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Effect of Hydrilla Management By Herbicides on A Periphyton Community[1]

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ABSTRACT

Chlorophyll *a*, cell numbers, and biovolumes were determined for the algae of the periphyton community of hydrilla (*Hydrilla verticillata* (L.f.) Caspary) infested Lake Pearl, Orange County, Florida, during the summer of 1980. Portions of one half of the lake (experimental data) were treated four times with herbicides to maintain recreational use of the north end of the lake. Periphyton chlorophyll *a* and biovolume increased, and hydrilla was reduced, following treatments 1 and 2. Treatment 3 was less effective at reducing hydrilla; but an increase in the periphyton community occurred. Treatment 4 was followed by an increase in periphyton; however, variation within experimental samples was so great that this increase cannot be considered significant.

INTRODUCTION

In Florida, aquatic weeds are a significant economic problem, blocking water flow required for irrigation and flood control, and limiting the use of water bodies for both recreational and commercial purposes. Consequently, there is a large continuous control effort throughout much of the state. Despite increasing use of biological and mechanical control, the use of chemical herbicides dominate this effort. Especially difficult to control are the exotic submergent weeds, such as hydrilla (*Hydrilla verticillata* (L.f.) Caspary) (3). Published research has examined the effects of herbicides on hydrilla; but relatively little information is available on the effects of herbicides on other primary producers in the ecosystem.

Hestand and Carter (4) and Carter and Hestand (1) tested the effects of herbicides and the herbivorous grass carp (*Ctenopharyngodon idella*) on phytoplankton and macrophyte communities. They observed greater densities of planktonic algal cells in herbicide pools than in control or grass carp pools. Several studies have examined the relationship between macrophytes and phytoplankton (2, 5) and between macrophytes and periphyton (6, 7) under varying conditions. The objective of the current study was to assess the effect of herbicide treatment of hydrilla on the associated periphyton community.

METHODS AND MATERIALS

Lake Pearl, Orange County, Florida is 32.5 ha in area and has an average depth of 2.5 m (maximum depth 7 m). Hydrilla is the dominant submersed plant, occupying 74% of the lake volume prior to herbicide treatment, and constituting greater than 99% by weight of submersed vegetation. In the spring of 1980, glass slide periphyton samplers were placed at stations scattered throughout Lake Pearl. One half of the lake had been designated "experimental" and was to be treated with herbicides; the other half had been designated "control". Every 2 weeks, slides were removed from the samplers, placed on ice, and returned to the laboratory. From each station, one pair of slides was examined for identification and enumeration of cells; the other six slides were used in pairs for chlorophyll *a* analysis. Counted slides were examined at 400X; all organisms were identified in 15 or more microscope fields. Measurements were taken to establish average sizes for each species, for later determination of biovolumes using nearest geometrical shape formulae (W. Taylor and E. Willen, personal communications). Slides for chlorophyll *a* analyses were arranged in pairs in Coplin jars with 60 ml of 90% acetone, then were sonicated for 1.0 minute (80% power on a Fisher Sonic dismembrator, model 300). After incubation overnight in a freezer in the dark, the supernatant was centrifuged and examined spectrophotometrically (9). A few direct counts of periphyton on the surface of the hydrilla leaves showed the same species in approximately the same ratios as were on the periphyton samplers. However, due to the extensive and locally unpredictable damage to host plants by the experimental treatment with herbicides, direct counting of the periphyton on hydrilla was not useful for interpreting the effects of the herbicides.

The areas treated and the chemicals applied to the hydrilla in the north half of the lake are listed in Table 1. The purpose of using various chemicals was to determine which ones were most effective, while at the same time maintaining the treated part of the lake as weed free as possible.

RESULTS AND DISCUSSION

Changes in the periphyton community following herbicide treatments in the summer of 1980 are indicated in

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Table 1. Summary of herbicide treatments used to control hydrilla in the north end of Lake Pearl during the summer of 1980.

Date	Herbicide[1]	Rate (kg/ha)	Area treated (ha)
3-26-80	Diquat & Copper	4.8 & 1.5	2.8
6-11-80	Diquat & Copper	4.5 & 3.6	1.0
	Endothall	34.7	3.2
7-6-80	Diquat & Copper	4.3 & 3.6	0.8
	Endothall & Copper	25.2 & 1.8	0.8
9-17-80	Diquat & Copper	4.5 & 3.6	0.8

[1]Diquat concentration is expressed as kg cation per hectare, copper is expressed as elemental copper from a chelated liquid formulation, and endothall is based on an acid equivalent basis.

Figures 1, 2, and 3. As shown by changes in chlorophyll *a*, peaks in periphyton biomass followed the first and second herbicide treatments (Figure 1). Those two treatments effectively controlled the hydrilla. The third treatment had little effect on the hydrilla; however, an increase in periphyton chlorophyll *a* was observed. The fourth treatment also controlled the hydrilla, but increases in periphyton were not significant.

Biovolumes (Figure 2) and cell numbers (Figure 3) are included here for completeness. The variability of the biovolume data makes it of dubious value for interpreting subtle changes due to treatment. Cell numbers are misleading because of great differences in the size of the cells counted. Biomass in March through May consisted primarily of large-celled filamentous green algae such as *Oedogonium* spp., *Mougeotia* spp., and *Spirogyra* spp. Later pulses in biomass consisted of populations of small forms, such as the pennate diatom *Achnanthes linearis* (W. Sm.) Grun, small blue-green filaments of *Lyngbya* sp., and green palmelloid forms including *Chlamydomonas* spp. and *Askenasyella* sp.

These results show that when hydrilla is controlled by herbicides, a periphyton bloom occurs. However, treating one end of a lake with herbicides changes many things which may affect algal growth: (1) nutrient content, through breakdown of the herbicide and the macrophytes, (2) bacterial populations, (3) circulation patterns within the lake, and (4) local fish behavior, etc. This empirical

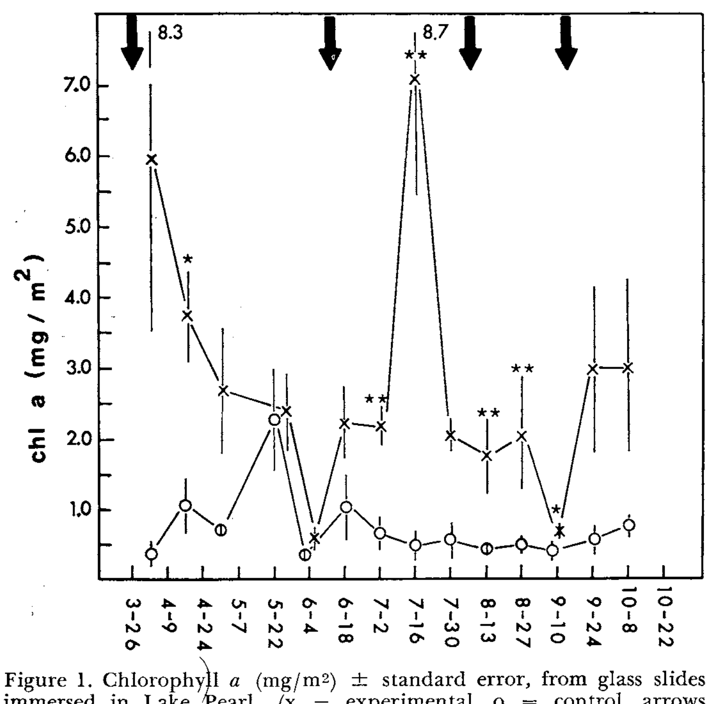

Figure 1. Chlorophyll *a* (mg/m^2) ± standard error, from glass slides immersed in Lake Pearl. (x = experimental, o = control, arrows indicate dates of herbicide treatments, * = experimental values significantly different from control values at the .05 level, ** = different at the .01 level).

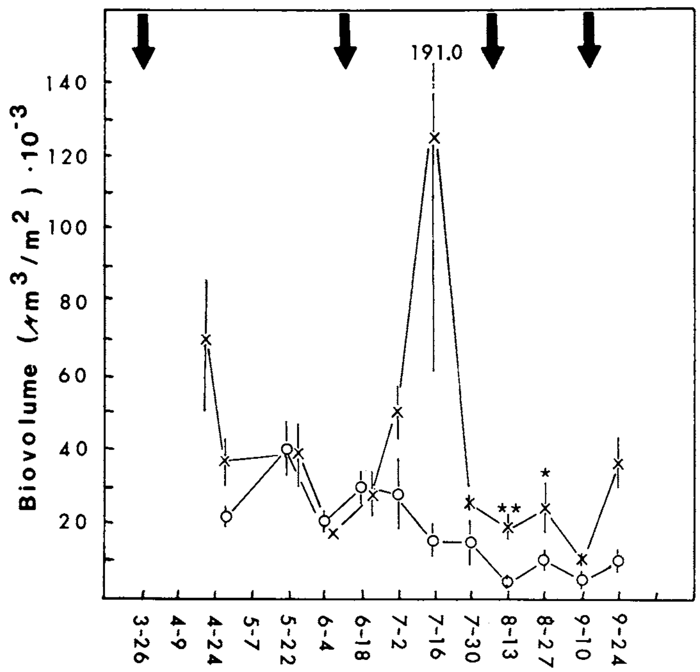

Figure 2. Biovolume (m^3/m^2) estimates ± standard error, derived from cell counts and measurements on glass slides immersed in Lake Pearl. (Data presented as in Figure 1.)

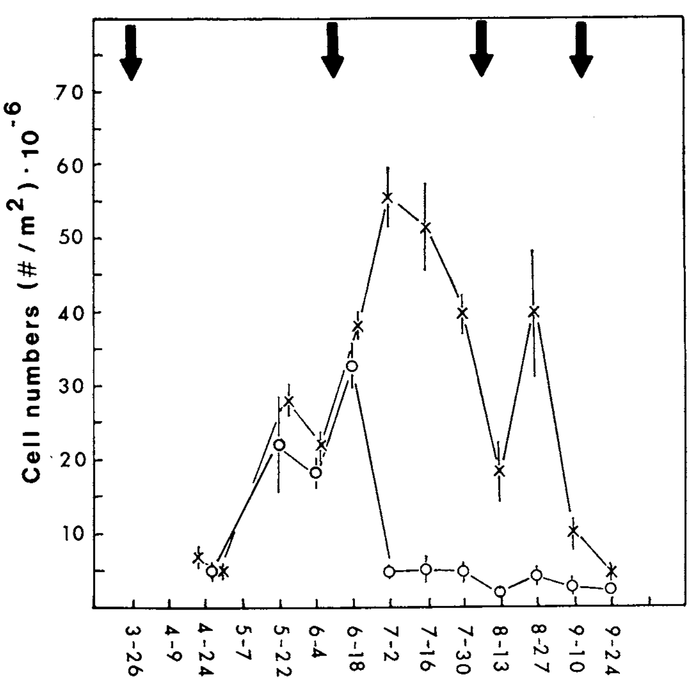

Figure 3. Cell numbers ± standard error, from cell counts on glass slides immersed in Lake Pearl. (Data presented as in Figure 1.)

result, however, gives little indication of the cause of the periphyton bloom. In this experiment, herbicide treatments were not sufficiently separated in time to allow experimental values to return to control levels between treatments. Our data are not yet detailed enough to assess the effect of herbicide treatment upon the primary producer communities as a whole. From our study and that of Hestand and Carter (4), it is apparent that the algal components of the system increase when macrophytes are reduced by herbicide treatments. Follow-up experiments in small 10 foot diameter pools confirm that increases in both phytoplanktonic and periphytic algal communities follow treatment with herbicides (Hodgson, unpublished data). It might be hypothesized, then, that the total biomass of all primary producers in the system is changing very little when one component (here, macrophytes) is removed.

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