Massachusetts *MarineFisheries* Standard Operating Procedure
The Burlap Disc Method: planting and monitoring eelgrass *(Zostera marina)*

Last updated 12/14 KO

Version #	Revision Date	Author	Changes made	Reason for Changes
1	12/1/14	K. Ostrikis		

Point of Contact:
Tay Evans
Massachusetts Division of Marine Fisheries
Annisquam River Marine Fisheries Field Station
30 Emerson Ave.
Gloucester, MA 01930
978-282-0308 x168
Tay.Evans@state.ma.us

I. OBJECTIVE:
Transplanting eelgrass using the Burlap Disc planting method (Pickerell, pers. comm.) and monitoring growth at HUB3 and other restoration sites

II. GEAR LIST:
(Per 2-person dive team)

- Dive gear
- Safety gear, dive float
- Field notebook
- Underwater digital camera and GoPro (if needed), charged
- $1m^2$ quadrat
- Burlap discs pre-drilled with 10 pairs of holes: 65 per 5x5m square plot (plus extras)
- Wire disc skewers w/stoppers and 20oz weights (1-2 skewers per 5x5m square)
- 5 green PVC 8inch planting rings
- 2 x 50m transect tapes
- Tote or cooler
- Harvested plants
- Clam shells for digging
- 4 x screw anchors (for site layout, pre-planting)
- 6 x oak stakes (for site layout, pre-planting)

III. METHODS:

A. Site Reconnaissance and Layout

After a suitable site has been identified through site selection models and inspected during a reconnaissance dive (and/or test plot trial), the planting site can be laid out by divers. In the field, divers determine the best location and orientation for the plots based on site bathymetry, substrate composition and presence of eelgrass, algae or rocks; but each plot should be as close to aligned with the cardinal directions as possible to ease navigation of the site. Divers will use transect tapes to measure and record all the boundaries of the planting area, and install screw anchors or oak

stakes at each corner (Figure 1). Marker buoys are temporarily placed next to the screw anchors so that GPS coordinates can be recorded for each corner.

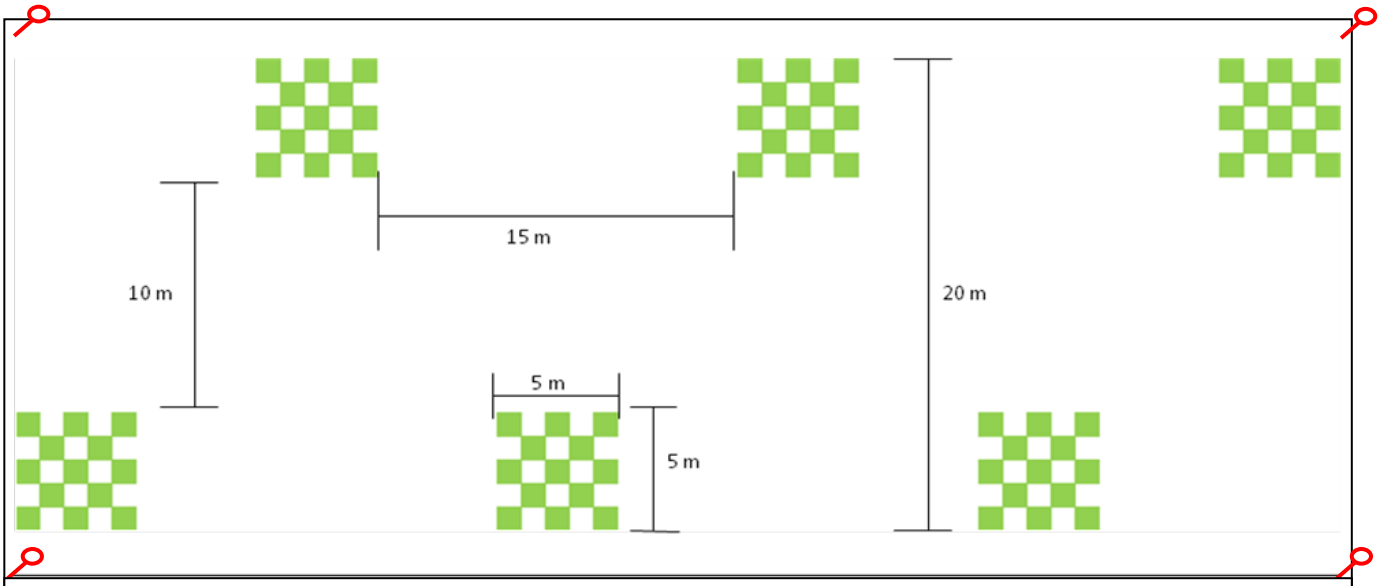


Figure 1. Planting site layout. Six 5m x 5m plots each in a checkered pattern of planted and unplanted squares. Screw anchors shown in red.

B. Harvest

Using a harvest site that has not recently been used, harvest plants (650 plants for a 13-quadrat (5mx5m) plot, plus 10% extra) using the methods outlined in SOP entitled *Massachusetts MarineFisheries Standard Operating Procedure: Harvesting eelgrass (Zostera marina).* Do not harvest reproductive shoots.

C. Weaving

Keep plants cool, shaded and submerged in seawater in a tote while weaving plants aboard a dive boat or on shore. If the boat has a roof or a bimini weave plants under the shade. Keep plants in a mesh bag over the side of the boat until they are ready to be used. Start by cleaning off any dead plant material (black or dark brown blades), and any epiphytic tunicates. Snap off dead or excessively long rhizome, being careful to leave at least 2-3 nodes (1-2 inches; or long enough to weave into the disc). Starting on the "punched" side of the disc, "sew" the rhizome into the outer hole then up and out of the inner hole (Photo 1). If a small lateral shoot or old leaf branches off of the rhizome, try to leave it intact and sew it through to act as an additional anchor (Photo 2). While weaving the discs, be sure that shoots already woven remain cool and moist at all times (Photo 3). Any desiccation will cause stress to the plant and impact survival. The meristem (pimple of growth at base of stem, Figure 2) must be exposed

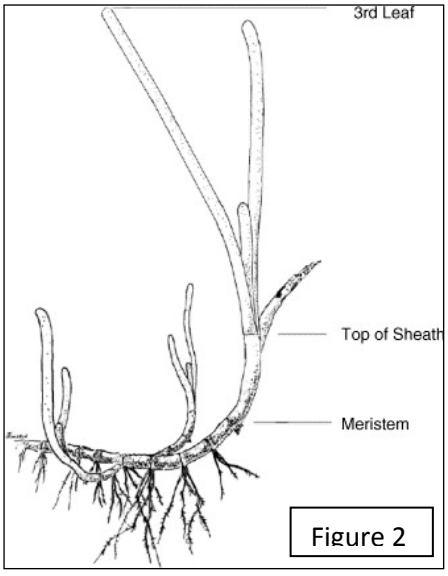


Figure 2

and at the top of the disk, after the plant is woven. The meristem needs to access oxygen to grow and cannot be trapped under the disk when planted. Continue weaving plants into the disc until it has 10 plants, and inspect for proper weaving and secure anchoring. Stack finished discs onto a wire skewer and keep submerged (Photo 4). Keep track of how many discs are on each wire skewer: each 5x5m planting plot will need 65 discs.

Note: Harvesting, weaving and planting of one 5m x 5m plot can generally be accomplished in one day with two-three divers and one topside person. For larger-scale efforts, volunteer events have been successful. In these cases, plants are harvested and stored overnight underwater (refer to harvesting SOP). The next day, volunteers weave plants on shore and discs are transported to divers for immediate planting. For more information about this, visit the blog posting at http://seagrasssoundings.blogspot.com/2012/06/restoration-in-salem-sound-volunteer.html

D. Planting

Divers arrive at the site and drop a mushroom weight attached to a surface buoy to mark the location. Depending on conditions, it may be helpful to send some equipment down in a mesh bag attached to the mushroom weight. Have skewers of plants prepared and ready. Divers enter water and follow the surface buoy down to the seafloor. Find the screw anchor that marks the corner of the large ¼ acre site and use a transect tape to delineate the north or south boundary. Find the first pre-determined planting area along the tape. Lay the $1m^2$ quadrat at the appropriate meter mark and flip the quadrat to get it 1m away from the tape. This is your first planting square. Divers place 5 PVC rings in an "X" formation and push them 1-2 inches into the sediment (Photo 5). Use clam shells or your hands to excavate the top 1-2cm of sediment from within each ring. Make sure each ring is free of rocks, shell and critters. Use your hand to sweep a circular motion within the ring to try to make the sediment level. Pull a disc off the wire skewer and place it into the ring with exposed rhizomes and leaves facing upward (Photo 2). Back-fill the ring with sediment until the disc is fully buried under 1-2cm of sediment. Check that all leaves are vertical in the water column and not buried or stuck under the disc. Continue this process until divers have planted all 5 rings (Photo 6). Remove rings by twisting them out carefully and flip the quadrat twice to your next planting location, creating a checkered pattern (Figure 3). Be sure to keep your legs, fins and gear out of the planted squares as you move throughout the plot. Watch the Burlap Disc method planting video for more information. After entire plot is planted swim over to QC when the water has cleared. This is an important step as there is often low visability while the digging and planting is occurring and it is not uncommon to have some leaves stuck under the disks or for the disks to not be sufficiently buried.

Note that if sediment and visibility allow, Diver 1 can excavate all the rings, while the Diver 2 pulls five discs off the wire skewer. Then Diver 2 hands three of the discs to the other diver. Both divers can place one disc in each ring and place a rock or pebbles on top to temporarily hold it in place while thoroughly burying discs one at a time. This is just a time-saver that can be worked out by the divers.

When using three divers, one diver can carry and hand out the discs to the other divers. That person can also take pictures and qa/qc the planting work. The other two divers would divide up the planting work, where one would plant two discs and the other plants three.

Typically, one 5m x 5m plot can be completed per dive by two - three divers. On subsequent dives, repeat the steps above until six plots have been planted (Figure 1). Reel in transect tapes before leaving the site.

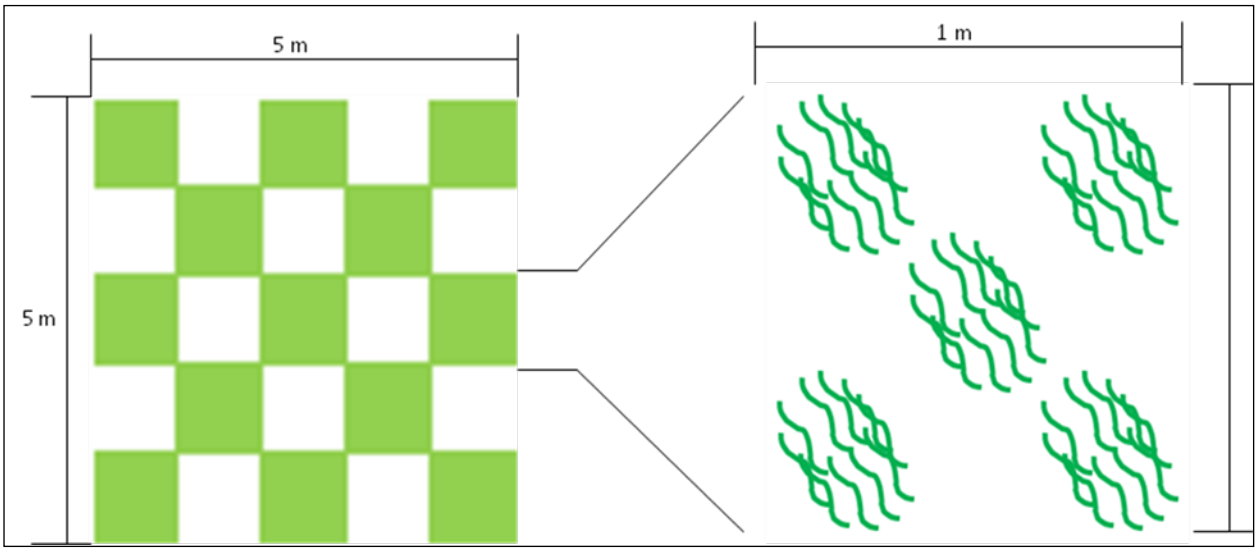


Figure 3. Burlap Disc Method Plot layout. Each 1m^2 quadrat will contain 50 transplanted eelgrass shoots.

E. Monitoring

After eelgrass is transplanted, monitoring occurs at intervals of one month, six months, and one year for the first year, and once annually for at least five additional years.

Post-planting monitoring, 1 month interval

From the boat, a marker buoy is deployed at one of the four corners of the site. Once in the water, divers follow the buoy line to the bottom and find the screw anchor marking the corner of the site. Using compasses for navigation, the transect tape is laid out and divers locate the meter marking of the first plot to be monitored. For newly planted plots, divers should be able to see distinct squares and determine which squares will be monitored. If for some reason distinct squares are not obvious (poor visibility, plants are gone, or plots have coalesced (for later-stage monitoring)) divers line the quadrat up at the transect tape and flip it over until the desired square is reached. During 1-month monitoring, divers record the following:

- Planting units:
  Divers swim over the 13-square planting area and record the presence or absence of 1m^2 planting units.
- Shoot count:
  Divers count the number of individual shoots within four 1m^2 quadrats (two per diver).
- General notes:
  Divers record observations about the appearance of the plants and burlap discs. Record any evidence of burrowing, grazing, epiphytes, etc as well as whether individual discs appear to be missing.
- Tend the plantings: re-burry any eroded disks, pull leaves out from under the disk if they are buried, shoo away crabs, brush away algae, etc. talk to the plants and use your green thumb!

Next, the divers monitor expansion of the plot over time. During the one month monitoring interval, divers locate the corner of the plot closest to the transect tape and closest to the zero-end of the tape (in Salem Sound, this is always the west corner). Divers hammer an oak stake into the edge of bed at this corner if missing or not already present. Using a tape measure, one diver holds the zero

end of the tape at the stake while the other diver measures the distance (m) along three axes (length, width, and diagonal)(Figure 4) of the plot and records on their dive slate.

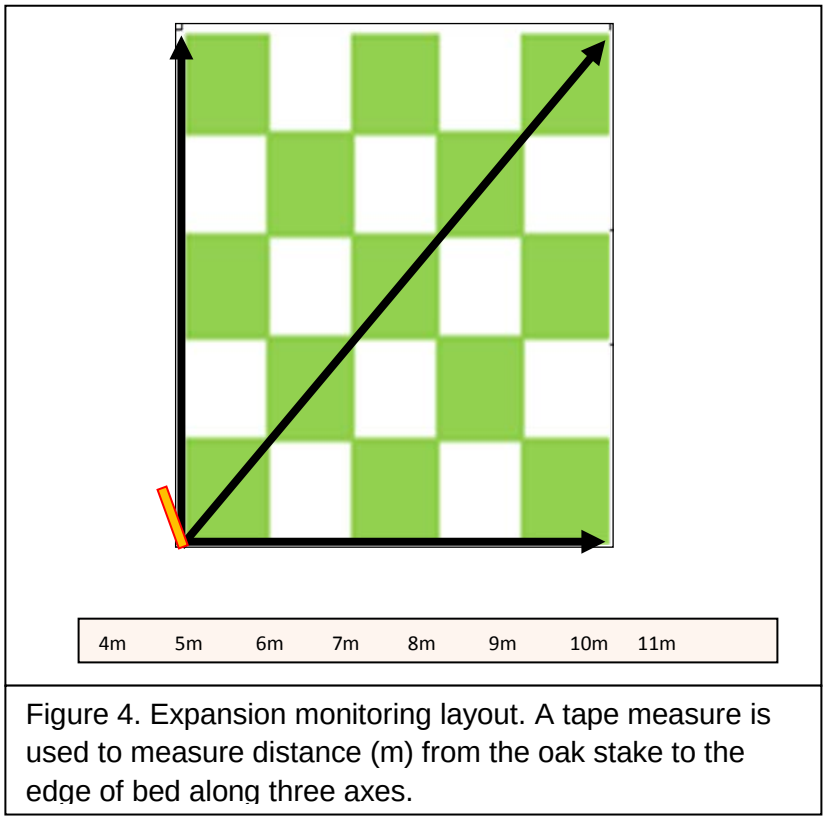


Figure 4. Expansion monitoring layout. A tape measure is used to measure distance (m) from the oak stake to the edge of bed along three axes.

Post-planting monitoring, 3 month and annual intervals
Divers follow all the steps listed above to sample 30% of the planted squares. Two additional tasks are to record the surface sediment type (mud, fine sand, sand, course sand, shell-hash, gravel, cobble), and take pictures of sampled quadrats. The extent of bed will also be measured along 3 axes of each plot, as described above.

At each sampling quadrat, divers use their slates to record the following measurements:

- Percent cover:
  Place the $1m^2$ quadrat on the sampling location and record the percent coverage of eelgrass when viewed aerially in the water. To quantify this, imagine that all the grass is pushed to one area of the quadrat and estimate how much of the quadrat it covers. Alternately, depending on your preference, imagine all the grass is pressed to the ground and estimate coverage that way.
- Canopy height:
  Place the meter stick vertically within the quadrat and use your arms to fan the grass upward. Record the height (cm) that describes 80% of the tallest leaves (i.e. ignore the tallest 20%). In July, plants are likely to be >1m in height so you may need to slide the meter stick up.
- Shoot count:

Count the number of individual shoots within the $1m^2$quadrat. Count the number of individual shoots rooted within the quadrat. A good method is to start from one corner and work your way around systematically, holding down the plants you have counted with your arm.

- Any additional notes (grazers, epiphytes, sediment characteristics, etc)

If plant density has greatly increased and percent cover is greater than 50%, it is acceptable to use the $0.25m^2$ quadrat by placing it in a representative area within the $1m^2$ quadrat (i.e. if percent cover is 70% in the $1m^2$, your $0.25m^2$ sample should also have 70% cover). Make note of what quadrat you are using on your dive slate and in the notebook.

Success Criteria

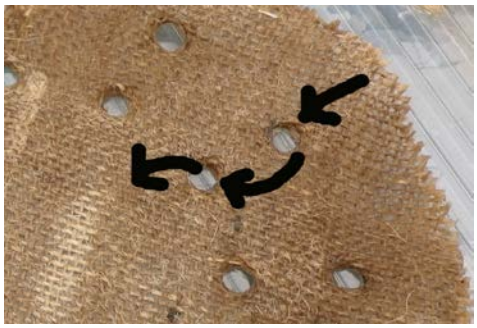
Success will be measured for individual parameters compared to reference levels measured at the self-established sites or "reference beds". Refer to SOP entitled *Monitoring eelgrass (Zostera marina) in a reference* bed and Short et al (2000) for more information.

IV. TROUBLESHOOTING NOTES:

While planting, be sure to keep all burlap discs on the skewer when not in use because the discs and plants will float. It helps to keep the skewer bent to keep discs from floating off.

Make sure data and notes are recorded into the field notebook when divers get settled back aboard the boat.

V. PHOTOS:

1. 

2. 

3. 

4. 

5. 

6. 

VI. DATA MANAGEMENT:
Monitoring data are entered and quality-control checked in the spreadsheet titled *HUB3 Monitoring Data* stored here W:\Habitat Project\Habitat Research\Seagrass\HUB3 Eelgrass restoration\Monitoring data

VII. REFERENCES:
Chris Pickerell, Cornell Cooperative Extention *Marine Meadows* program, personal communication

Anatomy of eelgrass: http://seagrassli.org/ecology/eelgrass/a_shoot.html

Underwater video of DMF divers using the burlap disc method to plant Middle Ground, Salem Sound: (Gloucester drive) W:\Habitat Project\Habitat Research\Seagrass\HUB3 Eelgrass restoration\Pictures\VIDEO_TS

Short, F.T., D.M. Burdick, C.A. Short, R.C. Davis and P.A. Morgan. 2000. Developing success criteria for restored eelgrass, salt marsh and mud flat habitats. Ecological Engineering, 15:239-252.