IL17 Nantucket Eelgrass Restoration

2024 Post-Planting Assessment Report

Nantucket Land & Water Council

Summarize the performance standards established in the approved mitigation plan, any modifications that may be required based on the actual implementation of the project, and the short-term level of attainment of trend toward attainment of the performance standards.

<u>Collection</u>

The main focus for the summer of 2024 was the collection of eelgrass (*Zostera marina*) reproductive shoots for the extraction of seeds. Reproductive shoots were collected from Pimney's Point and Shimmo Creek from June 7th to June 13th (Figure 1). Snorkelers harvested the shoots from the base directly above the rhizome to maintain the integrity of the subsurface root structure. In total, 25,678 shoots (~950,000 seeds) were collected.

Figure 1. Map showing harvest location for *Z. marina* reproductive shoots.

Harvested shoots were then returned to the Brant Point hatchery for storage in spat bags within an outdoor flow-through tank system. We processed the shoots from June 18th to July 19th. Processing involved removing excess vegetation, specifically separating the seed-bearing rhipidium from the main stem. We received assistance from a rotating team of volunteers recruited through flyering and posts on social media. In total, 8 volunteers assisted for a combined total of 37 hours. To further isolate the seeds, we ran the left-over rhipidia through a swirl tank system where decomposing vegetation floated to the surface and seeds sunk to the bottom. The seeds were then returned to the flow-through tanks, now downwelling in cylinders with 1 mm screens on the bottom.

Monitoring

Throughout the summer of 2024, surveys of the Monomoy restoration site (Site A) showed a success rate of around 90%. Seeds and transplanted shoots have taken root at the bottom (Figure 2). The height of the bed ranged from 28-45 cm throughout the site, with densely growing shoots. The bed has also extended well beyond our restoration plot and is approximately 1.5 acres in extent.

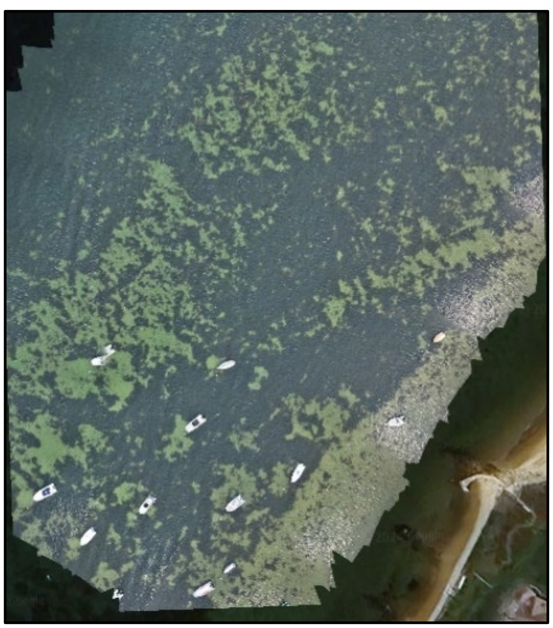

Figure 2. Drone images of Monomoy restoration site. August of 2024 (Left) and July of 2022 (Right).

Surveys of 5th Bend in May of 2024 indicated <5% eelgrass coverage and surveys in July 2024 found a 0% success rate of seeds or transplanted shoots in the restored area. Throughout the ½ acre, the bottom was bare, sandy, and dominated by spider crabs. The patchily distributed spider crabs were largely scavenging the remains of horseshoe crabs. Although the crabs likely contributed to the restoration failure, we assessed temperature conditions at the site over the last few years. The optimal temperature range for growth in *Z. marina* is 11-25℃; once the 25℃ limit is surpassed, eelgrass die-offs are more likely to occur. Therefore, we considered 25°C the upper-temperature threshold for eelgrass growth for restoration purposes. HOBO pendant data from July 24th, 2022, to May 23rd, 2023, and July 25th, 2023, to September 10th, 2023 was assessed. In 2022, from July 24th to the middle of September, there were 43 days when the temperature exceeded 25°C (Figure 3). In 2023, from the deployment on July 25th to September 10th, there were 39 days above 25℃ (Figure 3). Based on these results we conclude that the combination of high temperatures and the significant presence of spider crabs likely led to the failure of the restoration

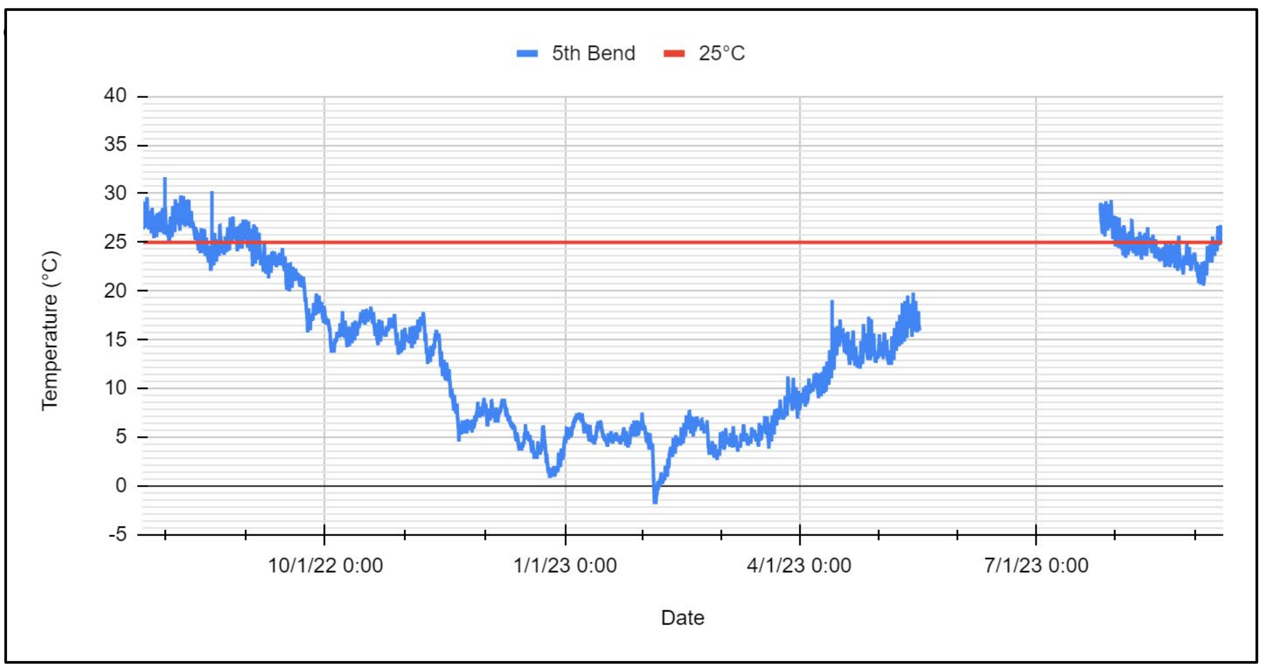

Figure 3. Plot of temperature over time at Restoration Site B, the 5th bend of Coatue. The red line represents the upper optimal temperature threshold of *Z. marina*.

Restoration

Given the lack of transplanting success at Site B in 5th Bend, we decided to relocate restoration efforts to two areas with more suitable conditions. During the month of August we surveyed multiple sites and assessed vegetative shoot density, proximity to healthy seagrass beds and mooring fields, hydrodynamics, and historic temperatures, and determined that the 4th bend of Coatue and a site 200 meters west of the existing Monomoy restoration site (Site A) would be suitable. The ~400,000 seeds collected in 2024 were split between these two ½ acre sites and planted along 100 meter transects in biodegradable tea bags. Seeds at Monomoy and 4th Bend will be monitored in the Spring of 2025 to determine the viability of these locations for future restoration efforts.

Describe any significant problems encountered during construction and how they were resolved.

In July of 2023, the NLWC team noted a mortality rate of about 99% of transplanted eelgrass shoots at the restoration site in the 5th Bend of Coatue (Site B). The mortality rate was linked (via footage and anecdotal observations) to foraging by spider crabs (*Libinia emarginata*) and high temperatures. There were multiple unsuccessful attempts to transplant vegetative shoots and seeds. In September 2024 we decided to abandon the site and plant seeds at two new locations within the harbor.

Recommend measures to improve the efficiency, reduce the cost, or improve the effectiveness of similar projects in the future.

Incorporating a staggered collection schedule, rather than gathering all shoots simultaneously, could potentially improve processing efficiency/efficacy. Generally, as the time spent in storage increases, the more likely it is that the seeds will germinate prematurely. By extending the collection period over a week or more, the team can avoid the bottleneck of processing a large volume of shoots in a short time, which also reduces the risk of shoot/seed deterioration and ensures higher seed quality. Based on our biweekly monitoring of sites right off the shore of

Wauwinet and Monomoy, reproductive shoots retained spathes until the end of July (Figure 4). This indicates that a collection window extending into early July is feasible without compromising seed viability.

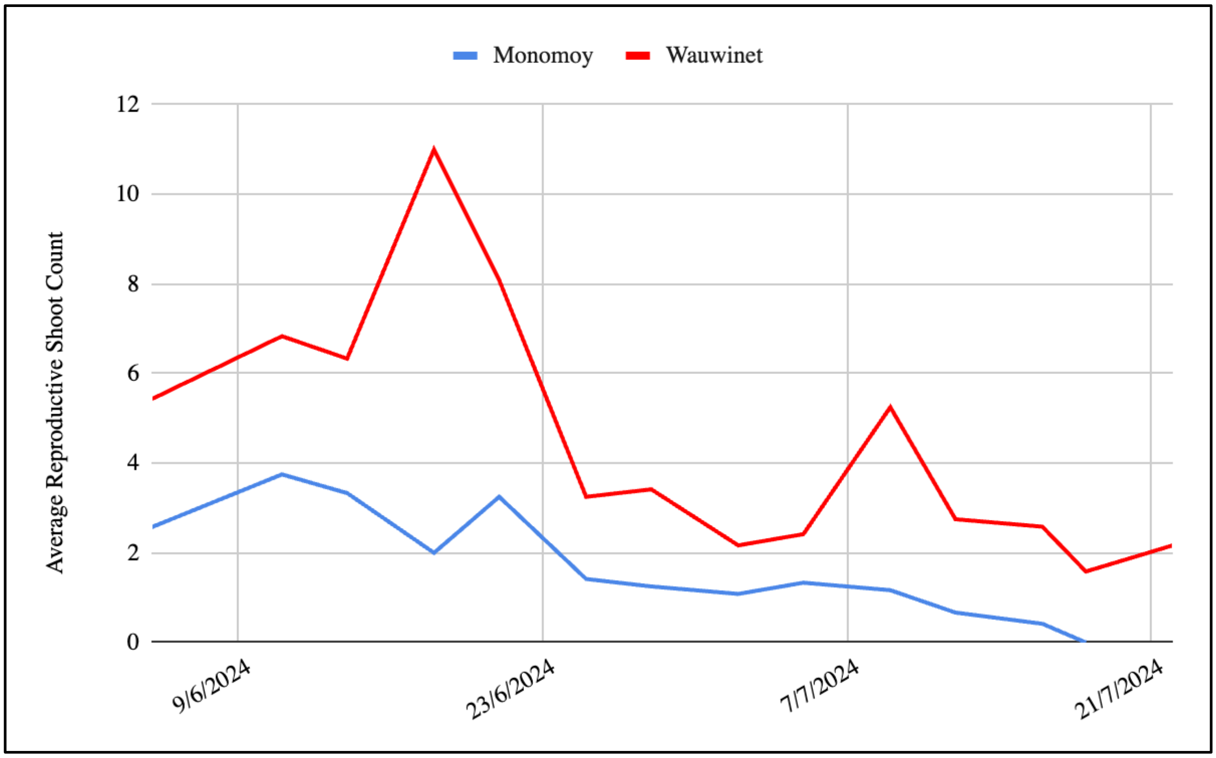

Figure 4. Plot of the average number of reproductive shoots counted within a 0.25m^2 area in the survey sites at Monomoy (blue line) and Wauwinet (red line).

An additional step to ensure seed viability/retention would be storing seeds in a low-temperature, high-salinity system. The unpredictability of shifting conditions while using an outdoor flow-through pump system creates a variety of challenges for maintaining healthy seeds. Increases in temperature from heat waves or drops in salinity from heavy rain are common because the inflow for the hatchery is in shallow water, causing germination. Previous studies and methodologies suggest storing seeds in closed systems with temperatures below 4℃ and salinities above 32 ppt greatly reduces the amount that germinate early. We suggest during the next collection season, a portion of the seeds are set aside to be put into cold storage in high-salinity water to determine if this will improve seed survival until planting in the fall.