Littorally Speaking

Benthic Barriers

By Roberta Hill

This article is the third in a four-part series focused on the challenge of controlling invasive aquatic plants in Maine. The first article looked at Maine's cautious approach to the use of aquatic herbicides. The focus of the remaining three installments is on the various "non-chemical" control methods (alternately referred to as "manual," "physical," or "mechanical" methods). Most groups currently involved in combating variable milfoil infestations in Maine are utilizing one (or more) of these non-chemical control methods. The first of the three, featured in the winter 2007 Water Column, was manual harvesting. This time we will look at the use of benthic barriers.

Some of the most successful invasive aquatic plant management projects in Maine involve the use of benthic barriers (also called bottom mats and bottom barriers). This method is especially effective in controlling pure (single species) stands of invasive aquatic plants such as variable milfoil, when the plants occur in dense, small-to-moderately-sized patches.

In larger infestations, benthic barriers are often installed in the high use areas only, such as boat channels, beaches, dock areas, etc., to establish "plant-free" zones, and to minimize opportunities for plant fragmentation and spread. However, in areas where boating occurs, barriers are recommended only in water deeper than five feet, to avoid entanglement with props. Control of entire larger infested areas (over 500 square feet) with benthic barriers, though not generally recommended due to the cost of installation and maintenance, *is* possible. Indeed several groups in Maine are now showing just how this technique can be effectively "scaled up" to larger infestations. An excellent example of a community that is pushing past previously held notions of the "limitations of benthic barriers" with great energy and innovation is featured in the *Lily Brook Case Study* on page 12.

IMPORTANT! All invasive aquatic plant control projects are subject to regulation under Maine's Natural Resources Protection Act. Before planning any control project, contact the Maine Department of Environmental Protection for specific permit requirements (1-800-452.1942 or milfoil@maine.gov). ***All native aquatic plants are strictly protected by Maine law.***

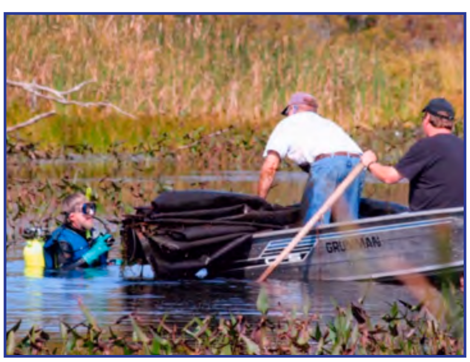
The basic concept is simple. Tarp-like material is placed over the invasive plants, on the lake floor, to prevent light penetration, disrupt photosynthesis and smother the plants. Over a period of time (generally forty-five to sixty days), the plants beneath are killed, roots and all. To go back to our garden analogy from the previous article*: think "black plastic mulch."*

An LEA control team in the Songo River in Naples, unfurling a 40' X 60' benthic barrier, constructed from a common blue plastic tarp. Benthic barriers are a tool for killing invasive aquatic plants. They are basically weighted tarps that provide the same function as black plastic mulch in the garden. (Photo courtesy of LEA)

Jim Chandler of Bryant Pond has been a pioneer of benthic barrier design and use in Maine. He feels that placing benthic mats requires less time than to manually harvest the same size area and the mats produce a "cleaner" (more effective) result. However, if the infested area is not dominated by invasive milfoil (i.e., if there is a significant amount of native plant growth mixed with the invasive species) then manual harvesting, a more selective method of control, is more appropriate. The exception to this is the mixed-vegetation stand where the sparsely distributed invasive plants persist despite repeated manual removal. In these cases small mats (5' X 5') may be placed strategically in order to "spot kill" the offending invaders, while allowing the natives growing around them to continue to thrive.

Which brings us to an important drawback with this method: benthic barriers are *not* selective. They will damage or kill *all* plants underneath, invasive and native, and can also negatively impact fish and bottom dwelling invertebrates. Negative impacts on non-target animal populations are minimized, *but not eliminated entirely,* by avoiding benthic barrier placement during fish spawning season (from April 1 through June 30) and by limiting the amount of area covered at any one time. The general rule is that no more than 10% of the littoral zone of the waterbody (or distinct portion of the waterbody such as a cove) should be covered at any one time. Larger infestations are managed by covering a limited portion of the infested area, and then moving each mat to the next adjacent infested plot, and repeating this process as necessary, every sixty days.

The most common materials used in the construction of benthic barriers include: fiberglass screening, geotextile or other heavy-duty landscape fabric,



The PLPPA control team preparing to deploy one of the many 12.5' X 10' benthic barriers that have been used to control variable milfoil in Lily Brook. (Photo by Nikki Leamon)

impervious pond liner, and burlap. In Maine, experimentation is under way with other recyclable and low-cost materials. Thanks to Lakes Environmental Association (located in Bridgton) and their work to control variable milfoil in the Songo River, Maine now has yet one more use for the ubiquitous blue plastic tarp. (For more information on experimental materials see "On the Cutting Edge" on page 9.)

Obviously there is a bit more to killing "weeds" in the aquatic environment than just rolling out the black plastic. And if we may go back to the plastic mulch analogy for a moment, and try to imagine installing the plastic sheeting to a "garden" under several feet of water, we soon glimpse the key challenges with benthic barriers: 1) the unwieldy material must be transported as efficiently as possible to a designated location on the lake floor; and 2) the material must be kept in place as water currents and surface activity above, and gas release below, conspire to dislodge it.

Let's start with the challenge of keeping the mats in place, since this needs to be determined and provided for in advance of deployment, and then work our way back to the challenge of transport and placement.

Most of the tarp-like materials used to construct benthic barriers will float and must therefore be anchored in place. Decisions regarding what type of weights to use and how they will be placed must be made well in advance of deployment. Sandbags, bricks, cinderblocks and rocks are all useful anchoring materials. The weights are simply lowered onto the mats in whatever pattern and frequency may be needed to make the material lie relatively flat on the bottom. If calculated and executed correctly, the combined effect of all individual weights is sufficient to keep them all in place.

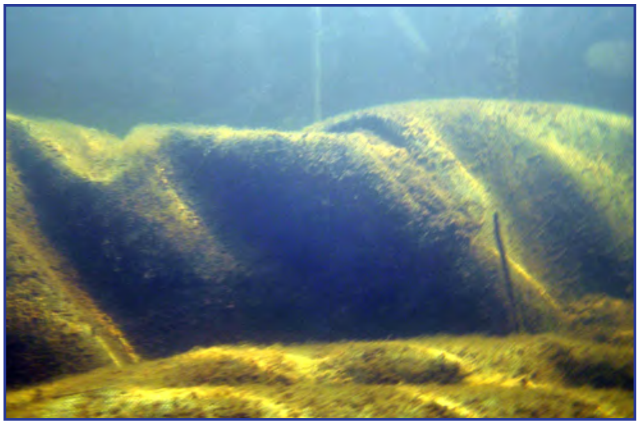
rock-bag anchors

Benthic barriers must be weighted to hold the tarp like material in place. Common methods are rebar attached with electrical ties, rock-bag anchors, and bricks.

Another type of weight system involves rebar rods (or rebar encased in perforated PVC pipe). In this case, the weighting devices are directly attached to the barrier material (often with "electrical ties") to ensure that they will maintain their position on the mats. One benefit to using rods is that some of the rods (those running across the width of the mat) may be attached to the mat prior to deployment, and then rolled up in the mat to provide the weight needed to get the mat to the bottom. (The rods that run down the sides of the mat are installed later, when the mat is in place.)

Regardless of the anchor used, the amount of weight needed to hold the mat in place will vary depending on the water depth at the deployment site and other localized conditions such as water currents, surface use activity, amount of plant material being covered, etc. In general, mats tend to be more stable in deeper, calmer water.

Some benthic barrier materials (e.g., fiberglass screening) are porous, allowing for gases to escape from under the barrier. Other barrier materials (geotextile, plastic tarps, etc.) are less permeable and have a tendency to trap gasses. Gas accumulation under the



Underwater photo of a benthic barrier "in action" in Lily Brook. Note that some mild billowing has occurred as a result of gas released from decomposing plants. (Photo by Lew Wetzel)

barriers can lead to billowing, and displacement. To keep these mats in place, perforations must be made at regular intervals prior to installation. Two-inch-long slits may be cut with a sharp knife, or holes may be burned into the material with a wood burning tool. Obviously, care must be taken to perforate the mat only as much as is needed to prevent billowing without diminishing the light blocking integrity of the mat.

Despite the best installation and weighting, boat anchors, propellers, swimmers or other localized activity may disturb, damage, or dislocate benthic barriers. Frequent (at least twice a month) visual inspection and maintenance are essential to ensuring that the mats stay in place and maintain their effectiveness. Maintenance chores include repair work, silt removal, and release of gas build-up to correct billowing problems. Clearly marking the treatment areas, and asking the public to temporarily avoid activity near the sites, will help to minimize disturbance problems.

Transporting and deploying the mats also requires advanced planning and preparation. Anchored buoys, floats, underwater marking devices (such as fiberglass rods or PVC pipe) and Geographic Positioning System (GPS) devices may be used to mark the perimeters or corners of treatment plots and the barriers once in place, and also to guide the control team to the deployment sites for maintenance and moving to a new location.

For offshore sites, barriers must be constructed in such a way that they may be efficiently transported, generally by boat, from shore to the designated location of deployment. Mats that have been constructed and packed (folded or rolled) for deployment on shore are loaded into boats and transported out to the pre-determined treatment plots. Working as a team, one person in the boat feeds and guides the mats to SCUBA diver (or divers) in the water, who then swims the mats to the lake floor. There the mat is "unpacked," spread out over the treatment area, and weighted. If manual harvesting is being done in combination with the barrier placement, the team may also include additional divers and weed handlers, fragment spotters, etc.

Benthic barriers vary significantly in size. Mat size is determined by a variety of factors such as the size and configuration of the infested area to be controlled, the number of individuals that can be brought to bear upon the task of installation and removal, the size of the boat to be used to carry the mats to the deployment site (for offshore areas), the types and amounts of material resources available, the storage space available, etc. Generally, the larger the mat size the more cumbersome it will be to move and manipulate. Benthic barriers used in control projects in Maine range in size from 5' X 5' to 40' X 60'.

Most barriers are designed to be removed after the treatment period, cleaned, repaired, and stored for later use. In some cases barriers may be removed from the water and placed in a new location; sometimes they are

"Locally Grown"

Benthic Barrier Designs

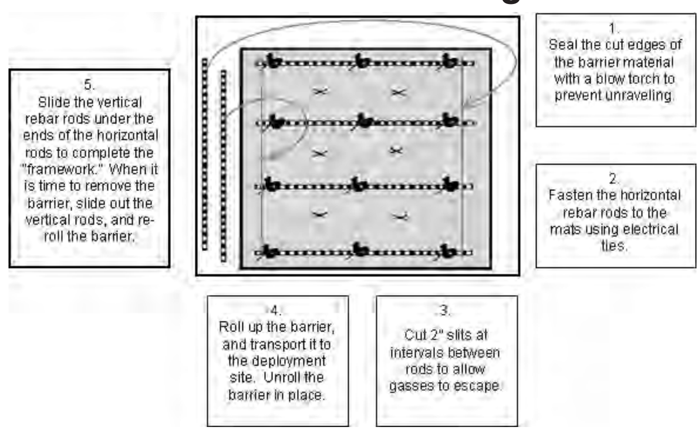


Diagram of a 10' X 12.5' benthic barrier designed by Jim Chandler, adapted from Maine Congress of Lakes Association's Winter 2006 Newsletter

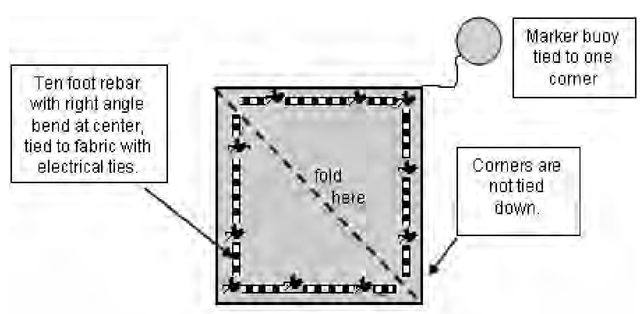


Diagram of a 5' X 5' "clamshell-style" benthic barrier designed by Trevor Tidd of Parker Pond/Pleasant Lake Association.

simply shifted underwater. (In some New England states, though not yet to our knowledge in Maine, non-removable barriers made out of non-synthetic, natural fibers such as burlap are installed and simply left in place to biodegrade.) Properly maintained reusable barriers may last for up to ten years, possibly longer, depending on the material composition, usage and maintenance.

Removable barriers installed during the growing season must be removed with in 60 days of installation. The only exception to this are barriers installed in late fall (when the 60 day time frame extends into the winter). Mats left overwinter must be removed from the lake or moved to a different site at the beginning of the following growing season.

Benthic barrier layering material costs vary in accordance with the type, quality and performance rating of the material. Massachusetts Department of Natural Resource Conservation provides a cost estimate of $0.22 cents to $1.25 per square foot, and a total cost per acre of $20,000 to $50,000. This cost does not include weights, barrier marking devices or any installation costs. New York State Department of Environmental Conservation estimates the additional cost of professional installation to be $10,000 to $20,000 per acre.

With the help of innovative, energetic and dedicated volunteers, lake groups in Maine are finding creative ways to minimize the costs typically associated with installing benthic barriers. Their work is also leading the way to more effective methods for controlling invasive aquatic plants moving forward. For a good example of this, please see the *Lily Brook Case Study* on page 12 of the Summer 2007issue of *The Water Column*.

Thanks to Laurie Callahan, Jim Chandler, and the DEP Invasive Aquatics Team for their contributions to this article.

On the Cutting Edge

One of the most recent innovations to come out of the quest for lowering the cost of benthic barriers is now being tested in Shagg Pond in Woodstock. In 2006, the Community Lakes Association control effort, under the direction of Jim Chandler, began experimenting with the use of 10' X 40' mats constructed of 6-mil polyethylene black-plastic sheeting with 3/8" rebar attached across the width every six or seven feet. Electrical ties are used to attach the rebar to the sheeting and clear duct tape is used to reinforce the holes for the ties. At the both ends of the mat, the sheeting is wrapped around the rebar several times, reinforced with clear duct tape and tied with five electrical ties. Rope "handles" are attached to both ends to make the mats easier to maneuver into place. A box cutter is used to make a line of five, evenly spaced 2-inch slits midway between each set of rebars. No side bars are used in this application, and each mat is overlapped about one-foot with the previous mat. The slippery nature of the polyethylene sheeting enhances gas escape along the sides of the mats.

According to Jim Chandler, the polyethylene mats are much lighter and more cost effective than those made out of more commonly-used materials. A 10' x 40' "poly" barrier is of comparable weight to a 10' X 12.5" mat constructed from geotextile. The cost of the poly barrier is about 10 cents per square foot for the sheeting and rebars (about $4000 per acre not including installation costs). Eliminating the side bars further lowers materials costs and reduces installation time.

Contstruction of a 6-mil polyethylene benthic barrier.

So far the results from this new benthic barrier have been quite good, particularly in deep water. The question remains, of course, of how well these mats will hold up over time. But in the meantime, those who are battling the invaders in Maine are not wasting any time wringing their hands. They need their hands for more important things!