Low Gradients, High Importance:
A Study into Important Taxa in Low Grade Streams

Samantha "Sammy" Parnin,[1] Chloe Edwards,[2] Justin Kaput,[3] Andy Zhang[4]

[1]Suffield High School; [2] CT Dept. of Energy & Environmental Protection; [3] Suffield School District; [4] UConn NRCA

Project Motivation & Goals

Though freshwater ecosystems make up **less than 1% of our Earth's surface**, they provide habitat to **35% of recognized invertebrate species**.[1] That is an incredible amount of biodiversity! Unfortunately, modern freshwater streams and ecosystems are threatened by agricultural pollution, habitat alteration, and climate change.[2]

Understanding how streams are affected by these changes lies in their macroinvertebrate population, as they respond in consistent ways to the stresses of environmental degradation and gradient. **High-gradient streams** have steep slopes, resulting in fast flowing oxygenated water while **low-gradients streams** have softer slopes resulting sluggish, less oxygenated water.[3] The CT Department of Energy & Environmental Protection (CT DEEP) currently focuses their **Stream Riffle Bioassessment by Volunteers (RBV) program** (a community-science stream water quality monitoring program) on high-gradient streams to find vulnerable macroinvertebrates because the method is built for larger riffles (i.e., a fast, rocky area of a stream; Fig 1a & 2a). While RBV sampling was created to target riffles in high-gradient streams, **my project aimed** to apply the state's RBV method to assess water quality using riffles in lower-gradient streams and macroinvertebrates as bioindicators.

My Objectives:

- Compare a medium-gradient stream to a low-gradient stream while using RBV protocols
- Observe the effectiveness of RBV sampling in lower-gradient streams
- Examine the presence of the most sensitive macroinvertebrate species to help assess the water quality of these lower gradient sites

*Fig 1. **A)** A low gradient site in the Kaeo River in New Zealand. [5] **B)** A high gradient stream called the Cascade Falls on the Kettle River in Minnesota with a riffle.[6]*

Methods

I studied two medium-low gradient streams in Suffield, CT (Fig 4c & 4d):

1. Stony Brook, which has a steep-to-medium gradient riffle (Fig 4c).
2. Devine Brook, which has a much softer, lower gradient riffle (Fig 4d).

I used the Riffle Bioassessment by Volunteers (RBV) sampling protocol at each stream:

1. Locate a riffle within each stream
2. Take photos of stream (upstream and downstream)
3. Identify six spaced out survey sites within the riffle area of each stream and carry out the following survey protocol within each site (starting upstream) (Fig 2a):
   a. Place kick-net so water flows into it
   b. Rub larger rocks that are resting on the stream's bed into net for 1 minute
   c. Kick in front of net and let debris flow into the net
   d. Dump net contents into one of three plastic containers (two close sites per bin)
   e. And repeat at other sites!
4. On the bank, review content in bins and identify macroinvertebrates to broad taxa types using the CT DEEP RBV field key (Fig 2b, c, & d)
5. Note which category of taxa the macroinvertebrates fall into: Other, least wanted, moderately wanted and most wanted

★ Surveys were conducted within 8 days of each other in October of 2023.

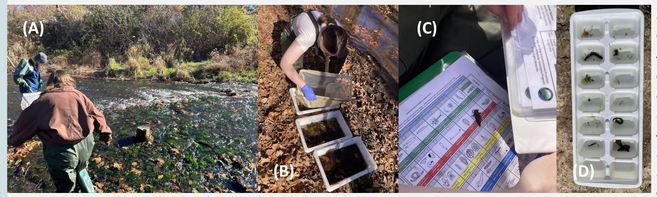

*Fig 2. **A)** Chloe Edwards and Sammy Parnin sample in Stony Brook. **B)** Sammy washes kicknet into bucket at Devine Brook. **C)** Sammy matches Macros with sheet. **D)** Macros in ice cube container.*

Community Partnership

- My main community partner was **CT DEEP's Environmental Analyst, Chloe Edwards**. She provided me with an idea of what my future career would look like and the supplies required to complete my current research. She was incredibly knowledgeable on macroinvertebrate sampling and clearly passionate about her work. I really enjoyed working with her and am forever thankful for her help in this project.
- I also had help from **Justin Kaput, my previous Environmental Science teacher**. He helped me by asking how my project was going to keep me excited to complete all of my work. He also recommend this NRCA program to me! At some points I was struggling with finding a location to survey and he kept me on the right path in finding a good location to sample as well as making sure I didn't get frustrated.
- After this partnership has ended, I hope that both **Chloe and Justin** will help me with connections within the environmental career. Both are amazing people and will be very helpful with career advice and networking.

*Fig 3. **A & B)** Chloe Edwards (left) instructs Sammy Parnin (right) on RBV sampling. **C)** Sammy uses materials borrowed from Chloe to complete her independent sampling of the Devine Brook.*

Project Outcomes

What do these findings show?

- Using the RBV protocol, streams with **14 taxa types in the 'Most Wanted' category** is used to indicate stream segments that are among Connecticut's healthiest stream.[4]
- **Stony Brook** comprised 0 most wanted, 2 moderately wanted, and 4 least wanted/other macroinvertebrate taxa (Fig 4a).
- **Devine Brook** comprised 2 most wanted, 4 moderately wanted and no least wanted/other macroinvertebrates taxa (Fig 4a).
- Although **4 Most Healthy Taxa groups** are required for a high gradient stream to be called one of the healthiest, being such a small stream, this could be a good sign but, according to RBV protocol there is no assessment to be made.
- **Most Wanted Taxa** are the some of most sensitive to pH and water quality shifts, which *could* tells us that the Devine Brook Site is less polluted than the Stony Brook Site.
- The riffle site for Stony Brook sits next to a bridge on Remington Street in Suffield, Connecticut.
- The riffle site for Devine Brook is in a patch of woods between the Suffield High School and Spaulding Elementary School, which has a walking trail that goes above the river roughy 800 ft away.

Important Note:

- Due to how RBV sampling works, any data collected can only be used to say a stream has a *good* water quality, not that it has poor water quality. Not finding Most Wanted Macros just means that we didn't find them, not necessary that they aren't there.

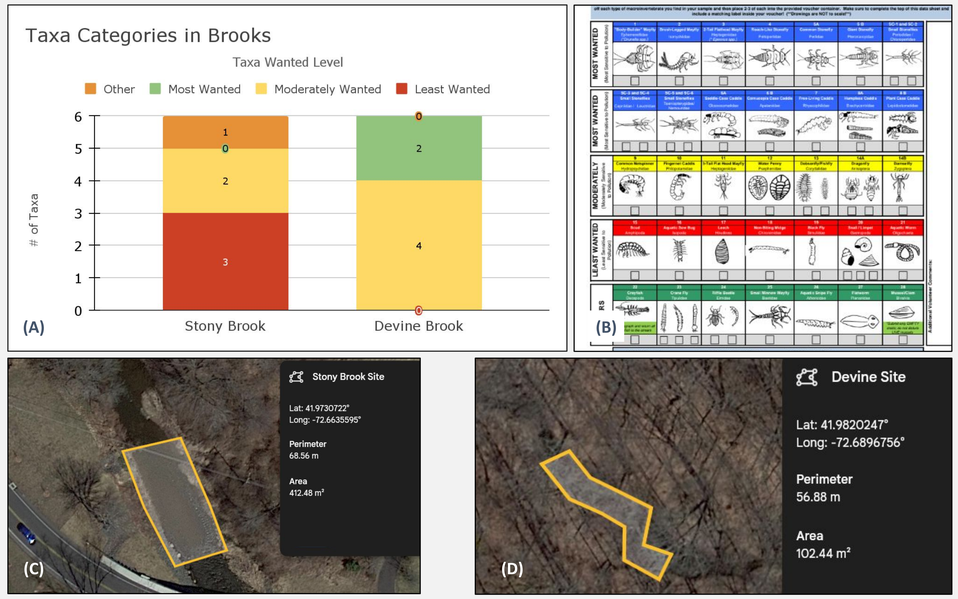

*Fig 4. **A)** Graph depicting number of taxa types per category found in each brook. **B)** Sheet used to mark macroinvertebrates found in RBV sampling. **C)** Area of Stony Brook site and it's latitude and longitude. **D)** Area of Devine Brook site and it's latitude and longitude.*

Conclusion and Next Steps

- Though the RBV sampling method itself worked well, the standards for higher gradient streams **do not work** with lower gradient streams.
- Due to the **negative correlation** between Most Wanted taxa and pollutants, it can serve as a way to assess on the quality of streams as long as a certain number of Most Wanted taxa are found.
- **If we study more low gradient streams**, we can use the data of Most Wanted Taxa as a means to determine the benchmarks for stream health through the number of Most Wanted Taxa caught.

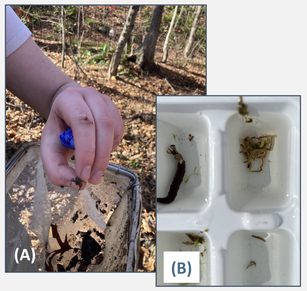

*Fig 5. **A)** Sammy shows dragonfly larva captured. **B)** Caddisfly larva captured*

Acknowledgements and References

Thank you to Chloe Edwards, Justin Kaput, Andy Zhang, Laura Cisneros, Nicole Freidenfelds and Frank Parnin for the assistance with my project and the help I have received to make this possible! Thank you CT DEEP for the field equipment! And thank you to Ms. Candia-Bovi for some poster pointers!

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