MARTHA'S VINEYARD SHELLFISH GROUP

1976

Final Report

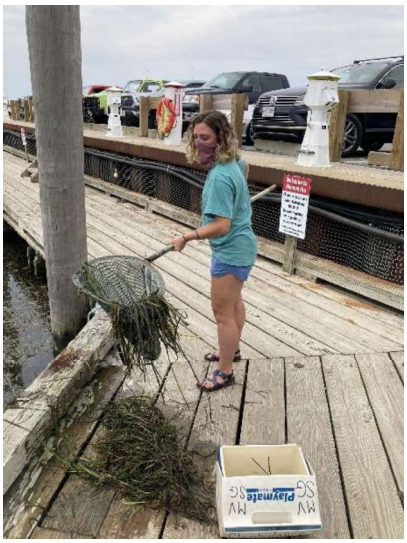
Year 2 of 2

Continued eelgrass propagation: Using indoor and outdoor nurseries

December 31, 2020

Background and Motivation

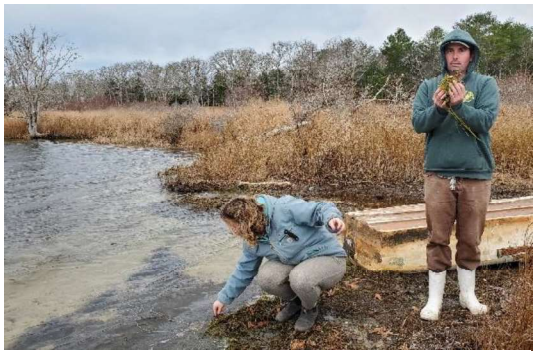
Eelgrass (*Zostera marina*) restoration is now a highly valued aspect of our work. Eelgrass is the optimal and preferred habitat for bay scallops (*Argopecten irradians*), of which we propagate every year, by the millions, for the whole island. The intricate rhizomatic root system and dense canopy of healthy eelgrass meadows help to protect our coasts from erosion by absorbing wave energy and stabilizing the sediment. The seagrass also increases water clarity, sequesters nitrogen and carbon, and provides nursery habitat for a multitude of other marine species, in addition to bay scallops.



Alley McConnell finding eelgrass plants floating in Menemsha Harbor.

Seagrass beds are in steep decline all around the world, mostly due to the impacts of excess nutrients (nitrogen) and warming oceans. We are seeing the same trends on Martha's Vineyard, in nearly every pond that has historically had eelgrass. Edgartown Great Pond is one of the very few exceptions, because over 20 years ago now, the town of Edgartown invested many millions of dollars to reduce the flow of nitrogen to the Great Pond. The town put ~75 homes on to the sewage system, which previously operated on private septic systems in the Edgartown Great Pond watershed. Simultaneously, they upgraded the wastewater treatment plant (which discharges into the Edgartown Great Pond watershed) to tertiary treatment, which removes most of the nitrogen from the effluent. Combined with annual dredging to improve flushing of the pond to the ocean and 13 years of oyster restoration by MVSG, nitrogen reductions in the watershed have resulted in lower dissolved nitrogen and the return of the eelgrass throughout the pond. This strategy should serve as a model for most of the down-Island ponds with sewage systems. Nitrogen pollution in most of our pond, especially those up-Island, will need to be mitigated using more creative and varied tools.

There are several great eelgrass restoration success stories in the mid-Atlantic thanks to the investment of millions of dollars by local, state and federal agencies. In our small embayments on the Vineyard, we have yet a ways to go. Some eelgrass has re-appeared in Quitsa Pond recently, at least in part as a result of the restoration efforts of the Chilmark Shellfish Department and funded by the Edey Foundation. While nitrogen reductions are really key to restoration success, this project has added substantially to the local knowledge and eelgrass restoration efforts. We feel very positive about the progress we have made.



Alley and Chris Edwards finding eelgrass plants in a northern corner of Edgartown Great Pond.

In 2020, we continued to rescue uprooted shoots from harbors and ponds around the island. Most often, eelgrass shoots are harvested from donor beds for transplanting in a restoration site. This can

cause harm to already stressed meadows. Conversely, we use nets to collect floating eelgrass with intact rhizomes and rehabilitate them for restoration. By collecting floating uprooted eelgrass instead of extracting shoots from healthy meadows, resources needed for these projects are minimized and we give uprooted eelgrass a second chance to provide ecosystem services for our estuaries.

Shoot and Seed Collection

In 2020 we collected more shoots from harbors and shores than in 2019! We frequented Menemsha Harbor, Tashmoo, Edgartown Great Pond, and Moshup Beach more often this summer and always found a large amount of uprooted eelgrass with full rhizomes. Collecting from multiple sites is important in order to optimize genetic diversity in the program. The shoots were brought back to the Hughes Hatchery and were groomed by trimming the longest shoots and plucking the dead brown shoots off of the plant body. Some shoots were planted into biodegradable pots, but most of the shoots into the floating nursery raft.

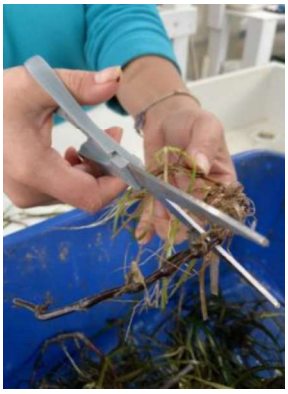
We a found a large number of reproductive eelgrass shoots this summer on Edgartown Great Pond and Tashmoo. The reproductive shoot is structured so that it naturally breaks off from the parent plant and may drift away to a new meadow to sow its seeds. If you follow the prevailing winds, you can find concentrated patches of seed shoots, at the right time in the early summer. The shoots containing seeds were kept in a mesh bag in one of our flow-through seawater tanks at the Hughes Hatchery. As the seeds matured and fell out of the seed pods, they were removed from the bag and put in a mesh tray floating in a tank. While we waited for the seeds to mature, we read many academic papers and made plans for planting the seeds in the fall.

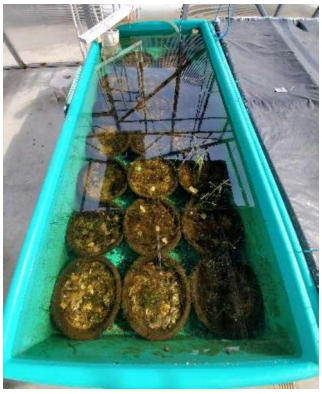



Planting in Biodegradable Pots

At the recommendation of a researcher at Northeastern University, we use a 3:1 sand to potting soil ratio in the biodegradable pots. The sand was collected from the beach behind the Hughes Hatchery, sifted through a 1.2mm mesh to isolate the finest sand and mixed with ⅓ the amount of soil. Shell fragments were patted down on top to prevent the shoots from floating out of the pots.

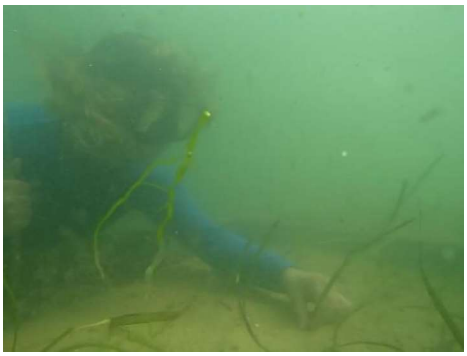
Late in the summer, we dissected one of the eelgrass pots that had been in the hatchery since the summer of 2019, and were happy to find the rhizomes had become interconnected as the rhizomes reassimilated themselves into the sediment. This proved to use that the plants are relatively happy in the biodegradable pots, in the hatchery.



Planting in Floating Rafts: Lagoon Pond

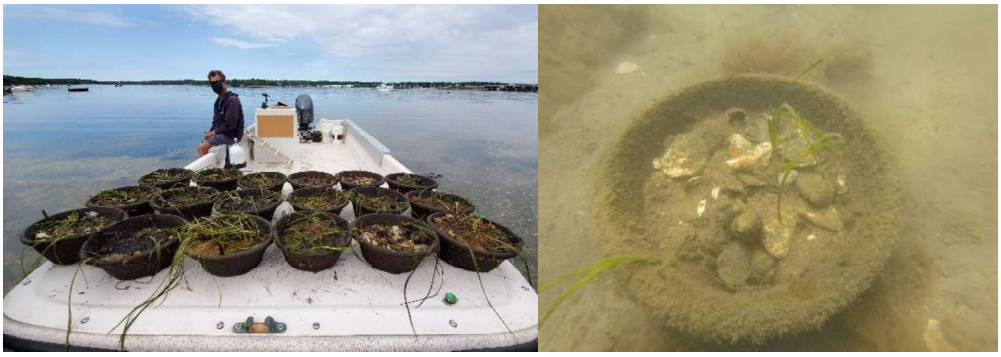
With generous assistance from the Tisbury Shellfish Department, we deployed a floating nursery system this summer, as we did in 2019, on the same mooring. We updated the floating nursery with round buoys instead of the dock floats that were used last summer, in an effort to discourage the roosting of cormorants. Phil Colarusso from the Environmental Protection Agency (EPA) warned us last fall that concentrated nitrogen from large deposits of bird guano could be very bad for eelgrass. The raft was filled with sand prior to planting with shoots. Something new we tried this summer was we added coconut fibers in with the sand to increase the organic matter. Equipped with snorkels and masks, three staff members from the MV Shellfish Group planted about 600 eelgrass shoots into the raft! It looked like a beautiful forest of seagrass. The nursery system stayed about 4 feet under the surface of the pond and stayed securely attached to a mooring to the east of Hines Point. The floating nursery system is a more efficient method than using the biodegradable pots. Burying the pots into the bottom sediment is physically difficult.



In January of 2019, we had dismantled the floating raft of eelgrass plants and estimated that they increased in shoot count by about 30%. This was very exciting, but we still took the plants out and re-planted them into pots (which were later planted into the Lagoon in May 2020). This year, we planted the shoots into an old wooden raft used by the Tisbury Shellfish Department to grow quahogs for several years. In October of 2020 we let the raft sink to the bottom at a marked site off the east side of Hines Point, south from the mooring. This site was chosen because there was healthy eelgrass there just a few years ago, so it should be somewhat hospitable to the eelgrass. As of mid-December, the raft was still visible on the bottom, although the water was too turbid to see how the eelgrass was doing.

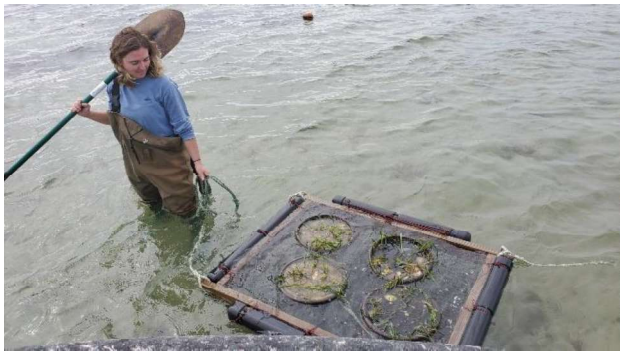
Planting Pots in Lagoon Pond and Quitsa Pond

In May 2020, 18 biodegradable pots were planted into the benthic sediment in Lagoon Pond by Georgio Caramanna, a professional diver from Oak Bluffs and the Woods Hole Oceanographic Institute. They were planted in between the tip of Hines Point and the drawbridge, where there was a very dense (~1,000 shoots/m^2) eelgrass meadow until the construction activities of the new bridge covered it with sand and silt several years ago. The meadow has not reemerged as we hope it would, but the site was chosen because it should present the best possible conditions for new eelgrass to establish. The bottom was harder than expected, and it was very difficult for Giorgio to dig deep enough holes to bury the pots. In September, most of the pots were still present, but there were very few eelgrass shoots left in the pots. We left the pots in place, and hope that in the spring, a new shoots will emerge. The site is marked with four, black corner buoys so that the area is not disturbed by boats and fishing. If the eelgrass does not emerge in the spring, it could be because the environmental conditions (temperature, water clarity) are unfavorable or it could be because the pots restrict the growth of the plants in some way.



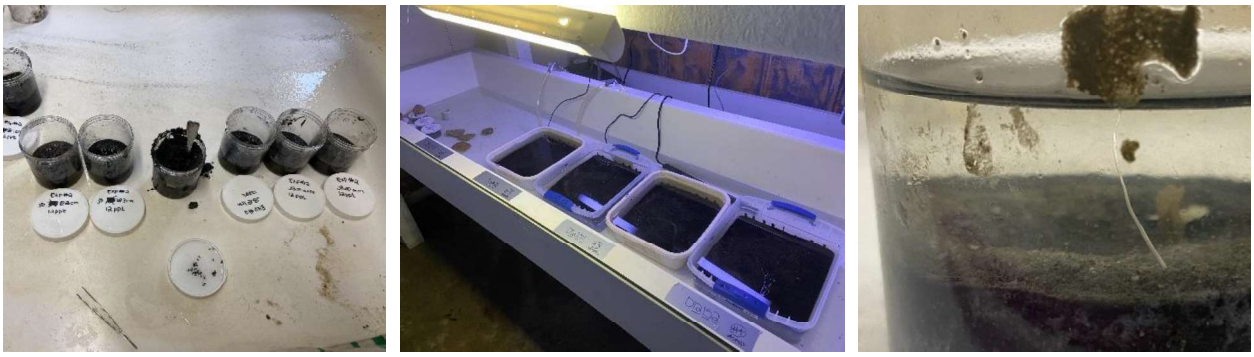
In September 2020, 4 biodegradable pots were planted in Menemsha Pond with help from the Chilmark Shellfish Constable, Isaiah Scheffer. We were able to go out on a very low tide, which made the planting easier. We chose a site on the edge of the extensive eelgrass bed to act as somewhat of a control to isolate the effects of the pots on shoot survival. If these pots persist and shoots emerge in the spring, we can be more confident that the pots themselves are NOT hindering growth and survival of the eelgrass.

While the eelgrass shoots show signs of assimilating well in the biodegradable pots, working with the pots has proven to be more difficult than the floating nursery system because they are hard to plant into the firm benthic sediment. They were much easier to plant into the sediment in hip-height water in Menemsha Pond, than in five feet of water in Lagoon Pond.



Planting Seeds in the Hatchery

We are interested in growing eelgrass from seeds as a means to increase the number and genetic diversity of the plants we can use to restore eelgrass beds. We collected about 1,500 seeds from Edgartown Great Pond and Tashmoo this summer. The seeds were allowed to fall naturally from the reproductive shoots over the duration of the summer. The released seeds were held in a floating mesh tray in a greenhouse tank at the Hughes Hatchery. As they changed color and some showed signs of maturity, we separated the darker seeds (more mature) from the lighter seeds (Immature). On August 25th, we put the more mature seeds in the fridge at 1-2 degrees Celsius until October 22nd when we started our experiment with the seeds. This cold period gives the seeds a 'false winter' and allows them to fully mature and get ready to germinate.

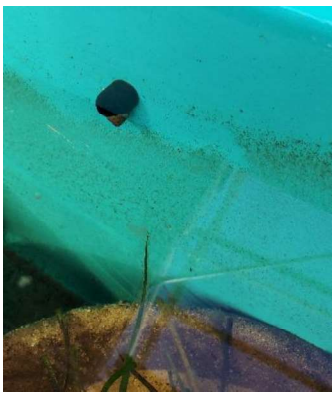


Seeds were planted at different depth in jars and in different salinities in the tubs. After about 4 weeks the first seedling emerged!

We set up an experimental tank at the Hughes Hatchery with a water chiller (also used in the kelp nursery) and a heater in order to maintain at a temperature of 9-12 degrees Celsius on the outside of the tubs and jars. We planted four rectangular tubs to determine optimal salinity for germination, 6 jars to determine optimal seed burial depths, and separated the seeds from dark brown and jet black to indicate optimal seed color, signifying maturity. Our ultimate goal is to determine optimal growing conditions for eelgrass in the hatchery. The tank was filled with brackish water. The 4 tubs were placed in the tank and were all filled with fine, anoxic sediment, which we read is ideal for eelgrass germination, and then filled with water at a specific salinity (either 10ppt or 15ppt). Two of the tubs we filled with only dark brown seeds, and the other two tubs we filled with only jet black seeds (each seed color was given one 10ppt tub and one 15ppt tub). In total, 64 seeds were buried at about 1cm deep into the sediment in the tubs. In the secondary portion of our experiment, 6 jars were filled with the same fine sediment and 5 jet black seeds each, with sets of 2 jars corresponding to a specific seed burial depth of either 1cm, 2cm, or 3cm. About 5 weeks into the experiment, the first seedlings started to emerge from the sediment.

As we write this, we are about 8 weeks into the experiment. A total of 5 seedlings have emerged from the sediment. We are waiting until they grow and get stronger before transplanting them to a new tank with more sunlight and higher salinity. The seeds may germinate well in low salinity water, but the seedlings will not develop properly in low salinity water.

What we have learned:



- Shoots should be planted so that the rhizome is 1-2" below the surface. If they are planted too shallow, the sand moved around and the plant becomes dislodged
- Shoots should be trimmed before being planted out to prevent currents from pulling at the shoots and help the plant focus energy on growing roots. It also helps to see how much the blades grow.
- After planting, something with more mass or point to it (rock, shell) should be put over the rhizome to stop shoots floating away. In the pond, this might also help discourage curious crabs from digging up newly planted shoots.
- Periwinkle snails will graze algae and help keep the indoor tank cleaner.
- Thick circular pots are difficult to bury in the sediment underwater. Even the highly skilled professional diver had a hard time!
- The pots maintain their structure for over 1 year in seawater!
- Plants WILL grow and reproduce vegetatively (through rhizomatic growth, not seeds) in the raft
- Plants WILL produce new roots in the pots in the hatchery
- Plants WILL NOT reproduce if kept in the hatchery over the winter. This is probably because the tank is allowed to warm up during the day in our greenhouse, and doesn't allow for real winter conditions needed to trigger flowering.
- Planted pots CAN survive the winter in Lagoon Pond, even if the plants do not.
- Seeds need to be kept cool and dark as they mature in the hatchery

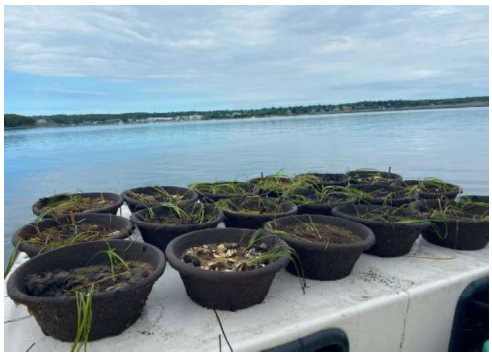
What We Do **NOT** Yet Know

- Will the pots break down enough so that the eelgrass plants can expand into the surrounding bottom?
- What will become of the sunken raft? Will the plants survive? Will the wood start to break down?
- Can we grow viable eelgrass seedlings in the hatchery?
- Does seed color significantly affect germination/germination rate?
- Will a significant percentage of the seeds germinate with the conditions we've given them in the hatchery?

Continuation of the project

Eelgrass restoration is now an ongoing project of the MV Shellfish Group, thanks to the Edey Foundation and the Lagoon Pond Association. The EPA-hosted eelgrass conference – Zosterapalooza – was postponed from March to May, and we were unable to attend due to the busy hatchery schedule at that time. However, we will share our results and progress with the shellfish and restoration community, in the future, because that is how we will grow and learn. It is hard to say what 2021 will bring, but we look forward to presenting and

attending meetings like Zosterapalooza, the International Conference on Shellfish Restoration, the New England Estuaries Research Society, and others. In 2020 we created a new position of Restoration Coordinator and hired Ms. Alley McConnell to lead and organize Eelgrass Restoration, Shell Recovery and some aspects of our Oyster Restoration programs. Having a designated staff member will help to ensure these programs continue, grow and thrive. Emma Green-Beach held this role as Special Projects Manager before becoming the Executive Director.



How, exactly, this program will grow in 2022 depends on how the plants and structure of the sunken raft on Hines Point, the pots in the Lagoon and Menemsha Pond, and the seedlings in the hatchery do.

- If the planted pots survive the winter and the plants emerge in the spring, we will continue to plant shoots into pots, and only try to plant them where the bottom is somewhat soft.
- We will definitely refine the floating raft technique because it seems to be the most promising at the time being.
- If we can learn enough about starting seeds in the hatchery, we will continue to refine this technique as well.
- We are working with Isaiah from the Chilmark Shellfish Department to develop another planting method that could be accomplished from a boat, without the need for diving.
- We will do more research into ways to plant seeds directly into the pond, while maximizing their survival to the maturity stage.
- We would like to set up and designate a restoration site that would include multiple techniques, predator (crab) traps and perhaps rafts of oysters to increase water clarity and increase the chances of success. It may take us a few seasons to find the right location for an official restoration site.
- We will continue working in the Lagoon and plan to increase activity in Menemsha/Quitsa Pond. The next estuary in our sites in Sengekontacket, once we feel more confident in our methods.
- We may designate a small workboat to Lagoon Pond, so that our increased workplan does not but undue burden on the Tisbury Shellfish Department, even though the Constable, Danielle, really enjoys this work as well!

This program to restore and support eelgrass beds has really highlighted the need for nitrogen mitigation. It is a frustrating realization, but many of our efforts are really hindered by the detrimental effects of excess nitrogen and eutrophication. MVSG will continue to work with the town departments and committees, the MV Commission and the many pond associations to develop and promote nitrogen mitigation tools for our community.