Pacific Salmon Strategy Initiative | Initiative de la Stratégie relative au saumon du Pacifique

Salmon Habitat Restoration Center of Expertise
Technical Bulletin Vol. 5

June 2026

Eelgrass Restoration Using the Burlap Bag Seeding (BBS) Method

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Technical Bulletins are intended to disseminate technical information, guidelines, and workflows relevant to restoration practitioners.

This Technical Bulletin describes the methodology for eelgrass seed-based restoration using burlap bags. The method was used in Burrard Inlet by DFO restoration staff and the Tsleil-Waututh Nation səlilwətaɬ, and builds on earlier published work that describes methodology for eelgrass restoration using the Buoy-Deployed Seeding (BuDS) system (Spooner, 2025).

Introduction

Eelgrass *(Zostera marina*) is a flowering seagrass that is vital to the health of coastal and estuarine ecosystems and provides exceptional value as nursery habitat for juvenile Pacific salmon (Kennedy et al., 2018). Eelgrass is facing widespread declines due to anthropogenic pressures and climate change (Orth et al., 2020). Various techniques have been applied in restoration projects over the past several decades to counteract these losses. Spooner (2025) describes the ecological importance of eelgrass and provides a brief comparison of restoration approaches.

Along the Pacific Coast, the most common restoration method is transplanting eelgrass shoots from healthy donor beds to restoration sites. Eelgrass seeding is a much less common method that has been trialed in Washington, Oregon, California, and most recently in British Columbia (Spooner, 2025; Beheshti & Ward, 2021). Seeding offers a key advantage over transplantation in that it may increase genetic diversity at a site, which is associated with improved plant fitness and ecosystem resilience (Kendrick et al., 2012; Reynolds et al., 2012).

Two seeding methods, the Buoy-Deployed Seeding (BuDS) method (Spooner, 2025) and Burlap Bag Seeding (BBS) method (described herein, also known as ‘hessian’ bag seeding method), are intended to be low-tech and low-cost restoration approaches that support eelgrass recovery and

encourage community engagement. Both are suitable for subtidal and intertidal sites where environmental conditions are favorable for eelgrass establishment. In general, these conditions include low turbidity, neutral pH, salinity of 20-30 parts per thousand, and mud to coarse sand substrate (Spooner, 2025). At intertidal sites, some caution is warranted due to the increased possibility for the restoration seeding plots to be disturbed by human activity, or impacted by elevated summer water temperatures or desiccation during exposure at low tide.

There are some distinctions between the two seeding methods. The BuDS method deploys reproductive shoots and requires no overwinter seed storage, whereas the BBS method can be deployed either with reproductive shoots (described herein), or deployed in spring after over-wintered seed storage. The BuDS system has buoys/floats that remain visible on the water surface for 45-60 days during seed dispersal. This may be problematic in areas with high human activity as the floats are vulnerable to tampering or theft. In contrast, the BBS method has equipment anchored to the seabed that is not visible from the surface, when deployed subtidally, thereby reducing the risk of public interference. A trade-off of the BBS subtidal method is the inability to detect possible displacement or disturbance of the burlap bags (e.g., caused by waves or currents) without regular snorkel checks. These differences may factor into which seeding method is chosen for a given restoration site.

This Technical Bulletin describes the methodology for eelgrass seeding restoration using burlap bags and is based on recent project experience in Burrard Inlet with the Tsleil-Waututh Nation səlilwətaɬ at Whey-ah-Wichen (Cate's Park), which is a popular marine recreational area for activities such as boating, crabbing and other fishing activities. Two variations in methodology are presented based on the size of bag used.

Burlap Bag Seeding Workflow

The workflow for a Burlap Bag Seeding (BBS) project is presented in Figure 1 and described in detail in subsequent sections. Briefly, donor beds are monitored weekly by snorkeling, starting in early summer, until seeds are ripe and the reproductive shoots are ready for harvest. Reproductive shoots are harvested following protocols to ensure the health and integrity of the donor bed as described in Spooner (2025) and depicted in the video by Smith (2026). On shore, shoots or spathes are placed into prepared burlap bags, which are then deployed by snorkelers and anchored to the seabed to allow seed maturity and germination *in situ*. Monitoring occurs the following spring and fall to evaluate establishment and project success. Site access should be by snorkeling, boat, kayak, or standup paddleboard to ensure seeds and seedlings are not disturbed until established.

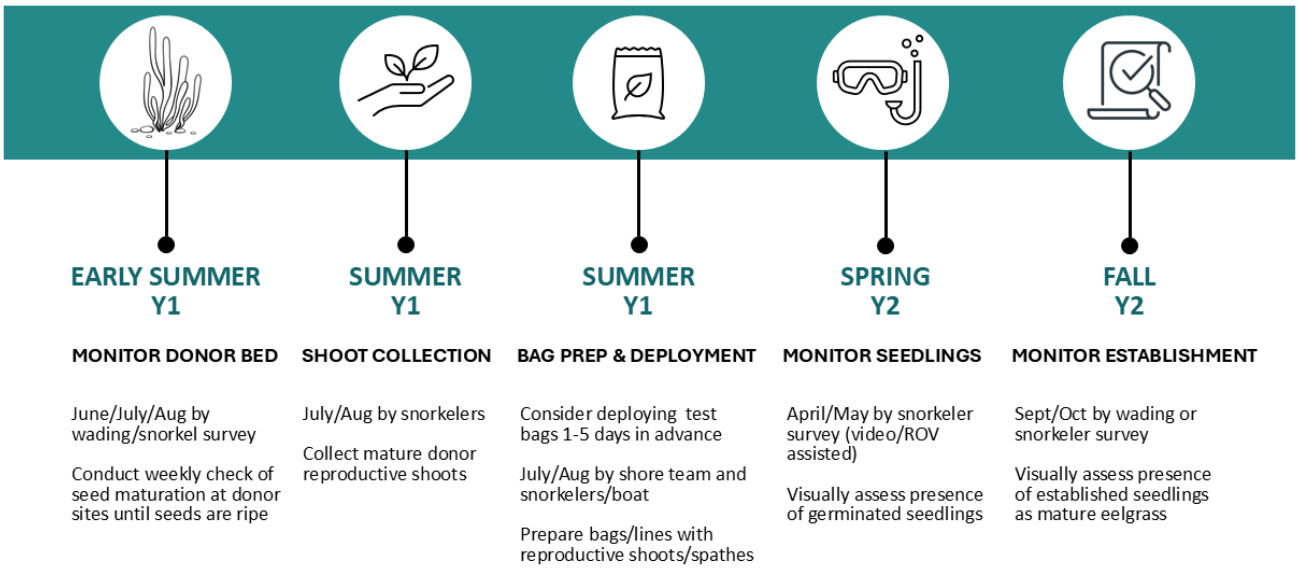

Figure 1. Workflow of an eelgrass seeding restoration project using the Burlap Bag Seeding method.

Reproductive Shoot Collection

Reproductive shoot collection is typically carried out by snorkelling with the following equipment:

- Mesh laundry bags to collect the shoots
- Totes and buckets
- Coolers
- USB rechargeable aerators (pet store grade)

The timing of shoot collection is critical to ensure seeds are collected at an appropriate stage of maturation. Collection teams should therefore be familiar with the full sequence of seed development, from pollination through to seed release. In general, collection should occur when more than 50% of the spathes of a reproductive shoot have Stage 4 (mature) or Stage 5 (releasing) seeds (Figure 2). Because multiple stages may be present on a single shoot, some judgement is required to determine optimal collection timing. Reproductive shoots should be snapped near the substrate, taking care to avoid disturbing or uprooting the rhizome. To minimize impacts to donor beds, total collection should not exceed 50% of the donor bed's reproductive shoot density. To maximize the genetic diversity of the restoration project, shoots should be collected from multiple donor beds whenever possible. Additional guidance on shoot maturation stages and best practices for collection are provided in Spooner (2025).

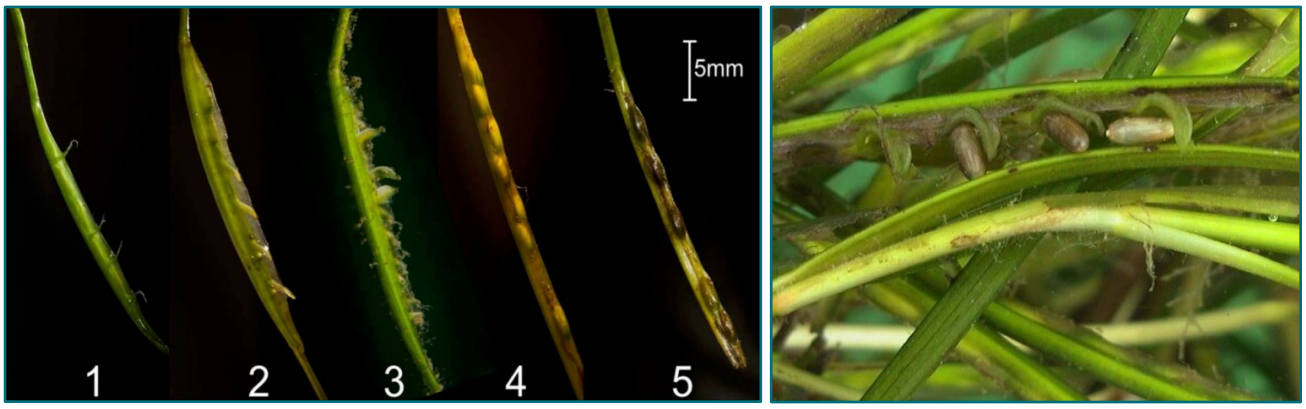

Figure 2. Left: Developmental stages of Z. marina seeds in spathes. Right: Mature seeds shown at release stage (Pickerell et al., 2006).

Burlap Bag Assembly

The methodology described herein is for both large and small-sized burlap bags. For the Burrard Inlet project at Whey-ah-Wichen, large bags measured 35 cm x 66 cm and small bags measured 10 cm x 15 cm. The size of burlap bag will determine both the deployment method and if the full reproductive shoot or only the seed spathe is used for the project. Bags can either be purchased or sewn from burlap fabric into any size. Bags should have open weave and any inner liner removed before use. If the weave spacing of the burlap is tight, consider scoring the fabric to ensure water and sand penetration, and ease of seedling shoot growth through the weave. Large bags are best suited for low to moderate energy sites whereas small bags are tolerant of higher energy conditions.

The equipment required for bag deployment is listed in Table 1 and can be purchased at a hardware store or online. All equipment is intentionally natural so will decompose or rust away, eventually leaving no trace and no contamination impacts. Bag assembly can be done the same day as reproductive shoot collection if enough team members are available. In this case, a *shore team* prepares the bags for deployment while a *water team* of snorkelers collects the reproductive shoots. Once sufficient shoots are collected, the *combined* team then works quickly on shore to prepare and place the reproductive shoots or spathes into the bags, ready for deployment. If same day deployment is not possible, the shoots should be kept in a cooler of aerated seawater for up to 48 hours, either in burlap bags or loose.

Table 1. Equipment required for seed-based eelgrass restoration using large and small-sized burlap bags.

Equipment Required for Large Burlap Bags	Equipment Required for Small Burlap Bags
• 10 cm steel landscape staples • Loose weave burlap bags (~35 cm x 66 cm) • 1/4-in. hardware cloth cut into rectangles • Twine • Local sediment or play sand • Shovel/trowels • Buckets • Scale (optional) • Anchor for site marking • Line for site marking • Floats for site marking	• 9.5 mm natural-fibre line • Small loose-weave burlap bags (~10 cm x 15 cm) • Malleable wire • Local sediment or play sand • Shovel/trowels • Large rocks for line end anchors • Sorting trays • Buckets • Anchor for site marking • Line for site marking • Floats for site marking

Large Burlap Bags

Large burlap bags are prepared by first inserting a piece of 1/4-in. hardware cloth into the bag to prevent it from rolling up from wave action (Figure 3). This step may be optional depending on site conditions. Reproductive shoots are then divided equally by weight or volume among the number of bags prepared for deployment. Shoots are placed into each bag along with some sediment (250-500 ml); either local sediment from the donor or deployment site, or sterile play sand can be used. Detritus will self-generate as the reproductive shoot breaks down in the bag. The bag is tied shut with a piece of twine or wire, kept horizontal, and stored in totes filled with seawater until deployment. The cost for 10 large burlap bags and equipment is $115 (at time of publication).

Figure 3. Left: Hardware cloth to be inserted in a large burlap bag. Right: Reproductive shoots are weighed and divided into prepared burlap bags. Whey-ah-Wichen (Cate's Park), Tsleil-Waututh Nation.

Small Burlap Bags

Prior to deploying small burlap bags, the 9.5 mm natural fibre (e.g., sisal or hemp) line should be pre-soaked to ensure it is negatively buoyant and will settle securely on the seabed. Because of the small bag size, mature seed-bearing spathes are first separated from the reproductive shoots using trays, keeping the plant material moist throughout handling (Figure 4). The spathes are divided equally among the bags, typically five or more spathes per small burlap bag, and a small amount (~60 ml) of sediment from either the donor or deployment site is added to each bag. Clean play sand may also be used. Detritus within the bag will self-generate as the spathes break down. The pre-soaked line is laid out onshore and the prepared bags are attached along its length with wire (Figure 5). Do not use twine as it may rot away, causing the bags to detach from the line prematurely. Once assembled, large rocks are secured to both ends and possibly the midpoint of the line as anchors. The prepared line should be placed in a covered tote of seawater until deployment. The cost for a 30 m sisal line with 36 small bags is $75 (at time of publication).

Figure 4. Seed spathes separated from the reproductive shoots before being placed in small burlap bags.

Figure 5. Left: Small burlap bags before filling. Right: Bags filled with reproductive spathes and sediment, and tied to a pre-soaked natural fibre line. Not shown are the rock anchors at the ends of the line.

An alternative deployment option for small burlap bags is to hold the reproductive shoots in marine wet tanks until natural seed release (approximately 40 days) and then store the seeds in cold storage through the winter. The following spring, transfer 50 to 100 seeds into the small bags with sediment and detritus, and deploy as described above. Note this alternative method and the associated costs and equipment are not addressed herein.

Burlap Bag Deployment

Burlap bag restoration sites can be configured in a variety of layouts including: multiple small plots or a single larger plot and arranged in linear, rectangular, or irregular configurations, depending on project objectives. Large and small bags may be used in the same project or separately, as the site dictates. Plot spacing, orientation, and number should be informed by site characteristics such as slope, bathymetry, and substrate, as well as project goals and budget. Large bags may be deployed at site-appropriate spacing, or clustered to mimic natural eelgrass patches. When using natural fibre lines with small bags, line length and layout should be adjusted to match the dimensions and bathymetry of the restoration site.

The location of BBS plots should be documented using GPS coordinates, along with deployment depth, date, time, and height of tide. To aid site relocation, photographs taken from the plot toward the shoreline are recommended, particularly noting where distinctive features such as prominent trees, rock formations, or buildings are visible. Where appropriate, subtidal plots may be marked with small, tethered buoys that remain below the surface at all tidal stages and do not pose a submerged navigational hazard.

Test Bags

Several days in advance of burlap bag deployment, it is recommended that test bags lacking reproductive shoots or spathes be deployed at the restoration project site. This is because tidal and current regimes can be difficult to predict and have the potential to displace the anchored burlap bags, jeopardizing project success. These pre-deployment test bags can provide an indication of whether site-specific currents, waves, or other physical forces are likely to result in bag movement or displacement. If displacement is observed during a multi-day test period, adjustments to plot layout, site selection, or bag deployment method should be considered before proceeding.

Large Burlap Bags

Deployment of the large burlap bags involves snorkelers placing the prepared bags of reproductive shoots, hardware cloth, and sediment directly onto the seabed and securing them with 2 to 4 landscaping staples (Figure 6). If the sediment is too sandy and loose, or currents are strong, the bags may drift. Checking plots soon after deployment is recommended, especially if deploying test

bags in advance was not possible. Deployment typically occurs on the day after reproductive shoot collection because a low tide is needed for the snorkelers to be effective. If the restoration site was delineated in advance and marked with temporary surface marker buoys, these should be retrieved on the day of deployment. Confirm that GPS coordinates along with photographs and all site information have been documented.

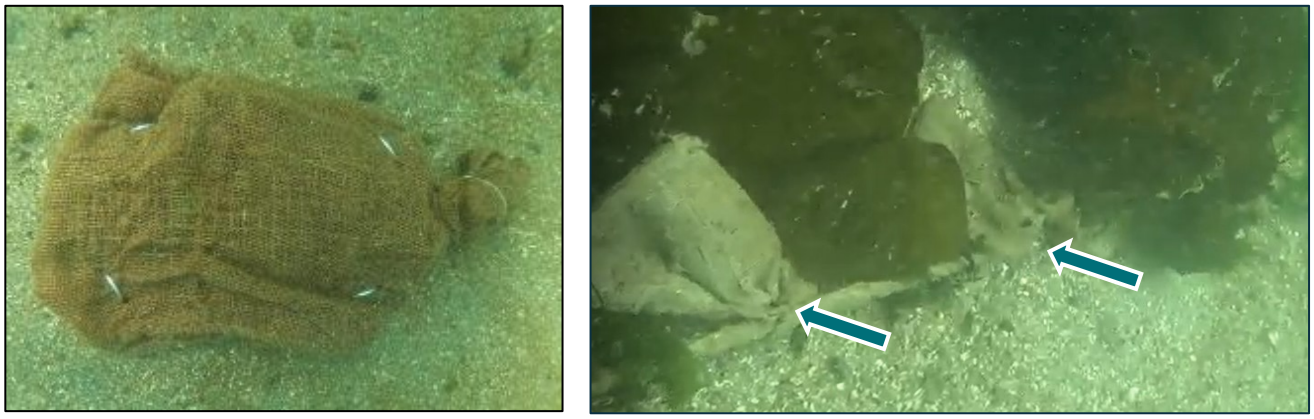

Figure 6. Left: Large bag pinned with 4 x 10 cm landscape staples. Right: a section of sisal line with small bags (green arrows) attached. Location: Whey-ah-Wichen (Cate's Park), Tsleil-Waututh Nation.

Small Burlap Bags

The pre-soaked natural fibre line with attached small bags can be placed by snorkelers at low tide, or from a boat, kayak or standup paddleboard at higher tides with support from snorkelers to verify placement (Figure 6). Tie anchors to the ends and possibly at the mid-point of the line, factoring in any observations of local currents gained from deploying test bags in advance. Deployment is typically scheduled for the same day as reproductive shoot collection. Checking plots within a few days after deployment is recommended, especially if test bags were not deployed in advance. Similar to the deployment of large bags, any surface marking buoys should be retrieved once deployment is complete and confirm that GPS coordinates along with photographs and all site information have been documented.

Monitoring

Monitoring is a critical component of any restoration project to evaluate project success and inform adaptive measures for improving project effectiveness. Protocols to monitor eelgrass seedling emergence and establishment are described in detail in Spooner (2025). Key points are summarized below with respect to monitoring seedlings and eelgrass establishment.

Monitoring is best carried out by snorkellers. Analysis of underwater video footage is also a viable method for documenting plant establishment. Continued annual monitoring is recommended to assess long term trends in bed development and determine overall project success.

Seedlings

Referring to Figure 1, monitoring to determine seedling emergence is conducted in April or May of the year following seeding. Timing is important as seedlings may be difficult to detect when they first emerge, yet by June they often resemble established eelgrass (Figure 7). Because the restoration area is still highly sensitive at this stage, surveys should be completed by snorkeling. Methods for conducting visual surveys and options for recording observations (e.g., quantitative, categorical, qualitative) are described in Spooner (2025). Gently mark any seedlings with a flagged landscaping staple or metal pin flag for subsequent monitoring visits to determine if these seedlings establish into mature eelgrass.

Figure 7. Left: Seedling (red circle) in spring monitoring with gloved fingertip for scale. Right: An established seedling (red circle) in fall monitoring next to a 2 year old eelgrass patch for scale. Location: Gordon River BuDS seeding project, Pacheedaht First Nation.

Establishment

Monitoring in the fall of the year after seeding evaluates seedling survival to establishment (Figure 1). Establishment rates at this stage are typically lower than initial seedling emergence. By late summer and fall, the restoration area can generally be accessed on foot at low tide for direct counts, though snorkel surveys may be repeated if preferred, or if site conditions limit wading access.

Conclusion

The Burlap Bag Seeding method offers a practical, low-tech, and cost effective approach to eelgrass restoration that complements traditional transplantation techniques, with the advantage of enhancing genetic diversity. As this was one of the first documented seeding-based restoration projects on the Pacific Coast, continued trials across a broader range of environmental conditions are encouraged. Deployments can be designed for either intertidal or subtidal environments and configured using large or small burlap bags depending on site conditions, project objectives, and logistical constraints. While the configuration of burlap bag deployments is highly flexible, decisions on plot spacing, orientation, and plot size will be influenced by site characteristics such as slope, bathymetry, and substrate, as well as available time and budget. Ongoing monitoring will be essential to evaluate effectiveness, refine deployment practices, and strengthen understanding of seed-based restoration success.

The BBS method is particularly well suited to sites with archaeological or cultural sensitivities, or where diver safety is a concern, as it can be implemented without divers. Though establishment rates are generally slow, the straightforward, low-cost nature makes the method well suited for community participation and citizen science-based restoration initiatives. With thoughtful planning, well-timed reproductive shoot collection, and consistent post-deployment monitoring, the BBS method represents a promising tool for supporting eelgrass recovery along the Pacific Coast.

Land Acknowledgement

Gratitude is extended to the Tsleil-Waututh Nation *səlilwətaɬ* for access to their lands and waters for this burlap bag seeding project.

Project Acknowledgements

The author would like to thank the following people and groups for supporting the field work on which this report is based. Grateful acknowledgement to Senior Environmental Specialist, Marine Ecosystems at Tsleil-Waututh Nation, Anuradha (Anu) Rao, for her direction, site selection and contributions in the field, and to the Tsleil-Waututh Nation for embracing this project and involving youth and Elders on site. Many DFO staff provided field support and equipment for this project. Special thanks goes to the Nearshore Ecosystems Team, particularly Cher LaCoste; and to Ann-Marie Norris and Stephen Healy for their field and equipment support through the Burrard Inlet

Environmental Science and Stewardship Reconciliation Agreement as the vehicle for collaborations. Finally, sincere thanks to Laura Weatherly for provided editing and publishing support.

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Cat. No. Fs143-5/5-2026E-PDF *ISBN 978-0-660-99481-9* *ISSN 2818-4629*

Correct citation for this publication:

Spooner, A. (2026). Eelgrass Restoration Using the Burlap Bag Seeding (BBS) Method. Salmon Habitat Restoration Center of Expertise Tech. Bull. 5. 12p.