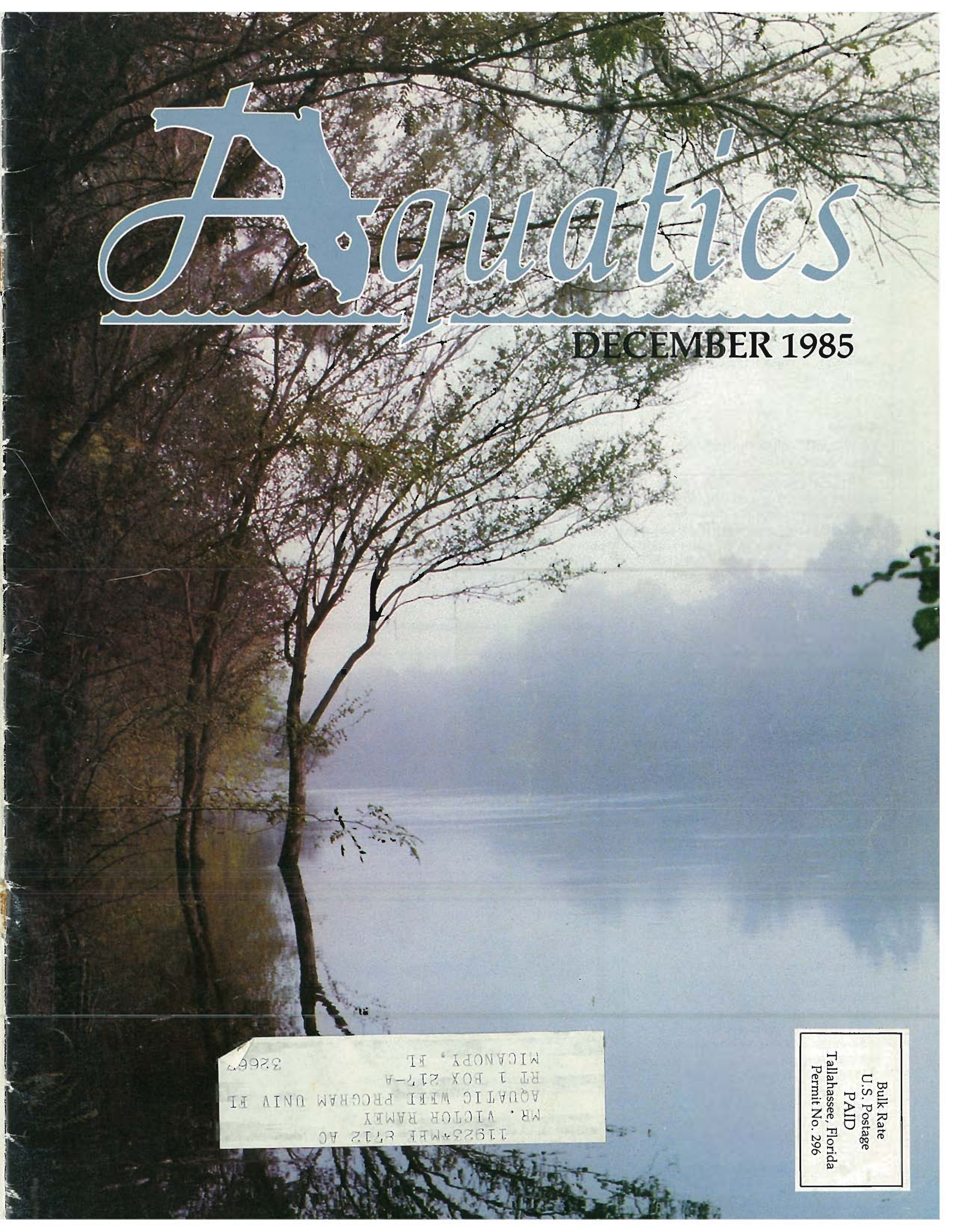
Aquatics

DECEMBER 1985



Applicator's Corner
ask the
Weed Doctor

Question:

I am presently experiencing problems with a species of Utricularia, commonly referred to as cone-spur bladderwort. What are the applicators around the state using to control this weed?

Answer:

Jim Wilmoth, Applicator-President, Aqua Plant Control, Inc.

The Lentibulariaceae family consists of many different species that inhabit aquatic ecosystems throughout the tropics, Europe, tropical Africa, Asia, Australia, and over half the states within our country, primarily those east of the Mississippi River. Twelve out of 120 species of the genus Utricularia, occur within the state of Florida. A common species of these 12 that shows up consistently within this territory is ***U. biflora*** or cone-spur bladderwort. It has been documented in many aquatic plant I.D. manuals, as a free floating, submerged, carnivorous aquatic macrophyte. Reproduction is by seed germination and fragmentation.

Before A.P.C. chooses an aquatic herbicide to manage cone-spur, several water quality parameters are obtained (pH, D.O., hardness, temp. and salinity). Other factors involved include the environmental conditions, surroundings and the intended use of the waterbody (aesthetics, irrigation, recreational, etc.) With these results, we will choose either a Diquat-Copper ion complex (pref. Koplex) with polymer, or Hydrothol-191 formulation. Our first choice, is a formulation of 2 gal. Diquat, 2½ gal. Koplex, with .25 to .50% polymer per tank, per acre. If water quality parameters indicate waters within the treatment zone are hard, copper rates will increase to 4 G.P.A., and a penetrant surfactant (Cide-Kick) at 1 to 2 qts. per acre, will be added to this formulation.

When aesthetics is the primary concern, and the macrophyte is established in shallow areas with a muddy, or clay substrate, Hydrothol-191 at a rate of 2.0 to 3.0 PPM will be applied.

These formulations are applied from a D-30-50 Hypro Diaphragm pumping system, 50 gal. tank with jetted by-pass, intank (paddle) agitation, and a H-43 Sprayjet gun, with D-7 or D-6 orfice plates. Hydrothol-191 may also be applied via a sub-surface boom mounted at the stern of an airboat. With this system, the herbicides and adjuvants are applied with even distribution from the tank solution to the target plant within the treatment zone.

All treatments to cone-spur should be completed by 9:30-10:30 a.m. on the treatment date. Weather conditions should be optimum with no chance of rain, heavy winds, or severe overcast skies on the treatment date or 24 hours prior to the treatment time.

With these formulations, favorable weather conditions, and a uniform application, effective control of ***Utricularia biflora*** is obtained 90% of the time.

Answer:

John Fernandes, Aquatic Bio Technician, The Lake Doctors, Inc.

There are over 100 species of bladderwort worldwide. A dozen of which are found here in Florida. Bladderwort is an aquatic carnivor feeding on larvae and small fish fry. Most have yellow flowers, but some have white or purple flowers.

Being a warm water plant, the cone spur species is usually on the surface July thru October.

Usually found in shallow water, bladderwort will grow in hard and soft water canals, lakes, and swamps. It

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EDITORIAL

During the past ten years aquatic plant management personnel in Florida achieved what was once thought to be an unattainable goal, i.e. the maintenance control of waterhyacinths. The rivers and lakes are no longer perpetually covered with rafts and jams of waterhyacinths which restrict navigation, cover recreational beaches, impede water flow, and adversely impact native vegetation, fish and wildlife habitats. This has been achieved through the prudent use of aquatic herbicides and the spread of biological control agents into waterhyacinth nursery areas. Unfortunately, as Florida's population has grown, the percentage of water users who remember the "good ole days" of waterhyacinth control (pre-1975), have decreased rapidly. As such, the public's and governmental administrative perception of the priority of maintaining a low level of waterhyacinths has also decreased. The "squeaky wheel" of the waterhyacinth jam has been well greased. It is now the responsibility of the professional aquatic applicators and the research community to exert a conscious effort towards educating the public on the need for aquatic plant management.

Joe Joyce

ABOUT THE COVER

Early morning fog lifting off of the Santa Fe River. First place award in the photo contest at the 9th annual meeting of the FAPMS.
Photo by: Joe Hinkle, DNR, Lake City.

Aquatics

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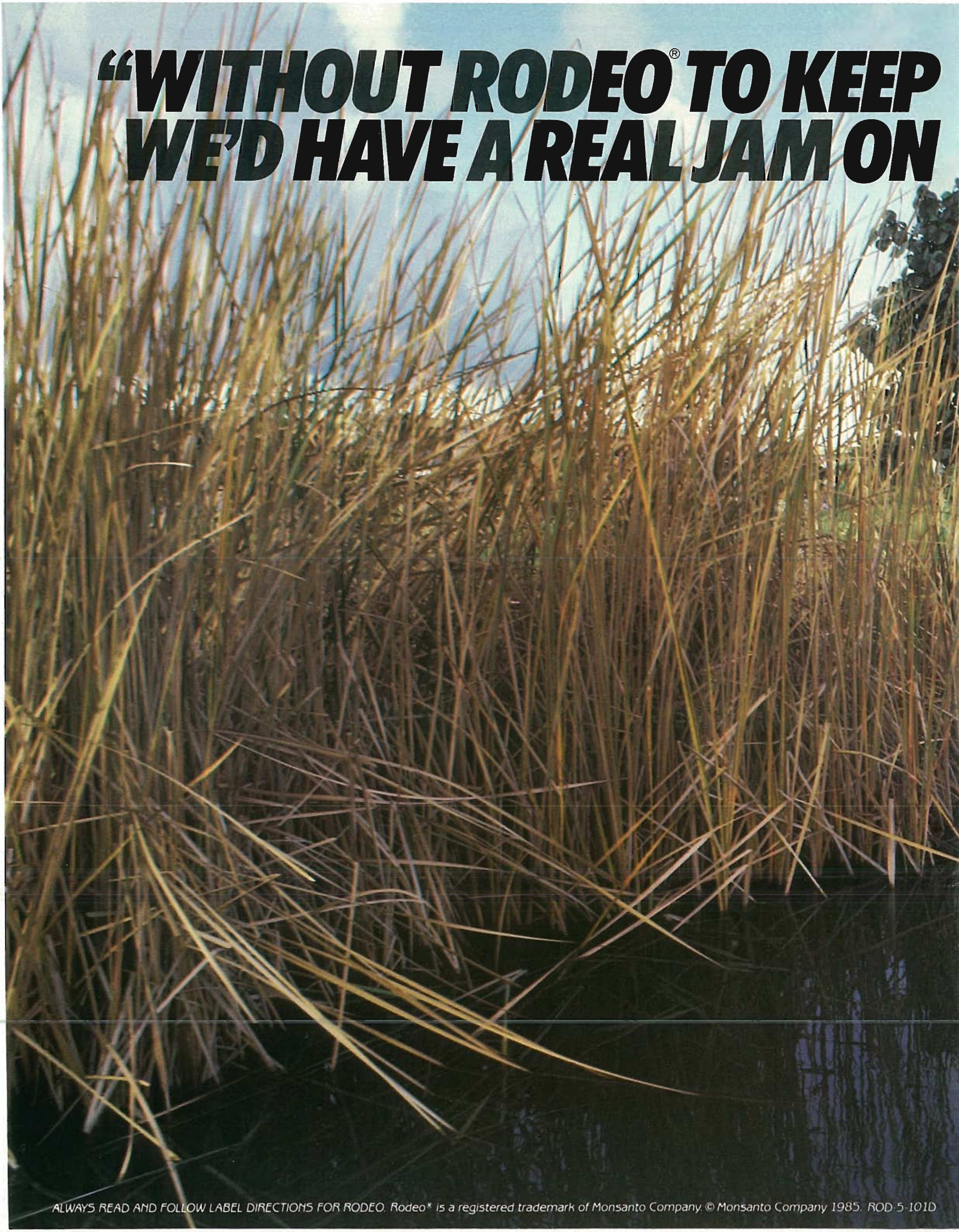
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Parrot-feather

by
David L. Sutton
Center for Aquatic Weeds
Fort Lauderdale Research and Education Center
University of Florida — IFAS
3205 College Avenue
Fort Lauderdale, FL 33314

Introduction

Parrot-feather *(myriophyllum aquaticum* (Vell.) Verdc.) is a member of the genus Myriophyllum, or watermilfoil as plants in this group are commonly called. This genus includes about 40 species widely distributed around the world.

In North America there are about 13 watermilfoil species of which 10 are indigenous. Many of the watermilfoil species are extremely difficult to distinguish from each other unless flowers or seeds are present because they exhibit very similar anatomical characteristics. However, parrot-feather plants possess several characteristics which make them relatively easy to identify.

Classification and Nomenclature

Parrot-feather was first described in 1829 and given the scientific name *Myriophyllum brasiliense* Camb. Later it was also named *Myriophyllum proserpinacoides* Gill. Recently its scientific name has been changed to *Myriophyllum aquaticum* (Vell.) Verdc.

Parrot-feather is the preferred common name for this plant; however, other common names found in the literature include parrot's-feather, parrotfeather, and water-feather.

Native Habitat and Areas of Naturalization

Parrot-feather is indigenous to South America. Little is known of the factors which regulate growth of this plant in its native habitat; however, it appears that a complex of insects, including the flea beetle *Lysathia flavipes* (Boheman) and the weevil *(Listronotus marginicollis* (Hustache), feed on it.

Vegetative propagation is characteristic of many aquatic plants and is the primary means of plant invasion by parrot-feather. Colonization by seed is rare, and in fact, may not occur at all. Male flowers have not been found on any plants in areas where parrot-feather has naturalized. Even in its native habitat, South America, plants with male flowers are scarce.

Parrot-feather has been introduced in a number of countries throughout the world for use as an ornamental in both indoor and outdoor aquaria landscaping because of its aesthetic attractiveness and ease of cultivation. It has escaped cultivation primarily by transportation of fragments in flowing water and by man planting it in field sites. Parrot-feather has naturalized in many areas, especially in the warmer climates of the world.

In North America, the exact date of introduction of parrot-feather is unknown, but was probably in the late 1800's or early 1900's. Since its introduction, this plant has become established along the east coast from New York to Florida, in the South and Southwest, in California, and in other isolated areas throughout the United States.

In Florida, parrot-feather may be

Figure 1. A drainage ditch near Vero Beach, Florida, filled with parrot-feather.

found in drainage ditches in the east central part of the state (Figure 1), the Withlacoochee River, Lake Okeechobee, and several other locations.

Morphological and Anatomical Characteristics

Parrot-feather derives its name from the almost feather-like leaves which occur on this plant (Figure 2). The leaves are arranged in whorls of 4 to 6 around the stem. The emersed leaves are dark green and quite stiff as compared to the submersed leaves which are lighter green in color and more filamentous. Each leaf may have 20 or more linear-filiform divisions which gives it a feather-like appearance. The leaves, oval in transverse section and covered by an epidermal layer of irregularly shaped cells, are pinnately compound with a single vascular bundle in each leaflet.

The presence of emersed stems is one of the identifying characteristics of parrot-feather. These emersed stems, generally with few branches, grow up to 30cm or more above the surface of moist, muddy areas, or they may be attached to the bank and extend out several meters over the surface of the water. In shallow bodies of water, it is not uncommon to have submersed and emersed leaves on the same stem; however, under these conditions, the emersed portion tends to lay on the surface or extend only a few centimeters above it.

Parrot-feather is dioecious with flowers borne in the axils of the emersed leaves. The pistillate flowers are about 1.5mm long and appear as a tuft of white or pinkish plumos stigma lobes. Little is known of the appearance of male flowers, fruit, and seed. Essentially no information is available on factors affecting pollination, fruit set and development, and seed germination since the presence of male flowers is rare.

As with most aquatic macrophytes, air canals and aerenchyma are abundant in parrot-feather plants. Elongated air canals, radially arranged in the cortex of the stem internode, are present in the emersed portion of the plant. The air canals are interrupted at the nodes in the stem but aerenchyma is continuous from one end of the root or leaf to the other. The stem may contain 24 to 30 air canals per internode. The air canals are formed by the extension of a single layer of parenchyma cells from just under the epidermal layers of the stem to its center.

Figure 2. Parrot-feather plant showing the linear-filiform divisions which give it a feather-like appearance.

Growth and Development

Growth of parrot-feather plants may be extremely luxuriant under some conditions. Although it has naturalized in a number of locations throughout the world, parrot-feather is not generally considered a major noxious weed problem. Under natural conditions, parrot-feather tends to prefer a warm climate and muddy banks or shallow bodies of water. It grows in isolated patches primarily as the emersed form.

Parrot-feather has been found in static and flowing water up to 2.0m in depth. It grows best when high levels of nitrogen are present and with temperatures 8 to 30C.

Little information is available on growth and accumulation of biomass of parrot-feather under field conditions. Crude protein in parrot-feather may range from 12 to 18# on a dry weight basis. It readily absorbs nitrogen and phosphorus from the sediment, and over 90# of phosphorus in the plant may be derived from uptake by the roots with the amount related to the mass of roots present.

Copper is uniformly distributed throughout the shoots and roots of parrot-feather at an average concentration of 16ppm. The amount of copper in the roots is related to the ambient concentration.

Parrot-feather is more tolerant to seawater than many other freshwater aquatic plants. Salt concentrations of 10.0 to 13 parts per thousand (ppt) are necessary to inhibit growth of parrot-feather. Root growth may be stimulated by salt concentrations of 0.8 to 3.3ppt.

Management of Growth of Parrot-Feather

Herbicides: Copper at a concentration of 1.0ppm or higher in the root zone will reduce growth of parrot-feather when the plants are cultured under greenhouse conditions. Under field conditions, the use of copper sulfate would probably

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Pithophora

by
Carole A. Lembi[1]
Steven W. O'Neal[1]
David F. Spencer[2]

Pithophora Wittrock 1877, commonly called the horsehair alga, produces free-floating mats of vegetation in static or slow-moving bodies of water. In large lakes it is likely to be confined to coves and channels, but its often luxuriant growth can completely fill in shallow lakes and ponds (Figure 1). Unlike other filamentous algae which float to the surface, a considerable portion (as much as 3 times) of the biomass may be found lying on the bottom sediments. This coupled with a reputed resistance to copper sulfate and other algicides makes this alga a definite challenge to aquatic weed control specialists.

Description

Pithophora is a green alga (Chlorophyta) in the family Cladophoraceae. Other members of this family include *Cladophora*, the common alga of the Great Lakes, *Rhizoclonium*, and *Basicladia*, an unusual alga which is only found attached to the shells of turtles. All members of the Cladophoraceae are filamentous. *Pithophora* and *Cladophora* are branched filaments whereas the other two members are unbranched or only sparsely branched.

Identification of *Pithophora* without a microscope is frequently possible. The mats themselves tend to be think, in large clumps, and coarse. When water is squeezed from the mats, the clumps are springy and the filaments stand out from one another. The texture of the mat may almost be as coarse as a Brillo pad. This is in contrast to an alga such a *Spirogyra* which is extremely slimy and in which the filaments adhere to one another when the water is drained from the clump.

The branching of *Pithophora* filaments is easy to detect when the alga is spread between the fingers. The key feature, and the one most frequently used to separate the alga from *Cladophora*, is the presence of akinetes, dark spore-like bodies that are also visible with the naked eye. In fact, the derivation of the *Pithophora* is from the Greek "pith = casks; phora = to carry".

Since akinetes are not always present, a microscope may be necessary to confirm the identification. Attention should be given to the point of branching. In *Pithophora*, branches are initiated some distance (often as much as 50um) below the cross wall of the main filament. This is due to the presence of a rigid band of chitin that prevents the emergence of the branch at the cross wall itself (1). Branches thus diverge almost at right angles from the main filament. In *Cladophora*, which lacks chitin, branches are initiated at the cross wall, thus giving the filaments a forked or dichotomous appearance.

Chitin, which is also the material that comprises insect exoskeletons, is extremely rare in algae. Its presence in *Pithophora* not only accounts for the distinctive branching pattern but probably also accounts for the coarseness and rigidity of the filaments. In addition, all members of the Cladophoraceae have extremely thick cell walls which are readily epiphytized (encrusted with other algae). Thus, older filaments of *Pithophora* may be covered with diatoms, blue-gree algae, or germlings or other filamentous green algae such as *Oedogonium*. Overwintering filaments may be black in color due to a coating of ferrous sulfide on the cell walls.

Distribution

At the time *Pithophora* was first described, it was considered primarily tropical in distribution. In fact, Wittrock (1877) collected the specimens for his original description of the genus from the Tropical Aquarium-Water Lily House at the Kews Gardens near London, England. Fritsch (2), who published in 1907, considered *Pithophora* to be a prevalently tropical genus well suited to stagnant waters and *Cladophora* to be a temperate genus requiring cooler, flowing waters in order to obtain sufficient quantities of oxygen and carbon dioxide. All of the species of

[1] Professor and Research Associate, respectively, Department of Botany and Plant Pathology, Purdue University, W. Lafayette, IN 47907.

[2] Research Ecologist, USDA/ARS Aquatic Weed Control Research Laboratory, University of California, Davis, CA 95616

Figure 1. Pithophora infestation in a central Indiana lake.

Pithophora are found in tropical and subtropical habitats, and at least in Europe, the organism is probably an introduction. Whether the alga is native or introduced to the United States is unclear, but it was reported in this country as early as 1887 by Wolle.

Pithophora has been reported in virtually all states, from Florida to Minnesota and New Jersey to California (3). As a weed problem it is probably most prevalent in the southeast and midwest. At lease eight species have been listed for the United States, the two most common being *P. oedogonia* and *P. varia*. Filament width of *P. oedogonia* is approximately 50-80um; of *P. varia*, 75-155um. The Akinetes of *P. oedogonia* are all cask-shaped to cylindrical. A survey of 8 collections of from Indiana, Minnesota, and Ohio showed all specimens to be in the *P. oedogonia* complex.

Life Cycle and Growth

Growth of the filaments of *Pithophora oedogonia* occurs optimally at temperatures between 25-30 C; thus, in the midwest it tends to reach its maximum biomass in mid to late summer or even early fall (4). Nutrient requirements for growth are quite high. Half saturation constants (ks values) relating growth to external nutrient concentrations at 20 C are 1.23 mg/1 (88 uM) for nitrate-N and 0.1 mg/1 (3.22 uM) for phosphate-P (5). Concentrations of nutrients in water equal to or higher than these Ks values are likely to support *Pithophora* growth. In contrast, Ks values for *Cladophora glomerata* (at 23 C) are much lower at 0.25 mg/1 nitrate-N and 0.013 mg/1 phosphate-P. This suggests that one of the reasons *Cladophora* is generally of wider distribution in the United States than *Pithophora* is its lower N and P requirements.

Akinete formation occurs in response to decreasing levels of available N. Thus, in a heavy infestation akinete formation can occur in those microenvironments (for example, in the middle of a clump) where nitrogen has been used for growth and the lack of water movement prevents the introduction of new nitrogen supplies. For this reason, at least some akinetes can be found throughout the growing season, but the highest numbers are produced toward the end of the growing season when the biomass is at its maximum. In an Indiana lake, akinete number per gram fresh weight ranged from a low of 200 in June and July to a high of 50,000 in October.

Although the high akinete numbers persist through the winter in midwestern ponds and lakes, the purpose of akinetes appears to be as a mechanism to survive periods of low nutrient concentrations rather than to aid in overwintering. This is consistent with the presumed tropical origins of the alga in which the major environmental fluctuation would be nutrient availability rather than temperature. *Pithophora* can overwinter quite successfully in the midwest without the formation of akinetes.

Both akinetes and filaments survive freezing and show excellent survival when exposed to winter drawdowns (6). Akinetes are very susceptible to desiccation, but are protected from the drying effects of drawdowns or shoreline stranding by the thickness of the vegetative mats (which in turn are protected by a surface layer of dead filaments).

Although *Pithaphora* biomass is at its lowest point in the winter, values of 10 to 50g dry wt per m² (in contrast to 200 to 300 g in late summer) indicate the presence of a significant amount of overwintering algal material, usually lying on the bottom sediments. In the spring in the midwest both akinetes and filaments germinate to produce new vegetative filaments in response to an increase in water temperatures (from 10 to 20 C) and a replenishment of nutrients from winter and spring rains.

Overwintering akinetes also are present in the sediments at densities as high as 15 million per m² in the upper cm and are 95 to 100% viable (6). Viability remains excellent to sediment depths of 10 cm. Akinetes kepts in cold, dark storage have shown good viability for as long as 5 years. Akinetes in the uppermost sediment layers, like those in the free-floating mats, germinate in the spring. However, germination of the sediment akinetes lags behind that of akinetes in the free-floating mats by approximately a month (7). This delay may be due to the slower warming of the sediments.

Resistance to Algicides

Crance in 1974 stated that "few if any herbicides kill *Pithophora* and give desirable control" (8). The resistance of *Pithophora* to algicides was recognized as early as 1924 when Tiffany concluded that a concentration of copper sulfate at least four time greater than that used for other common filamentous algae such as *Spirogyra* was required for control of *Pithophora* (9). Eipper in 1959 (10) found *Pithophora* to survive copper sulfate at concentrations 15 to 20 times greater than the recommended use rate for other algae (0.5 - 1.0 ppm).

Our research substantiates the greater tolerance of *Pithophora* to copper sulfate than *Spirogyra* and *Oedogonium*, although on a fresh weight basis, *Cladophora* appears to show the same degree or even greater tolerance than *Pithophora*. We have considerable evidence that, at least in *Pithophora*, the mode of resistance is the binding of copper to the outer layers of the cell wall so that very little copper enters the living cytoplasm (6). The copper binding is reversible, and it is likely that most of the cell wall-sorbed copper is released back into the water and replaced by calcium and magnesium as the pond concentration of available copper is lowered. We also believe that another important factor in *Pithophora* tolerance is the tight clumping of the filaments, particularly later in the season, which inhibits the penetration of copper to the interior of the mat.

Even more interesting is the tolerance to simzine (Aquazine). There is no question that simazine shuts off photosynthesis in *Pithophora*. However, the phytotoxic symptoms (loss of pigment and severe wilting) typical of land plants seldom occur (11). The reason appears to be related to the fact that simazine phototoxicity decreases with decreasing light intensity. When Aquazine is applied to a *Pithophora*-infested lake, the loss of oxygen production due to the cessation of photosynthesis causes the mats to sink to the bottom. The lower light intensity typical of these depths protects the alga from the phytotoxic effects. In addition, *Pithophora* is capable of surviving on stored internal materials until the simazine residues have dissipated from the water. For example, *Pithophora* can survive at least 60 days in the dark (with only a 19% reduction in biomass) in contrast to *Spirogyra* which loses approximately 76% of its biomass over the same period of time.

Another protective device is the fact that light intensities are greatly reduced within the tight *Pithophora* clumps. 90% of incident light can penetrate no farther than 3 mm of the surface of a mat of *Pithophora*. Since a range of approximately 100 to 400 uE m^2s^1 is the minimum intensity required for phytotoxicity, on a bright day with maximum available light of 1500 uE m^2s^1, filaments 3-4 mm within the mat will be protected.

The effectiveness of simazine as an algicide against *Pithophora* in natural situations thus depends on factors that affect light intensity: turbidity of the water, the depth of distribution of the alga both before and after treatment, and the thickness of the algal mats.

Control

Chemical control is usually inconsistent and short term with the alga reappearing within a few weeks of treatment. Most control efforts utilize high dosages of quick-acting contact herbicides such as copper sulfate,

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Parrot-feather *from Page 7*

not be practical as it would be difficult to maintain this concentration for the period of time necessary to kill the plants.

Combinations of certain herbicides have been shown to be more effective on some aquatic plants than the individual compounds. However, little information is available on the influence of various combinations of herbicides on growth of parrot-feather. Exposure of the roots of the emersed form of parrot-feather to concentrations as low as 0.02ppm of 6,7 dihydrodipyrido[1,2-a:2',1'-c] pyrazinediium salt (diquat) will result in a decrease in dry weight of the plant. Older plants appeared more susceptible to diquat than young plants. Diquat is not translocated in parrot-feather.

Control of parrot-feather may be achieved with the low-volatile esters of (2,4-dichlorophenoxy) acetic acid (2,4-D) at rates of 4.4 to 8.9kg per ha (4 to 8 pounds per acre) when sprayed on the leaves of emersed plants. Also, granular formulations of 2,4-D will control parrot feather. Foliar applications of 2,4-D result in translocation of the herbicide to the root zone so that growth of both the shoot and root portions of the plant will be affected. Young, actively growing parrot-feather plants appear to be more sensitive to 2,4-D than older plants.

Biological: Little attention has been given to the biological control of parrot-feather. The flea beetle and weevil previously mentioned feed on parrot-feather. In Florida, the flea beetle *Lysathia ludoviciana* (Fall) is present on the plants, but the extent of damage caused by it is unknown. Two species in the Tortricidae family, *Choristoneura parallela* (Robison) and *Argyrotaenia ivana* (Fernald) may be found on plants in Florida, but again little information is available on their feeding activity.

An isolate of *Pythium carolinianum* Matt. was collected in northern California from diseased emersed parrot-feather plants which showed a severe rot of underwater roots and stems. When mycelium of this isolate was inserted into the stems of parrot-feather cuttings, the fungi girdled the stems and caused collapse of the plants. Additional testing under field conditions showed that growth of parrot-feather plants inoculated with this isolate was lower than uninoculated controls.

Mechanical: Excessive growth of parrot feather may be removed by mechanical means. Little information, is available, however, on the regrowth of plants after harvesting. Since fragments form shoots and roots under appropriate growing conditions, regrowth will occur vegetatively as well as from any plants not removed from the harvested site.

Conclusions

Parrot-feather in general may be considered more a beneficial than a noxious plant. It provides shelter and protective cover for a number of aquatic organisms, and may serve as a feed source for some herbivorous organisms. In some countries it is eaten as a vegetable by humans. Parrot-feather is an especially attractive plant for aquaria and it is easy to cultivate. This plant removes nutrients from the water, and helps ameliorate wind and wave action. In some shallow bodies of water, ditches, and small rivers, parrot-feather may present serious problems when it grows to such an extent that it reduces water flow and interferes with other water uses. Studies are needed on management methods which will provide effective control of parrot-feather for situations where it becomes a problem.

Acknowledgements

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Applicator's Corner *from page 2*

grows well with other aquatic plants, such as chara and slender spike rush.

Hydrothol-191 at label rates works well, but care should be taken when using this formulation not to exceed 0.2 PPM for the entire body of water or a fish kill may occur. Diquat at 2 gallons/acre with $CuSO_4$ or chelated copper is effective. 2,4-DE at maximum label rates with polymer works well. Spot treatments can be made with granular $CuSO_4$, or granular 2,4-D such as Weedtrine II or AquaKleen.

Answer:

Ed Miller, President-Biologist, Southern Weed Control Management, Inc.

Cone-spur bladderwort is one of our biggest problems. In irrigation ditches or where irrigation poses a potential treatment problem, we use 2,4-D amine at maximum label rates with citrus oil at 1% and polymer as thick as possible to keep the solution in suspension longer, then spot treat the problem areas. Although this works well, it is only temporary. When possible, we use 2,4-D granular at a rate of 200 lbs./acre or Aquazine at maximum label rates in closed ponds. Hydrothol-191 at 5 GPA plus Nalcotrol II is effective when used as a strip treatment.

Benefits of Maintenance Control of Waterhyacinth

by
Joseph C. Joyce
Director, Center for Aquatic Weeds
Institute of Food and Agricultural Sciences
University of Florida

Three of the main criticisms of the public concerning the use of herbicides to control waterhyacinths are: (a) the quantity of chemical used to control the plants, (b) the amount of organic material deposited on the lake or river bottom by the dead waterhyacinths and (c) the increased oxygen demand and lower dissolved oxygen (D.O.) levels created by the decaying plant material. Management personnel have implemented waterhyacinth maintenance programs designed to address these three issues (3), however no quantitative data have been collected to document the predicted benefits of maintaining low levels of waterhyacinths. Numerous studies have been conducted to correlate the growth of waterhyacinths with dissolved oxygen levels (4,6,7) and detritial accumulation (1,2,5,6). However, no studies have been conducted to correlate the maintenance control of waterhyacinths with the D.O. levels, amount of organic sedimentation, and quantity of herbicide utilized on an annual basis. In order to test this relationship, ten waterhyacinth plants were planted in each of 18 concrete vaults at the Center for Aquatic Weeds in Gainesville, Florida. The plants were maintained at six maximum levels of coverage (3) replicates each) i.e. zero, 5%, 25%, 50%, 100% and 100% unsprayed. For example, when the waterhyacinths increased to 25 plants (equivalent to 5% coverage) in the three 5% tanks they were chemically treated with 2,4-D to the original 10 plants; when the plants reached 25, 50, or 100% coverage in other predetermined tanks they were sprayed back to 5% coverage. In the tanks labeled 100% unsprayed, the plants were allowed to completely cover the water surface and no herbicide control was conducted. Records were maintained on the number of times each tank was treated with 2,4-D and the quantity of herbicide solution utilized over the one-year study period. Once spraying operations were initiated, biweekly D.O. measurements were made. At the end of one year, the live plants remaining after the winter freeze were removed, the tanks were drained, and the organic sediments were dried and weighed.

The amount of herbicide used under the six different treatment levels is shown in Table 1. In the most intensely managed tanks (5% coverage), eight separate treatments were required throughout the year. This was twice the number required at the 50% level and four times more than at the 100% level of coverage. However, at the 5% level only 17 milliliters of spray solution was required during each spraying, whereas four times that amount was required at 50% and ten times (175 mls) more herbicide solution was required for each spraying at the 100% level of coverage. Calculations of the total amount used throughout the one year study period and extrapolation of the data to a per acre base's indicates that 1.7 lbs of herbicide (less than one half gallon*) would be required to maintain the plants at the 5% maintenance level, whereas 3.3 lbs (.83 gallon*) would be required at the 50% coverage level and 4.5 lbs. (1.13 gallons*) of herbicide would be required at the 100% coverage level. This latter amount is 2.65 times more than that required to maintain the plants at the 5% maintenance level.

The annual amount of detrital material deposited by the six levels of waterhyacinth management is shown in Table 2. At the 5% coverage level only 0.39 inches of drained sediment accumulated in the tanks. This amount is essentially the same as the 0% coverage level. These amounts were almost doubled at the 25 and 50% coverage levels. The 100% coverage level deposited almost two inches or four times more sediment than the 5% maintenance level. The unsprayed waterhyacinth produced almost four inches of sediments or ten times more than the 5% level. The higher amount in the 100% unsprayed tanks is due to the deposition of large quantities of frost killed waterhyacinths and the lack of organic decomposition of these plants prior to sediment measurement. This fact is also evident in the average

*4.0 lbs 2,4-D acid per gallon of concentrate

Table 1. Annual Herbicide Useage Under Various Waterhyacinth Management Schedules

Percent of Area Covered Prior to Control	Number of Times Sprayed	Average Volume 2,4-D solution per treatment (ml)	Average Total Volume 2,4-D solution per tank (ml)	Total Amount 2,4-D assuming 1 Acre Pond (lbs)
0	0	0	0	0
5	8	17	136	1.7
25	7	34	238	3.1
50	4	63	252	3.3
100	2	175	350	4.5
100 (Unsprayed)	0	0	0	0

Table 2. Annual Organic Sedimentation Caused by Various Waterhyacinth Management Schedules

Percent of Area Covered Prior to Control	Average Sediment Depth (inches)	Average Percent Organic Content	Sediment Deposition (Tons/acre, dry weight) Total	Organic
0	0.35	35	2.4	0.9
5	0.39	54	2.5	1.3
25	0.67	59	2.5	1.5
50	0.71	59	3.2	1.9
100	1.90	70	4.2	2.9
100 (unsprayed)	4.02	80	6.5	5.2

percentage organic content and appearance of the sediments. In the 5, 25, and 50 coverage tanks, the sediments were unconsolidated, finely divided with few plant parts identifiable, and ranged between 54 to 59% organic matter. In the 100% and 100% unsprayed tanks, the sediments were more consolidated and plant parts more easily identifiable. These sediments had undergone less decomposition and averaged between 70 and 80% organic content, respectively. In terms of total amount of sediment deposited per acre on an annual basis the unsprayed waterhyacinths deposited 6.5 tons/acre (dry weight) which is approximately 2.7 times more than the 5% maintenance level. The organic portion of these sediments was 5.2 tons/acre in the unsprayed tanks which was four times the amount (1.3 tons/acre) in the 5% coverage tanks. It is interesting to note that the amount of sediments deposited in the 100% tanks is exactly equal to that reported (4.2 tons/acre) for the renovation of a citrus pond completely covered with waterhyacinths (1).

Biweekly D.O. levels associated with the various treatment levels are shown in Table 3. As expected the D.O. levels are higher in the tanks with fewer waterhyacinths. This is due to a higher percentage of open water which allowed disfusion of oxygen from the atmosphere, and less oxygen demand created by decaying waterhyacinths, more solar radiation entering the water column which allowed greater production of D.O. by phytoplankton. In a similar study which evaluated the effects of various levels of waterhyacinths on fish production (4), it was observed that reductions in phytoplankton growth in ponds with 10 and 25% waterhyacinth coverage resulted in much lower fish production due to a reduction in the food base. However, the presence of 5% cover by waterhyacinth did not significantly affect fish production (4).

An additional observation made during the study was the amount of live waterhyacinths which survived the severe freeze during January, 1985. During this freeze approximately 3-4 inches of ice was observed on the surface of most of the tanks. Two weeks following the freeze waterhyacinths in all the tanks appeared brown and completely killed, however two months later when the experiment was ended the 100% coverage unsprayed tanks contained an average of 90 live plants (only ten plants were stocked in each tank initially. No live plants remained in the 5 or 25% coverage tanks. This is caused by the insulating nature of the waterhyacinth which reduces the heat loss from the water surface and the insulation of the plant meristem by the high amounts of plant material in the large "bull" hyacinths (2,6).

In summary, it is evident that maintenance of waterhyacinths at low levels (less than 5% coverage) can (a) reduce annual herbicide useage by a factor as great as 2.6, (b) reduce organic

Table 3. Effects of various levels of waterhyacinth management schedules on dissolved oxygen concentration

Percent of Area Covered Prior to Control	Average Dissolved Oxygen Concentration mg/1
0	10.3
5	9.3
25	4.0
50	1.6
100	1.3
100 (unsprayed)	2.0

deposition by a factor of 4.0., (c) prevent the depression of dissolved oxygen concentrations, and (d) accentuate the killing effects of winter freezes on the waterhyacinth. Data such as these can be extremely useful in explaining the benefits of the maintenance of waterhyacinth control to the concerned public.

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Acknowledgements

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Herbivorous Fish Permitting Update

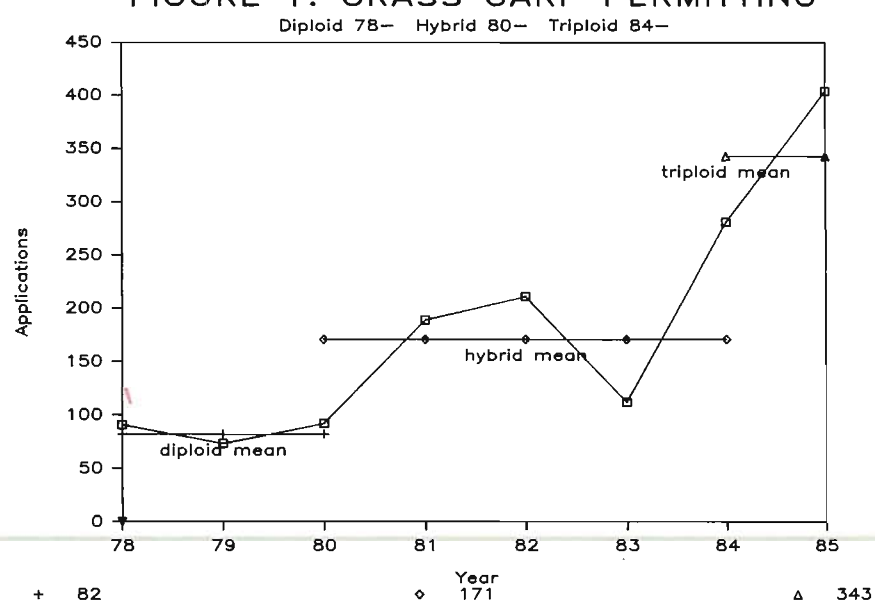
by
Deborah J. Valin
Florida Game and Fresh Water Fish Commission
Lakeland

An average of 82 applications for (diploid) grass carp were received annually by the DNR between permitting years 1978 and 1979 (Figure 1). Grass carp use within the DNR permitting system, however, was restricted to sites of 25 surface acres maximum for control of non-indigenous species only. The increase in applications for hybrid carp (209% averaged annually) is therefore not unexpected, since the surface acreage and exotic plant restrictions were eliminated.

Although permitting (as expressed in numbers of applications processed) increased from 92 to 211 within a 2 year period following introduction of the triploid hybrid grass carp in 1980, a decrease was observed in 1983. It is probable that the decrease reflected inadequacies observed with use of hybrid carp to manage aquatic vegetation.

Since inception of triploid grass carp permitting in 1984, applications received by the Commission for herbivorous fish have significantly increased. Compared to an average 171 applications received annually between 1981 and 1983, 281 were handled in 1984 and 303 just in the first three quarters of 1985 (projected annual mean of 343). This would indicate a 164% increase in 1983 and 177% in 1984.

FIGURE 1. GRASS CARP PERMITTING



Although greater numbers of sites were stocked annually for hybrid carp than for diploid grass carp on the average (52 versus 48), there was a progressive decrease in numbers of sites stocked with the hybrid annually after 1981, as shown in Figure 2a. The number of hybrid sites stocked each year decreased 23% between 1981 and 1982 (70 to 54), and 39% between 1982 and 1983 (54 to 33).

Numbers of fish stocked annually is

somewhate dependent on surface acreage permitted, but the trend between 1981 and 1983 has been a decrease corresponding to that of sites stocked (Figure 2b). A total of 36,000 hybrids were stocked in 1981, which decreased to 7,357 and to 4,839, in 1982 and 1983, respectively.

The problems experienced with triploid hybrid grass carp use, combined with the expense of stocking at relatively high rates (compared to diploid grass carp) thus determined necessary, probably contributed to the decline of their use. When hybrid carp were first introduced into Florida for aquatic plant control purposes, Commission biologists recommended their use at stocking rates determined from research with grass carp.

Many sites were stocked at these lower rates prior to results obtained indicating much higher rates were necessary to manage vegetation. The lack of aquatic plant control experienced at these lower rates, confirmed by similar research observations, created hesitation regarding further use of the hybrid. In addition it has been determined that at least ⅓ of the sites stocked were done so at rates below those recommended by Commission biologists.

When the triploid grass carp was first introduced commercially in 1983 it was anticipated that deficiencies associated with the hybridization process would be eliminated, while retaining the benefits of triploidy. The total number of sites stocked with triploids within 1.75 years already exceeds the number of hybrids stocked a total of 3 years by 40% (270 for triploid grass carp, 157 for hybrid carp). The number of sites stocked annually averaged 151 (projected) for triploid carp and 52 for hybrid carp (300% increase)(figure 2a).

The total number of triploid grass carp correspondingly stocked is 122,347, compared to a total of 98,193 hybrid carp stocked which represents a 20% increase over a shorter time period. Rates recommended for triploid carp have been lower than those deemed necessary for triploid carp have been lower than those deemed necessary for triploid hybrid carp. Annually, an average 73,129 (projected) triploids have been stocked, versus 16,065 hybrids (500% increase)(figure 2b).

Although mean numbers of applications received and sites stocked have increased with replacement of triploid hybrid carp by triploid grass carp in Florida, historically ⅔ of the sites permitted have not been stocked. Percentage of sites actually stocked has not increased with triploid grass carp, probably due to a fear that they will develop problems similar to those of the hybrid. Also, a tendency to understock has occurred at a rate of approximately ⅓ sites stocked.

Major target species occurring among sites stocked between 1980 and 1985 include hydrilla (36%), naiad (mostly southern, 18), spikerush (16), filamentous algae (15), duckweed (10), and chara (6%) (Figure 3). Within 1985, fish have been stocked for control of naiad in a projected majority of sites (33%), followed by spikerush (32) and hydrilla 14%).

Approximately ⅔ of the sites stocked in 1984 are geographically distributed among ten counties. The top ten include Orange, Lee, Seminole, Brevard, Hillsborough, Duval, Leon, Pinellas,

FIGURE 2. GRASS CARP STOCKING

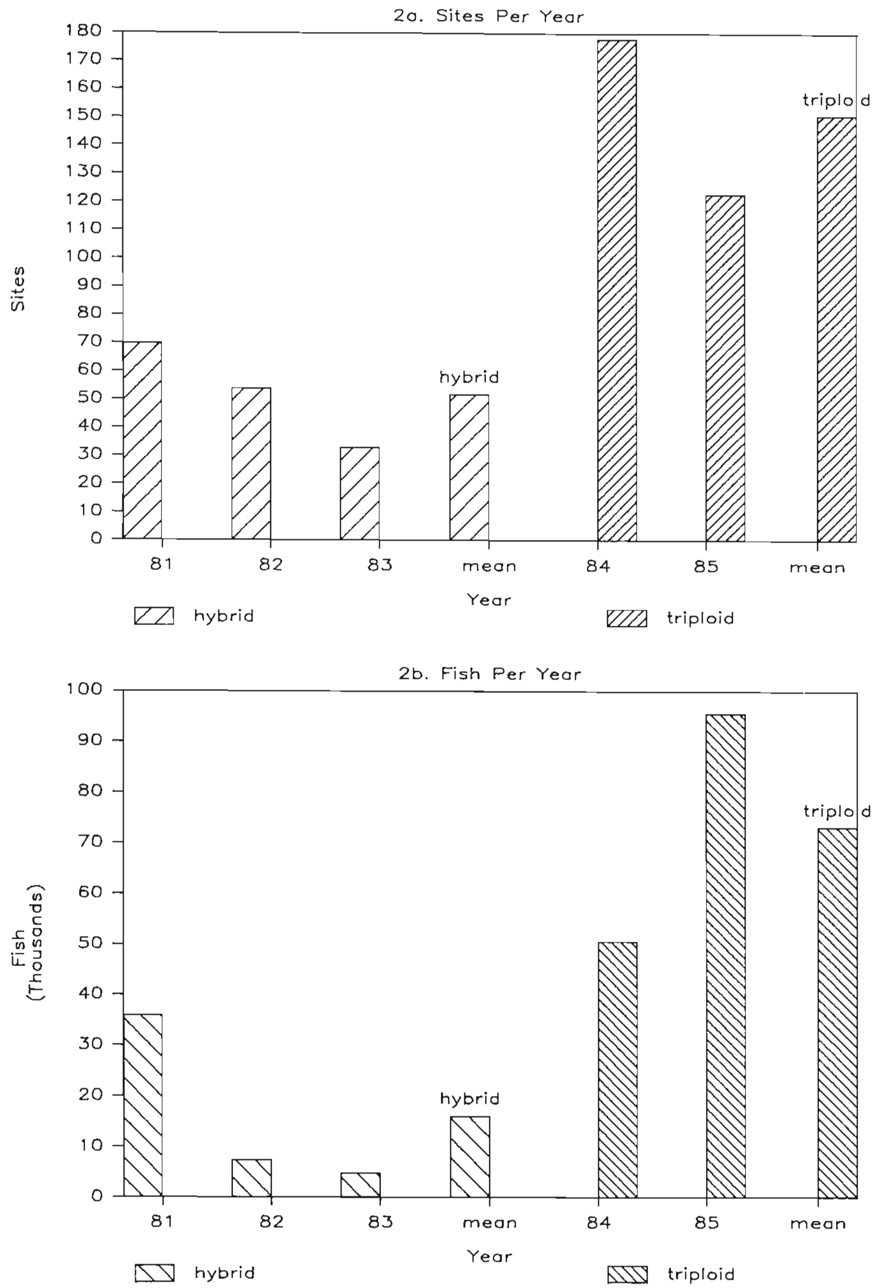


Table 1
Grass Carp Distribution
1984

County	Sites Stocked	% Total
Orange	21	13
Lee	15	9
Seminole	14	9
Brevard	12	8
Hillsborough	10	6
Duval	10	6
Leon	9	6
Pinellas	7	4
Escambia	7	4
Palm Beach	4	3
Total	109 sites	68%

(Total sites stocked assumed to be 158)

Continued on page 21

DNR:
New Faces — Different Places

By

Jeff Schardt

Various changes have taken place during the past year at the Department of Natural Resources (DNR) which relate to the aquatic plant control community. Several positions have been added, new personnel hired and duties and responsibilities have been realigned. The following is a summary of the most significant of these changes.

Mr. Jack Woodard, formerly the Department's Assistant Director of the Canal Authority and interim Chief of the Bureau of Aquatic Plant Research and Control was appointed Assistant Director of the Division of Resource Management on October 1, 1985. Also, he is currently serving as interim Division Director until a permanent director is appointed. Jack will continue to be involved in the aquatic plant control community by serving as DNR's representative on the Aquatic Plant Adivisory Council. Concurrently, Ms. Shirley Fox was appointed Chief of the Bureau as Jack's replacement. Prior to her appointment, Shirley worked for DNR's Internal Audit Section as a Program Management Specialist. In addition to her current duties, Shirley will serve as DNR's alternate Advisory Council representative.

Shirly Fox

Personnel and program changes have occurred in each of the Bureau's three sections (Research, Survey and Control Permitting and Grants Administration). Two research positions were appropriated by the Legislature in the Bureau's 1985-86 approved operating budget. Rob Kipker, a graduate of Michigan State University and formerly a temporary employee in the Research Section for the past year-and-a-half, has been selected as the Section's Biological Scientist II assigned to the Tallahassee office. His duties are to assist in the ongoing in-house research as well as assist in the exotic aquatic plant permitting and inspection program. A second Research position approved by the Legislature (Biological Scientist III) has not yet been filled. This position, which should be operational by January 1986, will be located in Gainesville at the Center for Aquatic Weeds. The person selected will develop a technology transfer program, training materials, and assist aquatic plant managers in solving aquatic plant control related problems.

A program change affecting both the Survey and Control Permitting and Grants Administration Sections was initiated on November 1, 1985, to more effectively monitor aquatic plant populations and control operations. In addition to the six regions, each staffed with a biologist from the Survey and Control Permitting Section, the state has been divided into three districts, each staffed with a biologist from the Grants Administration Section. The Regional Biologists will continue to perform four major functions: 1) annually survey aquatic plant populations in approximately 500 public water bodies, 2) issue permits under the Rules of Chapter 16C-20, F.A.C., 3) provide education and information services to the general public, and 4) conduct investigations for violations of the aquatic plant control permitting rules. The Grants Administration Section District Biologists will assist the Regional Biologists in conducting the annual aquatic plant survey; however, their primary functions will be to: 1) provide educational and program design assistance to cooperators and grantees who participate in the aquatic plant control funding programs, and 2) monitor state (Chapter 16C-50, F.A.C.) and federally funded aquatic plant control operations to ensure efficiency and effectiveness.

Marty Allsup, formerly of Aquatic Systems, Inc., was selected in June to fill the Biological Scientist III vacancy in the Southern District's West Palm Beach office. The Legislature also approved a second field position in the Grants Administration Section which was filled on November 1 by Stephanie McCarty, who was affiliated with the Environmental Protection Department at DisneyWorld. She is assigned to work in the Central District's Orlando office. The Northern District will be staffed by Brian Nelson who has been with DNR for five years; the past year-and-a-half with the Grants Administration Section.

Finally, the St. Johns regional office was relocated from Palatka to Orlando on October 1, 1985, to more effectively handle the increased survey and permitting workload in Central Florida. In conjunction with this move, all of Alachua County was placed under the jurisdiction of the Suwannee River Regional Biologist.

Plant Biomass in Several Florida Rivers

by
Mark Hoyer and Dan Canfield
Center for Aquatic Weeds

A project to determine the nutrient assimilation capacity of the Little Wekiva Rivier, Seminole County, was initiated because it was hypothesized that nutrient discharge from the wastewater treatment plant at Altamonte Springs was causing a degradation of the biological functioning of the river. Excessive growth of paragrass *(Panicum purpurascens)* was offered as evidence to support the hypothesis that eutrophication was adversely affecting the biota in some sections of the river. A definitive determination of the effect of discharging nutrient-rich effluents into the Little Wekiva River, however, has proven difficult to obtain. One small aspect of this study, which will be reported in this paper, was the need to measure plant biomass in the Little Wekiva River and other Florida rivers with a range of nutrient loads.

The aquatic vegetation in the study rivers was sampled by the use of two boats and divers. One boat started at the mouth of the river and the other boat started at the headwater area. To randomly sample the plants each boat was motored at idle speed for five minutes. When the allotted times had passed, a sampling transect was established across the river perpendicular to the main flow. The river width, depth and plant abundance were measured at five equally spaced locations along the transect. At each plant sampling location a $0.25m^2$ quaduat was dropped and divers removed all vegetation present within the quaduat. The vegetation was placed in meshed nylon bags, spun to remove excess water and weighed to obtain fresh weight biomass estimates. Prior to leaving the transect the species of aquatic plants present were recorded.

The aquatic vegetation in the Little Wekiva River was sampled in March and September 1985. Plants were not sampled prior to March because the aquatic macrophytes in some sections of the river had been sprayed with herbicide. By March, however, plants were again growing in all sections of the river. Analyses from data collected along 90 transects indicates the aquatic macrophyte biomass in the Little Wekiva River averages 1.7kg (fresh weight)/m^2(Table 1). Aquatic macrophyte biomass, however, varies considerably in different sections of the river. In areas where the forest canopy completely covers the river, there are no aquatic macrophytes. Where there is no forest canopy, aquatic macrophytes biomass generally averaged greater than 1kg (fresh weight)/m^2. In the region of the Springs Landing Bridge, an area where there is no forest canopy, aquatic macrophyte biomass on some transects averaged greater than 4kg/m^2.

The presence of more aquatic macrophyte biomass in the open canopy sections of the Little Wekiva River suggests that light availability may be a factor controlling aquatic macrophyte biomass. This hypothesis was also suggested by the U.S. Environmental Protection Agency (1981) study. To further test this hypothesis, paragrass is currently being grown at the Center for Aquatic Weeds under different light conditions. Growth will be allowed to continue until the onset of winter when plants from the shaded and nonshaded areas will be harvested and compared.

Analysis of the summer aquatic macrophyte biomass in several rivers indicates a wide range of conditions (Table 1). Aquatic macrophyte biomass averaged less than 1kg/m² fresh weight in the Little Econlockhatchee River, Alafia River, and Alligator Creek. Alexander Springs, Ichetucknee, Rainbow River, and Wacissa Rivers, all natural spring-fed rivers has an average river aquatic plant biomass in excess of 3kg/m² with the Wacissa River supporting an average of 11kg/m² of aquatic macrophytes. Rock Springs Run and the Wekiva River had a slightly higher average plant biomass per m² than the Little Wekiva River (Table 1). Two rivers with major sewage inputs (Little Econlockhatchee and Alligator Creek) had less macrophytes and four natural spring-fed rivers (Ichetucknee, Rainbow River, Alexander Springs, and Wacissa River) had more macrophytes than the Little Wekiva River. This suggests that nutrient inputs to Florida rivers are not the major factors determining macrophyte biomass in Florida rivers systems.

The factors that control the biological functioning of Florida rivers are poorly understood. The intense study of the Little Wekiva River along with survey information of several Florida rivers should yield valuable information on the management and use of Florida river systems.

Table 1. Average fresh weight biomass of aquatic macrophytes in some Florida rivers. Numbers in parenthesis are the minimum and maximum values measured.

River	County	Fresh Weight (kg/m² ±) Plant Biomass
Little Wekiva	Seminole	1.7 (0-14)
Alexander Springs	Lake	4.4 (0-24)
Ichetucknee	Columbia	5.7 (0-16)
Alligator Creek	Bradford	0.7 (0-7)
Rock Springs	Orange	2.0 (0-8)
Little Econlockhatchee	Orange/Seminole	0.2 (0-3)
Wacissa	Jefferson	11 (0-23)
Wekiva	Orange/Seminole	1.9 (0-8)
Alafia	Hillborough	0.2 (0-3)
Rainbow	Marion	3.4 (0-6)

Update on Pyrrhalta Nymphaeae (Galerucella) in Central Florida

by
Jim Kelley
Southwest Regional Biologist
Department of Natural Resources

The native insect *Pyrrhalta Nymphaeae* (Galerucella) commonly referred to as the Lily leaf beetle, and reported on by John Cassani in the September '81 issue, has been active in Central Florida. While surveying Lake Weir in November of '84, I discovered that the *P. Nymphaeae* had temporarily wiped out the Nuphar population, which is its primary host.

Patches of fragrant Water-lily intermixed with the Nuphar were untouched. The water-lily leaf beetle which belongs to the family Chrysomelidae (leaf beetles) is found throughout North America, Northern Europe and in various areas of North and Central Florida including Lake Gibson (Polk County), Lake Eustis (Lake County, Lake Miccosukee (Jefferson County), Lake Weir (Lake County).

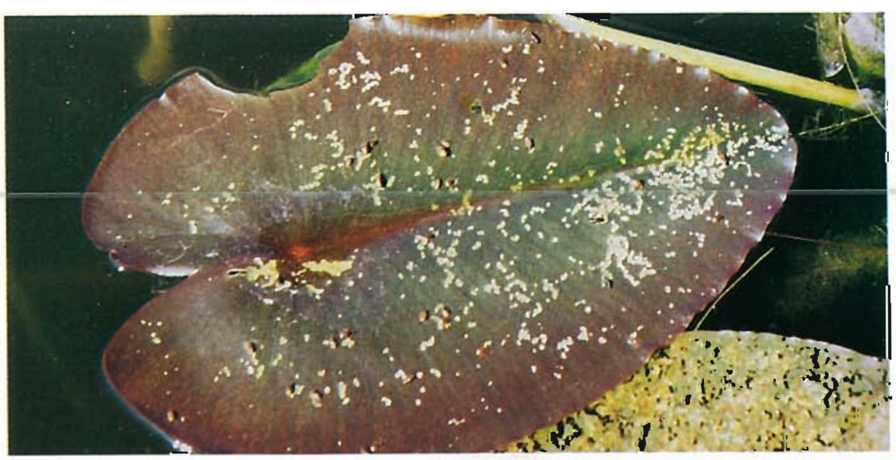
The larva and adults of the Lily-leaf beetle attack the Nuphar stem and flower and in some cases as was observed on Lake Weir, the leaves are entirely destroyed, probably with the help of fungal pathogens. Many Nuphar leaves observed on Lake Weir contained up to 50 or more adult *Pyrrhalta.*

More research is needed on *Pyrrhalta nymphaeae* to assure its safety as a biological control agent. Presently, indications seem to show that the insect is not easily spread. I have not observed these insect on nearby Lake Tsala Apopka which contains approximately 2,000 acres of Nuphar. *Pyrrhalta* normally reduces the population of Nuphar rather than totally destroying it.

Although *P. nymphaeae* has been found on some other types of aquatic vegetation, including *Polygonum* (Smartweed), it appears to greatly prefer Nuphar.

The adult *Pyrrhalta nymphaeae* is dark brown on top with yellow margins and approximately 6mm long. The larvae are black or dark brown above and yellow underneath and are approximately 8mm long.

Nuphar, in many situations is desirable as fish & wildlife habitat and each potential site must be carefully considered prior to attempted controls with biological and /or other means.



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The 9th Annual Meeting of the FAPMS

The attendance at this year's annual meeting goes on record as the largest ever. More than 350 people registered for the meeting, packing the conference hall to its capacity.

Paul Myers welcomes Clarke Hudson to the elite group of past Presidents.

This year's winner of the Applicator of the year recognition award was John J. Fernandes, Aquatic Bio Technician for The Lake Doctors, Inc. John was a commercial deep sea diver and a graduate of the Commercial Diving Institute of New York prior to his entering the field of Aquatic Plant Management. While vacationing in Florida, he saw a commercial aquatic applicator and became interested enough to change jobs and move to Florida. Now aquatics is in his blood and he is extremely proud to be involved in this industry and this Society.

Left bottom: The first recipient of the FAPMS William L. Maier Scholarship was awarded October 17, 1985, at this year's annual meeting. The scholarship committee selected Patricia L. Smith who is an undergraduate assistant to Dr. John Osborne. Patricia is a limnology major interested in working with the grass carp, and is an active member of FAPMS, Fl. Native Plant Society, Audubon, and the National Wildlife Federation. Patricia's essay, submitted as part of the requirements of the award, dealt with the reasons why we manage aquatic plants in Florida. The Society hopes that this award will help aid Patricia through her studies at UCF.

Additional Award Winners

Photo Contest:
Operations - 1st Place - Joe Hinkle
Aquatic Scenes - 1st Place - Joe Hinkle
Membership Drive:
Dan Thayer
Best Applicator Paper:
Stew Metzler
Exhibitor Award:
Southern Mill Creek Products Co.

Herbivorous Fish *from page 14*

Escambia and Palm Beach as listed in Table 1.

The total acreage for with permits were requested in 1984 was 5,442, of which 2,658 were stocked (50%). The average site stocked in 1984 was 20 acres, with 39% of sites between 1-5, 23% between 5-25, 14% between 25-100, and 3% greater than 100 acres (Figure 4).

An assessment of 25 sites stocked with triploid grass carp in central and south Florida indicates visible target plant control in 16. Table 2 summarizes the results of the assessment. Hydrilla has been maintained or reduced in 6 sites, naiad and chara in 5, spikerush in 3, filamentous algae in 2 and coontail in 1. Rates which controlled hydrilla were between 13 and 25 per acre in most sites; naiad and chara, 11 and 35 in all sites; spikerush, 20 and 30; filamentous algae, 20 and 35; and coontail, 11 per acre. The 16 sites where control has been documented range between ◄ 1 and 6 acres, except for a 50 - acre lake where coontail was controlled.

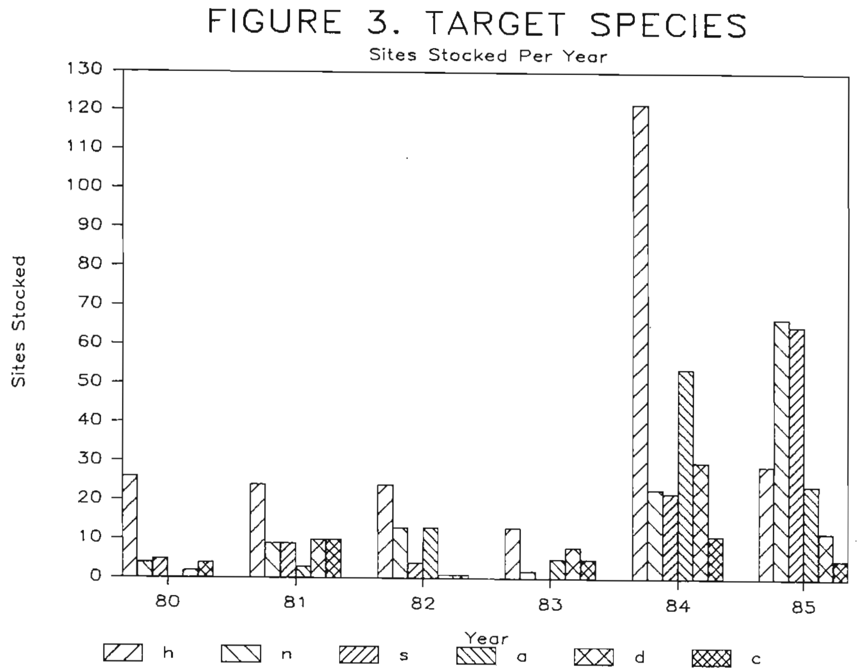
Duckweed and bladderwort were present in 3, and 1 sites, respectively. Duckweed was not affected in a site stocked at 40 per acre, but has recently decreased in coverage in a second site stocked at 60 per acre. Since the density of this species fluctuates naturally, further assessment will be necessary to ensure that fish stocked in the latter site are responsible for the decrease. A third site containing duckweed went dry. Bladderwort growth increased in a site stocked at 18 fish per acre, once hydrilla was reduced.

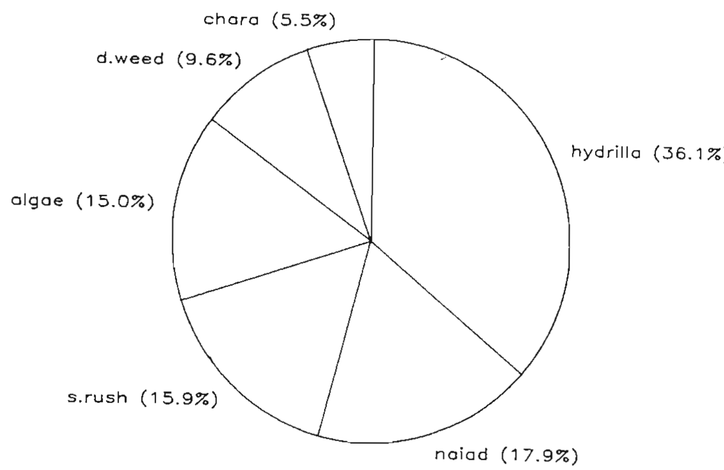
Table 2
25 — Site Assessment

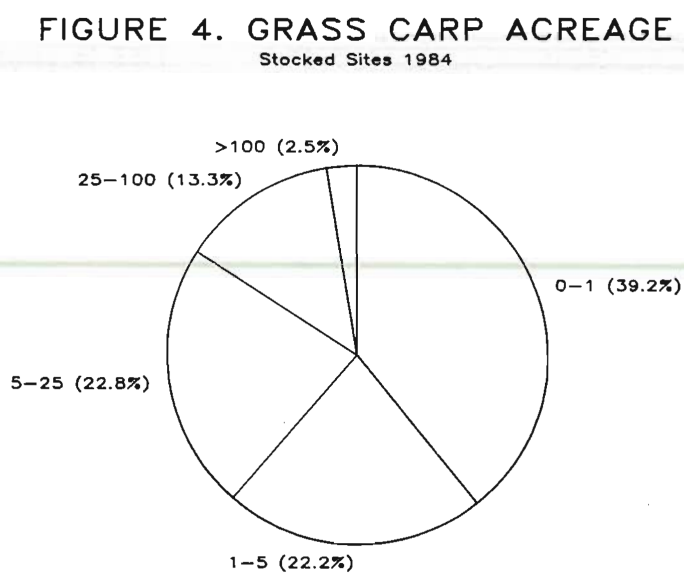
Target Species	(1) Sites Controlled	(2)Stocking Rate
Hydrilla	6	13 - 25
Naiad and Chara	5	11 - 35
Spikerush	3	20 - 30
Filamentous Algae	2	20 - 35
Coontail	1	11

(Sites ranged ◄ 1 to 6 acres, except for 50 - acre site with coontail.(

(1) Triploid grass carp stocked between 1984 - 1985
(2) Number fish per surface acre







Pithophora *from page 9*
chelated copper compounds, or Hydrothol 191. Combinations of copper and diquat or copper and Hydrothol are frequently used with some success. The addition of Cide-Kick to copper-Hydrothol combinations appears to enhance activity.

Good distribution of the chemicals, including that to botton-lying mats, is essential. Repeat treatment every 3 to 4 weeks may be necessary to prevent mats from floating to the surface. Repeat treatments are also necessary when longer-lived chemicals such as Aquazine are used. However, given the longevity of akinetes that may be stored in the sediments, it is doubtful that any chemical treatment will provide long-term control.

In the long run, nutrient reduction, in those bodies of water where nutrient input can be regulated, is the most promising control measure for *Pithophora*.

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YOU KNOW ITS GOING TO BE A BAD DAY WHEN........

1. Your supervisor tells you to grab the dip nets & buckets;
2. The overhanging limb you just docked under is full of WASPS;
3. You attempt returning to the ramp to find the control structure closed between you and the ramp;
4. When someone stuffs a ripe cattail down your defroster vent;
5. After getting your airboat unstuck, the resident holding a leaf rake says "Thanks alot, Buddy";
6. You load up your spray tank for Hyacinths and rain drops start falling;
7. Your quick disconnect fitting does just that;
8. You step down into the boat to find out your Polymer container has been leaking;
9. You wife finds Burger King wrappers in your lunch box;
10. The granules you just applied turned out to be your emergency chemical spill absorbent granules;
11. Your boss wakes you up at the ramp;
12. Game and Fish asks you what the D/O was BEFORE you treated a certain area;
13. As you're pouring Bulls-Eye in your tank, a freak gust of wind comes through;
14. You complete the filling of your mix tank to find the drain has been open;
15. When you stick your airboat on a sand bar and the tide is going OUT at 4:30 p.m.;
16. The sign you didn't SEE at the Drive-Thru Window said, "CLEARANCE 8'0".

CITRUS COUNTY ENVIRONMENTAL DIVISION

AQUA — VINE

"BURN LAW"

As of June 12th, a new ruling allows for the burning of pesticide containers made of paper, plastic or burlap to be done in the field. Burning may be done between 9:00 a.m. and sunset, at least 200 feet from buildings or wooded areas and 100 feet from public roads. A maximum of 500 lbs. of containers can be burned per day at any one location. For further information contact the Florida Environmental Regulation Commission or your local Extension Agent.

USEFUL TOLL-FREE NUMBERS

Pesticide Accident 1 (800) 424-9300
Pesticide Information. . 1 (800) 241-1754
Pesticide Clearinghouse 1 (800) 858-7378
Amnesty Days Hotline. 1 (800) 342-0184

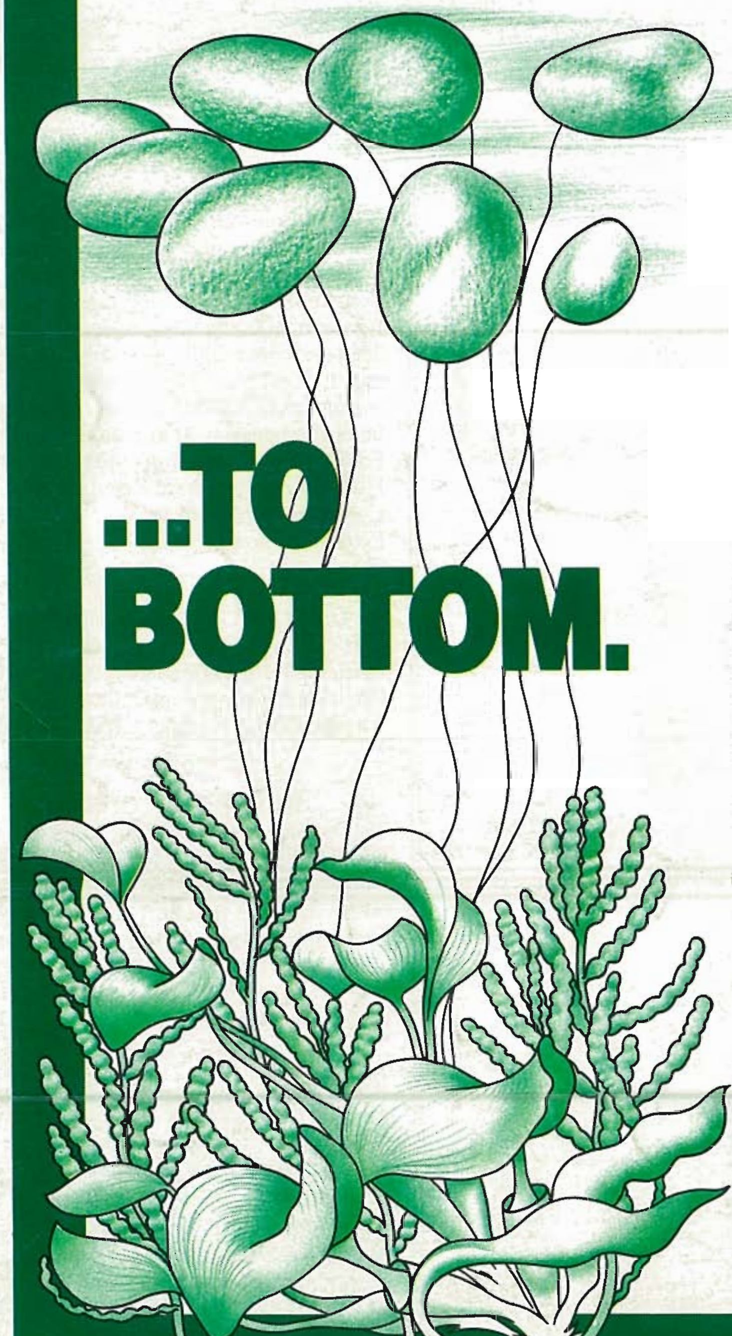
IFAS SHORT COURSE

This is the year of the IFAS Aquatic Weed Short Course. The course will be held in Gainesville, June 9-13. More information on the short course will be available at a later date. If you have comments or questions about the short course contact Joe Joyce at the Center (904) 376-0732.

GRADUATE SCHOOL

Graduate assistantships are presently available at the University of Florida for those interested in pursuing a M.S. or Phd.in Aquatic Pant Management, Assistantships range from $ 7-10,000. per year depending upon your qualifications. If you are interested in otaining further information, contact the Editor at (904) 376-0732.

DIQUAT CLEARS OUT WATER WEEDS FROM TOP...



...TO BOTTOM.

Water weeds that clog Florida's waterways are sunk when treated with ORTHO DIQUAT Herbicide-H/A. DIQUAT is a broad spectrum herbicide that kills both floating and submerged weeds—even the tough ones like hydrilla, water lettuce and water hyacinth. And DIQUAT works fast—in just a few days after application you can see dramatic results.

DIQUAT interrupts photosynthesis in plants. And DIQUAT is economical to use. It can be used to spot-treat small areas, or control larger infestations. When surface spraying, apply with ORTHO X-77® Spreader for best results.

Licensed applicators: see supplemental label for complete details.

ORTHO DIQUAT. It sends water weeds straight to the bottom.

Chevron

ORTHO

Chevron Chemical Company

DIQUAT
Herbicide-H/A