conducting is also helping to document the species diversity found in Berry, Oak, and Soap creeks.