What's for dinner?: Beetle herbivory as a biological control for purple loosestrife

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Background

Purple loosestrife has been found in Nothern New York around the 1940's. It is an invasive plant that is commonly found disrupting wetland environments. This invasive plant 1-2 meters tall and has 30-40 stems that produce thousands of seeds that get dispersed predominantly through water. Purple loosestrife does well in high temperatures, with climate change we may see an increase in infestations in once cool regions. Biological control is a promising approach for managing invasive plants, and several species of beetles have been introduced as biological control agents for purple loosestrife.

QUESTION: how do different management treatments affect the success of purple loosestrife over 4 years?

Methods

We monitored 5 different treatment types where we expected to see an impact on the growth and reproductive success of purple loosestrife over a period of 4 years. In this study, we monitored 5 different treatments over 4 years: the impact of the beetle species, *Galerucella calmariensis*, cutting the stems to the ground, cutting off the flowers, digging up 1' of the earth, and a control plot. Each 1m2 plot was surrounded by PVC pipe and left in the field year-round. Every August, Dr. Rogers and interns collected total purple loosestrife stems and inflorescences, average number of inflorescences, length of primary, average height of purple loosestrife and the number of inflorescences per stem. What I did with Dr. Rogers in Spring 2023 was to clean up all of this data, and ensure we had data for each site. All data was put into Excel to be analyzed and made into graphs to view comparisons between the different treatments

Sites

A-Control Plot
B-Cut off flowers in 2019
C-Cut stems to the ground in 2019
D-Tented with beetles 2019 and 2021
E-Dug up 1' of earth in 2019

Materials

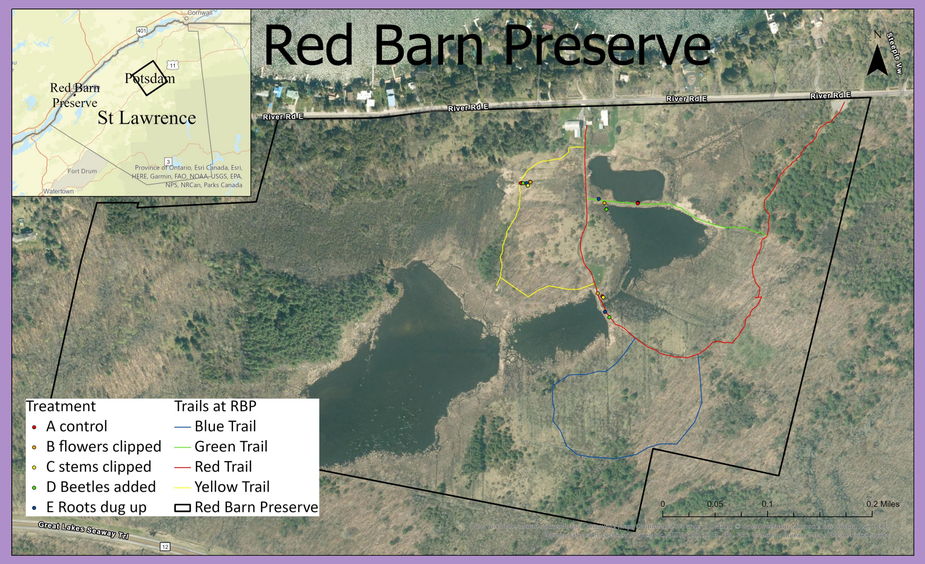
- ArcGIS
- Excel
- RStudio
- PSPP Statistical software

Results

Overall, our results show that the introduction of beetles significantly reduced the success of purple loosestrife compared to control or to limited cutting of plants. USE STATS DATA FROM PSPP

The plant stem numbers ($P<0.01$) varied by treatment across years, and average plant height (Figure 1) was also significantly different in certain treatments ($P<0.005$), indicating that beetles were feeding on the leaves and meristem tissue and causing damage to the plants.

In addition, the different treatments caused changes over time. The total inflorescences changed significantly over time, by treatment ($P<0.007$). The total inflorescences per stem showed similar and significant changes ($P<0.0000$) (Figure 2).



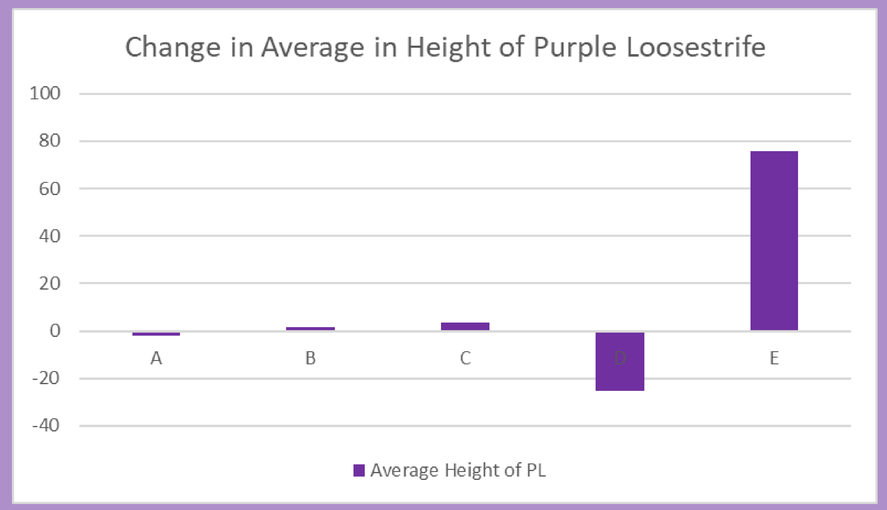


Figure 1 - Average height of PL overall decreased throughout A,D. Although A had decreased in height although there was no treatment. D had the most dramatic change in height likely due to beetles eating the primary meristems, preventing the roots from accumulating nutrients each year. B and C had very slight, not-significant increases over the control, which could be because trimming the plants only led to increased growth.

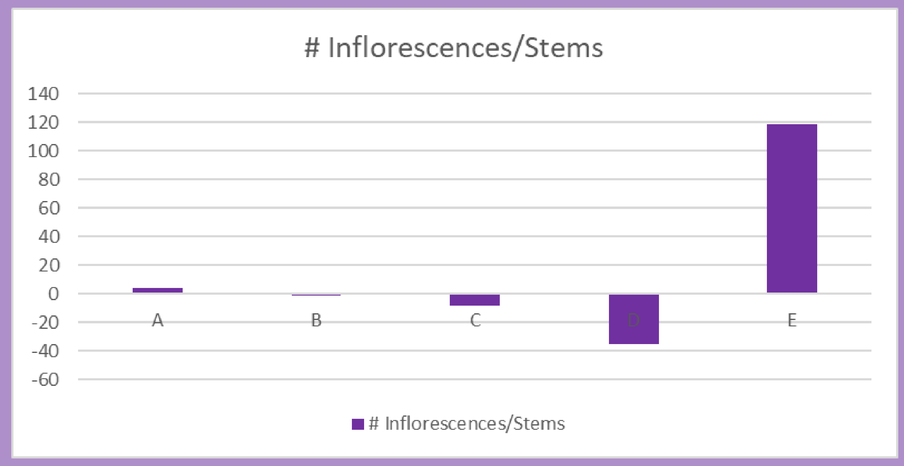


Figure 2 - The number of inflorescences/stems varied throughout the treatments. A had a small increase with no treatment, which shows the standard growth over the 4 years. B declined a small amount, C declined slightly more indicating that cutting the flower or even the stems has very minimal effect. With D being treated with beetles it decreased in inflorescences substantially. With having been dug up site E had a great increase in the number of inflorescences/stems as would be expected given that the area started with zero. Overall, this graph shows the exact trend we would expect, and similar to the average heights.

2022 summer intern Kelly Bloom measuring purple loosestrife

Field of purple loosestrife

Discussion

Beetle herbivory was more effective than the other treatments.
High growth in E treatment is only a result of starting at zero – which is expected. However, it does show that digging up all the plants in one area doesn't mean there won't be growth the following year. Seeds can move by water to inhabit new areas.

The results of our study demonstrate that the introduction of beetles can be an effective means of controlling the spread of purple loosestrife, and other methods are not as successful at limiting growth of purple loosestrife.

Galerucella calmariensis herbivory on purple loosestrife

Conclusion and Next Steps

Dr. Rogers will be working with interns during Summer 2023 and 2024 to continue this analysis and expand the sites to Upper and Lower Lakes Wildlife Management Area.

The goal is to understand how many years of adding beetles will create a sustained population, and how much damage that sustained population of beetles will cause.

Bibliography

Rogers, J., Humagain, K., & Pearson, A. (2022). Mapping the purple menace: spatiotemporal distribution of purple loosestrife (Lythrum salicaria) along roadsides in northern New York State. *Scientific Reports*, *12*(1), 5270.

Hight, S. D. (1988, March). Available feeding niches in populations of Lythrum salicaria L.(purple loosestrife) in the northeastern United States. In *Proceedings of the VII international Symposium on the Biological Control of Weeds* (pp. 269-278).

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