The Impact of Canopy Cover on Macroinvertebrate Biodiversity

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Abstract

The purpose of this research was to investigate the impact of canopy cover on benthic macroinvertebrate diversity in a wooded stream in northern Connecticut. Between Oct 26, 2020 and Nov 6, 2020, a section of Broad Brook, a tributary of the Scantic River, located in East Windsor, CT was surveyed for benthic macroinvertebrates. Various habitat characteristics including foliage type, percent canopy cover, stream depth, and stream width were recorded. The null hypothesis was that there would be no difference in benthic macroinvertebrate diversity between the deciduous canopy area, the coniferous canopy area, and the open canopy area. The open canopy area had the highest amount of benthic macroinvertebrate diversity followed by the coniferous canopy area.

Introduction

Benthic macroinvertebrates are organisms that live on or in the substrate of rivers, lakes and streams. These organisms can be used to determine water quality levels. Some benthic macroinvertebrates, such as mayflies, are highly intolerant of pollution. Through a rapid bioassessment of macroinvertebrates, water quality can be determined by the presence or absence of sensitive, moderately sensitive, and pollution tolerant species.

The amount of canopy coverage has been linked differences in benthic macroinvertebrate abundance and diversity (Blaser et al., 2011, Callisto et al., 2017).

Methods

Three survey sections (Open canopy (Site A); >50% canopy coverage: Coniferous (Site B) , >50% coverage: Deciduous (Site C)) were established on Broad Brook, a tributary of the Scantic River (41.93° N 71.54° W East Windsor, CT). Between October 26, 2020 and November 6, 2020, all canopy trees within 15 ft of the river were identified and DBH was recorded. Percent canopy coverage of the 100ft section was estimated by averaging the percent canopy coverage at three locations (beginning of the section, end of the section, and midpoint). The open site was the farthest upstream, the next section was the deciduous canopy area, and the furthest downstream section was the coniferous canopy. The total study area was 100ft in length. Stream flow was recorded using the "float" method, at three locations (2ft from the left and right banks, and at midstream). Air temperature was recorded using a handheld digital thermometer at approximately 2ft above the water level. Water temperature was recorded the water surface and on top of the substrate. Stream depth (at approximately 6ft from the riverbank and midstream) and river width were recorded using a measuring tape.

Source: Google maps (n.d), East Windsor, East Road. Date accessed March3rd, 2021. from https://earth.google.com/web/search/121+East+Road,+Broad+Brook,+CT/

Methods Continued

Benthic macroinvertebrates were collected using the kick-net method. Two kicks were collected at each area (right bank, midstream, and left bank), for a total of six kick samples at each survey location. Samples were collected 6.5 ft from the riverbanks, and at midstream. Following collection, samples were emptied into a sieve, sorted into a tray, and identified using a field guide and an identification key. The type of organisms and number collected were recorded for each kick sample. All organisms were then released back into the river.

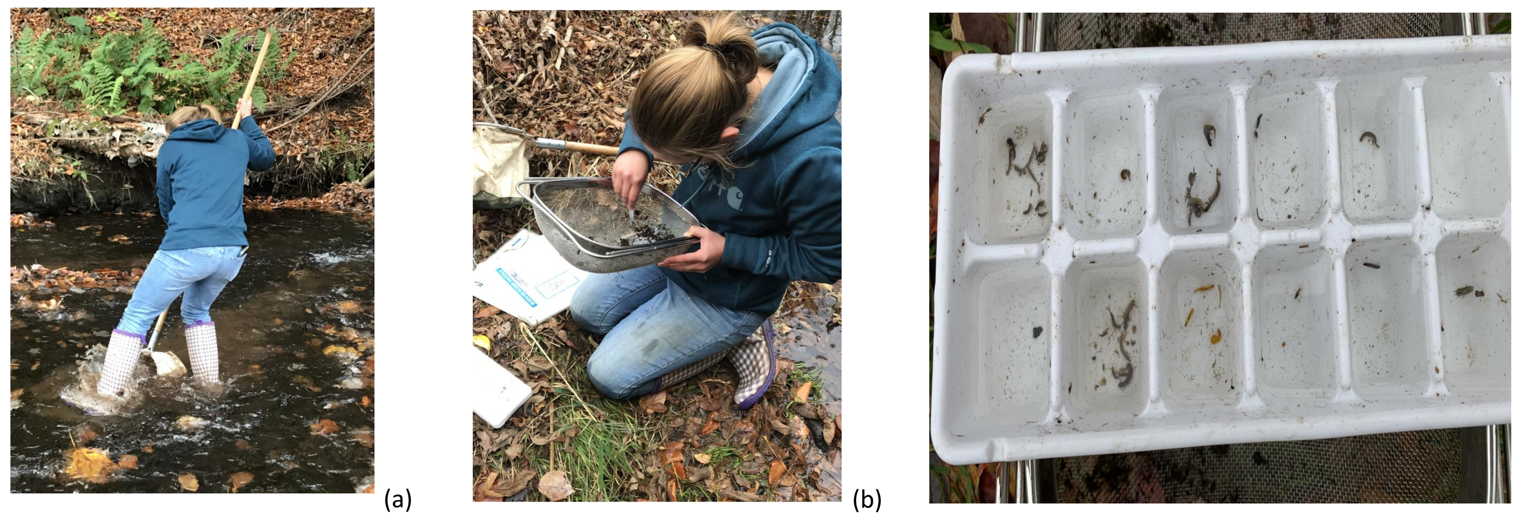

Photo 1: (a) Using a D-net and the kick sample method to collect benthic macroinvertebrates, (b) using a sieve to find the benthic macroinvertebrates, and (c) sorting out the samples using an ice-cube tray.

Results

Table 1: Abiotic Characteristics at the Three Study Sites

	Avg % canopy cover	Avg DBH of canopy trees (in)	Flow rate (ft./sec.)	River width	Water depth 6' from bank (in)	Water depth at midpoint (in)	Air temp. 2' above water (°F)	Water temp at surface (°F)	Temp sediment (°F)	pH at surface	pH at substrate
Site A	8.30	13	1.33	40' 5"	6"	1'	60.6	56.4	56.2	7.83	7.73
Site B	78	14	1.25	21'	4"	3"	55.8	55.1	55	7.68	7.66
Site C	50	14	1.19	20' 8"	4"	9"	58.2	53.1	52.8	7.75	7.73

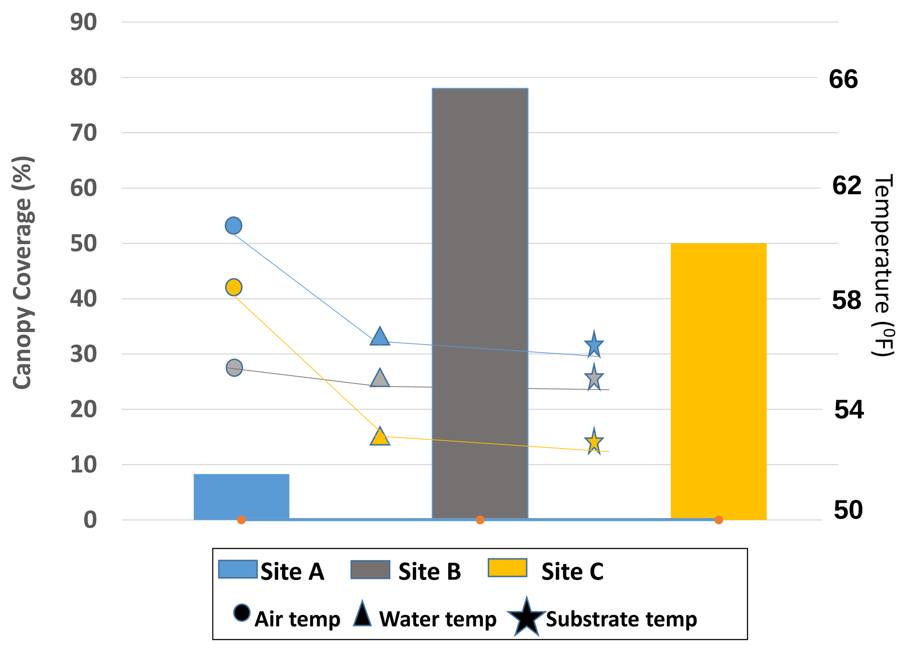

Fig 1: Percent Canopy Cover and Temperature

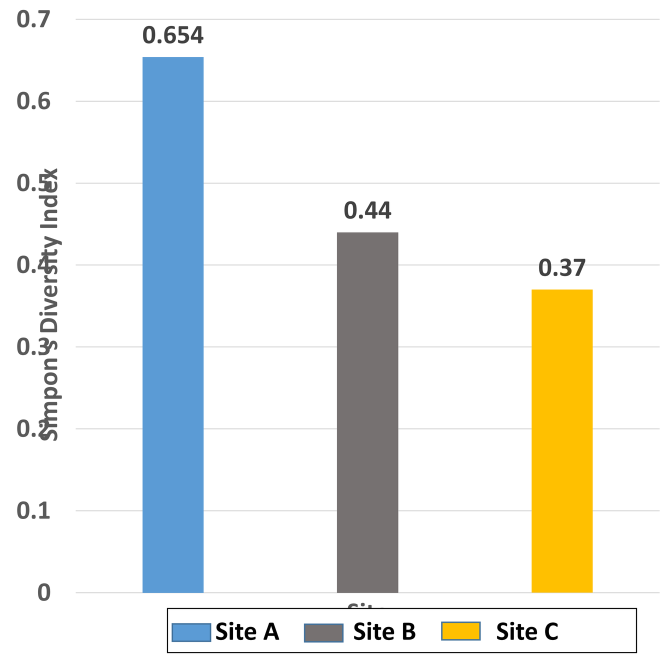

Fig 2: Benthic Macroinvertebrate Diversity at the Three Study Sites

Site A had the greatest river width (40.4 ft), water depth varied (riverbank: 6", midstream: 1ft), and the percent canopy coverage was 8.3% (Table 1, Fig 1.). The length of Site B was ~21ft, water depth was more consistent (riverbank: 4", midstream: 3") (Table 1). The main canopy tree in this area was *Tsuga canadensis*. Site C was 20.7 ft in length, and water depth was deepest at the midstream (riverbank: 4", midstream: 9") (Table 1). The main canopy trees in this area were *Quercus rubra* and *Fagus americana*.

Discussion

Benthic macroinvertebrate diversity was greatest in the area with the least canopy coverage, although overall abundance was the lowest (Site A) (*DI= 0*.654, n=71). The site with the most canopy cover had the next highest diversity, and the greatest abundance of macroinvertebrates (*DI*= 0.44, n= 178). Site C had the lowest biodiversity and the second highest abundance of macroinvertebrates (*DI*= 0.37, n=172).

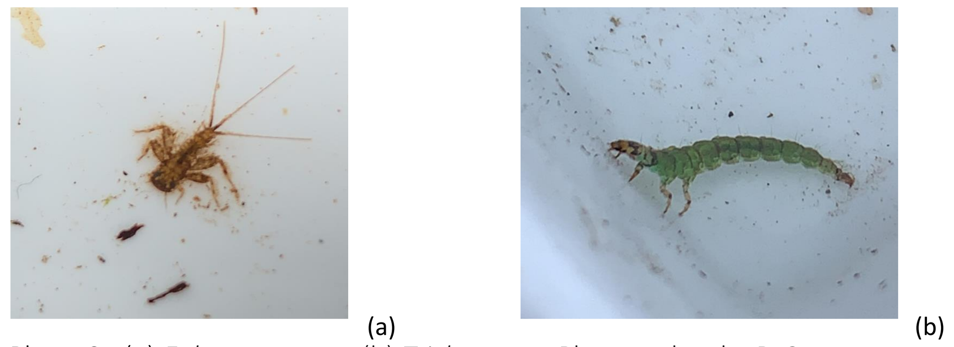

Photo 2: (a) *Ephemeroptera*, (b) *Trichoptera*. Photos taken by R. Syme

Conclusion

The null hypothesis was rejected. Benthic macroinvertebrate diversity did differ between the three survey locations. The highest diversity was found in Site A (Fig. 2). Percent canopy coverage was the lowest in this area (Fig. 1). Water and substrate temperature were the highest in this site (Fig. 1). Water and substrate temperature have been linked with higher benthic macroinvertebrate abundance and percent canopy coverage (Blaser et al., 2011). While a study by Callisto et al. (2017) suggested that overall canopy coverage had no impact on benthic macroinvertebrate diversity. Site A had the highest biodiversity (Fig 2). Interestingly, the site with the highest amount of canopy coverage (Site B) had the second highest benthic macroinvertebrate diversity and the highest temperatures (water and substrate) (Table 1, Fig. 1, Fig. 2).

Some factors that could have affected the results were that kick samples were collected on 3 different days. Site B was downstream and had deciduous leaves which could have affected the ph. Since this research was conducted in the autumn, the deciduous site (Site C), had already experienced some canopy reduction due to leaf fall.

In the future I would like to see how different seasons affect benthic macroinvertebrate diversity. I would also like to research how canopy coverage and species of tree influences pH, and how pH impacts macroinvertebrate diversity and abundance.

A long-term monitoring program of the Scantic River watershed has indicated that water at the study location has some impairment, yet the macroinvertebrates collected in this study suggest that water quality is good. I would be interested in conducting water quality analysis at the time of benthic macroinvertebrate collection.

Acknowledgements

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