Aquatic Weed Management By Benthic Semi-Barriers

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ABSTRACT

Closely woven fiberglass screening material applied directly over rooted aquatic plants resulted in plant decomposition over a two to three week period to produce a weed-free envrionment. The screen also retarded the emergence and regrowth of aquatic weeds over long periods of time. No adverse ecological effects were observed.

INTRODUCTION

Among the many consequences of both cultural and natural eutrophication occurring on a worldwide scale in aquatic environments is the intensive and often extensive seasonal growth of rooted aquatic plants comprised of native and introduced species (Smith, *et al.,* 1967; Vollenweider, 1968; Mulligan, 1969). It is well known that widespread weed growth may seriously impair the multiple uses of surface waters including recreation, fishing, navigation, irrigation, and aesthetic values (Smith, *et. al.,* 1967; Mulligan, 1969).

As a result, several weed control strategies have been developed to manage or attempt to eradicate aquatic macrophytes. In general the strategies that are effective include mechanical weed harvesting, chemical herbicide treatment, dredging, drawdowns, bottom barriers, and biomanipulation techniques (Dunst, *et. al.*, 1974; Nichols, 1974; Newroth, 1975; Mayhew and Runkel, 1962).

The two most widely used methods, chemical weed treatment and mechanical weed harvesting, leave much to be desired. While herbicides may be effective in killing certain weed species, often only partial or temporary control is achieved and chemical herbicides must be reapplied. Repeated application of herbicides in the same body of water can bring about loss in competition among macrophytes and emergence of resistant weed species (Nicholson, 1973). In addition, herbicides can have detrimental impact on non-target aquatic biota such as fish and fish-food organisms, limit the recreational use of aquatic environments, degrade the drinking water quality of treated waters, and, as biocides, cause counterproductive ecological change (Smith and Isom, 1967; Nicholson, 1973; Schultz and Harman, 1974; Schultz and Whitney, 1974).

Weed harvesting, while regarded generally as a more desirable management technique than the use of herbicides, is primarily a cosmetic procedure and often fails to bring about lasting results. Harvesting is a costly method of weed control, being both capital and labor intensive (Cayuga County, N.Y., 1975).

The concept of covering the bottom of an aquatic environment to prevent weed growth is not new. For example, sand and gravel as well as polyethylene sheeting were used in Windfall Lake, Wisconsin to control lake weeds (Nichols, 1974). While this approach to weed control offered some promise, the use of sand and gravel created logistical problems and had limited effectiveness (Born, *et. al.*, 1973). Plastic sheeting, by its nature, alters the aquatic environment by creating a barrier to the exchange of dissolved nutrients and gases between benthic communities and the overlying water column.

The use of a benthic semi-barrier screen to control aquatic weeds has not been reported. In this paper a fiberglass semi-barrier is described which is effective in managing the growth of several species of aquatic weeds.

METHODS AND MATERIALS

Fiberglass screening materials of mesh sizes 9.9 apertures/cm^2 (64 apertures/in^2), 39 apertures/cm^2 (252 apertures/in^2), and 62 apertures/cm^2 (400 apertures/in^2) have been studied over the past four years, beginning in November 1973, as a means of controlling rooted aquatic plants in Chautauqua Lake, New York. This lake is a shallow, eutrophic body of water which produces a variety of intensive weed growth each summer and fall. Weed communities are dominated chiefly by water milfoil (*Myriophyllum exalbescens* Fernald) in the lake's northern basin and by curly leaf pondweed (*Potamogeton crispus* L.) in the southern basin. Other species that are prevalent were identified according to Fassett (1957) as eel grass (*Vallisneria americana* Michx.), waterweed (*Elodea canadensis* Michx.), and coontail (*Ceratophyllum demersum* L.). While these communities are limited to littoral waters up to about 3.7 meters (12.1 feet) deep, they frequently limit access to the lake for boating, swimming, and fishing.

The semi-barrier screen is a polyvinyl chloride coated fiberglass available as Aquascreen through Menardi-Southern Division of U. S. Filter Corporation. Screening with 39 apertures/cm^2 absorbs 40 percent of incident radiation at any wavelength within the visible spectrum while screening with 62 apertures/cm^2 absorbs 60 percent of incident visible light.

SCUBA divers placed experimental screens along littoral-area lake transects perpendicular to the shoreline of Chautauqua Lake in both the northern and southern basins. Numbered transects reflecting differing weed communities are identified in Table 1. Weeds along each transect were characterized by genus and species (Fassett, 1957), percent weed cover by visual observation, and seasonal variation. The screens were of three different mesh sizes: 9.9, 39, and 62 apertures/cm^2. They were placed directly over existing vegetation and fixed to the bottom initially using bricks but later by metal T-bars. While the semi-barrier tends to bulge somewhat when first placed over weeds, the covered vegetation decomposed within three weeks, allowing the screen to lie flat.

Observations of the response of aquatic weeds to the screen semi-barrier and related data acquisition were obtained at least monthly by SCUBA divers along established transects during ice-free lake conditions. Effectiveness of weed control by screens was determined by comparing percent weed cover above an experimental screen (E) with percent weed cover in an adjacent control area (C):

$$\text{Screen Effectiveness} = \frac{C - E}{C} \times 100\%$$

TABLE 1. 1976 SUMMARY OF ROOTED AQUATIC PLANT CHARACTERISTICS IN CHAUTAUQUA LAKE, NEW YORK IN UNTREATED CONTROL AREAS AND EXPERIMENTAL AREAS MANAGED WITH BENTHIC SEMI-BARRIER SCREENS. ABBREVATIONS: AP/CM^2, APERTURES PER SQUARE CENTIMETER; WM, WATER MILFOIL; CLP, CURLY LEAF PONDWEED; EG, ELL GRASS; W, WATERWEED.

Transect	Depth (m)	Macrophyte Community Structure[1]	Screen Area (m^2)	Screen Mesh (ap/cm^2)	Date Deployed	Screen Effectiveness[2]
1	1.8	wm, w	2.2	39	11/19/73	60%
2	1.2	wm	4.2	39	11/19/73	40%
3	1.2	wm, clp	6.5	62	11/2/74	95%
4	1.2	wm, clp	6.5	62	11/2/74	85%
5	1.2	wm	1.7	9.9	9/11/15	20%
6	0.8	wm, eg, w	10.4	62	6/12/76	95%
7	1.1	eg, clp	19.5	62	9/11/75	95%

[1] Predominant weed species during the period 6/15/76-9/15/76.
[2] Screen Effectiveness = [(C − E) ÷ C] x 100% where C = percent weed cover in control areas, and E = percent weed cover in experimental areas.

RESULTS AND DISCUSSION

The three different semi-barrier screens used in these experiments achieved varying degrees of weed control. In general, screens having 39 and 62 apertures/cm^2 brought about complete decomposition of above-ground rooted aquatic plants beneath the screen in about two to three weeks. Decomposition of different weed species occurred at the same rate. During this period SCUBA surveillance revealed that vegetation under screens gradually turned black and decomposed to yield a totally weed-free environment. Screens of larger mesh size, specifically 9.9 apertures/cm^2, failed to produce a similar result during the initial three-week period.

In the months following screen deployment, varying degrees of successful weed management were observed. The overall results for screens of different mesh sizes placed over different weed communities for various periods of time are given in Table 1. Clearly, the best results were achieved with the most closely woven semi-barrier. These screens were able to bring about and sustain a minimum of 95 percent control of aquatic weeds irrespective of weed species or underwater depth. Interestingly, the 5 percent of weed regrowth which did occur was limited to dwarf plants whose rootlets were constricted by the aperture size of the semi-barrier. For example, water milfoil in control areas along transect 3 averaged 1.2 meters in length in September 1976 while milfoil that had emerged through a 62 aperture/cm^2 screen adjacent to this area averaged only 7.6 cm in length.

Screens of mesh size 39 apertures/cm^2, while capable of reducing weeds within a three-week period, were not able to sustain high levels of weed control during a one-year period, especially in shallow areas of less than 1.2 meters depth. Furthermore, regrowth was not limited to dwarf plants as was the case for 62 aperture/cm^2 screens. At greater depths, however, specifically 1.8 meters, a significant degree of weed control was sustained (60%) by 39 aperture/cm^2 screens, apparently due to the combined effect of light absorption by the screen and light absorption by the water column above the screen.

In addition to limited emergence of macrophytes through semi-barrier screens, seed germination and regrowth was also observed to take place when and if significant sedimentation took place on top of screens. Generally, this occurred two to three years after a screen was deployed. In several cases, especially near shore, no sediment accumulated on screens and this problem was not encountered. Where sedimentation was a problem, it was found that by removing a screen annually (in the fall) and repositioning it in the spring, very high levels of weed control (95%) were achieved year to year.

Dissolved oxygen levels, determined monthly in the water column above experimental screens, were never less than that measured at similar depths in control areas adjacent to screens. Frequently, screens were covered with benthic fauna, especially fish food organisms, as well as attached algae. Fish were often observed directly above the screens. Indeed, no observation was made during these studies to suggest that the semi-barier caused any ecological stress other than to rooted aquatic vegetation.

In summary, fiberglass semi-barrier screens, particularly screens of mesh size 62 apertures/cm^2, have been found to be an effective means of aquatic weed management. These screens, which apparently can retain their structural integrity for long periods of time under water, completely eliminate rooted aquatic plants within a three-week period and limit further regrowth of weeds to about five percent of normal weed cover. Weeds emergent through the screen are restricted in growth to dwarf plants. The semi-barrier appears to be an ecologically desirable approach to weed management well suited to selective weed control as opposed to wide-scale weed eradication.

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