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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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 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.
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:

<table>
<thead>
<tr>
<th></th>
<th>Sculpin</th>
<th>Trout</th>
<th>Salamanders</th>
<th>Crayfish</th>
<th>Lamprey</th>
</tr>
</thead>
<tbody>
<tr>
<td>Berry</td>
<td>554</td>
<td>198</td>
<td>15</td>
<td>11</td>
<td>11</td>
</tr>
<tr>
<td>Oak</td>
<td>639</td>
<td>115</td>
<td>47</td>
<td>17</td>
<td>49</td>
</tr>
<tr>
<td>Soap</td>
<td>953</td>
<td>204</td>
<td>50</td>
<td>22</td>
<td>7</td>
</tr>
</tbody>
</table>
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.
Aquatic Inverts of McDonald-Dunn
Bugs we have found in our samples

- True Flies (Diptera)
- Alderflies (Megaloptera)
- True Bugs (Hemiptera)
- Snails (Achatinoidae)
- Copepods (Harpacticoida)
- Ostracods (Ostracoda)
- Springtails (Collembola)
- Water Mites (Hydracarina)
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.

![Graph showing the abundance of prey taxa in the stomachs of trout from Berry Creek, Oak Creek, and Soap Creek. Each graph displays the count of individual prey taxa found in the stomachs of 198, 115, and 204 trout, respectively. The graphs include various insect taxa such as Ephemeroptera, Diptera, and Plecoptera, with specific larvae and adult stages indicated.]
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*
- **Western Brook Lamprey**
  - *Lampetra richardsonii*
- **Snails**
  - *Juga spp.*
- **Stoneflies**
  - *Plecoptera*
- **Caddisflies**
  - *Trichoptera*
- **True Flies**
  - *Diptera*
- **Mayflies**
  - *Ephemeroptera*
- **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.