Salish Sea Ecosystem Conference

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Restoring damaged and declining eelgrass in the San Juan Archipelago: a pioneering program using seeds

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Abstract

The importance of eelgrass (Zostera marina) comes alive through the Coast Salish people's cultural stories and practices. The presence of these marine flowering plants is important for culturally iconic species such as the Dungeness Crab and Pacific Herring. In the San Juan Archipelago, loss of historical spawning sites for herring appears to coincide with eelgrass decline.

In an effort to offset eelgrass decline, the Puget Sound Eelgrass Recovery Strategy outlines a program that includes a plan to "restore and enhance damaged or declining eelgrass beds". The uprooting and replanting of adult eelgrass plants is commonly used as a restoration technique. However, throughout the range of eelgrass in the Northern Hemisphere the collection and dispersal of eelgrass seeds has been put forward as a low-cost and effective alternative. This technique is proposed because, after pollination, fertilization, and seed development, eelgrass flowering heads disperse a yearly seed rain, and these seeds populate available habitat either within the bed or a distant location. When seeds settle on the ocean floor in suitable conditions, seedlings sprout, and new patches form.

In spring 2020, we launched a pilot program at the Friday Harbor Laboratories, University of Washington, to restore eelgrass in the nearshore region of Bell Point in Westcott/Garrison Bays using seeds. In this poster presentation we illustrate a step wise description of our program that includes methods to: 1) estimate seed to ovule ratios to guide flowering head collection; 2) harvest flowering heads while limiting damage to the donor population; 3) capture the season of peak seed release; 4) efficiently gather and store seeds before planting; and 5) deliver seeds to a restoration site. We will also provide an estimate of human hours, supplies and construction materials needed to replicate our program at other sites in the Salish Sea.

Restoring damaged and declining eelgrass in the San Juan Archipelago: a pioneering program using seeds

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1. Estimate number of seeds per flowering head to determine season of peak seed release prior to harvest

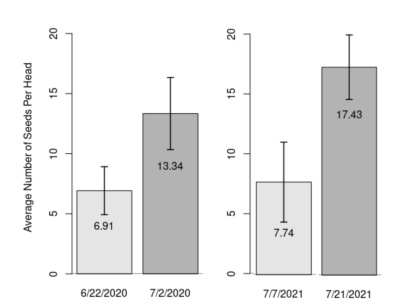

Figure 1. Higher density in later low tide series increases seed yield. Error bars show standard error of the mean, n=10 (2020) & n=5 (2021).

Depth of harvest also seems to affect ratio of seeds per flowering head (2021)

12:1 seeds per head at -0.88m
19:1 seeds per head at -1.2m to -1.5m

Figure 2. Later stage of seed development (DeCock, 1980) taken after being stored for a few weeks.

2. Harvest flowering heads while limiting damage to donor site

- Gently walking on the tide flat and limiting the number of volunteers to avoid trampling impact (Travaille et al. 2015)
- Remove flowering head, leaving rhizome intact in sediment (Zhang et al. 2016)
- Reduced sediment loading in storage

Figure 3. Collecting flowering shoots at donor site.

Figure 4. Eelgrass Culture System (ECS) is made of three storage tanks (left) plumbed with flowing sea water and filled with flowering heads (right).

3. Cultivate flowering heads while seeds develop

- Culture system catches mature seeds after dispersal
- Water temperature monitored continuously
- Salinity monitored weekly

4. Efficiently gather & store seeds before planting

- Seeds are removed and sieved several times to remove all detritus.

Figure 5. Seeds prepared for cold storage.

Cold stratification (Zhang et al. 2016)

Seeds are stored at 4°C over winter to increase rate of germination, and are planted the following spring.

5. Deliver seeds to restoration site after site evaluation

Minimum criteria for site selection:

- Historic or current presence of eelgrass
- Analysis on sediment grain size and H_2S concentration
- Accessible, both for planting and monitoring
- After germination seedlings are fragile so, if possible, protection from boat/land traffic

Past methods used at our restoration site:

- Seed buoys
- Broadcast seeding

New method being implemented in 2022:

Hessian bags filled with sediment and seeds provide a protective barrier, minimizing seed loss & promoting seedling recruitment.

Figure 6. Hessian bag stored in ECS as a control, with observable results: a seedling.

References:

De Cock, A.W.A.M., 1980. Flowering, pollination and fruiting in Zostera marina L. *Aquatic Botany*, *9*, pp.201-220.

Travaille, K.L., Salinas-de-León, P. and Bell, J.J., 2015. Indication of visitor trampling impacts on intertidal seagrass beds in a New Zealand marine reserve. *Ocean & Coastal Management*, *114*, pp.145-150.

Yang, C.J., Liu, Y.S., Liu, J., Xu, Q., Li, W.T. and Zhang, P.D., 2016. Assessment of the establishment success of Zostera marina (eelgrass) from seeds in natural waters: implications for large-scale restoration. *Ecological Engineering*, *92*, pp.1-9.

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