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Control of the Seagrass *Heterozostera tasmanica* by Benthic Screens

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ABSTRACT

Benthic screens were tested for their effectiveness in eliminating the seagrass, *Heterozostera tasmanica* (Martens ex Aschers.) den Hartog in Corio Bay, Victoria, Australia. Three types of screen (clear, mesh and black) measuring 2 x 2m were placed in triplicate over stands of the seagrass. *H. tasmanica* died within 1 month under black screens and within 3 months under clear and mesh screens. Control was achieved as a result of reduced light intensity rather than the result of contact with the sediment. The placement of opaque benthic screens is a potential method for controlling seagrasses in circumscribed areas.

Key words: marine, macrophyte, sediment, Australia, plastic, oxygen.

INTRODUCTION

Seagrasses have many beneficial functions in coastal ecosystems (11), but extensive stands of seagrass may restrict recreational activities such as swimming and boating. Control of seagrasses, therefore, is desirable in circumscribed areas. Herbicides have been tested in the control of the seagrass *Zostera marina* (9, 12), but there is widespread opposition to the use of herbicides because of their potential impact on nontarget organisms. Dredging or digging has been effective when the bottom was dredged lower than the compensation depth for seagrasses (4, 10), but was less effective when only 5 to 10 cm of surficial sediment was removed (12, Bulthuis and Collett, unpublished data).

Benthic screens have been tested for the control of submersed freshwater angiosperms. It has been reported that the screens effectively reduce plant densities (5, 6), have little or no effect on the animal community (other than that caused by loss of plants) (5), have few adverse effects on the water column (1), require very little maintenance and are reuseable (5, 6). Mayer (5) suggested that the effectiveness of the screens may be due to a reduction in light available for photosynthesis while Perkins *et al.* (6) suggest that sediment contact is the control mechanism.

The objectives of the present study have been to determine the effectiveness of bottom screens in controlling the seagrass *Heterozostera tasmanica* (Martens ex Ashers.) den Hartog, in Corio Bay, Victoria, Australia, and to indicate whether the mechanism of control is a reduction in light or contact with the sediment.

MATERIALS AND METHODS

Three types of benthic screens were used: (1) black and (2) clear solid plastic (200 μm, polyvinyl chloride) and (3) plastic mesh screen (Nylex 70—marketed for shading in greenhouses, polyvinyl chloride mesh, 30% open area). These were cut into 2 x 2m square sheets and a chain was attached to the screen perimeter. Screens were anchored to the bottom at each corner with 300 mm tent pegs. Nine screens, three of each type, were placed contiguously in a mixed pattern at the experimental site on 2 October 1980 (spring) and removed 5 January 1981 (summer). The site was located in Corio Bay, 200 to 300 m east of the Geelong Eastern Beach swimming enclosure where nuisance growths of *Heterozostera tasmanica* occur. Water depth was 2 m at mean water and tidal amplitude is 1 m during spring tides. Control measurements were made in plots contiguous to

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the experimental plots. Density of *H. tasmanica* was determined monthly for 4 months by lifting each screen, counting stems and leaf clusters in three randomly chosen 20 x 20 cm quadrats, and replacing screens. Density of *H. tasmanica* was measured also in December 1981, 11 months after removal of the screens. Irradiance from 400 to 700nm was measured under each screen and at the same depth outside of the screen with a Lambda Li-192S quantum sensor. Duplicate water samples for dissolved oxygen determination were taken with Scuba by placing the end of a tube under the screen near the centre of each plot and pumping at least 3 times the sample volume through a 300-ml sample bottle. Dissolved oxygen was determined by the Winkler method (8).

The density and dissolved oxygen data from each treatment were compared by one-way analysis of variance. When this analysis was significant ($P<0.05$) the means which were significantly different from each other were determined by the Student-Newman-Keuls multiple comparison test (7).

RESULTS AND DISCUSSION

One month after placement of the benthic screens, all *Heterozostera tasmanica* shoots under the black screens had died (Table 1). Density under the clear and mesh screens was similar to the control areas. During the following two months, the number of shoots under clear and mesh screens also decreased to essentially zero. Thus, within 3 months, *H. tasmanica* was eliminated from all treatment plots.

Freshwater angiosperms have been controlled by the placement of bottom screens (5, 6) and the present study shows that the seagrass, *H. tasmanica*, can be controlled similarly. Perkins *et al.* (6) suggested an application time of two months for control of *Myriophyllum spicatum*. Mayer (5) reported that four species of freshwater angiosperms were eliminated within three weeks of screen placement. In the present study *H. tasmanica* was eliminated within one month by solid black screens and within three months by mesh and clear screens during spring and early summer.

Light levels under the benthic screens were initially distinct among treatments: 88% (s.e. = 7.2, n = 3) of radiance was transmitted through the clear screens, 28% (s.e. = 0.9) through the mesh screens and no measurable light under the black screens. During the course of the study, however, sediment settled on all the screens so that in December 1980, 2 months after placement of the screens, the clear and mesh screens transmitted only 12% (s.e. = 10.9) and 6% (s.e. = 3.6) of the light. Three months after placement of the screens there was no measurable light under any screen. The plants beneath the clear and mesh screens thus experienced declining light levels during the course of the study.

Dissolved oxygen levels, 1 month after screen placement, were significantly ($P<0.05$) lower under the solid screens, clear (3.2 ± 0.5 mg l^{-1}, $\bar{x}\pm$s.e.) and black (2.2 ± 0.52), than under the mesh screen (5.5 ± 0.19). After 2 months, oxygen levels were similar under all screens. There was no indication that the water became anaerobic under any of the screens during the course of the study. Under all screens, the surface of the sediments was always light coloured and appeared oxidised.

Of the factors tested in the present study the effectiveness of the screens is attributable to a reduction in light reaching the seagrass and not to contact with the bottom sediment. This is particularly evident in comparing the effect of the clear and black screens. Both of these types of benthic screens were made of similar material and thickness and equally would have compressed the plants onto the sediment. However, after one month all *H. tasmanica* under the black screens had died while the density of *H. tasmanica* under clear screens was similar to control plots (Table 1).

Because accumulation of sediment made all screens opaque after 3 months, the later effectiveness of the clear and mesh screens seemed to be due mainly to the progressive light reduction. Thus all screen types were effective in controlling *H. tasmanica* because the accumulated sediment eventually made all treatments alike (an opaque screen). The importance of light rather than contact with the sediments as the mechanism of control of *H. tasmanica* also is indicated by Bulthuis (2). In that study, when light was reduced to 4.5% or less of surface intensity, intertidal *H. tasmanica* in Western Port, Victoria, was eliminated from treatment plots even though mesh screens were positioned 10cm above the sediment to allow water flow beneath the screens (2).

In the present study, bottom screens were placed on the seagrass during spring. *H. tasmanica* may be more sensitive to changes in the light level at other times of the year. In intertidal areas of Western Port, *H. tasmanica* shoot density declined quicker under irradiance reduction during summer than during winter (2). This may be due to the higher light compensation point of *H. tasmanica* at summer temperatures than at winter temperatures (3). Thus, more effective control of *H. tasmanica* may be achieved during the warmer summer months.

Eleven months after the screens were removed, the density of *H. tasmanica* in the treated area was 207 leaf clusters per m² (s.e. = 6; n = 9) compared to 720 (s.e. = 111) in the control area. The rate of recolonization of any treated area by *H. tasmanica* would depend, in part, on the size of the treated area, the proximity of other *H. tasmanica* beds, and the nature of any changes in the substrate following removal of the seagrass. In the present study, regrowth occurred mainly by rhizome extension of *H. tasmanica* plants at the plot edge.

TABLE 1. DENSITY OF *Heterozostera Tasmanica* FOR THREE MONTHS FOLLOWING PLACEMENT OF THREE TYPES OF BENTHIC SCREENS ON 2 OCTOBER 1980.

	Months			
Screen Type	0	1	2	3
Control	310[1]	$380^a\pm97$[2]	$850^a\pm13$	$500^a\pm102$
Clear		$555^a\pm115$	$240^b\pm40$	$6^b\pm6$
Mesh		$550^a\pm191$	$110^b\pm55$	$8^b\pm5$
Black		0 ± 0	0 ± 0	n.d.[3]

[1]Mean number of leaf clusters m^{-2} ± 1 S.E. (n = 3 plots).
[2]Means within each month not significantly ($P>0.05$) different from each other by the Student-Newman-Keuls multiple comparison test have the same superscript letter.
[3]Not determined.

A second seagrass, *Halophila ovalis* (R. Br.) Hook. *f.*, had a patchy distribution in the experimental area so that treatments did not begin with similar densities of *H. ovalis*. Nevertheless *H. ovalis* occurred under some of the clear and mesh screens after all *Heterozostera tasmanica* shoots had died. Thus, the minimum light requirement of *H. ovalis* may be less than that of *H. tasmanica*. In support of this hypothesis, *H. ovalis* is generally distributed at greater depths than *H. tasmanica* in Corio Bay.

The present study has demonstrated that the placement of bottom screens is a potential method of controlling *H. tasmanica* in circumscribed areas. A treatment time of one to two months during spring with an opaque screen may be expected to provide control over the summer period. The effectiveness of the screens appears to be due to a reduction in irradiance to the seagrass beneath the screens and not due to plant contact with the sediments.

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