Urban Ecology: The Role of Solar-Powered Greenhouses in Promoting Native Plantings and Water Efficiency

Sammy Mickiewicz[1], Reginald Saint Fortcolin[2], Julianna Service[3]
[1]Regional Vocational Aquaculture School, [2]Aspetuck Land Trust, [3]UConn NRCA

Project Motivation & Goals

- Connecticut's (CT) largest urban center, Bridgeport, has **27%** forest cover (ct.gov,2012)
- Within CT, forests are mostly made up of **edge forest** (CEQ, 2022), as urban development created fragmentation (Fig. 1).
- This edge area is susceptible to **invasive species** (CEQ, 2023), making important urban green spaces **susceptible** to species like exotic honeysuckle, leading to insufficient amounts of native biodiversity (Conservect, 2020).
- Biodiverse green spaces are crucial for a **functional** environment.

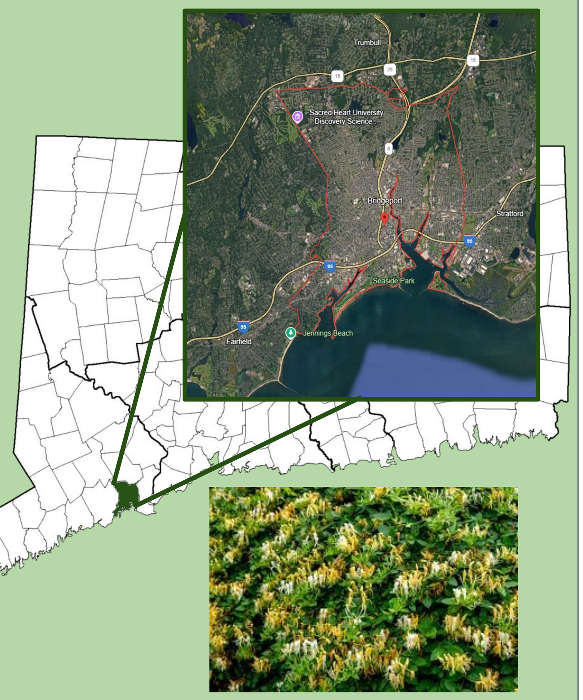


Fig 1. (Top) An aerial map of Bridgeport, CT showing urban (tan color) and forest (dark green color) cover. (Bottom) Image of Japanese honeysuckle shrub

Goal: To **add native plant biodiversity to urban green spaces** within Bridgeport, my project focused on creating a school native plant green space by:

- Identifying potential spaces for native plantings via soil testing.
- Designing and leading a workshop to educate students about the importance of native wildflowers and how to sow them via "mini greenhouses."
- Building a greenhouse sustained by a solar pump to raise natives.

Community Partner

I worked collaboratively with **Reggie Saint Fortcolin** (Fig. 2), the Conservation Outreach Director for **Aspetuck Land Trust.**

Fig 2. (Left) Photo of a Miyawaki forest (photo by Aspetuck Land Trust). (Right) Working in partnership with Mr. Fortcolin during seed sowing workshop.

- Mr. Fortcolin helped spearhead the **Bridgeport Miyawaki Project** with the installation of densely populated micro-forests at local schools through his work with the Aspetuck Land Trust.
- His profound experience connecting people to nature and **bringing native species** back across CT has been crucial to my project's success.
- Mr. Fortcolin graciously paid for **supplies** needed to hold my wildflower event, the greenhouse, and has donated his **time** to help hone in details my project.

My project was conducted at **Bridgeport Aquaculture School** (Fig. 3) where **Mrs. Margaret Oquendo**, the Principal, helped me reach my goals of **building** a **native plant green space** that can be used to:

- Teach **students** in the environmental classes about **biodiversity**
- **Add native plants** to our **urban school campus.**

Fig 3. Aquaculture School Campus.

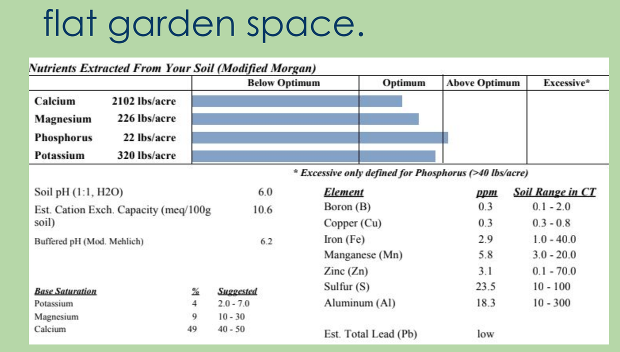
Planning & Soil Testing

The **planning stage** of my project lasted 3 months from August to October and it included:

- Acquiring approval to build the greenhouse on school property
- Mapping the process of making a fully fledged biodiverse garden
- Selecting native edible plants and pollinator plants based on the results of a soil test

Soil testing is critical to understand the chemistry of the land and to confirm that the soil has the proper nutrients to support plant life.

- 8 samples were gathered in an area near the school and were sent to the UCONN soil nutrient analysis lab
- Testing results indicated the soil chemistry **fell in Optimal Ranges**, except for phosphorus (Fig. 4), allowing for us to till the land to prepare a flat garden space.



Nutrients Extracted From Your Soil (Modified Morgan)

		Below Optimum	Optimum	Above Optimum	Excessive*
Calcium	2102 lbs/acre				
Magnesium	226 lbs/acre				
Phosphorus	22 lbs/acre				
Potassium	320 lbs/acre				

** Excessive only defined for Phosphorus (>40 lbs/acre)*

Soil pH (1:1, H2O)	6.0
Est. Cation Exch. Capacity (meq/100g soil)	10.6
Buffered pH (Mod. Mehlich)	6.2

Base Saturation	%	Suggested
Potassium	4	2.0 - 7.0
Magnesium	9	10 - 30
Calcium	49	40 - 50

Element	ppm	Soil Range in CT
Boron (B)	0.3	0.1 - 2.0
Copper (Cu)	0.3	0.3 - 0.8
Iron (Fe)	2.9	1.0 - 40.0
Manganese (Mn)	5.8	3.0 - 20.0
Zinc (Zn)	3.1	0.1 - 70.0
Sulfur (S)	23.5	10 - 100
Aluminum (Al)	18.3	10 - 300
Est. Total Lead (Pb)	low	

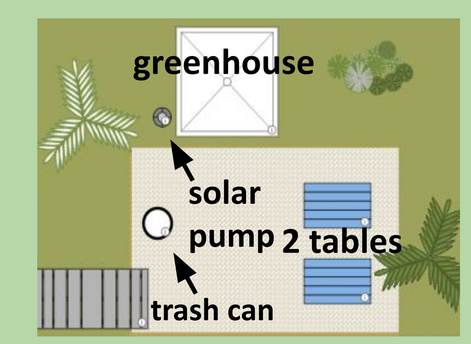


Fig 4. (Top right) Photos to the side demonstrate soil collection. (Bottom left) Soil chemistry results for multiple chemistry parameters and if they fall within a optimal range. (bottom right) Graphic of my plan for the greenspace of where greenhouse will be placed next to school.

Seed Sowing Event

I held a **native wildflower workshop** (Fig. 5) on Feb. 20, 2025 to:

- Teach Aqua students about the ecological importance of native wildflowers.
- Demonstrate how to make **mini "greenhouses"** out of milk jugs. The seeds were bought from **Eco-59**, a local company that sells **wildflower seeds native to two specific regions**, Bridgeport falling in one of them.
- I chose to use **cold stratification**, the process of germinating seeds through cold weather, in an attempt to give the seeds a simulated winter dormancy period for the best results.

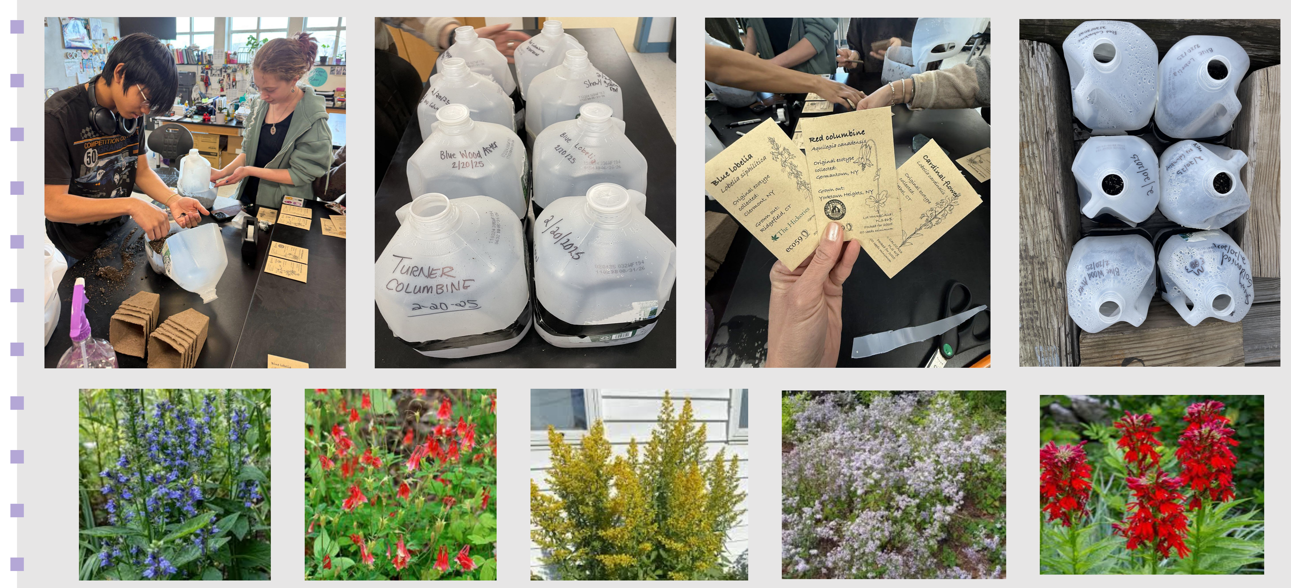


Fig 5. From left to right, students learned how to sow native wildflower plants and made 8 mini greenhouses during the workshop. Eco-59 wildflower seeds were planted separately in each mini greenhouse. Finally, we placed the mini greenhouses in 3 locations outside the school to allow for cold stratification. The wildflower seeds used were blue lobelia, red columbine, showy goldenrod, bluewood aster, cardinal flowers.

Solar Pump

- **A solar pump** is used to make rain barrel water collection system more efficient as it runs on solar power.
- Through my independent research, I developed the design and a set of instructions to build the solar pump, which included aspects of electronics, plumbing and carpentry (Fig. 6)
- A **gutter system** built into the greenhouse, where the water drained into **2 rain barrels**.
  - The gutter system needed a connection point to the water collection system, so I created a down spout out of sheet metal to collect water in an efficient and sensible manner.
  - From there, the **solar pump sends the water into the greenhouse** for use via a garden hose.
- In addition to providing water to the native plants, another benefit of this solar powered water collection system is minimized rain runoff in Bridgeport's shoreline urban environment.

Fig 6 . The images depict the solar pump that I built, it shows the outside box, pump components, the electric components, and the hinged lid (left: outside view; right: inside view).

Greenhouse

With the help of two dedicated student volunteers, the **greenhouse** was built in 4 weeks after a **total of 8 building sessions**.

Saplings Present:

- ***Persimmon Tree*:**
  - Dark green glossy leaves, grey-brown bark
  - Edible orange-yellow fruit, small white flowers
- ***Highbush Blueberry*:**
  - Deciduous shrubs, twiggy branches, small white-pink flowers, waxy ovate leaves
  - Edible fruit, resilient, easy to care for, attracts pollinators
- ***Winterberry Tree*:**
  - Deciduous shrubs, bright red berries through the winter, rounded shape, showy
  - Easy to grow, feeds birds, attracts pollinators

Fig 7. Inside of greenhouse after installation, about 12' long by 11' wide by 6' tall (Bottom) The inside features the plants I grew.

Location:

Fig 8. (Left) My volunteers and I securing the greenhouse into position. (Right) One of the benches I painted, located in the green space next to the greenhouse.

Conclusion & Next Steps

Next Steps:

- Past this, I will continue to upkeep the greenhouse and plant maintenance. This is a continuous process, and the first few years are the most important to ensure the plants live (National Forests.org). I will also be installing the solar panels.
- After finishing, our school will use the greenhouse, garden, and solar pump to provide useful educational tools for the school to utilize next year. Classes such as ECE environmental science or freshman biology will be enjoying my project the most in the next year as they are the most involved in different types of ecosystems, terrestrial and aquatic.

Native Plants:

- As the trees and shrubs continue to mature, they will need to be transferred into the soil, that is when they will begin their true integration process with the urban ecosystem
- The fruit-bearing flora will provide food for humans and animals, and they all will provide shelter for organisms

References and Acknowledgements

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