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.

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.”

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...
Lakeshore Habitat Measures

The shallow area around a lake where water meets land is called the littoral zone, in direct contrast to the deeper, offshore limnetic zone of a lake. The relative condition of this watered shore land area, in terms of the presence or absence of human alterations, is a critical component of overall lake habitat for resident fish and associated aquatic organisms.

In the last (Winter) issue of the VLMP Newsletter, we presented an introductory article which spoke of natural conditions observed in remote lakes with minimal human perturbations. This second article will report on recent and past developed lake shore investigations in New England and elsewhere, while the third article (Fall 2007) will address the question posed by lake managers and researchers (Kirsten Ness 2006):

"Are shoreline protection regulations enough?"

The presence of high quality water in the littoral zone is important for maintaining lake biointegrity, as is the complex presence of natural structure, in terms of woody debris, rocks, and plants, above and below the lake water level. Historically, developers and lakeshore residents have typically modified both shoreline and inlake littoral zones for perceived recreational and aesthetic purposes. The human tendency to create and maintain uncluttered or "clean" man-icured lakeshores is not necessarily the best way to manage our aquatic natural resources. As we have seen, lakes with minimal shoreline development are generally characterized by large accumulations of large and small woody debris originating from fallen (dead) trees along the lake shore (see Photo's 1 and 2). This natural woody structure serves as a nutrient source and provides valuable overhead and in-lake habitat cover for a very diverse community of resident aquatic organisms, from invertebrates (insects, mollusks, crayfish) to minnows to trout (see Photo 3). relationships between the degree of development, in terms of shoreline disturbance and the number of shoreline resi-
dences, and the biointegrity or health of the aquatic community have been investigated in several recent published and unpublished studies - as reviewed and results summarized below:

Aaron Jabar (M.S. 2004, Michigan State University) "quantified the effects of residential lakeshore development (LSD) on littoral fishes and habitat" in south-eastern Michigan. He found that "extensive alterations to north temperate lakes due to LSD and associated activities have the potential to negatively affect habitat features in the littoral zone of lakes." He also recognized "the vulnerability of littoral fish species to effects of habitat loss given their use of near-shore habitat for nesting, foraging, and as refuge sites." Undeveloped lake sites had significantly greater abundance of coarse woody material and submerged macrophyte (rooted aquatic plants) cover compared to developed sites. According to Jabar, "littoral fish populations, though somewhat variable in their response, may also respond to LSD, demonstrating the importance of investigating the cumulative effects of LSD on lake ecosystems."

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appropriate. The exception to this is the mixed-vegetation stand where the sparsely distributed invasive plants persist despite repeat 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 draw-back 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, 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, cinder-blocks and rocks are all useful anchor- ing 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.

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 gases. Gas accumulation under the
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 integ-
rity of the mat.

Despite the best installation and
weighting, boat anchors, propellers,
swimmers or other localized activity
may disturb, damage, or dislocate ben-
thic barriers. Frequent (at least twice a
month) visual inspection and mainte-
nance 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 bil-
lowing 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 peri-
meters 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, barri-
ers must be constructed
in such a way that they
may be efficiently trans-
ported, generally by boat,
from shore to the desig-
nated location of deploy-
ment. Mats that have
been constructed and
packed (folded or rolled) for deploy-
ment on shore are loaded into boats
and transported out to the pre-deter-
mined 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 place-
ment, the team
may also include
additional divers and
weed handlers, fragment spotters,

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,
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.

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!