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EDITORIAL

By

William Maier

Was it really the weed-eating fish or was it the growth and development of a true profession and extensive use of our fresh water resources? Whatever the cause, the recommendations of the American Assembly Conference clearly call for more responsiveness on the part of state government. The final report strongly recommends the establishment of an advisory council, stating that it was vital for various disciplines to have input into the decisions of the lead agency.

The Legislature undoubtedly will address this report, and some changes seem certain. Dr. Arnett Mace has prepared a summary of the final report which is included in this issue.

This volume of "Aquatics" signifies our first anniversary. The publication has received tremendous praise from our readers as well as some criticisms. I would like to thank personally the numerous people who have assisted in putting this publication together, particularly Ed Menninger, Jr., of Southeastern Printing Co. and all our advertisers who totally support the cost of "Aquatics."

In order to continue this magazine, it will require each and everyone of us to encourage the industries we work with to advertise in "Aquatics."

The "Aqua-vine" will be a new addition to our next issue. Industrial and governmental points of interest, abstracts of reports, news releases and insight will comprise this section. Anyone interested in including information in "Aquatics" is encouraged to do so.

The Florida Aquatic Plant Management Society, Inc., has not tested any of the products advertised in this publication nor has it verified any of the statements made in any of the advertisements. The Society does not warrant, expressly or implied, the fitness of any product advertised or the suitability of any advice or statements contained herein.

LITERATURE CITED for "Use of Aquashade" Story which starts on Page 14.

1. Bowes, G., A. S. Holaday, and W. T. Haller. 1979. Seasonal variation in the biomass, tuber density, and photosynthetic metabolism of hydrilla in three Florida lakes. *J. Aquat. Plant Manage.* 17:61-65.
2. Bowes, G., T. K. Van, L. A. Garrard and W. T. Haller. 1977. Adaptation to low light levels by hydrilla. *J. Aquat. Plant Manage.* 15:32-35.
3. Buglewicz, E. G. 1972. The impact of reduced light penetration on a eutrophic farm pond. Masters thesis, University of Nebraska. 97 p.
4. Eicher, G. 1947. Aniline dye in aquatic weed control. *J. Wildlife Manage.* 11:193-197.
5. Haller, W. T. 1976. Hydrilla, a new and rapidly spreading aquatic weed problem. Circular S-245, IFAS, University of Florida. 13 p.
6. Haller, W. T., J. L. Miller, and L. A. Garrard. 1976. Seasonal production and germination of hydrilla vegetative propagules. *Hyacinth Contr. J.* 14:26-29.
7. Haller, W. T. and D. L. Sutton. 1975. Community structure and competition between Hydrilla and Vallisneria. *Hyacinth Contr. J.* 13:48-50.
8. Hartung, R. L. 1972. A laboratory assessment of growth retardation on *Microcystis aeruginosa*, *Anabaena flos-aquae*, and *Selenastrum capricornutum* utilizing twelve selected dyes. Masters thesis, University of Nebraska. 241 p.
9. Johnson, B. and J. Manning. 1974. Hydrilla, the most serious threat to Louisiana's water resources. *Louisiana Conservationist*, 26:26-29.
10. Lovejoy, W. H. 1928. Algae control by creating turbidity at Louisville, Ky. *Engr. News-Record*. 101:505-507.
11. Mackenzie, J. W. and L. Hall. 1967. Elodea control in Southeast Florida with Diquat. *Hyacinth Contr. J.* 6:37-44.
12. Mahler, M. J. 1979. Hydrilla, the number one problem. *Aquatics*. 1:5-6.
13. Mayhew, J. K. and S. T. Runkel. 1962. The control of nuisance aquatic vegetation with black polyethylene plastic. *Iowa Acad. of Sci. J.* 69:302-307.
14. Miller, J. L., L. A. Garrard, and W. T. Haller. 1976. Some characteristics of hydrilla tubers taken from Lake Ocklawaha during drawdown. *Hyacinth Contr. J.* 14:29-31.
15. Steward, K. K. 1969. Effects of growth regulators and herbicides on germination of *Hydrilla turions*. *Weed Sci.* 17:299-301.
16. Steward, K. K. and T. D. Center. 1979. Evaluation of Metham for control of hydrilla regrowth from tubers. *J. Aquat. Plant Manage.* 17:76-77.
17. Van, T. K., W. T. Haller, and L. A. Garrard. 1978. The effect of daylength and temperature on hydrilla growth and tuber production. *J. Aquat. Plant Manage.* 16:57-59.

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COVER

Aquatic plant control operations require specialized equipment and safety gear. This photo was taken on lake Okeechobee of a South Florida Water Management crew during a hydrilla control application. (Photo by Bill Maier.)

CONTENTS

Algae Blooms	5
Aquatic Vegetation Sampling In Lake Conway	7
American Assembly Conference Recommends Major Changes	10
Third Annual FAPMS Meeting	12
The Use of Aquashade	14

CALENDAR NOTES

- Jan. 4 FAPMS board meeting, Tallahassee
Jan. 15-17 Southern Weed Science Society meeting at
Arlington Hotel, Hot Springs, Ark.

PEOPLE ON THE MOVE

Paul King, after 16 years with the Florida Game and Fresh Water Fish Commission, has accepted a position with Crescent K Ranch in Georgia. We wish Paul and his wife, Shirley, success in their new endeavor.

George Whortley has accepted a promotion with Nalco and has been transferred to Texas. **Don Widmann**, formerly with the GFC, has replaced George as the Florida representative with Nalco. **Lowell Trent** has been promoted to regional botanist to fill the GFC vacancy. **Joe Joyce** has been granted a leave of absence from the U.S. Army Corps of Engineers to further his education. Joyce is conducting his graduate work in Gainesville under supervision of Dr. William Haller.

Robert Lennerty has accepted a new position with the Department of Agriculture in Consumers Services in Jacksonville. Bob had served as the administrator of pesticide registrations; this position is now vacant.



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ALGAE BLOOMS

By
Carl Joe Hinkle

Algae occupy an irreplaceable portion of the environment, being responsible for ninety percent of photosynthesis on earth. Problems associated with excessive algae growth have been around since medieval times, but are accelerating in many areas as the result of the increased demand placed upon aquatic systems by high population densities and intensive agricultural practices.

Expanding urbanization, water stabilization, and decreased frequency of lake fluctuation from tropical storms have increased the nutrient loads in many of Florida's lakes to levels which have favored the growth of introduced species and algae over our native vascular flora. This basic change in the food chain affects the system all the way up to Florida's top carnivore, the largemouth bass.

The major environmental conditions in Florida which are favorable for algae blooms include high water temperatures, extended day length, shallow bodies of water, a good carbonate supply in most waters, and excessive nutrient levels (especially nitrogen and phosphorus).

A specific biological definition of a "bloom" is a population of algae which exceeds 500,000 organisms per liter, however, a population exceeding this level is not necessarily considered a problem by the public. Algae become a problem when they interfere with fishing, create stress in fish from daily oscillation of oxygen levels, or impart an unpleasant color or odor to the water.

In extension work, the most common algae classifications include:

- "moss" — an algae attached to the bottom
- "scum" — floating mats of algae
- "skunk grass" or "mush grass" — Chara
- "angel's hair" — a filamentous algae
- "slime" — a filamentous algae with a musilaginous texture such as members of the group Spirogyra.

The more classical nomenclature divides algae into seven major groups which contain approximately 32,000 different species. The majority of algae species responsible for blooms can be narrowed down to approximately 50 species of one of the

three following groups: the blue-greens, greens, or dinoflagellates (group responsible for the red tide).

The most primitive algae group, the blue-greens, are responsible for the largest number of troublesome blooms. Members of this group are not always blue-green in color; some members are capable of changing their color dependent on the wavelength of light present.

Approximately 20 species of the following genera have members which are capable of producing blooms if conditions are favorable: Aphanizomenon, Anabaena, Microcystis, Merismopedia, Oscillatoria, Gloeotrichia, Coelosphaerium, Nostoc, Nodularia, Synechococcus, and Spirulina.

The majority of deep water blue-green blooms are made of the genus Oscillatoria which usually floats to the surface in layered mats when it begins dying. Surface blooms are usually dominated by Microcystis, Anabaena, or Aphanizomenon.

Specific members of the genus Aphanizomenon, Anabaena, Coelosphaerium, Microcystis, Nostoc, Nodularia, and Gloeotrichia are capable of producing toxins which are directly toxic to fish, birds and mammals. Fortunately, it is relatively uncommon to find population numbers which produce the toxin in high enough concentration to cause a direct kill.

The blue-greens are also capable of producing inhibitor substances which inhibit the growth of other algae, higher vascular plants, and in some cases the toxin reaches a concentration which inhibits the algae producing it.

Members of the genera Anabaena, Aphanizomenon, Gloeotrichia, Nostoc, Calothrix, and Tolypothrix also have a competitive advantage over other groups in that they have the capability to fix nitrogen directly from the atmosphere.

Some of the blue-greens which are normally good indicators of pollution and eutrophication include *Aphanizomenon gracile*, *Oscillatoria redekei*, *Oscillatoria rubescens*, *Aphanizomenon flos-aquae*, and *Anabaena flos-aquae*.

GREEN ALGAE

The green algae are composed of plankton forms, filamentous forms and those which resemble higher vascular forms. Several genera of green algae cause blooms, but these are not usually as harmful as blue-

green blooms. Common genera of bloom forming species include Spirogyra, Oedogonium, Pithophora, Cladophora, Hydrodictyon, Rhizoclonium, Zygnema, and Chlamydomonas.

Many filamentous green algae grow on the bottom. One of these, Spirogyra, forms a slimy bloom, and although not aesthetically pleasing, is utilized by waterfowl and is preferred food of deer.

Spirogyra communis is common in organic polluted water. Chlamydomonas, Carteria, and several species of Scendesmus are favored by organically polluted waters.

Some green algae clean water indicators include *Phacus*, *Staurastrum punctulatum*, *Euastrum oblongum*, and *Ankistrodesmus falcatus*. *Volvox aureus*, *Eudorina elegans*, and *Pandorina morum* give a fishy smell to water when they occur in high populations.

Chara and Nitella which resemble higher vascular plants, are one of the few groups which can be identified without the aid of a microscope. Chara normally has a musky odor, preferring hard water lakes and springs, whereas Nitella is normally found in soft water areas.

DINOFLLAGELLATES

The dinoflagellate group includes the genera that are responsible for the red tide, Glenodinium and Gymnodinium. Occasional fresh water genera such as Ceratium and Peridinium become overly abundant.

In my past five year's experience with extension work, only one algae bloom complaint was the result of this group.

ENVIRONMENTAL INFLUENCE

A great number of factors affect the abundance and distribution of algae, many of which are still unknown. Some of the known factors which influence the growth of a bloom are season, temperature, oxygen, pH, phosphorus, nitrogen, turbidity, and alkalinity.

SEASON AND TEMPERATURE

The planktonic green and dinoflagellates usually achieve their maximum concentration and photosynthetic rate in spring or early summer and in fall. The blue-greens achieve maximum concentration and photosynthetic rates in warmer temperatures of mid to late summer. In general, the blue-green algae have a higher photosynthetic rate than the other algae groups.

pH

The blue-green algae favor neutral to slightly basic waters. They are almost never found at a pH of below 4. The green algae usually grow best at pH around neutral and die at pH's below 4 and above 9. Slightly alkaline waters favor species of Euglenophyta such as Phacus, Trachelomonas, and Euglena. In general, slightly acid water, pH of 4.0 to 6.5 gives a richer number of species, whereas slightly alkaline water gives smaller numbers of species, but with a greater abundance of those present.

ALKALINITY

In general, blooms of blue-green usually occur at an alkalinity of 50 to 100 ppm CaCO_3 . Dinoflagellates have highest photosynthesis at less than 50 ppm and around 175 ppm, and the green algae have a high photosynthetic rate at 50 ppm or below.

PHOSPHORUS AND NITROGEN

Algae have the capability of storing up large amounts of nitrogen and phosphorus in very short periods of time which can then be used later when supplies in the water might become limiting. Blooms of

algae can remove a great deal of nitrogen and phosphorus from the water in a short period of time. Very high concentrations of nitrogen (such as sewage lagoons) tend to inhibit the blue-greens and favor the green algae.

Nitrogen and phosphorus levels in part regulate the distribution of vegetation types with high levels favoring phytoplankton, low levels favoring vascular plants, and intermediate levels favoring filamentous algae growth. High yields of vascular plants do not normally coincide with high growths of phytoplankton. One exception to this rule was observed in the summer of 1977 when Orange Lake supported 10,000 acres of Hydrilla and a heavy blue-green algae bloom at the same time.

CONTROL MEASURES

At present, algae control measures are almost exclusively limited to herbicide control. Basic active ingredients of these various commercial herbicides include diuron, sismazine, copper sulfate, and endothall.

Copper sulfate (including various formulations) is used in more instances than any other herbicide for algae control, especially in rural

areas. This herbicide is readily available, has a low toxicity to applicators, and provides consistent results. Disadvantages include corrosiveness to metal and direct toxicity to fish at high rates. Pellet formulation and crystal of copper sulfate are best utilized for controlling attached filamentous blooms, while liquids are best suited for controlling planktonic blooms. During the high water temperatures of summer, copper sulfate is probably the best tool for obtaining partial control of the algae population in anticipation of preventing a fish kill. Chelated formulations should be utilized in hard water lakes to increase the duration of control.

Sismazine and diuron are very effective as algicides at low levels, are less expensive than copper sulfate under most circumstances, and provide control of up to a year in length. These products are effective in soft water, hard water, and brackish water. Disadvantages of these herbicides include persistence, restrictions on irrigation and livestock, damage to trees, and possible damage to the food chain supporting fish production with continual usage.

Spray application of these herbicides in many cases provides up to a year's control in north Florida. Summer applications of these products are not normally recommended because in most instances results are immediate, complete algae control, and a fish kill as a result of low dissolved oxygen.

In extension work, endothall products are not normally recommended because of the hazards involved in their application and not being readily available in most rural areas.

When appropriate, a fertilization program can provide a farm pond owner with a means of maintaining a good planktonic bloom for fish production while discouraging filamentous algae, which interferes with fishing. To be successful, this program must be conducted periodically in order to promote beneficial densities of phytoplankton.

FISH KILLS ASSOCIATED WITH ALGAE BLOOMS

Under specific environmental conditions, one or two species can dominate the phytoplankton community of the lake. The majority of these bloom species have gas vacuoles which allow them to stay on or

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continued on page 10

AQUATIC VEGETATION SAMPLING IN LAKE CONWAY

By Larry E. Nall*

The "Large Scale Operations Management Test of the White Amur in Lake Conway" is probably the most extensive environmental study that the white amur will undergo. Lake Conway is an 1820 acre chain of 5 suburban lakes located in south Orange County near Orlando. The project is the brainchild of the U.S. Army Corps of Engineers, Waterways Experiment Station (WES) in Vicksburg. WES hopes to assess the environmental impact of the fish, evaluate its ability to control vegetation, develop ecological models to predict the effect of the fish on other lake systems and devise a management plan for large scale use.

WES has contracted the most qualified area experts in many fields to study a particular phase of the lake's ecology. The Florida Game and Fish Commission studies the fisheries and waterfowl, the University of South Florida studies the amphibians and reptiles of the lake, Orange County Pollution Control monitors the water quality and the University of Florida samples the plankton and benthic organisms. The Florida Department of Natural Resources, Bureau of Aquatic Plant Research and Control, is monitoring the changes of the large submerged plants.

The Lake Conway vegetation study is unique because it is the first major aquatic weed control study that has estimated the actual weight (or biomass) of the plants. Previously, all aquatic weed control efforts have been based on percent coverage or acreage of the problem plant. Whether chemical control or biological control with the amur is selected, the agent used will only destroy a certain amount of vegetation at a particular rate. The actual biomass of vegetation is highly variable and is not accurately measured by current methods. Therefore, the chemical application rate or the stocking rate is only an educated guess and the results are not always predictable.


Studies of the biomass of aquatic vegetation are rare and are primarily

done as pure research. Measurement of plant biomass for applied purposes was formerly impractical because the technique normally required the use of a scuba diver who must remove the plants by hand from a small measured area. This technique is too time consuming, costly and inaccurate to be prac-


tical. Recently, however, several new sampling devices have been invented that allow rapid survey of plant populations. One of these machines was designed and constructed specifically for the Lake Conway project. The device (figure 1) is a cylinder with rotating cutting blades on the bottom. As the cylinder is



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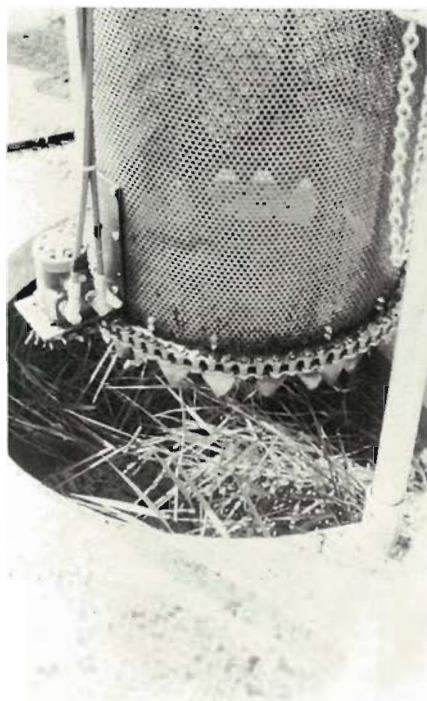
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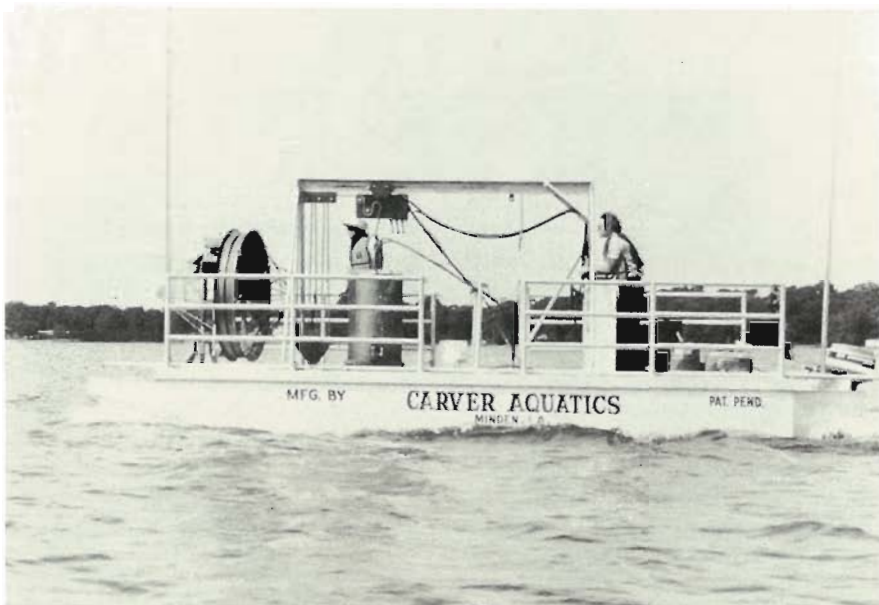
slowly lowered through the water column, the blades cut a core through the vegetation. When the device reaches the lake bottom, doors on the bottom of the cylinder are closed to contain the sample. The sampler is totally powered by hydraulics and is transported on a large pontoon boat. Under proper conditions, 100 samples per day can be taken, thus making lake biomass surveys rapid and practical.



This device is used for taking samples.

In Lake Conway, approximately 200 samples per month are taken at fixed points along 18 transects across the lake. Sixteen underwater sampling plots are also placed in representative types of vegetation. These plots are sampled each month by a diver. Species composition, stem number, plant height, and number of leaf nodes are among the parameters noted by the divers. Vegetation mapping and aerial photography are also being used to record changes in the distribution of plants. After the data are collected, they are forwarded to the WES computing center in Vicksburg for analysis. The results are then returned for interpretation by the researchers.

From this investigation of the aquatic plants we hope to discover the rate of consumption (control) and feeding preferences of the amur in a large lake system. Such information is known from laboratory experiments. However, it is not known if these studies are valid for a



A flat pontoon boat of this nature makes an excellent work platform for sampling vegetation biomass.

large natural lake situation. We also hope to learn much information about the biology of the various plants in the lake, such as, maximum attainable weights and densities, growth rates, seasonal changes, responses to environmental factors and competition between different species. Of particular interest would

be the method and rate by which hydrilla spreads and dominates a lake.

In addition to vegetation research, we hope to evaluate current survey techniques, develop new more effective ones where necessary and establish these as the standard methods used in vegetation control, research and application. □



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continued from page 6

near the surface, forming what is commonly called "scum." In many cases, this scum is composed of the blue-greens, *Microcystis* and *Anabaena*.

This stratification of algae on the surface blocks sunlight to lower levels of the lake, concentrates oxygen in the upper levels, and increases water temperatures at the surface. During the day, oxygen can become supersaturated near the surface and deficient at the bottom of the lake. At night, respiration of this algae bloom decreases oxygen levels drastically.

An overcast day would further decrease oxygen levels even lower due to decreased photosynthesis rates and increased respiration rates of the algae. Several cloudy days would cause oxygen levels to be deficient, resulting in a fish kill. During June, 1979, three fish kills were observed during the same time period under these conditions in different areas of northeast Florida.

This problem can usually be eliminated by a partial herbicide control of the algae in a two or three application program. These treatments will allow light penetration in a greater portion of the water column, decreasing the diurnal fluctuations of oxygen levels.

Complete algae control would eliminate oxygen production through photosynthesis and would increase algae decomposition resulting in increased BOD and a fish kill. □

AMERICAN ASSEMBLY CONFERENCE ON MANAGEMENT AND CONTROL OF AQUATIC WEEDS RECOMMENDS MAJOR CHANGES

By
Arnett C. Mace, Jr.^{1/}

The over 90 participants of the American Assembly Conference on Management and Control of Aquatic Weeds in Florida strongly recommended major changes in statutes, rules and permits, operations, research and funding at the conclusion of this two and one-half day conference. These participants representing various agencies, institutions and the private sectors discussed policy issues for two days prior to concluding with these recommendations on policy issues pertaining to: 1) statutes, rules, and permits; 2) operations; 3) research; and 4) funding.

This conference began with comments from Colonel Robert M. Brantly, Executive Director of the Florida Game and Freshwater Fish Commission, Dr. Elton Gissendanner, Executive Director of the Florida Department of Natural Resources, Mr. Jay Landers, former Interim Executive Director of the Department of Natural Resources; and Ms. Victoria Tschinkel, Assistant Secretary of the Department of Environmental Regulations. Each spoke to the increasing magnitude of aquatic weed problems in Florida and the "Sunbelt"

states, the need for clarification of agency responsibility, and objectives of the conference. Four discussion groups focusing on the four major policy issues were led by Harold Brown, Thomas Lawton, Jr., Hal Scott, and Jim McGehee.

Recommendations which emanated from these discussion groups were reviewed by the entire delegation and very strongly supported by a final vote; however, it should not be assumed that every participant subscribes to every recommendation. □

^{1/} Director, Aquatic Weed Research Center and School of Forest Resources and Conservation, Institute of Food and Agricultural Sciences, University of Florida, Gainesville, FL 32611

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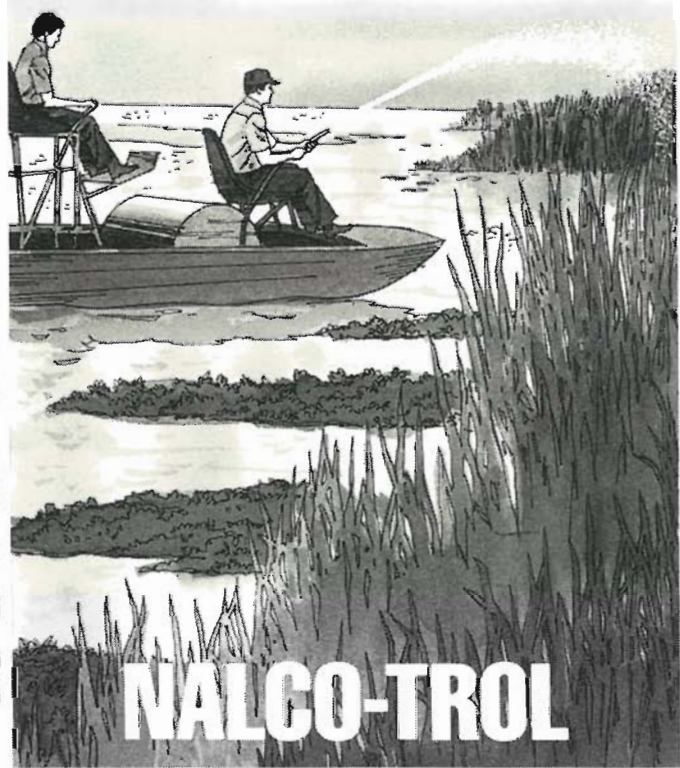
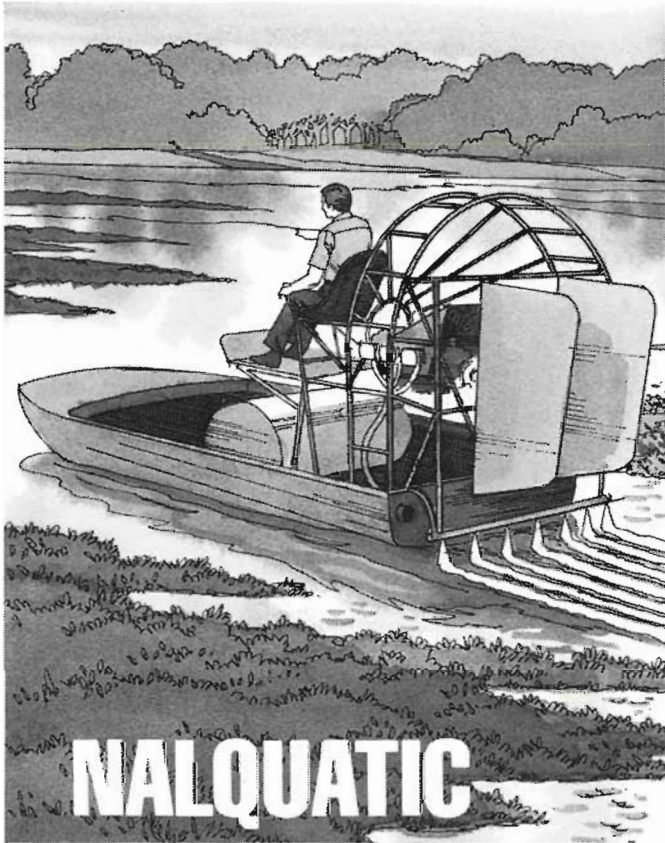
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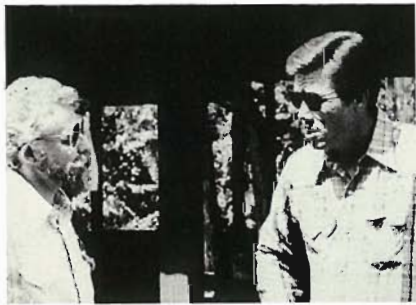
The third annual meeting of the Florida Aquatic Plant Management Society was tremendous. An excellent program provided the attendance with recent developments in aquatic plants management. One of the highlights was the panel discussions in which experts in the field responded to hours of questioning from the membership.

The barbecue dinner could not be surpassed. Nick Sassic, with assistance from Paul King, Carlton Layne, Larry Maddox and many others, provided a delicious meal.

The Society now has 347 paid members with approximately \$5000 in its treasury.



Our past president, Harold F. Brown, did an outstanding job in the office during his term which was climaxed by the success of this meeting.



Clarke Hudson and Gordon Baker capitalized on an opportunity to discuss business informally.



Registration lines were long. However, through the hard work of Mrs. Dee Brown, Carlton Layne and Tom and Judy Minter, all went smoothly.

The Florida Aquatic Plant Management Society, Inc., would like to extend a special thanks to the Orange County Sportsmen Association for the use of its picnic area and the following Kentucky Country Fried Chicken stores for donations they made of plates and utensils:

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THE USE OF AQUASHADE TO CONTROL THE REINFESTATION OF HYDRILLA AFTER HERBICIDE TREATMENT

See Contents Page
for "Literature Cited".

By
John A. Osborne

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ABSTRACT

After an autumn application of herbicide (Hydrothol 191), Aquashade (an inert blue dye) was successfully used to control hydrilla reinfestation from tubers and turions in a 0.41 ha test pond in Central Florida. Aquashade was maintained in the pond (2-3 ppm) in order to reduce incoming red light to 1-3% of full sunlight intensity at a depth of 1.0 m. Complete elimination of hydrilla was achieved by spring (May) and this control was maintained throughout summer. Sprouting tubers were not found in the test pond until the end of the study when the concentration of the dye declined below 1.0 ppm and the amount of light (especially red wavelengths) increased. No significant differences were found between seasons for tuber density although a significant decline in turion density was observed from winter through summer. The use of Aquashade (after an autumn herbicide application) is recommended for control of hydrilla reinfestation in suitable impoundments which have a perpetual weed problem.

INTRODUCTION

The subterranean tuber, and to a lesser degree, the axillary turion have long been recognized as the primary causes of hydrilla (*Hydrilla verticillata* Royle) reinfestation after the application of herbicide and/or during the onset of spring (5, 7, 9, 11, 12, 15, 16, 17). Hidden in the hydrosol, the tubers are protected from the herbicide that is applied to the overlaying water and is in contact with the parent plant (15). Regrowth from the tubers usually follows in a few weeks after the application of herbicide, and in many instances requires a second or even a third application.

Tuber formation on the roots of hydrilla is seasonal in Florida and elsewhere (1, 5, 6, 12, 17), and principally occurs during autumn in northern, temperate regions with the onset of short daylengths (13 hr. sunlight day⁻¹) (17). In North Florida, peak tuber production is between

October through April; no tuber production occurs during mid-summer (6). In South Florida, tuber formation is year round (17). While tubers generally form during periods of colder water temperature, it has been suggested that water temperature does not influence tuber formation (17). Tuber densities as high as 3×10^6 ha⁻¹ have been reported (1, 7). Generally, tubers are from ten to twenty times more abundant per unit area than turions, thus tubers are the dominate reinfestation mode (5). While the longevity of tubers and turions is unknown (7), the presence of these propagules in lake sediments is suspected to be longer than ten years.

Tuber germination usually occurs in spring and requires exposure to light and low CO₂ concentration (1). When tubers were sprouted under various wavelengths of light and different air regimes by Miller, et al. (14); only light was found to have a stimulatory effect. While sprouting of the tubers was not significantly affected by light wavelengths, it has been suggested that red light may stimulate propagule sprouting more so than shorter wavelengths (14). Germination of tubers occurs in very low light intensities, but generally the light flux is higher than 12-20 μ einsteins m² sec⁻¹ for sprouting (2). The lowest light irradiance in which hydrilla can function photosynthetically is 10-12 μ einsteins m² sec⁻¹ (2, 14) which is typically less than 1.0% of full sunlight (5, 12). Stored nutrients in the tuber will generally support sprout growth for 85 days or longer in the absence of light (9, 15). The optimal temperature for propagule germination is between 15 and 35 C (6).

While light reduction in natural waters has been advocated for the control of algae and rooted aquatics (3, 4, 8, 10, 13), the reduction of underwater light to control the reinfestation of hydrilla by restricting the germination of tubers and turions has not been attempted. This study serves as that demonstration. Operation-

ally, control of hydrilla regrowth would provide fewer herbicide treatments and lower the cost of plant control, annually, in suitable environments.

METHODS AND MATERIALS

A 0.41 ha pond, located in Orlando, Florida, with a heavy infestation of hydrilla was treated with Hydrothol 191 at double strength (10 gal/acre) on October 5, 1978, to remove the parent hydrilla population. Aquashade (an inert blue dye) was added to the pond on October 7, 1978, and was maintained at a concentration of nearly 2.0 ppm throughout the remainder of the study. The concentration of the dye was determined spectrophotometrically on a monthly basis using a Beckman Model 26 scanning spectrophotometer. The peak absorbance for Aquashade (630 nm) was used to determine the concentration from a standard curve; organic coloration which absorbs light in the blue region of the visible spectrum did not interfere with this procedure (Figure 1).

Water temperature, Secchi disc transparency, and relative underwater light measurements were taken within the water column on a bimonthly schedule. Light measurements were taken using a Kahl submarine photometer, Model 268 WA 300, and intensity paired colored glass filters for blue, green, and red light.

Tuber and turions were collected bimonthly from 12 random stations in the pond with a 0.0225 m² tall-form Ekman grab with additional lead weights (4 kg). The bottom sediment was sieved through a #30 brass screen to remove the tubers and turions; these propagules were picked from the remaining sediment under magnification and light.

Hydrilla growth was monitored by producing a strip chart recording of the bottom and vegetation using a Raytheon recording fathometer (accuracy = 0.25 m). The percent frequency of occurrence for hydrilla along two parallel transects in the

pond was determined from the presence and absence of vegetation signals on the strip chart. Recordings were made with the fathometer bimonthly.

RESULTS AND DISCUSSION

Aquashade was applied to the test pond immediately after the herbicide application to aid in the reduction of the parent hydrilla population. An application rate of 1.0 gal acre ft⁻¹ of liquid Aquashade produces a 3.0 ppm concentration. While the concentration of the dye varied from 1.5 to 3.5 ppm in the pond throughout the study (Figure 2), much of this variation was due to dilution rather than by photo-oxidation. The dye holds its concentration for approximately three months during exposure to light. The largest decrease in the dye concentration resulted from heavy rains during January and May. While no attempt was made to spread the dye evenly during its application, similar concentrations were found throughout the pond after 24 hr.

Aquashade is most effective in reducing red light (Figure 1) but does absorb at all wavelengths of the visible spectrum. Since humic stained natural water absorbs blue light at a greater rate than red light, the addition of Aquashade in organic stained water results in a nearly equal reduction of blue and red light. Such was the case in the experimental pond; the depth of 1% sunlight was nearly the same for blue and red light when the dye concentration was from 2.5 to 3.5 ppm (Table 1). When the dye concentration was allowed to dilute toward the end of the study, the depth of 1% sunlight for red light increased. The amount of light at the bottom of the pond (2.0 m) was much lower than required for hydrilla photosynthesis. The maximum percentage of red light that was found at 2.0 m was 0.08%; that found for blue light was 0.18%. Secchi disc transparency was usually less than 1.0 m (Table 1).

Surface temperature in the pond was similar to that in other Central Florida lakes. Surface temperature ranged from 15.0 to 31.8 C throughout the study. Bottom water temperatures at 2.0 m were always lower than surface water temperatures, even during fall, winter, and spring when monomictic lakes in Central Florida are generally homothermal. Water temperature was 1.1 C lower at the bottom than at the surface in January and was lower by

3.2 C in July. There is little doubt that the prolonged and persistent thermal stratification of the experimental pond was induced by Aquashade limiting solar light penetration.

The percent frequency of occurrence for hydrilla declined exponentially from November through May; no hydrilla was found in the pond (even in shallow water less than 1.0 m) from May through September. In comparison, after an October application of herbicide in the pond during the previous year, hydrilla regrowth was pronounced by March (Orange County Pollution Control, personnel communication).

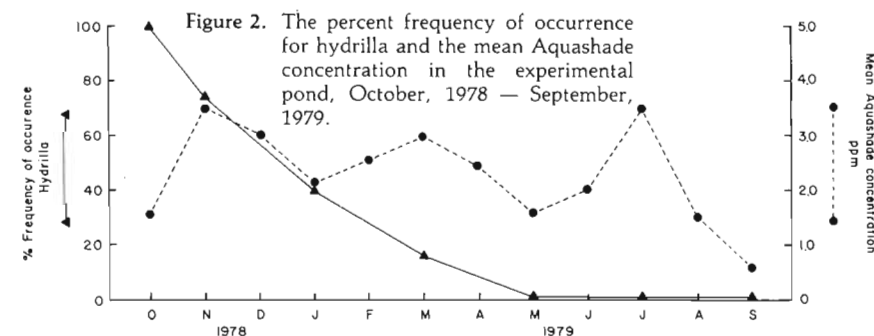
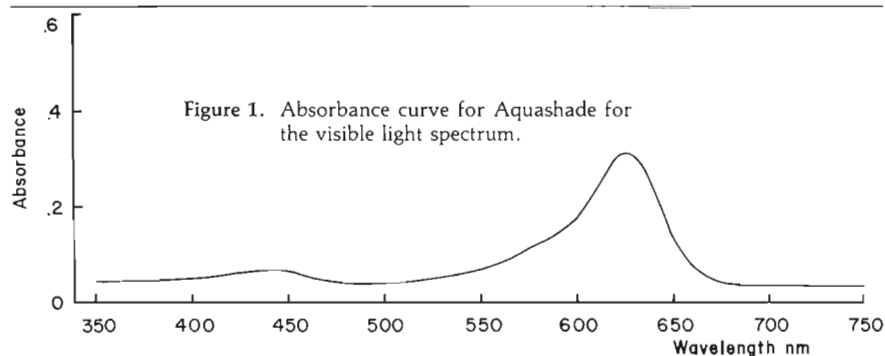
While the density of axillary turions declined substantially throughout the study, tuber density remained unchanged (Table 2). Germinating tubers and turions were

Table 1. The depth of 1% full sunlight for blue, green, red, and visible spectra and Secchi disc transparency in the experimental pond.

	Depth (m)				Secchi disc
	Visible	Blue	Green	Red	
November, 1978	1.59	1.16	1.82	1.00	1.59
January, 1979	0.87	0.76	0.85	0.89	0.50
March	1.14	1.25	1.26	1.30	0.80
May	1.35	1.46	1.53	1.17	0.94
July	1.39	1.18	1.41	1.23	1.05
September	1.53	1.05	1.59	1.62	1.05

Table 2. Mean density of hydrilla tubers and turions in the experimental pond. The standard error of the mean is presented in parenthesis.

	tubers m ²	turions m ²
November, 1978	73 (31)	906 (283)
January, 1979	81 (22)	539 (204)
March	59 (22)	238 (69)
May	22 (18)	88 (29)
July	92 (26)	132 (77)
September	121 (33)	66 (19)



only found at the end of the study when the dye concentration became less than 1.0 ppm. No significant difference ($P = 0.05$) was found between the mean tuber density for winter and summer.

SUMMARY

Aquashade can be used effectively to control hydrilla regrowth from vegetative propagules when the dye is applied at rates generally higher than 2.0 ppm before spring and following a herbicide application. In the neotropics, the application of the dye should immediately follow the herbicide treatment. Impoundments lacking effluents are most suitable.

ACKNOWLEDGEMENT

The author would like to thank Aquashade, Inc. for support and the dye used in this study and the Orange County Pollution Control for the application of the herbicide. □

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