Influence of stream macrophytes on slimy sculpin (*Cottus* cognatus) distribution and in-stream food webs

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Macrophytes & Stream Dynamics

- Aquatic vegetation is an important stream organism for its effects on stream processes and for its role as an energy source to stream food webs.
- Macrophyte effects on stream processes:
  - Influence channel shape by directing the main flow of water
  - Decrease water velocity
  - Retain fine sediments
  - Provide large surface area for the colonization of macroinvertebrates and epiphytic periphyton
  - Retain organic matter, which supplements nutrient cycles
  - Provide energy to the base of aquatic food webs
  - Intercept light and shade stream benthos

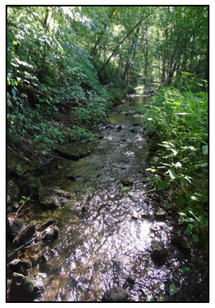
Slimy Sculpin

- Small, benthic, invertivores
- Prefer riffle habitats with cobble substrate
- In cold-water streams, they dominate fish assemblage in terms of biomass and abundance
- Influence invertebrate assemblage through predation
- Compete with young brook and brown trout for invertebrate prey
- Food source for large brook and brown trout
- Previous research shows small-bodied sculpin (<4cm) comprise a majority of the sculpin population at open canopy sites in the Coon Creek Watershed during late summer (Laukkanen 2012).

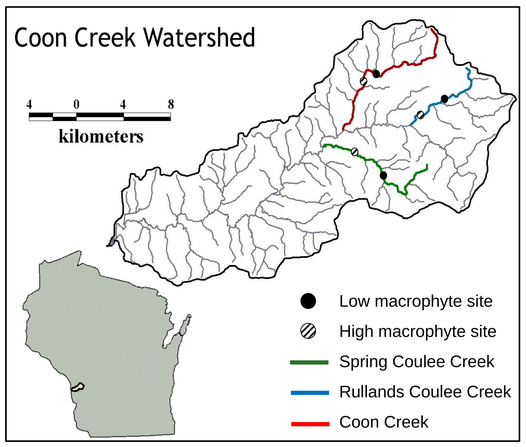
Slimy sculpin

Study Sites

- Three streams in the Coon Creek Watershed in Wisconsin served as independent replicates.
- Each contained a pair of riffle sites, both 20 meters in length; one had abundant macrophyte growth and the other contained little to no macrophyte growth.



Low macrophyte site



High macrophyte site

Objectives

1. Determine if the size distribution of slimy sculpin (*Cottus cognatus*) relates to the abundance of stream macrophytes
2. Determine if periphyton biomass and invertebrate community composition and biomass are influenced by macrophyte abundance
3. Determine if the diet of small and large sculpin and the mass of food in gut differs based on macrophyte abundance

Analytical Methods

Organism abundance

Macrophyte cover using a 0.25m^2 quadrat

- Macrophytes: Percent cover as well as total and species specific biomass were determined using the quadrat method
- Periphyton: Fifteen samples collected per site from a known area of substrate using a tube sampler. Ash free dry mass and chlorophyll *a* analysis were performed.
- Macroinvertebrates: Five replicate samples collected using a Hess sampler. Organisms were sorted to family; total and taxon specific biomass were calculated.

Hess sampler

Kicknet sampling

- Slimy sculpin: Sculpin were collected using a kicknet. All sculpin were measured for total length.

Sculpin diet

- Ten small (<5cm) and ten large (>6cm) sculpin were euthanized with MS-222. Gastric lavage was performed to extract gut contents. Whole and partial organisms were identified and the dry mass of gut contents were calculated per mm of body length.

Sculpin and gut contents after gastric lavage

Preliminary Results

Periphyton abundance

- Biomass of periphyton was significantly different between sites with high and low macrophyte abundance (Stream x Macrophyte interaction; ANOVA p = 0.004) (Fig. 1), however chlorophyll *a* only differed significantly between streams (ANOVA p = 0.01)

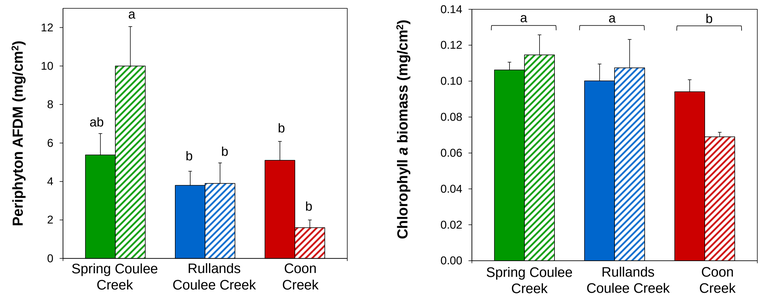


Fig. 1. Average and standard error of standing periphyton biomass (mg/cm^2) and chlorophyll *a* biomass (mg/cm^2) from low (■) and high (▨) macrophyte abundant sites in three streams. Differing letters indicate significant differences.

Preliminary Results

Sculpin abundance

- Sculpin density (Fig. 2) did not differ significantly between sites with high and low macrophyte abundance

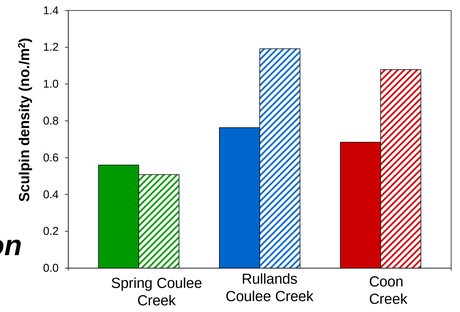


Fig 2. Density of slimy sculpin at sites with low (■) and high (▨) macrophyte growth in three streams

Sculpin size distribution

- Size distribution (Fig. 3) was not congruent with the findings of previous research
- Average sculpin sizes were significantly different between sites with and sites without macrophytes (Stream x macrophyte interaction, ANOVA p < 0.0001)

→The low macrophyte site at Spring Coulee Creek was significantly different than all other sites in terms of average sculpin length

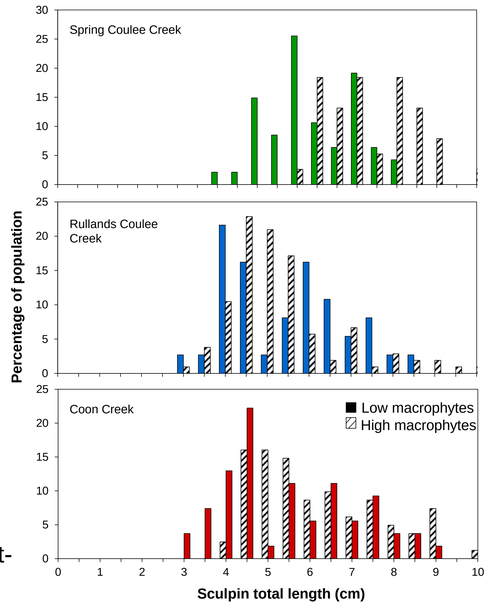
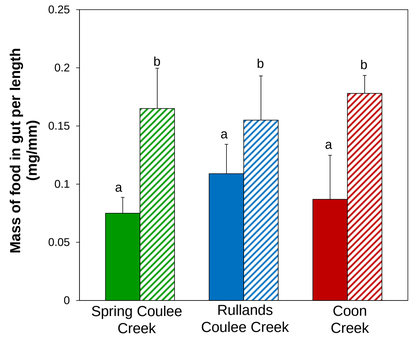


Fig 3. Sculpin total length and percentage of the population at sites with low (■) and high (▨) macrophyte growth in three streams

Sculpin diet

- There were no consistent diet patterns observed between replicate streams. Sculpin gut contents suggest that sculpin diet is stream specific.



- The average mass of gut contents per mm of sculpin length (Fig. 4) was significantly different between sites with low and high macrophyte abundance (ANOVA p = 0.001)

Fig 4. Average mass, and standard deviation, of gut contents per mm of sculpin length at sites with low (■) and high (▨) macrophyte growth. Differing letters indicate significant differences.

Preliminary Outcomes

- The results indicate that sculpin that inhabit stream reaches with high macrophyte abundance experience higher food availability than sculpin in reaches that lack macrophytes.
- The lack of significant difference in sculpin density between sites with and without macrophytes was likely due to physical differences between Spring Coulee Creek and the other two streams.

Acknowledgments

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References:

Hauer, F.R. and G. A. Lamberti, editors. 2006. Methods in stream ecology. 2nd Ed. Burlington, Massachusetts; Ademic Press.

Laukkanen, K.L. 2012. Effect of riparian vegetation on the spatial distribution of slimy sculpin *Cottus cognatus* in southwestern Wisconsin streams. MS Thesis, University of Wisconsin-La Crosse.

Additional information: