Trophic Relations in Streams and Rivers

<u>Introduction</u>

Aquatic ecosystems are very sensitive to perturbations. This may include changes in water chemistry or temperature, pollution from fertilizers or other organic materials, or changes in the terrestrial ecosystems that surround and encompass streams and rivers. These changes can alter the food webs. However, changes are difficult to observe in aquatic food webs because they are underwater.

One way to learn more about an ecosystem, without knowing exactly who's eating whom, is to categorize the inhabitants based on how they eat. Predators and scrapers are examples of these kinds of groups, known as functional groups. Predators eat other animals and scrapers remove algae, fungi, and other food from hard surfaces using a scraping motion.

When we talk about trophic relations, we're referring to how animals use food sources, and structure of the food web. In aquatic systems, we can use functional feeding groups to help us build a food web. We can look up what the animal eats after identifying them. We can often figure out what the aquatic invertebrates eat by looking at their mouthparts. Below is a description of the feeding functional groups of aquatic macroinvertebrates:

Shredders are macroinvertebrates that chew on large pieces of organic material (coarse particulate organic matter; **CPOM**). Some is consumed, but many of the smaller pieces wash downstream. The finer material that travels downstream is fine particulate organic matter (**FPOM)**.

Collectors are adapted to catch **FPOM**. This group can be subdivided into **filterers**, who may construct traps or have mouthparts that strain FPOM from the moving water, and **gatherers**, who collect FPOM from the sediments.

Scrapers consume material that is attached to substrate (for example, rocks, logs, plants), such as algae and fungi attached to rock surfaces.

Predators eat other animals. In some cases, they eat the whole animal; other predators pierce their prey and suck out the juices.

Parasites depend on a host animal to survive.

Another important question is where the energy that supports aquatic life is coming from. Aquatic plants and algae use energy from the sun to photosynthesize. Some of that energy is transferred to scrapers and shredders when they eat plants, and then on to predators. In aquatic systems, energy may come primarily from photosynthesizers or from terrestrial plants depending on the characteristics of the stream. For example, high mountain streams can be covered with bushes that let little light into the stream. The invertebrates in these streams get most of their energy from the leaves that fall in from the bushes. We would expect to see a lot of shredders in these streams. Streams that rely on terrestrial organic matter are called **allochthonous**, meaning energy comes from an external source (allo = other). On the other hand, a mountain stream with few bushes would have a lot of algae growing on the rocks and logs in the water. We would expect to see a lot of scraping invertebrates in these streams. These types of streams are called **autochthonous**, because photosynthesis within the stream provides energy to maintain the system (auto = self). The organic material attached to submerged structures (rock, sticks, underwater plants) is collectively known as **periphyton** or **biofilm** and is mainly composed of algae, fungi, bacteria, and organic matter.

Methods

Collect aquatic macroinvertebrates using one of the methods described in (see our Sampling Aquatic Inverts Lesson) While at your field site, make some observations about the stream—size, flow, clarity of the water, presence or absence of periphyton, etc. Based on your observations, hypothesize as to whether this stream is allochthonous or autochthonous, and which functional feeding groups you expect to be represented in the macroinvertebrate fauna. Identify specimens to family using Wyoming's Stream Macroinvertebrates, and record functional feeding group for each family found. Also record the number of individuals found in each family. With this information, you will also be able to calculate Hilsenhoff's Biotic Index with your data (see our Sampling Aquatic Inverts Lesson Plan)
Make a tally of the number of individuals of each functional group. You will need the total number of individuals in each category to calculate ratios of invertebrate groups.

Macroinvertebrate Functional Feeding Groups Data Sheet

Team members____

Location___________________________________Date______________________________________

Substrate: Bedrock Coarse gravel Fine sediment Organic litter

Tally

Shredders	Collectors
Total =	Total =
Scrapers	**Predators**
Total =	Total =

Ratios to calculate

Scrapers/(shredders + collectors) ___________________________________

Shredders/collectors_____________________________________

Predators/all other groups______________________________________

Interpreting your results

1. At this site, scrapers/(shredders + collectors) = ____.

This ratio is an indicator of the relative abundance of periphyton present in the stream, compared to CPOM and FPOM.

What is the main food source at this site, algae in the stream or leaves from the surrounding terrestrial vegetation? __________________________________

What is the primary food source for the macroinvertebrates living here? ___________________

2. The upper reaches of a creek typically have a high proportion of CPOM compared to lower

reaches. Why? ____

Which functional feeding group would you expect to be most abundant in the upper reaches of a stream? ____

The ratio of shredders to collectors will indicate the relative amount of CPOM to FPOM. The ratio at this site is _______________________. Do you expect the ratio to be higher or lower downstream from this site? ____

3. What is the ratio of predators to all other functional groups?

   ____

Would you expect that ratio to change as you move up or downstream? __________________________

How would you expect it to change? ____

A normal predator to prey ratio is <0.15. Is the ratio normal at this site? __________________________

4. What is the most common scrapper at this site? _______________________________________

What is the most common collector? ____

What is the most common shredder?

____

Do you expect the species to change if you move to another site? _____________________________

5. Based on your assessment of the macroinvertebrates, draw the trophic relations in your stream.

Evaluation of trophic relations based on functional feeding group ratios

Ecosystem parameter	Functional group ratio	Value of ratio	Stream evaluation
Within stream to outside stream primary production	Scrapers/ (shredders + collectors)	>.75 Within stream primary production	Depends on autochthonous energy*
		<.75 Outside of stream primary production	Depends on allochthonous energy*
CPOM/FPOM	Shredders/ collectors	>.3	Heavy dependence on CPOM (shaded small streams)
		>.15	CPOM and some FPOM (open small streams)
		<.1	Abundant FPOM (medium size, open rivers)
		<.05	Little or no input of CPOM (large rivers)
Predators: prey	Predators/ all other groups	<.15	Typical value for any stream or river

Compiled from Merritt and Cummins 1995 and Hughes 1995.

* Interestingly, the proportion of scrapers is highest midway through the course of a river. This is because periphyton requires sunlight, and rivers with lots of FPOM, which is picked up along the way, are too murky for light to penetrate.

References

Hughes, R.M. 1994. Defining acceptable biological status by comparing with reference conditions. In: Biological assessment and Criteria: Tools for water resource planning and decision making. W.S. Davis and T.P. Simon, eds. Lewis Publishers, pp 31-177.

Merritt, R.W., and K.W. Cummins. 1996. Trophic relations of macroinvertebrates. In: Methods in Stream Ecology. F.R. Hauer and G.A. Lamberti, eds. Academic Press, Inc. pp. 453-474.