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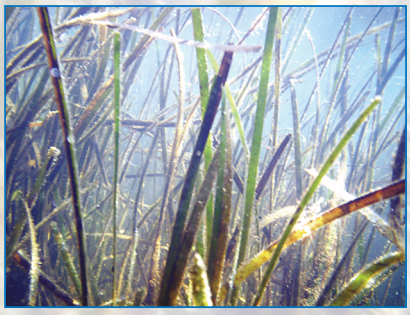
Negative Effects of Commercial Mussel Dragging on Eelgrass Beds in Maine

Eelgrass *(Zostera marina)* forms extensive meadows in the low intertidal and shallow subtidal zones of estuaries and bays throughout New England. Ranked among the most productive plant communities on the planet, eelgrass beds are particularly noted as critical habitat for a wide variety of commercially valuable fish and shellfish. The dense eelgrass canopy provides protection from predators and a rich food supply. Some fish, such as winter flounder, Atlantic cod, and striped bass, use eelgrass beds as nurseries. Larval blue mussels and bay scallops settle on eelgrass leaves, and juvenile lobsters find refuge by burrowing in eelgrass beds. Many fish such as pollock feed on the abundant sand shrimp, amphipods, and other invertebrates that occur in eelgrass beds. Eelgrass also supports high densities of small fish, including sticklebacks, silversides, and grubby. Waterfowl, wading birds, and shore birds concentrate in eelgrass beds – some species feed on the leaves and seeds, while others rely on fish and invertebrates. In addition, eelgrass reduces water pollution by absorbing nutrients. The eelgrass canopy dampens wave energy and slows currents while roots and rhizomes bind bottom muds, all of which help to stabilize sediments and buffer shorelines. Because of these important ecological functions, loss of eelgrass beds can result in reduced fish and wildlife populations, degraded water quality, and increased shoreline erosion.



Eelgrass *(Zostera marina)*.

Introduction

Maquoit Bay, which forms the northwestern arm of Casco Bay, Maine (fig. 1), has an extensive eelgrass meadow of over 1,300 acres covering half the bay bottom. When eelgrass began piling up on the shoreline early in the summer of 1999, local residents knew something was wrong. Preliminary evidence pointed to commercial mussel dragging as the source of habitat disturbance – large bare areas within the eelgrass meadow were marked with distinctive, linear dredge scars on the bay bottom, and piles of mussel shell appeared to have been dumped overboard during mussel washing and sorting operations. Although natural resource managers, shoreline citizens, commercial harvesters, and scientists had all expressed concern over the years about the impacts of commercial mussel dragging on eelgrass habitat throughout Maine, no scientific study had ever measured the magnitude of damage from dragging. Significant damage to eelgrass beds by mussel dragging could have negative effects on the fishery, as eelgrass is known as important habitat for blue mussel larvae.

Therefore, the U.S. Geological Survey (USGS) provided funds from its State Partnership Program, which is focused on state natural resource management problems, to address issues concerning commercial mussel dragging in Maine eelgrass beds. In 2000, scientists from the USGS, the University of New Hampshire, and the Maine Department of Marine Resources embarked on a study to quantify the effects of mussel dragging on eelgrass in Maquoit Bay and to project the time required for the habitat to recover from dragging impacts.

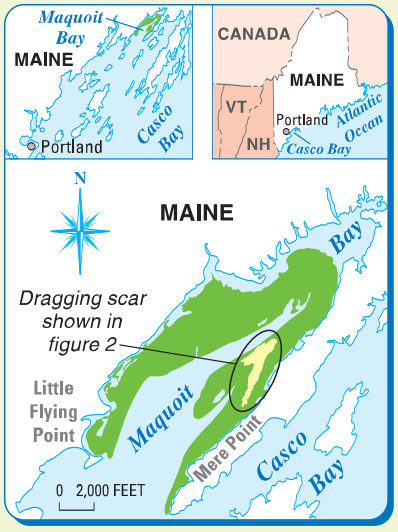


Figure 1. Location of eelgrass beds (shown in green) in Maquoit Bay, Maine.

Impact of Dragging on Eelgrass

Commercial dragging for mussels occurred in Maquoit Bay throughout the 1990s, leaving four identifiable dragging scars ranging from 8 to 79 acres in size. The largest of these scars is shown in figure 2. Aerial photographs of Maquoit Bay taken in 2000 revealed that a total of 132 acres of eelgrass, or about 10 percent of the eelgrass in the bay, had been disturbed by dragging. Two sites that

Mussel dragging poses a severe and long-lasting threat to eelgrass.

- **Dragging uproots eelgrass plants completely.**
- **Dragging can damage large areas – individual drag scars up to 79 acres in size have been found in Maine eelgrass beds.**
- **Under the best environmental conditions, complete revegetation of a dragged area requires an average of 11 years.**
- **Under conditions less favorable for eelgrass growth, such as reduced water quality, dragged areas could require more than 20 years to recover.**
- **Protection of eelgrass from commercial dragging will preserve important coastal habitat.**

U.S. Department of the Interior
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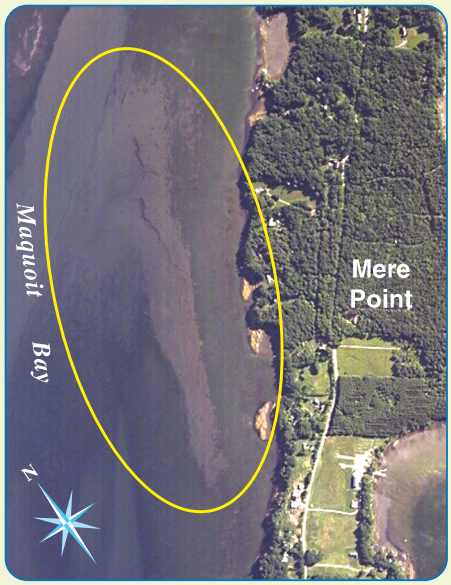

Figure 2. Dragging scar, 79 acres in size, in Maquoit Bay eelgrass bed created in June 1999 (photo July 2000 at a scale of 1:12,000). The scar is nearly a mile long and ranges from 125 yards to a quarter of a mile across.

were dragged in 1999 had very little eelgrass cover in 2000. Dragging completely uprooted eelgrass plants, removing leaves, rhizomes, and roots. Underwater video measurements showed that dragging intensity was variable. In some areas, patches of mature plants remaining after dragging suggested relatively light impacts; however, an average of 86 percent of the recently dragged bottom was bare, indicating heavy dragging over most of the area. Two older dragging scars (one that had been dragged 2 to 7 years earlier and one that had been dragged more than 8 years earlier) showed continuous eelgrass cover in 2000, but drag marks were still evident and eelgrass abundance was still substantially reduced. Dragging did not alter the physical characteristics of the sediment.

Eelgrass Recovery Following Dragging

The pattern and rate of eelgrass bed recovery depended on initial dragging intensity. Aerial photographs showed patchy eelgrass regrowth in areas of relatively light dragging after 1 year, but very little revegetation in heavily dragged areas (fig. 3).

Two independent methods were used to predict the rate of eelgrass recovery in heavily dragged areas. One method was based on measurements of the current eelgrass abundance at sites that were dragged at different times over the past decade. The other method involved development of a computer model of eelgrass revegetation, based on measurements of the rate of seedling appearance and plant growth in dragged areas. Both methods led to the same prediction — it takes an average of 11 years for eelgrass in dragged areas to revegetate to a level of 95 percent of the eelgrass cover found in undisturbed beds. It is important to note that the eelgrass meadow in Maquoit Bay was expanding during this study, indicating that conditions were highly favorable for eelgrass growth. The computer model predicted that under conditions less favorable for eelgrass growth, such as reduced water quality, recovery could take up to 22 years.

For More Information

Neckles, H.A., F.T. Short, S. Barker, and B.S. Kopp. 2005. Disturbance of eelgrass *Zostera marina* by commercial mussel *Mytilus edulis* harvesting in Maine: dragging impacts and habitat recovery. Marine Ecology Progress Series 285:57-73.

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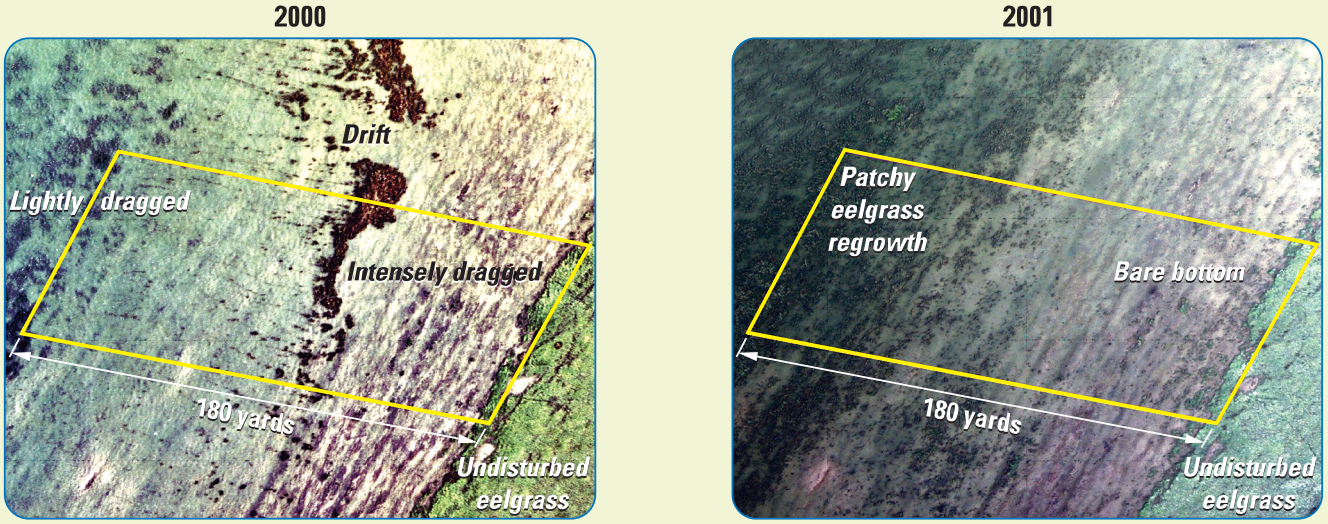

Figure 3. Large-scale impacts and revegetation in a portion of an eelgrass bed that was dragged in 1999. Aerial photographs were taken in July 2000 (left) and June 2001 (right), at a scale of 1:2,400. Area within rectangle is 2.3 acres.