How Do Functional Feeding Guilds Respond to Habitat Distribution?

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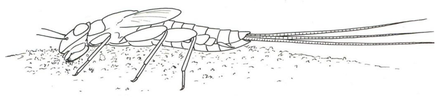
Biology Department | University of Wisconsin - Eau Claire | 2011-2012

BACKGROUND

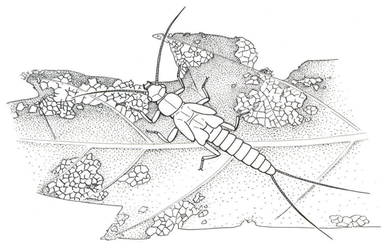
Functional Feeding Guilds

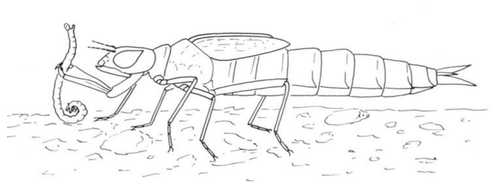
Understanding how macroinvertebrates respond to variation in habitat can lend us insight on how they mediate ecological processes. Macroinvertebrates play an important role in transporting and cycling energy, nutrients, and resources through a stream. They can be categorized according to their food-acquisition strategy into five ***functional feeding guilds (FFGs)***: scrapers, shredders, predators, gatherers, and filterers. Each FFG preferentially consumes a specific food source, thereby mobilizing it through the stream food web.



Scrapers remove periphyton, which includes algae, from coarse substrates. The flat-headed mayfly (pictured left) scrapes periphyton off the surface of rock.

Shredders feed on aquatic plant and coarse particulate organic matter (CPOM). The stonefly (pictured right) eats parts of leaves that have fallen into the stream.

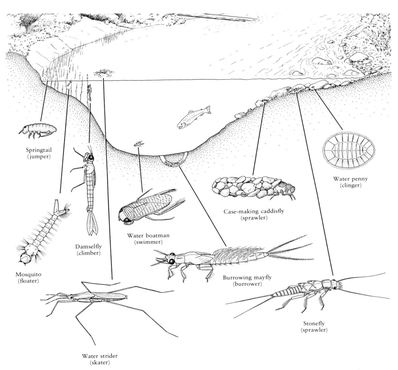




Predators consume small, aquatic animals. They may capture their prey as the dragonfly nymph pictured at left.

Gatherers (such as the *Chironomidae* caught by the dragonfly nymph pictured above) collect fine particulate organic matter (FPOM) that has settled on the bottom of the stream.

Filterers eat FPOM suspended in the water column. The net-spinning caddis (pictured right) attaches a net to its case which collects FPOM as water passes through.



Ecological Niche

An ***ecological niche*** describes the environmental conditions which a group of organisms can tolerate. It often reflects the role of the group in the context of its community and ecosystem. For this reason, different macroinvertebrates will occur in different habitats (as diagramed left). Due to differences in diet, behavior, and morphology, we suspect FFGs will differ in their ecological niche.

HYPOTHESIS

We expect functional feeding guilds to have **distinct ecological niches**, which will be reflected in two ways:

1. FFGs will differ in the **nature and degree of their response to habitat** variables.
2. Each FFG will respond to a **unique set of habitat variables**.

METHODS

Field Techniques

We studied a 40-meter reach centered at a primary logjam in Cabin Creek, Superior National Forest. We surveyed ***benthic*** (bottom-dwelling) macroinvertebrates through ***Surber sampling*** (as pictured right) at 49 random sites. Prior to Surber sampling, we assessed the physical characteristics of the Surber site: velocity, depth, substrate, and wood surface area.

Statistical Analysis

We used ***structural equation modeling*** (***SEM***) to investigate the effects of habitat variables on FFG distribution. SEM begins with a proposed model which diagrams possible direct and indirect relationships among the variables, then uses collected data to eliminate unsupported relationships. In the final model, arrows indicate supported causal/correlated relationships. The number associated with the arrow, the standardized correlation, indicates the strength and direction of the relationship.

RESULTS & DISCUSSION

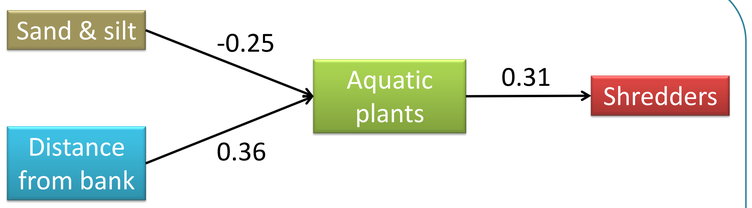


Fig 1. Shredders were located near or around aquatic plants. Aquatic plants tended to occur away from the banks in areas lacking fines substrates such as sand and silt. The distribution of shredders was not affected by availability of CPOM, their secondary food source.

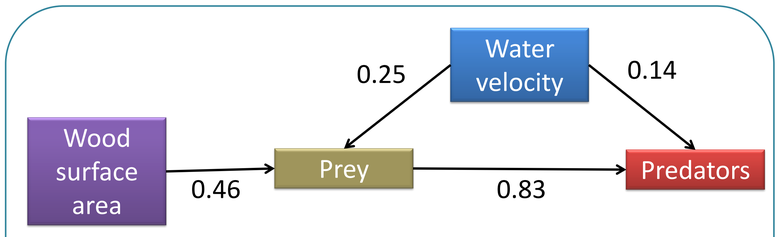


Fig 2. Predator abundance was best predicted by prey abundance, which increased with velocity and wood surface area. Like prey, predator abundance also increased with velocity.

- The SEM models show that high velocity and high wood surface were favored by every FFG except for shredders. This demonstrates that wood and velocity may provide crucial services to most macroinvertebrates.
- The SEM models also indicates that shredders have a distinct ecological niche while predators, scrapers, filterers, and gatherers, overlap in their niche.
- Predator abundance is optimized by high prey abundance, scraper abundance is optimized by high velocity, and filterer abundance is optimized by high wood surface area.

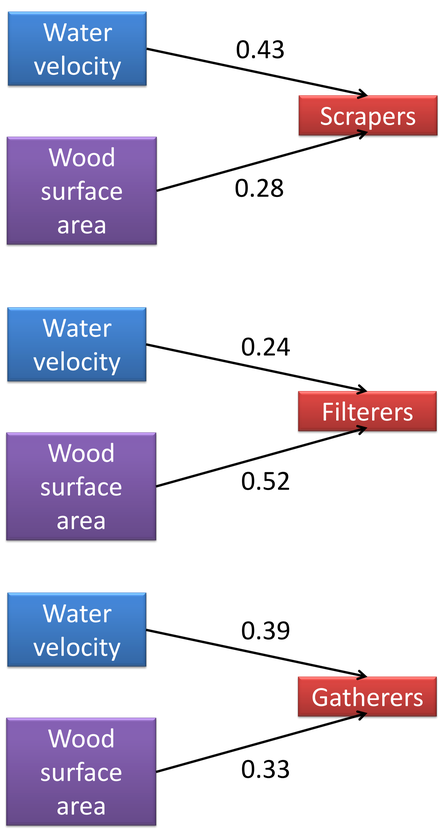


Fig 3. The abundance of scrapers, filterers, and gatherers was associated with high water velocity and high wood surface area. However, they differed in their relative response to each. Scrapers responded more strongly to velocity than wood, filterers responded more strongly to wood than velocity, and gatherers responded equally to both.

Acknowledgements: *Funding and support for this project was provided by the National Science Foundation, the US Forest Service, the Office of Research and Sponsored Programs, the UWEC Center of Excellence for Faculty and Undergraduate Student Research Collaboration, and the UWEC Diversity Mentoring Program. Special thanks goes to all the members of Team Logjam, including Zach Snobl and Jennifer Mack, who helped process the samples for this study.*