The Massachusetts Division of Marine Fisheries

Conservation Boat Mooring Recommendations in Eelgrass and Other Sensitive Aquatic Habitats

June 10, 2019

The Division of Marine Fisheries (MA DMF) defines conservation moorings as boat and float moorings, where all parts of the mooring rode floats off the bottom at all times. MA DMF recommends replacing conventional chain moorings with conservation moorings in eelgrass (*Zostera marina*) and other sensitive habitats to protect valuable natural resources, according to the guidelines described below.

Introduction

Eelgrass (*Zostera marina*) is a marine, meadow-forming plant that provides valuable habitat for commercially and recreationally important marine species such as scallops, lobster and striped bass. In addition to providing marine species with areas for spawning and foraging, eelgrass also enhances water quality, protects the shoreline from erosion, and sequesters carbon through photosynthesis. Conventional boat moorings have been observed to adversely impact eelgrass as the chain drags and scours along the bottom with the current and tides (Figure 1). Chain drag can damage eelgrass, shellfish and invertebrates that inhabit the area, and resuspend sediments into the water column causing cloudy or turbid waters. An alternative to chain moorings that may minimize damaging impacts to eelgrass are called conservation moorings. Conservation moorings are equipped with floating, flexible rodes that are designed to minimize or eliminate drag on the seafloor by floating throughout the tidal cycle (Figure 2). The rode, coupled with a helix anchor driven into the harbor bottom, reduces the footprint compared to conventional block or mushroom anchors. There are different conservation mooring designs on the market including Eco-Mooring, Hazelett, Stormsoft, Seaflex and others. The Eco-mooring design uses a short section of chain to connect the floating rode to the surface buoy. The short "top chain" keeps the rode lower in the water column and away from boat propellers. When the

Figure 1. Aerial image of boat mooring scars in an eelgrass meadow in West Falmouth. Photo credit: DMF and Lighthawk, 2014

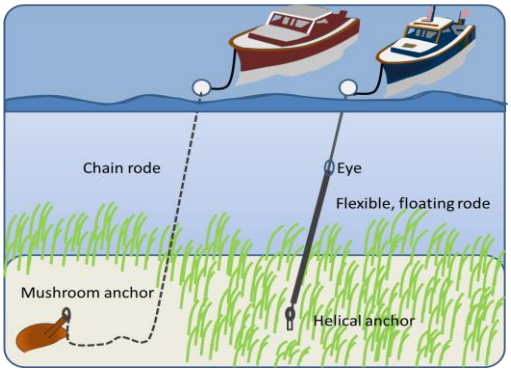


Figure 2. A conventional chain mooring showing a scar in eelgrass meadow (left), a floating conservation mooring (right).

conservation moorings properly float, they can minimize impacts to eelgrass and other benthic habitats that are important to the ecology of estuarine systems.

Monitoring Observations of Conservation Mooring Installations

For over a decade, the MA DMF has been monitoring conservation boat moorings that were installed to replace conventional boat moorings in six Massachusetts harbors with well-established eelgrass meadows.

From 2011 to 2013, five Eco-Mooring and three Hazelett moorings were installed in West Falmouth, and eight Hazelett Moorings were installed in Manchester-by-the-Sea. In 2014, 275 Eco-moorings were installed across seven harbors, including Gloucester, Manchester-by-the-Sea, Boston, Wareham, Onset, West Falmouth and Quisset Harbors. More recently, in 2018 Stormsoft moorings were installed in Manchester-by-the-Sea to replace several Eco-Moorings that failed or were no longer functioning properly. Since 2011, MA DMF has been monitoring a subset of the installed conservation moorings. To date we have monitored 60 moorings. At each mooring, the area of the scar in the eelgrass, as well as shoot density, percent cover, and canopy height inside and outside of the scar were measured annually or biennially. Finally, extensive notes on MA DMF's observations were documented in the field including the condition of the mooring tackle, presence of fouling, placement in the water column (floating or lying on the bottom), and any other unusual or notable observations.

MA DMF's monitoring data show that in the majority of cases the conservation moorings were effective at reducing the size of eelgrass scars after a minimum of three years (Figure 3). Of all the moorings monitored, 67% showed a reduction in scar size after at least three years of monitoring, while 33% had an increase in scar size during the same time period. There were no cases where the scar size stayed the same, however, some scars changed very little (ex. 21m^2 to 20m^2 after three years).

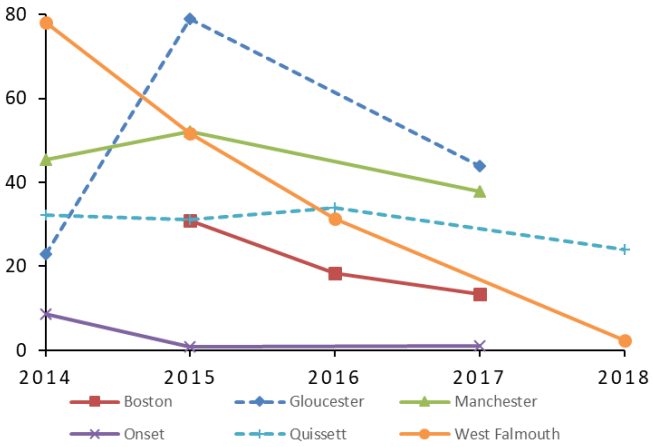


Figure 3. Average scar size decreased after Eco-moorings were installed in the six surveyed sites from 2014 to 2018. Note: Moorings monitored through Massport grant.

Conservation Mooring System Performance Evaluation

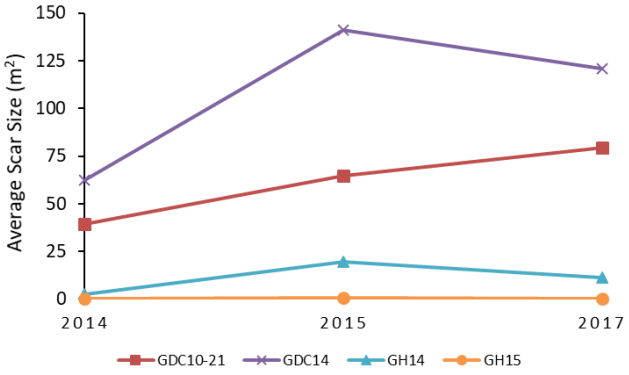


Figure 4. Scar expansions recorded at multiple Gloucester moorings caused by excess rode

Mooring scars expanded rapidly when the mooring dragged on the seabed. In certain cases, scar expansions were attributed to improperly sized moorings that were not sized correctly for the site or the vessel, causing the mooring to drag (Figure 4). Scar expansions were also recorded when a conservation mooring was converted back to a chain mooring; and also when the helix and mooring were installed in the vegetated meadow next to the mooring scar, rather than in the unvegetated scar where the former chain mooring had previously been placed. In addition, when conservation moorings were installed in eelgrass, scars resulted if any part of the mooring tackle dragged on the bottom. Changes in the scars associated with moorings in patchy meadows, as in Manchester-by-the Sea and Gloucester, were difficult to attribute to conservation moorings because the scar edges were never clearly defined and the eelgrass patches were inherently shifting. In summary, of the six harbors in our study two showed clear, positive results, approaching full recovery of eelgrass into the scars after three years. The other four harbors have shown variable success, with failure primarily due to improper installation and maintenance, resulting in mooring drag on the harbor bottom.

Criteria for Assessing Successful Conservation Moorings

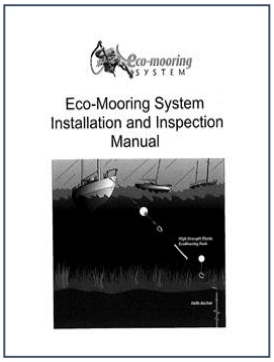
Two primary criteria must be met before conservation moorings can be considered successful at minimizing or eliminating impacts to eelgrass: 1) eelgrass must recruit into and persist in the former unvegetated scar, reducing the measured scar area, and, 2) eelgrass characteristics (e.g. shoot density, % cover and canopy height) must be statistically equivalent within the original scar area compared to those measured in the reference vegetated locations. Based on this definition, to date, success has only been achieved at the conservation moorings in West Falmouth Harbor. Mooring scars in other harbors are improving; however, obstacles to success remain a concern.

To ensure conservation moorings have minimal impact on eelgrass meadows, MA DMF provides the following recommendations:

Recommendations for harbormasters, mooring installers and mooring owners

- **Follow the mooring manufacturer's manual for installation and maintenance**

  The success of conservation moorings can be improved with proper installation and maintenance. For Eco-moorings: Eco-mooring System Installation and Inspection Manual, © 2014 Boatmoorings.com. For Hazelett moorings: https://hazelettmarine.com/installation-support/.



- **Correctly size the mooring for the specific site depth and tidal range**

  Conservation moorings must be sized correctly for the site-specific location in order to be effective in reducing/minimizing eelgrass impacts. The rode length and length of top chain, if any, must be short enough that the rode does not drag at any tide, but long enough or with enough flex that the mooring will hold during a storm. MA DMF recommends that conservation moorings be fit at a low, low tide to ensure that dragging does not occur, and then observe the mooring system throughout all tidal cycles after the initial installation so that any necessary adjustments can be made. In cases where top-chain is installed, as described earlier, the length of this chain should be less than the depth at the lowest, low tide. We observed moorings where the top chain was too long causing the rode eye to drag in the grass (Figure 5). We also observed the top chain hitting the bottom during low tides at both deep and shallow sites. However, even with a short top chain, some sites are too shallow for some or all conservation moorings to work effectively. In such cases, shorter rodes or different designs should be considered. In cases where a short length of bottom chain is installed, as described earlier, underwater buoys were often missing and the bottom chain was dragging around the helix creating a small scar area that could not revegetate.

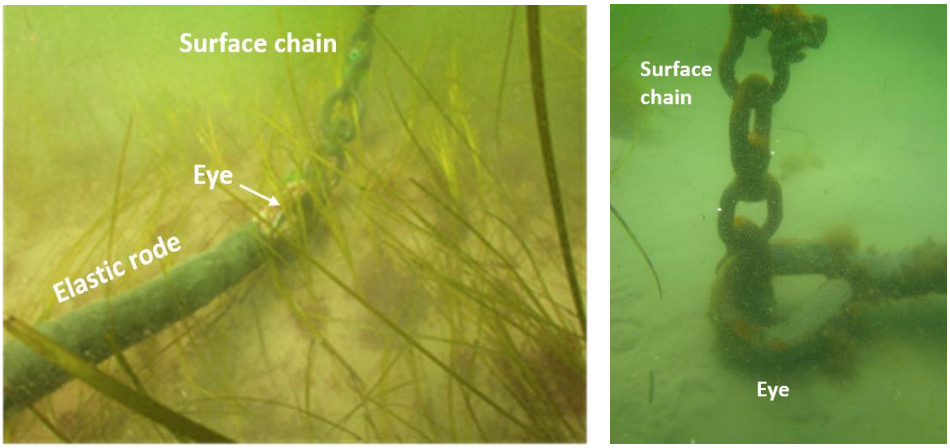


Figure 5. Rode grounding due to long top chain at shallow Manchester site (left) and close-up of the eye hitting the bottom (right).

- **<u>Adhere to a regular maintenance schedule</u>**

  Because of their porous surfaces, conservation moorings foul more quickly than chain moorings. Conservation moorings should be cleaned with a scrub brush and gloved hand to minimize fouling, or by annual power washing if so directed in the manufacturer's manual. Cleaning may need to be done as much as once a month in some harbors. When moorings were not maintained and cleaned for one season, MA DMF observed heavy fouling and moorings dragging on the bottom due to the load of algae and tunicates (observed in harbors both north and south of Cape Cod; Figure 6).

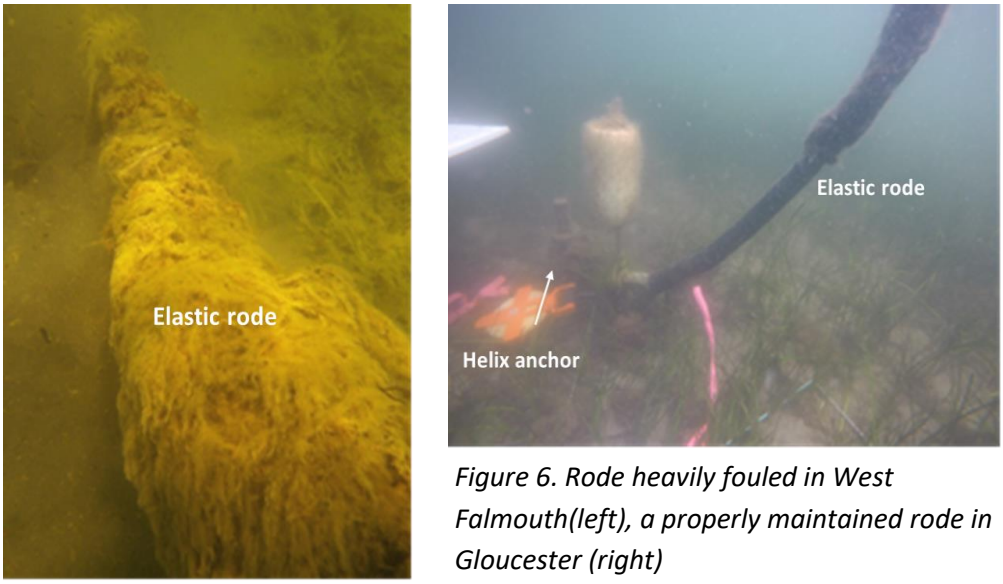


Figure 6. Rode heavily fouled in West Falmouth(left), a properly maintained rode in Gloucester (right)

- **<u>Remove the flexible rode each winter and store on land</u>**

  Conventional mooring chains are commonly dropped to the bottom with an attached winter stick during the off-season. When this practice is done with conservation moorings, the rode may become fouled and drag on the bottom, scouring eelgrass (Figure 7). MA DMF recommends removing the mooring gear (flexible rode and floats) before attaching a secure line from the helix anchor to a winter stick for the duration of the off-season, in accordance with the Eco-mooring manufacturer's Installation and Inspection Manual. This procedure reduces the chance that the mooring will sink to the bottom and scour the seafloor while not in use. In addition, once out of water, a thorough inspection and cleaning of the mooring rode can be done prior to upland storage. The maintenance practice also has the benefit of extending the life of the system.

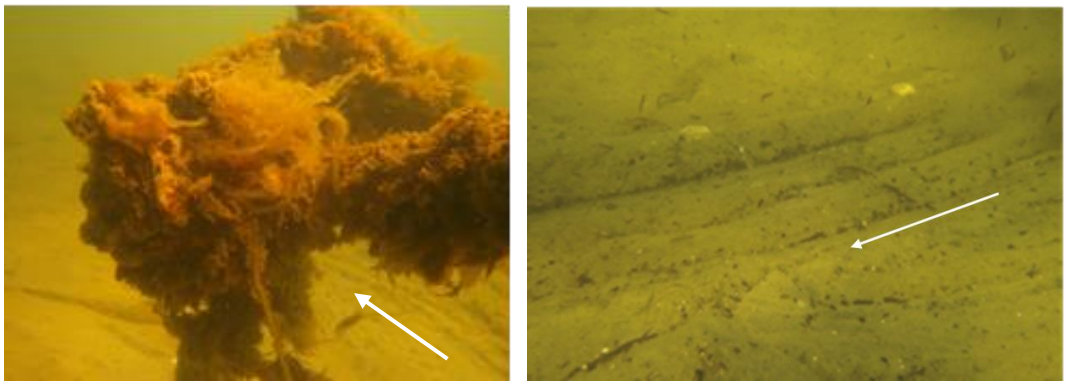


Figure 7. Fouled float and rode with drag marks (indicated with arrows) in the background (left) and close-up of the drag marks made by the eye portion of the rode hitting the bottom (right).

- **<u>Some Conservation mooring designs may not be appropriate for every harbor condition</u>**

  Shallow sites or sites with high energy and very patchy eelgrass may require some altering of the conservation mooring in order for it to properly function. For example, if the size of the mooring required to provide sufficient holding power during a storm surge results in the rode dragging on the bottom at low tide, then that conservation mooring design is not appropriate for that site, and another design should be considered.

- **<u>Use conservation moorings in eelgrass, at the edge of eelgrass and in areas that formerly supported eelgrass</u>**

  Areas that formerly supported eelgrass may restore once the impact of mooring chain drag is reduced through the use of conservation moorings (Figure 8).

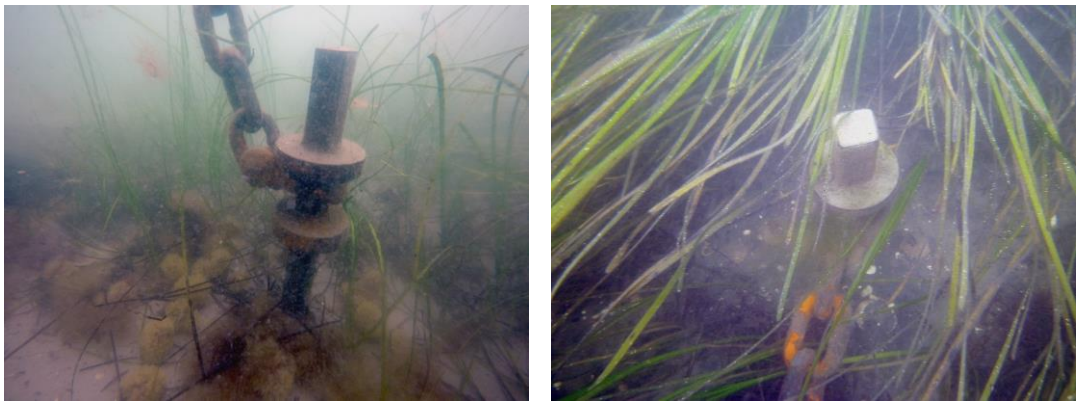


Figure 8. Eelgrass growing nearly up to helix anchor in Manchester (left) and West Falmouth (right)

- **Group conservation moorings together**

  Mooring placement has been a concern of boat owners due to differing scopes of a conservation mooring compared to a conventional mooring. Grouping conservation moorings together may be necessary for efficient mooring field space utilization, and will require careful placement by the harbormaster.

- **Educate boaters**

  MA DMF recommends that all mooring owners receive educational materials when they renew their mooring permit in or near eelgrass, or in other protected resource areas. In addition, the Division of Marine Fisheries has developed signage that can be displayed at boat ramps, boat clubs, and Harbormaster's offices indicating the importance of eelgrass and its location in the waterbody with information about conserbation moorings (Figure 9). Propellers can scour eelgrass in shallow water. Use well-marked channels to avoid boating and anchoring in shallow areas to minimize damage to eelgrass.

Figure 9. Eelgrass and conservation mooring signs at the town dock and public boat ramp in West Falmouth.

- **Conduct regular surveys**

  Further study of the continued efficacy of conservation moorings and eelgrass restoration success should be prioritized for both existing and new conservation moorings. Continued monitoring is needed to ensure the moorings are functioning as designed and are not impacting eelgrass. Further study can help inform manufacturers on design changes that are needed as the industry continues to expand.

For questions and more information about our monitoring results please contact:
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