

The Effect of Substrate on Biodiversity of Macroinvertebrates

Jessica Gagne and Teddi Simons

Hypothesis

Biodiversity is important for ecosystem resilience. Among other factors, river substrate impacts the biodiversity of macroinvertebrates.



It is predicted that a stream with higher embeddedness (measure of substrate) will have a higher macroinvertebrate biodiversity.

Why does substrate matter?

Microscopic algae and other microorganisms growing on hard surfaces in freshwater are food for some macroinvertebrates.



Why Do We Care?

- ◀ Pollination
- ◀ Pest and disease management
- ◀ Fresh water, food, fibre, habitat and genetic resources
- ◀ Recreation and tourism
- ◀ Spiritual health, cultural identity



- ▶ Erosion prevention
- ▶ Protection from natural disasters
- ▶ Carbon sequestration and storage
- ▶ Air and water pollution control
- ▶ Nutrient cycling and soil fertility

Methods



Benthic Macroinvertebrates

Functional Feeding Groups

- Grazers and scrapers
- Shredders
- Collector/gatherers
- Filter-feeders
- Predators



Measures of Biodiversity

$$D = \sum_{i=1}^S \frac{n_i(n_i - 1)}{N(N - 1)}$$

D= Simpson Diversity Index

N= number of individuals in a species

n= total number of individuals collected

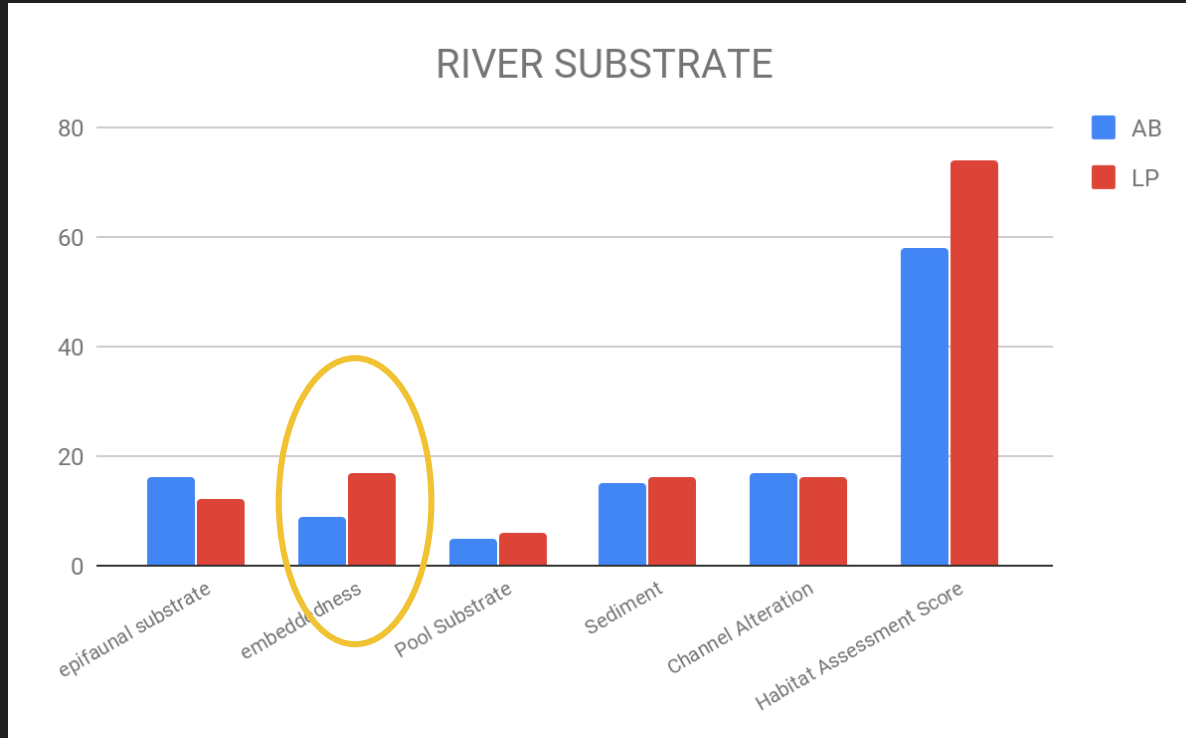
S= total number of species (richness)

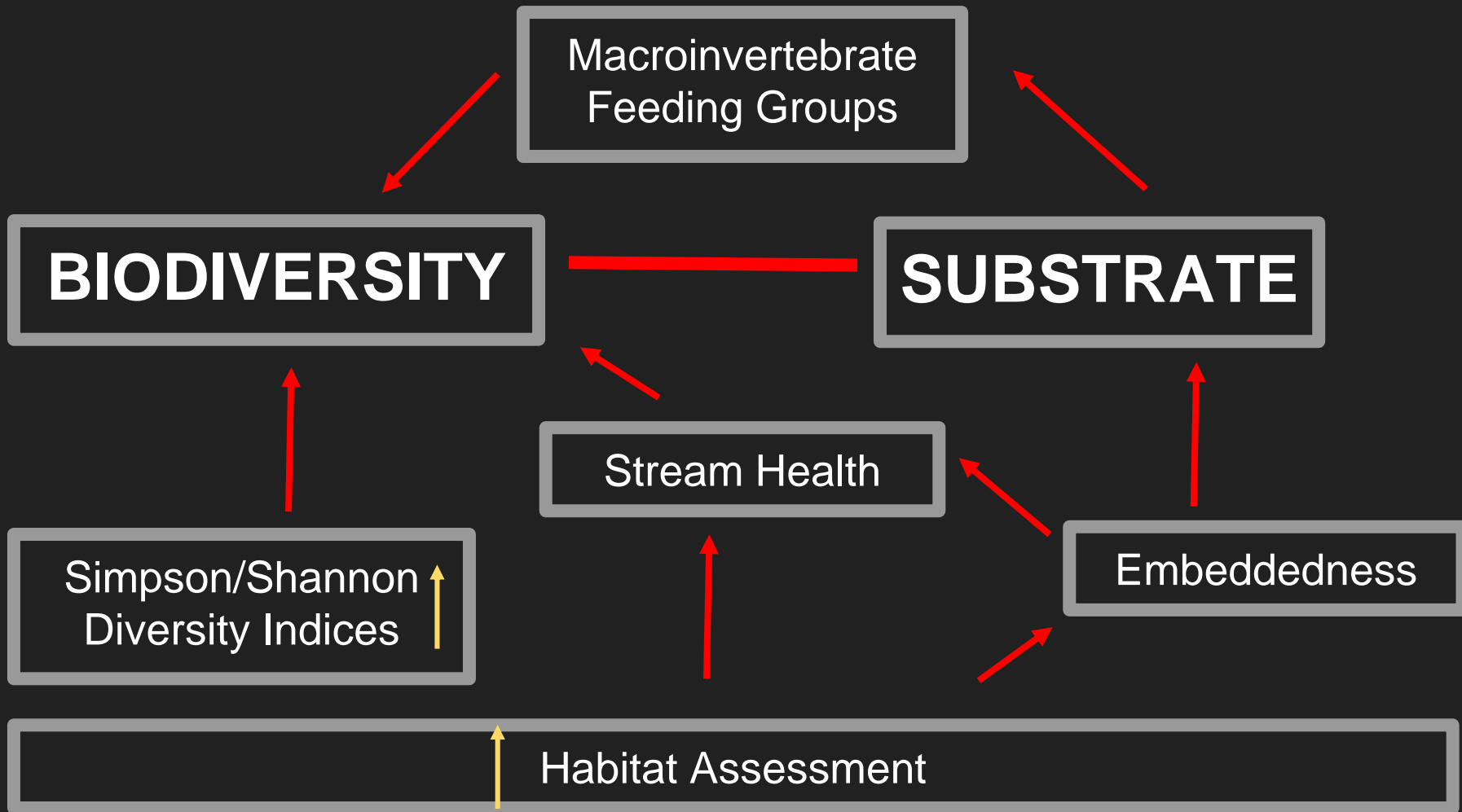
$$H' = - \sum_{i=1}^S p_i \ln p_i$$

H= Shannon Diversity Index

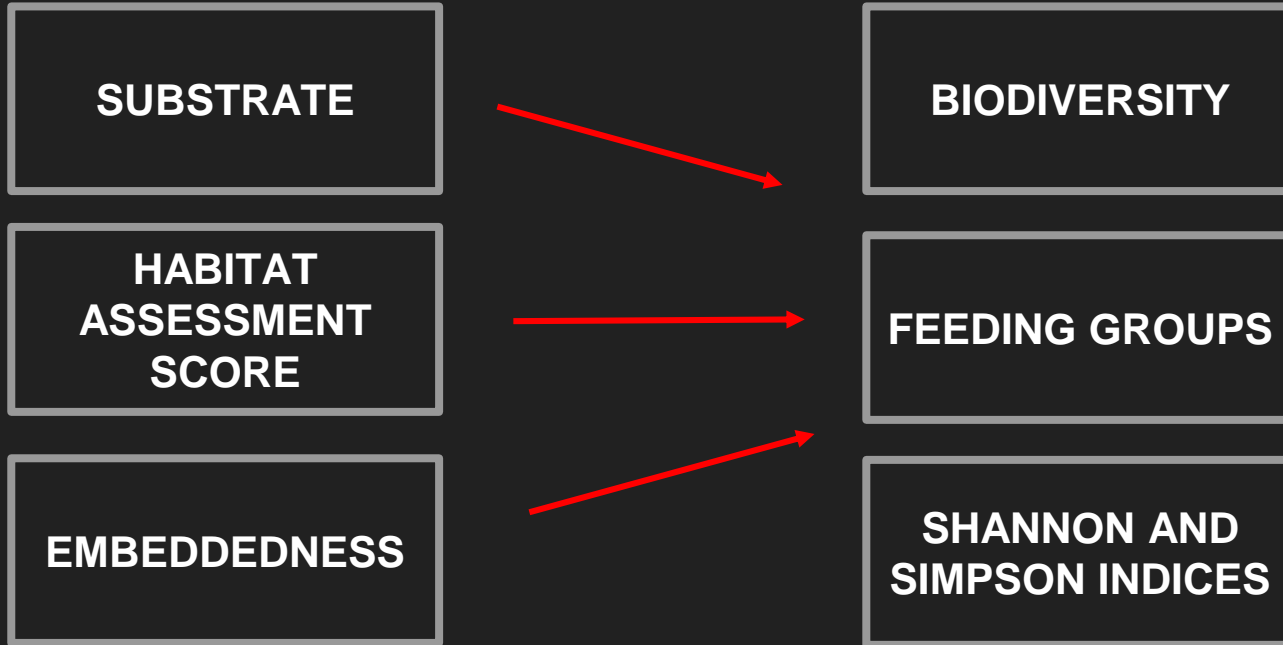
p_i = proportion of S made up of i th species

River Substrate





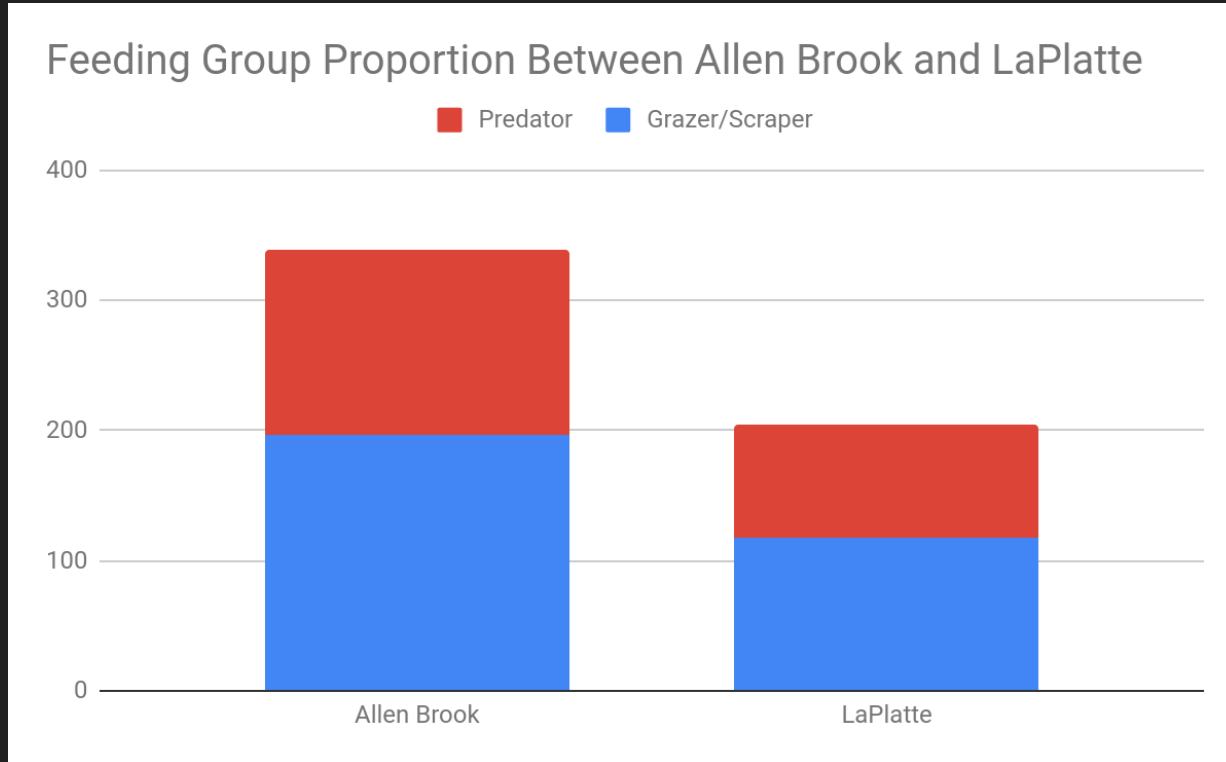
Analysis and Rationale



Conclusion

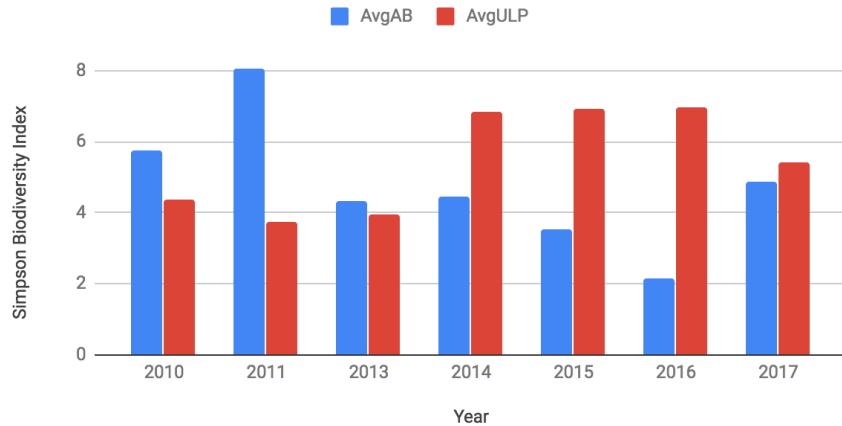
- Evidence does not support a direct connection between river substrate and biodiversity
- Difficulties with measures of river substrate as well as biodiversity resulted in an unclear connection between the two factors

Functional Feeding Groups

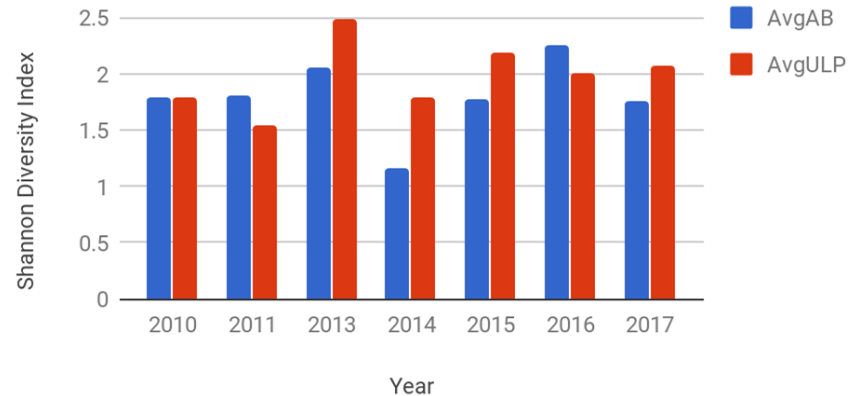


Effect of Substrate on Biodiversity

Simpson Biodiversity Index for the Allen Brook and LaPlatte Rivers



Shannon Diversity Index for the Allen Brook and Upper LaPlatte Rivers

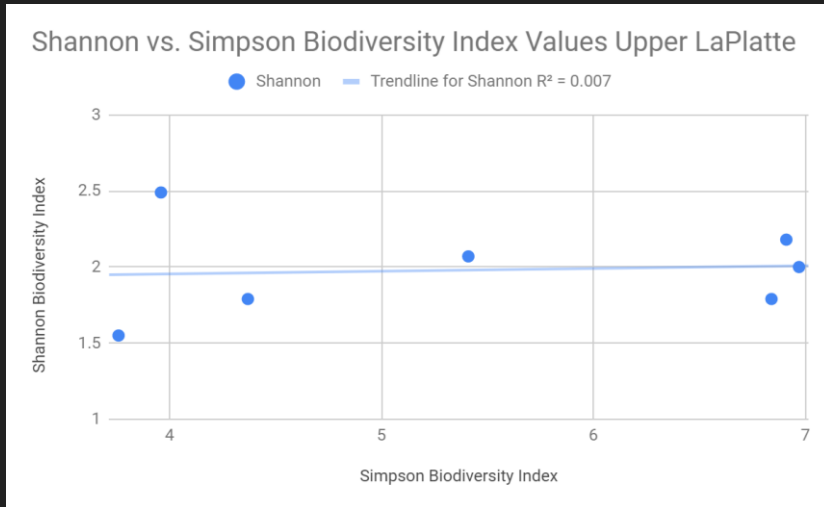


Discussion - Biodiversity

- Measures of biodiversity do not consistently support the hypothesis
- In more recent years, the Simpson Index supports that as embeddedness increases, biodiversity increases
- In some of the same years, the Shannon Index supports the same, positive correlation

Measure of Biodiversity?

- Limitations with both diversity indices



Simpson 2016

Shannon 2016



Further Questions

- Better measures of substrate
- Better measures of biodiversity



Sources

Diversity Indexes. Performance by London Jenks, 2015. *Youtube*, www.youtube.com/watch?v=UkNzP99jhoQ. Accessed 18 Mar. 2019.

McCabe, Declan. "Rivers and Streams: Life in Flowing Water." *Nature Education*, 2011, www.nature.com/scitable/knowledge/library/rivers-and-streams-life-in-flowing-water-23587918. Accessed 20 Feb. 2019.

Rivers, International. "Healthy Rivers." *International Rivers*, Creative Commons, www.internationalrivers.org/healthy-rivers. Accessed 17 Mar. 2019.

Suhaila Abdul Hamid & Che Salmah Md Rawi (2011) Influence of substrate embeddedness and canopy cover on the distribution of Ephemeroptera, Plecoptera and Trichoptera (EPT) in tropical rivers, *Aquatic Insects*, 33:4, 281-292, DOI: 10.1080/01650424.2011.640940

West Virginia Department of Environmental Protection. "Habitat Assessment." *West Virginia Department of Environmental Protection*, DEP Office, dep.wv.gov/WWE/getinvolved/sos/Pages/SOPHabitat.aspx. Accessed 29 Mar. 2019.

Grants and Sponsors



Funding provided by NSF Grant OIA 1556770