Effects of Invasive Species on Trophic Dynamics

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BACKGROUND

Trophic Cascades and the Importance of Invasive Plants

- Invasive plants can change the diversity of invertebrate populations and the density of their predators[1]
- May also alter microbial communities[2]
  - Impacting soil nutrients for native plant species and impacting herbivore populations[3]

Invasive Plants of Western New York

- Autumn Olive (*Elaeagnus umbellate*)
  - Native to Asia and introduced to the US in the 1830s[6]
  - Dense patches can competitively exclude native forest species[6]
  - Capable of fixing nitrogen through a symbiotic relationship with the actinobacteria *Frankia*[6]
- Multiflora Rose (*Rosa Multiflora*)
  - Native to Japan and Eastern China, was introduced to the US in the 1940s as a living fence[7]
  - Capable of arresting succession at the shrub stage[8]
  - Can photosynthesis during the winter[8]

Important Microbes of Forested Systems

- *Pseudomonas*
  - Plant growth-promoting rhizobacteria[4]
  - Promotes growth and disease suppression in plant species[4]
- *Arthrobacter*
  - Capable of nitrogen fixation[5]
  - Produce nitrate that is more accessible for plants[5]

HYPOTHESES:

1. **Invertebrate species diversity will increase in sites without invasive species**
2. **Microbial biomass will increase in areas with invasive species**

MATERIALS AND METHODS

Samples were collected from an 8.3 acre region in Allegany, NY from June 6th to August 10th, 2019

- Four site types: Untouched (U) were no invasive species or trees were removed; Invasive (I) were invasive plant species were removed; Successional (S) were invasive plants and trees were removed; and Field (F) were no trees naturally occurred (Figure 1)
  - Invasive species were controlled using 1.5% Crossbow and 2% Glyphosate foliar spray
  - 415 trees were removed from successional sites
- Three samples of 140mL of soil from each site type were collected for microbial culturing and analysis (Figure 6)
  - Colonies formed on selective media for *Pseudomonas* and *Arthrobacter* were counted and recorded
- Pitfall traps were used to collect invertebrate species (Figure 5)
  - Invertebrates were ID'd using bugguide.net
  - Invertebrates were analyzed through measures of diversity, richness, and evenness

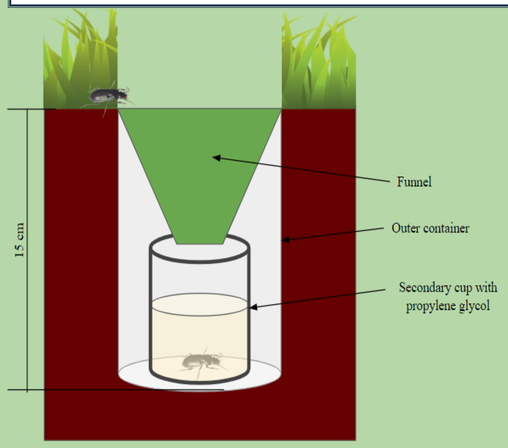

Figure 5. Method of pitfall traps used to collect invertebrate species.

RESULTS

No significant difference of microbial biomass was noted when comparing site types for either selective media (Kruskal-Wallis, p>0.05).

No significant difference in invertebrate species evenness across the collection periods (repeated measures ANOVA, p>0.05). However, there was a significant difference across the collection periods for both species richness and invertebrate diversity (repeated measures ANOVA, p<0.05)

CONCLUSIONS

The time of the collections was significant and influenced factors of species richness and invertebrate diversity.

Continuing research should investigate the changes of fungal communities due to invasive species, investigate the changes in soil nutrient levels, and extend the period of research to better analyze the influence of collection periods.

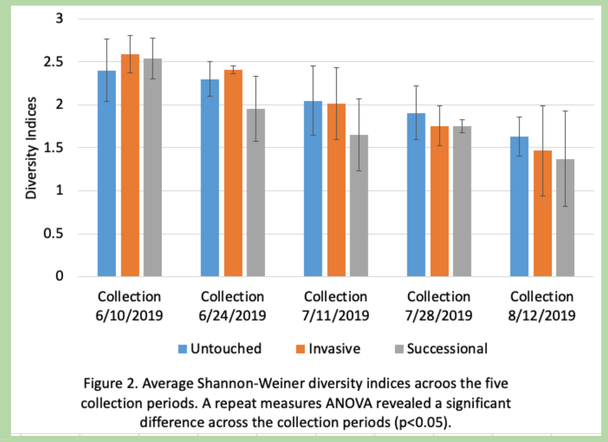

Figure 2. Average Shannon-Weiner diversity indices acroos the five collection periods. A repeat measures ANOVA revealed a significant difference across the collection periods (p<0.05).

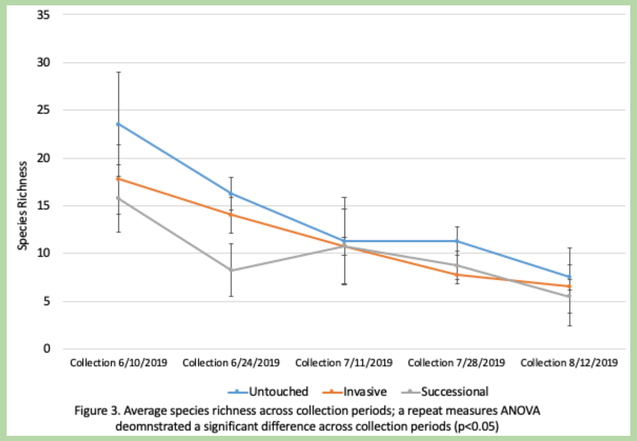

Figure 3. Average species richness across collection periods; a repeat measures ANOVA deomnstrated a significant difference across collection periods (p<0.05)

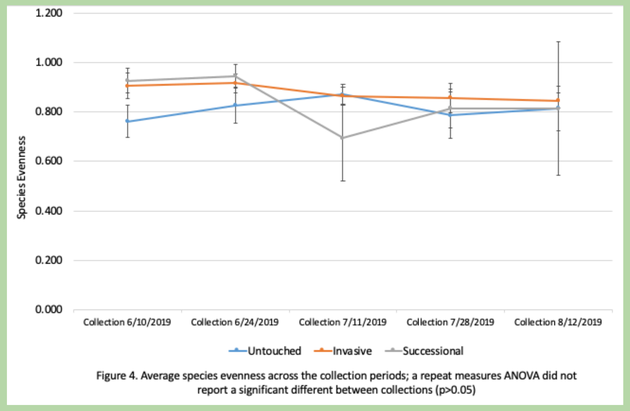

Figure 4. Average species evenness across the collection periods; a repeat measures ANOVA did not report a significant different between collections (p>0.05)

Invasive Site where invasive species were removed.

Control (Untouched) Site where nothing was removed.

Successional Site where invasive species and trees were removed.

Representative image of a Field Site where no trees were growing. At the research site, the ground cover was more overgrown.

Figure 1. Images of the site types including a representative image of the Field site.

Table 1 and 2. Count of microbial colonies on each selective media (Kruskal-Wallis, p>0.05)

Bacterial Colony Density: KB agar for *Pseudomonas*				
	Untouched	**Invasive**	**Successional**	**Field**
1	141	245	212	219
2	105	133	127	163
3	100	221	166	134
Total	346	599	505	516
Average	115.33	199.67	168.33	172.00

Bacterial Colony Density: Hagerdorn and Holt agar for *Arthrobacter*				
	Untouched	**Invasive**	**Successional**	**Field**
1	21	6	50	28
2	14	21	25	44
3	35	10	9	8
Total	70	37	84	80
Average	23.33	12.33	28.00	26.67

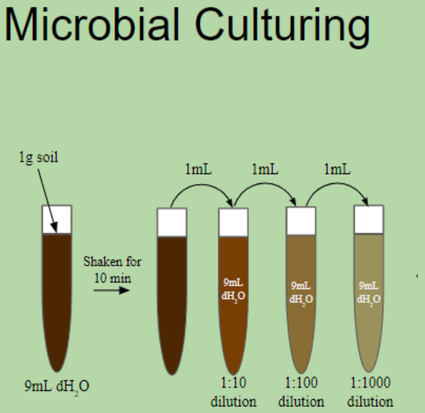

Figure 6. Method used to culture microbial bacterial collected from soil samples. One ml of the 1:1000 dilution was added to petri dishes with selective media; KB agar for Pseudomonas and Hagerdorn and Holt agar for *Arthrobacter.* Each plate was incubated for 6 days at 28ºC

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