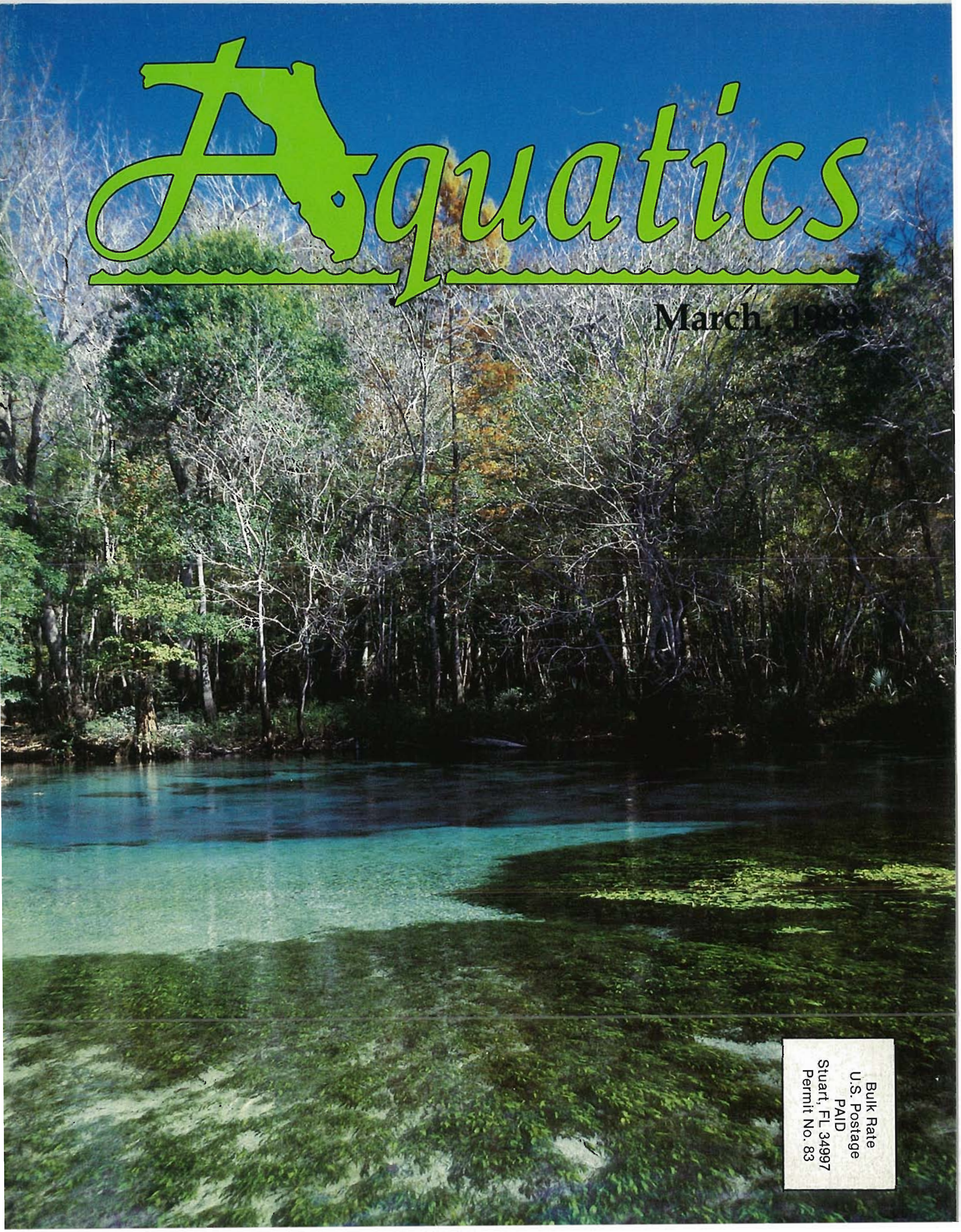
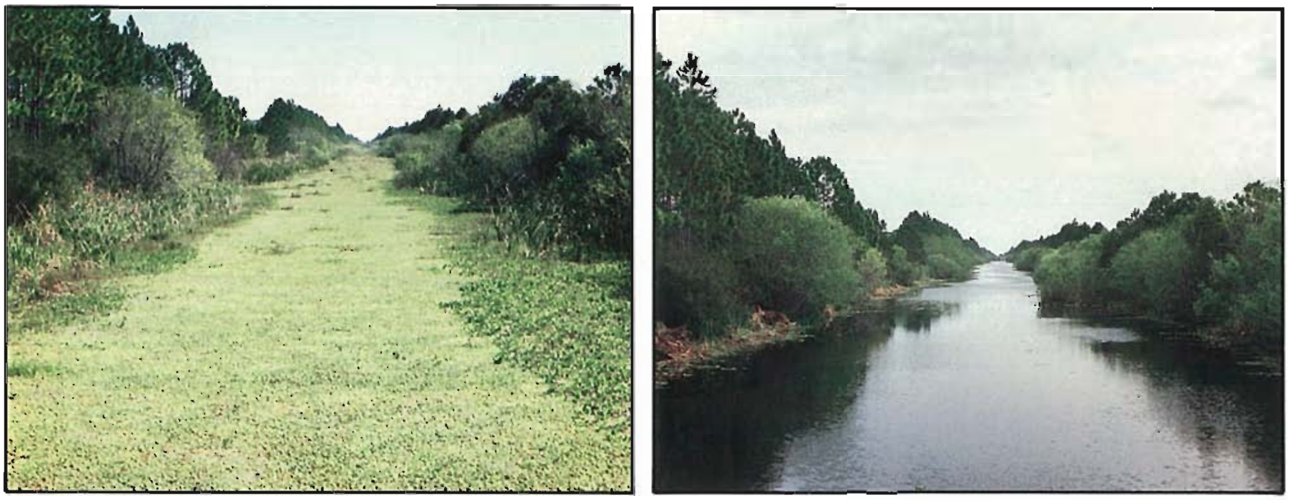
Aquatics

March, 1988





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Unfortunately, many of these creative ideas are not being shared with everyone affected by their need. Some Applicators tend to show reluctance when called upon to contribute an article to the *Aquatics* magazine or give a presentation at our annual meeting, thus restricting the far reaching effect that both sources have on the aquatic plant control industry.

The Society was founded on the concept that ideas and technology should be discussed and exchanged. Most ideas that are simple or mundane to the creator, often have a significant impact to someone still in search of a related need.

The Florida Aquatic Plant Management Society is based on a solid foundation of expertise that ranges widely from the scientist to the applicator. Broadening our field of knowledge in search of a better way, we should strive to exemplify the true meaning of professionalism through an increased sharing of operational technology.

Edward D. Knight

ABOUT THE COVER

Cypress Spring boil in Holmes Creek, a tributary of the Choctawhatchee River.

Photo by: Jess Van Dyke

Aquatics

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CONTENTS

AQUATICS: Published quarterly as the official publication of the Florida Aquatic Plant Management Society. This publication is intended to keep all interested parties informed on matters as they relate to aquatic plant management particularly in Florida. To become a member of the FAPMS and receive the Society newsletter and Aquatics magazine, send $10[00] plus your mailing address to the Treasurer.

EDITORIAL: Address all correspondence regarding editorial matter to Daniel Thayer, Editor, "Aquatics" Magazine, 7922 N.W. 71st Street, Gainesville, FL 32606.

The Florida Aquatic Plant Industry

By
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The aquatic plant industry began in Florida in the late 1950s and early 1960s, when a few entrepreneurs began to cultivate native and exotic varieties of aquatic plants for the aquarium trade (McLane 1969). The industry has expanded in the state, and today there are 30 permitted aquatic plant farmers, 12 of which also import species of plants from all over the world. It is estimated that yearly gross sales for the industry is currently about six million dollars (Don Schmitz, DNR, personal communication). It is estimated that for every dollar of income to the industry, seven dollars of associated business income are generated (Don Bryne, personal communication). By this estimate, the total industry contribution to the state's economy is about 48 million dollars.

Florida's climate is ideal for the culturing of aquatic plants. Most of the aquatic plant growers in Florida are located in south Florida in the Miami and Tampa areas. The weather is typically mild and sunny, and ground water is 72-76°F year-round, allowing the culture of aquatic plants without the added expense of greenhouse nurseries. In north Florida many of the same conditions prevail, but as temperatures often dip below freezing in winter, growers must use greenhouses. It is interesting to note, however, that northern growers are able to fill orders from their greenhouse protected stocks when south Florida has experienced a winter freeze, as has happened in recent years. These freezes consequently provide periods of peak sales for northern growers.

Another factor making Florida a major exporter of aquatic plants is the great numbers of both exotic species and native species of aquatic plants occurring in the state's waters, including *Cabomba* spp., *Nymphoides aquatica, Isoetes* spp. *Vallisneria americana, Egeria densa,* and *Sagittaria* spp.; all popular plants in the aquarium hobby. These plants are collected by suppliers under Department of Natural Resources permits, then packaged and shipped with none of the expense associated with the cultivated varieties.

Species of plants are imported from all parts of the world, with a majority of them coming from South America, the Far East, and Africa. Upon arrival the grower either ships the plants directly to dealers or plants them in the nursery where they can be held for later shipment or used as stock for producing more plants.

Many of the species cultured as aquarium plants are not true submersed species, but are plants that have evolved in habitats in which they are submersed during portions of the year. In fact, many species are cultivated that are also sold as house plants. Very often these plants do not grow in the submersed condition, but will maintain their beautiful appearance long enough to be of value to the aquarist. These plants are grown in the emersed form at the nursery, either in beds or hydroponically. In any case, nearly all

The queen of the water lilies, Victoria amazonica *is a popular lily in botanical water gardens throughout the United States.*
Photo by Ken Langeland

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are tropical species and in northern Florida require the warmth and humidity afforded by greenhouses.

An important development in the cultivation of aquatic plants has been the increasing use of hydroponics. One method now in use by some growers was developed by Holger Windelov, founder of Tropica (Taylor 1984a). Tropica is a Danish company which has marketed hydroponically raised aquatic plants throughout Europe for 13 years. The method uses a small plastic "basket" pot which holds the plant in a rock wool substrate. A large sheet of styrofoam with appropriately spaced holes floats many of these potted plants in a tank of nutrient solution, which is changed periodically. Thus, plants are grown with only their roots submerged, with the leafy portions emerged. Problems with soil fungi, nematodes, algae growth, snails and other hazards are consequently eliminated. Rooting and growth are very rapid, and plants are of good, uniform quality. An added benefit of this method is the absorption of nutrients by the rock wool substrate. The rock wool will provide for up to six months of the plants nutrient requirements. The plants are placed in the aquarium substrate without removing them from the pot. Thus the chances of the plant surviving the initial adjustment and rooting stages in the aquarium are much improved (Taylor 1984).

Plants are sold in tropical fish stores, typically at a 50 to 100 percent or greater markup over the store's wholesale cost. Live aquatic plants have varying requirements for light, water quality, and substrate, making their culture and reproduction in the aquarium difficult for most aquarists. Plastic plants are an alternative to live plants in the aquarium, and many of the newer brands of plastic plants appear quite life-like in the aquarium.

For shipping, plants are loosely wrapped in a damp newspaper, enclosed in a plastic bag, and then placed in a sturdy cardboard shipping box. This method keeps the plants alive for two to three days. Florida growers receive orders for aquatic plants from retail stores throughout the United States and Canada, and air freighting the boxes of plants ensures their arrival at the eventual destination in a healthy and living condition.

William McLane (1969), an early aquatic plant farmer, wrote an interesting account and evaluation of the beginnings of the aquatic plant industry in Florida. The "real" aquatic plant industry began in Florida in the late 1950s and early 1960s when several businesses began cultivating aquatic plants. Prior to that time, most of the plants provided for sale to the tropical fish hobbyist were collected from the wild, or were introduced into natural habitats and later harvested. According to McLane's article, in 1968 one firm in North Carolina stocked 25 localities in Florida with both native and exotic species of aquatic plants for harvest at a later date. In those early years of the beginning industry, there was no federal or state regulation of species introduction

One of the more popular aquatic plant groups in the aquarium trade are the sword plants.

Table 1. List of aquatic plants prohibited by the DNR for transport, import, cultivation, collection, sale or possession.

Scientific Names	Common Names
Alternanthera philoxeroides	Alligator weed, green lead plant
Cabomba aquatica	Yellow, green cabomba
Eichhornia spp.	Water hyacinth
Hydrilla spp.	Hydrilla, Florida elodea, stargrass, oxygen grass
Hygrophila polysperma	Hygro
Ipomoea aquatica	Water spinach
Lagarosiphon spp.	African elodea
Limnophila sessiliflora	Ambulia
Mimosa pigra	Giant sensitive plant, cat's claw
Monochoria hastata	
Monochoria vaginalis	
Myriophyllum spicatum	Eurasian watermilfoil
Nechamandra alternifolia	
Pontederia rotundifolia	Tropical pickerelweed
Salvinia spp. (excluding *S. rotundifolia (minimal))*	
Sparganium erectum	Exotic bur-reed
Stratiotes aloides	Water-aloe, soldier plant
Trapa spp.	Water chestnut
Vossia cuspidata	Hippo grass

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or cultivation. The U.S. Department of Agriculture only inspected incoming plant shipments for possible pest and parasite threats to agriculture in the United States. As a result, many species of aquatic plants were introduced into Florida waters, including hydrilla, Brazilian elodea (*Egeria densa*), Eurasian watermilfoil (*Myriophyllum spicatum*) and parrots-feather (*M. aquaticum*), hygrophila, slender naiad (*Najas minor*) and *Salvinia rotundifolia*. McLane estimated that over 200 species of exotic plants had been imported into Florida by aquatic plant entrepreneurs. He concluded that regulation of the new industry was necessary to prevent the further introduction of species potentially harmful to the state's waters.

State regulations governing the aquatic plant industry in Florida were instituted in 1971. Title XXVII of the Florida Statutes, Chapter 369, gives to the Florida Department of Natural Resources (DNR) the authority to protect state waters from the introduction and spread of noxious aquatic plants. Chapter 16C-52 of the Rules and the Department of Natural Resources specifically details regulations governing aquatic plant importation, transportation, cultivation and possession. Chapter 16C-52 provides for the permitting of any person in the state who deals with aquatic plants for any business purposes. The permit is provided at no cost to the applicant, and is renewed yearly.

A general permit may be issued for all activities involving the transportation, importation, cultivation, collection, sale or possession of any non-prohibited aquatic plant. Prohibited plants are listed in 16C-52.011 and include 19 plant species, fewer than half of which are aquarium plants (Table 1). The important provisions of the permit program are:

- A permittee importing plants must notify the Bureau of Aquatic Plant Management (DNR) in writing within seven days after the arrival of imported plants. The notification includes the botanical identification of the imported species.
- If the permittee intends to culture any aquatic plants, the DNR must inspect the facility to ensure that it will not contaminate adjacent waters.
- Permitted facilities are subject to inspection by any law enforcement officer or inspector "at any reasonable time."

In the event of non-compliance with any of the rules and regulations of 16C-52 or Chapter 369 of the Florida Statutes, the permittee may be subject to fines not less than $100 nor greater than $1,000, and imprisonment not to exceed 6 months. In addition, the permit may be revoked or suspended by DNR.

Any aquatic plant may be imported into Florida, as long as it is not on the 16C-52.011 prohibited list. The prohibited list includes all of the species known to have created problems in other locations world-wide and are suspected to pose a threat to Florida's waters. Incoming shipments of plants are inspected by the U.S. Department of Agriculture for possible agricultural pests and for aquatic plants prohibited from importation into the United States by the USDA as outlined in 7 CFR Ch. III, 1/1/87 Edition (Table 2). USDA also cooperates with Florida DNR by inspecting shipments of plants for suspected prohibited species as specified by the DNR. In the event such prohibited species are found, the DNR is contacted and the shipment is confiscated pending inspection by DNR personnel. Such occurrences are rare, however (Katherine Gilbert, personal communication).

The DNR has three full-time inspectors in Florida whose job it is to regularly inspect facilities permitted under the provisions of 16C-52. Importers' facilities are inspected four times a year, and retail stores are inspected once or twice a year (Katherine Gilbert, personal communication). Furthermore, the level of regulation is not so stringent as to severely limit the operations of aquatic plant growers

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and suppliers in the state (Don Bryne, personal communication).

The tropical fish industry and the aquatic plant industry are companion industries. As the popularity of the tropical fish hobby continues to grow in this country, associated businesses will likely grow in proportion. The combination of ideal climate and non-restrictive state laws governing the aquatic plant industry ensures the growth and future of the industry in the state of Florida.

References and Suggested Readings

[1] Erlich, Julie A. 1986. *From around the world to our own backyards.* Aquarium 9(11):53-58, 88.

[2] McLane, William M. 1969. *The aquatic plant business in relation to infestations of exotic plants in Florida waters.* Hyacinth Control Journal 8:48-49.

[3] Tarver, D.P.; Rodgers, J.A.; Mahler, M.J.; and Lazor, R.L. 1986. *Aquatic and Wetland Plants of Florida.* Third edition. Bureau of Aquatic Plant Research and Control, Florida Department of Natural Resources, Tallahassee, Florida.

[4] Taylor, Edward C. 1984a. *Aquatic plant revolution* (part 1). Tropical Fish Hobbyist 32(6):54-58.

[5] Taylor, Edward C. 1984b. *Aquatic plant revolution* (part 2). Tropical Fish Hobbyist 32(7):309-36.

[6] Rataj, Karel, and Horeman, Thomas J. 1977. *Aquarium plants: their identification, cultivation and ecology.* T.F.H. Publications, Inc. Ltd., Neptune City, New Jersey.

Table 2. List of aquatic plants designated as noxious weeds and prohibited by the U.S. Department of Agriculture for importation into the United States.

Scientific Names	Common Names
Azolla pinnata	Mosquito water velvet
Eichhornia azurea	Anchored water hyacinth, rooted water hyacinth
Hydrilla verticillata	hydrilla
Hygrophila polysperma	Hygro, miramar weed
Ipomoea aquatica	Water spinach, swamp morning-glory
Lagarosiphon major	Moss, African elodea
Limnophila sessiliflora	Ambulia
Monochoria hastata	
Monochoria vaginalis	
Sagittaria sagittifolia	Arrowhead
Salvinia auriculata	Giant salvinia
Salvinia biloba	Giant salvinia
Salvinia herzogii	Giant salvinia
Salvinia molesta	Giant salvinia
Sparganium erectum	Exotic bur-reed
Stratiotes aloides	Water-aloe, soldier plant

Recent Infestations of Chinese Water Spinach (*Ipomoea aquatica*) in South Florida

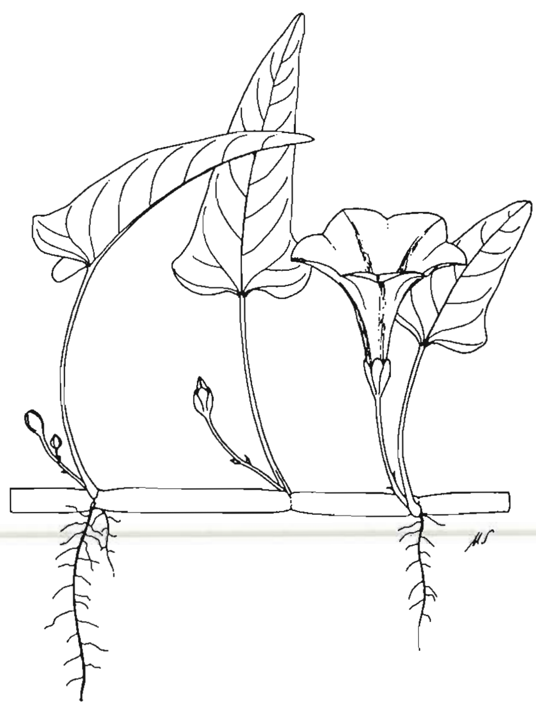
By
Judy Lamia
South Florida Regional Biologist
Department of Natural Resources
West Palm Beach, Florida

Water Spinach (*Ipomoea aquatica*) is a federally prohibited aquatic which has potential to be a threat to Florida waterways. It is a vine-like aquatic morning glory which can also grow on ditchbanks or other moist terrestrial habitats. Water spinach is tolerant of a wide range of physical, chemical, and climatic conditions. Given full sun and substantial nutrients, however, this plant can grow as much as 6 inches/day (Gilbert 1984). Native to southeast Asia, Taiwan and southern China, water spinach is favored as an edible vegetable by many western cultures. In Florida, this plant has been cultivated for personal use and for sale in local markets (Gilbert 1984). Because water spinach is edible and can grow rapidly, the chances of its introduction and establishment in Florida waterways are increased. If established, this plant may cause problems in moist cultivated areas such as rice and sugar cane fields, slow flowing canals, and the Everglades (Gilbert 1984).

On December 16, 1987 the Florida Department of Agriculture and Consumer Services informed the DNR Bureau of Aquatic Plant Management (B.A.P.M.) of a water spinach cultivation in Palm Beach County. Approximately 600 square feet of water spinach was found in a drainage canal with smaller disjunct cultivations in neighboring canals. An inspection by B.A.P.M. personnel revealed the water spinach was deliberately planted and used as food by nearby residents. Based on a recent independent investigation by Lake Worth Drainage and Joyce Environmental Consultant personnel, a second larger cultivation of water spinach was found in drainage canals of a nearby farm. It is possible, but as yet undetermined, that this second cultivation was planted as a cash crop. A coordinated effort is now underway between DNR-BAPM, LWDD, and landowners to remove these cultivations of water spinach.

For those of us involved in aquatic plant management, the reasons for keeping water spinach out of Florida waterways are obvious. For those people, however, who consider this plant profitable and/or edible, problems associated with "prohibited aquatic plants" may not be readily obvious. As in any aquatic plant management program, public education in combination with chemical, biological, or mechanical control will help to prevent the establishment of *Ipomoea aquatica* in Florida waterways.

Editor's note: For more information about water spinach, refer to the article in the September, 1979 issue of "Aquatics".

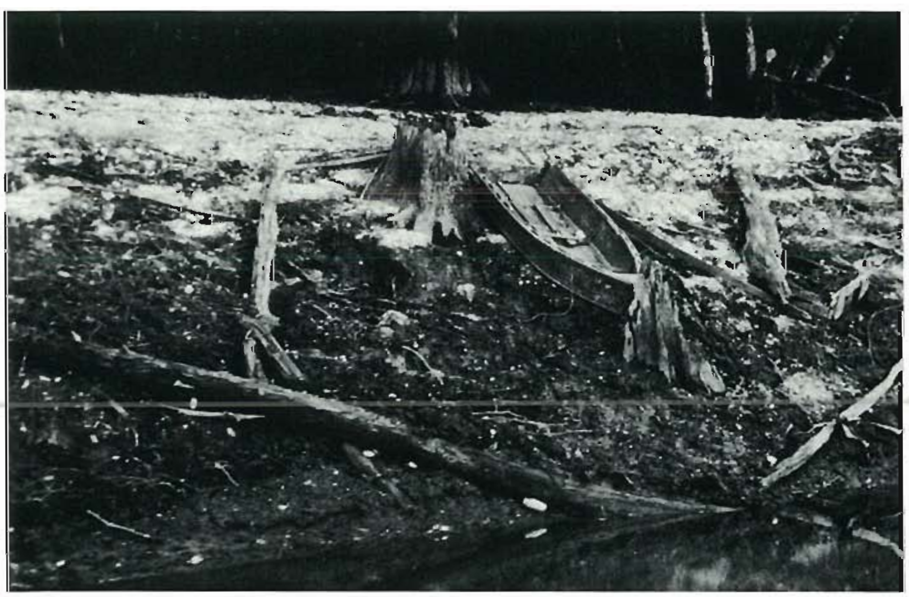


Drawing of Ipomoea aquatica *taken from Cook's "Water Plants of the World". Flowers are funnel-shaped and pink or pale lilac in color.*

Literature Review of Drawdown for Aquatic Plant Control

By
Andrew J. Leslie, Jr.
Florida Department of Natural Resources
Bureau of Aquatic Plant Management
Tallahassee, Florida

More and more lakes in Florida are being modified to allow strict regulation of water levels for purposes of flood control, mosquito control, irrigation and water storage. Stabilization of water levels, especially when regulated to the extent of being nearly static, produces profound changes in the lake system. The most elevated portion of the highly productive flood plain is protected from flooding, encouraging agricultural and urban development lakeward of the previous high water mark (Holcomb and Wegener 1971). The removal of natural vegetation which accompanies urban encroachment around the stabilized lake increases storm water runoff. Nutrients carried by runoff can be especially degrading to the aquatic habitat when combined with highly organic sewage effluents and agricultural runoff (Wegener and Williams 1974 a,b; Dooris and Courser 1976; Martz 1976). Enrichment leads to increased sedimentation rates and produces layers of unconsolidated organic (flocculent) material which destabilize the hydrosoil (plants cannot root and fish cannot construct spawning beds) and has a high biological oxygen demand (Holcomb and Wegener 1971, 1974; Dineen 1974; Wegener and Williams 1974 a,b; Dooris and Courser 1976; Martz 1976; Williams and Moyer 1978). Especially in deeper water, the resulting decline in dissolved oxygen becomes more acute as long as organic sedimentation exceeds oxidative decomposition rates within the lake, reducing the habitable area of the lake for fishes and invertebrates (Holcomb and Wegener 1971, 1974; Dineen 1974; Dooris and Courser 1976; Martz 1976; Williams and Moyer 1978).



To effectively reduce populations of submersed aquatic plants, the drawdown should expose as much of the photic zone as possible.

Drawdowns have been used successfully to retard the aging process and eutrophication of lakes (Jester 1971; Richardson 1975; Goldsby 1976). Dewatering aerates and dries the hydrosoil allowing accelerated oxidative decay of organic bottom sediments (Jester 1971; Wegener and Williams 1974 a,b). Drying eliminates flocculent organics, and compacts and stabilizes the hydrosoil (Wegener and Williams 1974 a,b; Richardson 1975; Martz 1976). Fluctuation of water levels (both natural and artificial) can be very effective at reducing problem populations of submersed aquatic plants (Cooper 1966; Lantz 1974; Richardson 1975; Davis and Brinson 1980) and managing fish populations (Bennett 1954; Hulsey 1956; Cooper 1966; Lewis 1967; Jester 1971; Richardson 1975).

The timing of a drawdown is very important. For aquatic plant control with minimal interference with fish spawning, a late summer/fall through winter drawdown is the most effective (Eschmeyer 1949; Wiebe 1960; Manning and Sanders 1975; Richardson 1975). In lakes with dense phytoplankton and loss of rooted aquatics, a late spring drawdown can reestablish emersed and some submersed species (Holcomb and Wegener 1971; Richardson 1975). Consecutive drawdowns are usually more effective for controlling aquatic plants (Richardson 1975; Goldsby 1976) and usually two to three consecutive years are required for

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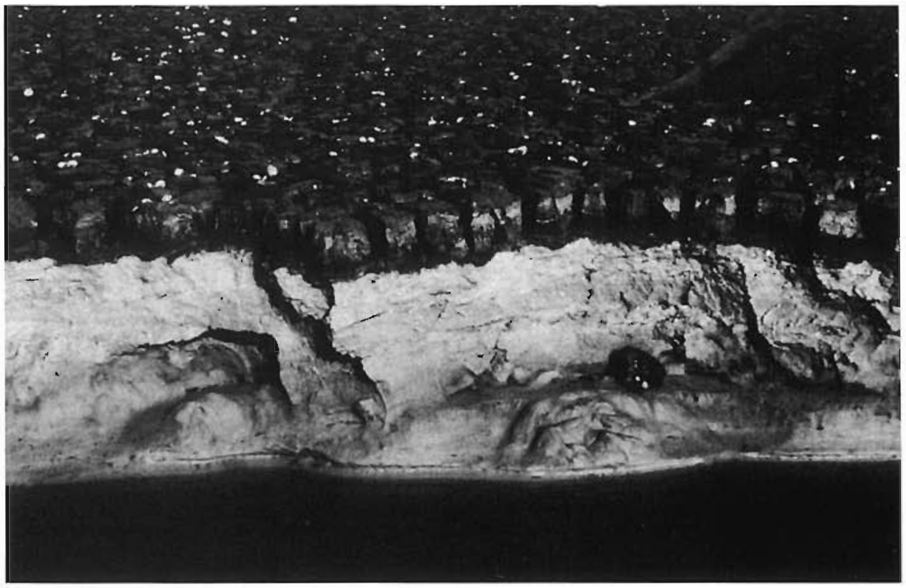

Dewatering aerates and dries the hydrosoil accelerating oxidation and compacting flocculent organics.

Table 1. — Summary of the effects of drawdowns on selected species of submersed aquatic plants based on a literature review. Numbers refer to the references listed below. R = reduced; I = increased; NC = not changed.

Species	Common Name	Drawdown	Drawdown & Herbicides	Consecutive Drawdowns
Cabomba	fan worts	R 1 11 13 14 16	—	NC-I 10, R 4
Ceratophyllum	coontail	R 1 2 7, I 11 13	—	NC-I 4 10
Chara	muskgrass	I 1 11 12 13	R 12	I 4, R 10
Egeria densa	Brazilian elodea	R 1 7 11 12 13	R 12	R 4
Hydrilla verticillata	hydrilla	I 1 7	R 12	R 6
Myriophyllum hyterophyllum	variable-leaf milfoil	I 16	—	NC-I 4 10
Myriophyllum spicatum	Eurasian watermilfoil	R 1 5 15, I 15	—	—
Najas	naiad	NC 7, R 1 8	—	NC-I 4 10
Potamogeton	pondweed	NC 2 12, R 1	—	R 4 10
Sagittaria subulata	dwarf arrowhead	R 12	—	—
Utricularia gibba	eastern bladderwort	R 1	—	NC 4
Utricularia inflata	floating bladderwort	I 1 11	—	I 4
Vallisneria americana	tapegrass	NC 7, I 1 9, R 8	—	—

[1]Carter (undated)
[2]Davis and Brinson (1980)
[3]Dineen (1976)
[4]Goldsby (1976)
[5]Goldsby et al. (1978)
[6]Haller (1976)
[7]Hestand and Carter (1975)
[8]Holcomb and Wegener (1971)
[9]Holcomb and Wegener (1974)
[10]Lantz (1974)
[11]Manning (1974)
[12]Manning and Johnson (1975)
[13]Manning and Sanders (1975)
[14]Richardson (1975)
[15]Stanley et al. (1976)
[16]Tarver (1980)

control (Lantz 1974; Richardson 1975). Submersed aquatic plants generally do not survive where drawdown persists for several years, or occurs frequently during one growing season (Davis and Brinson 1980).

Based on data presented by Hughs (1974), Dooris and Courser (1976) proposed a plan to simulate the natural water flucuation cycle usually encountered over a five-year period in central and south-Florida lakes. These authors defined four water levels to be used in their plan:

1) Maximum Operational — an elevation immediately below wax myrtles (4-6 feet tall), the palmetto fringe, or roughly two-thirds up the buttress of cypress;

2) Maximum Desirable — an elevation near the elevation of willow, buttonbush and cypress;

3) Minimum Desirable — the water level allowing year-long flooding of emersed aquatic plants such as *Pontederia* and *Sagittaria*.

4) Minimum Operational — the water level at about the lakeward extent of emersed aquatic plants. Dooris and Courser proposed to keep the water levels dynamic but between Minimum and Maximum Desirable (average conditions) well over fifty-percent of the time. Maximum Desirable should be reached during the rainy season and Minimum Desirable during the dry season. Maximum and Minimum Operational (corresponding to above and below average rainfall years) should be included twice and once during each five-year cycle, respectively. Wegener and Williams (1974 a,b) and Williams and Moyer (1978) proposed a similar regimen for Lake Tohopekaliga, Florida. They proposed that water levels should always be dynamic, with high and low pools reached at least once during a three-year cycle, and with at least a three-foot yearly fluctuation. An extreme drawdown was to be included once every six to seven years. Similar designs were presented by Richardson (1975).

The effects of drawdowns on aquatic plants are summarized in Tables 1 and 2. In general, submersed species can be effectively controlled but emersed species increase or are not affected. The biology of the target vegetation must be well known for best results. For example, in late summer-early fall hydrilla produces subterranean tubers that are resistant to dessication (Haller 1976). Drawdown kills the above-ground plants but the lake system is quickly reinfested by regrowth from tubers. In this case, a single ill-timed drawdown (even annually) would act to give this species a large ecological advantage by reducing plants which may compete with it. Haller (1976) recommends a spring drawdown to kill the standing crop followed by another drawdown prior to tuber production to kill hydrilla sprouted from tubers. A related species, Brazilian elodea, does not produce subterranean tubers or seeds, thus can be controlled by properly conducted drawdowns (Table 1). In lakes with a depauperate rooted aquatic flora, drawdowns conducted during the growing season will allow encroachment of terrestrial vegetation and spread emersed aquatics. If an extensive (or adequate) marginal flora exists, then a winter drawdown will minimize spread of the marginal species.

Literature Cited

1 Bennett, J. W. 1954. *The effects of a late summer drawdown on the fish population of Ridge Lake, Coles County, Illinois.* Transactions of the North American Wildlife Conference 19:259-270.

2 Carter, C. C. undated. *Response of aquatic plants to water level flucuation.* Unpublished report, Florida Game and Fresh Water Fish Commission, Tallahassee.

3 Cooper, G. P. 1966. *Fish production in impoundment.* Res. Dev. Rep. Mich. Dep. Conserv. 104:21 pp.

4 Davis, G. V. and M. M. Brinson. 1980. *Responses of submersed vascular plant communities to environmental change.* U.S. Fish and Wildlife Service Biological Services Program FWS/OBS-79/33.

5 Dineen, J. W. 1974. *Examination of water management alternatives in conservation area 2A.* In-Depth Report Central and Southern Florida Flood Control District 2(3):10 pp.

6 Dooris, P. M. and W. D. Courser. 1976. *Determining stages and flucuation schedules for regulated lakes in central and south Florida.* Florida Scientist 39:14-18.

7 Eschmeyer, R. W. 1949. *The fisheries picture with special reference to the TVA impoundments.* Progressive Fish-Culturist 11:267-271.

8 Goldsby, T. L. 1976. *Effects of consecutive water fluctuation on submersed vegetation and water quality of Black Lake, Louisiana.* MS Thesis Northwestern State University, Louisiana.

9 Goldsby, T. L., A. L. Bates, and R. A. Stanley. 1978. *Effect of water level fluctuation and herbicide on Eurasian watermilfoil in Melton Hill Reservoir.* Journal of Aquatic Plant Management 16:34-38.

10 Haller, W. T. 1976. *Hydrilla — a new and rapidly spreading aquatic weed problem.* Agricultural Experiment Station, University of Florida, Institute of Food and Agricultural Sciences Circular S-245.

11 Hestand, R. S. and C. C. Carter. 1975. *Succession of aquatic vegetation in Lake Ocklawaha two growing seasons following a winter drawdown.* Hyacinth Control Journal 13:43-47.

Table 2. — Summary of the effects of drawdowns on selected species of emersed aquatic plants based on a literature review. Numbers refer to the references listed below. R = reduced; I = increased; NC = not changed.

Species	Common Name	Drawdown	Drawdown & Herbicides	Consecutive Drawdowns
Alternanthera philoxeroides	alligator-weed	I[1 7 8]	—	—
Brasenia schreberi	watershield	—	—	R[10]
Cyperus	flat-sedge	I[8]	—	—
Cephalanthus occidentalis	buttonbush	I[3]	—	—
Eichhornia crassipes	hyacinth	I[1 7 9], R[8]	—	—
Eleocharis	spikerush	I[1 9 11 12 13]	—	NC-I[10], I[4]
Hydrochloa	southern water-grass	I[1], R[9 12]	—	I-R[4]
Ludwigia arcuata	lugwigia	I[8]	—	—
L. repens	red ludwigia	R[12]	—	—
Myrica cerifera	wax myrtle	I[3]	—	—
Myriophyllum brasiliense	parrots feather	—	—	R[10]
Nelumbo lutea	lotus	—	—	R[10]
Nymphaea	waterlily	—	—	R[10]
Nuphar lutea	spatterdock	I[1 7], NC[15]	—	—
Panicum geminatum	panicum	I[9 11]	—	—
P. hemitomon	maidencane	I[1]	—	—
P. repens	torpedo-grass	I[1]	—	—
Polygonum	smartweed	—	—	NC[4]
Pontederia	pickerel-weed	I[7]	—	—
Sagittaria	arrowhead	I[1 9]	—	I-R[4]
Salix	willow	I[3]	—	—
Scirpus	bulrush	I[1]	—	—
Typha	cattail	R[1]	—	—
emersed	—	I[2 3 8]	—	—

[1]Carter (undated)
[2]Davis and Brinson (1980)
[3]Dineen (1976)
[4]Goldsby (1976)
[5]Goldsby et al. (1978)
[6]Haller (1976)
[7]Hestand and Carter (1975)
[8]Holcomb and Wegener (1971)
[9]Holcomb and Wegener (1974)
[10]Lantz (1974)
[11]Manning (1974)
[12]Manning and Johnson (1975)
[13]Manning and Sanders (1975)
[14]Stanley et al. (1976)
[15]Tarver (1980)
[16]Tarver (1980)

[12] Holcomb, D. E. and W. L. Wegener. 1971. *Hydrophytic changes related to lake fluctuation as measured by point transects.* Proceedings of the 25th Annual Conference of Game and Fish Commissioners, pp. 570-583.

[13] Holcomb, D. E. and W. L. Wegener. 1974. *Response of floodplain vegetation to lake fluctuation.* Unpublished Report, Florida Game and Fresh Water Fish Commission, Tallahassee.

[14] Hughes, G. H. 1974. *Water-level fluctutions of lakes in Florida.* Florida Bur. Geol. Map Ser. No. 62.

[15] Hulsey, A. H. 1956. *Effects of a fall and winter drawdown on a flood control lake.* Proceedings of the Southeastern Association of Game and Fish Commissioners, pp. 285-289.

[16] Jester, D. B. 1971. *Effects of commercial fishing, and drawdown control on fish populations in Elephant Butte Reservoir, New Mexico.* Reservoir Fisheries and Limnology. American Fisheries Society Special Publication Number 8:265-285.

[17] Lantz, K. E. 1974. *Natural and controlled water level fluctuation in a backwater lake and three Louisiana impoundments.* Louisiana Fisheries Bulletin Number 11.

[18] Lewis, W. M. 1967 *Predation as a factor in fish populations.* Reservoir Fishery Resources Symposium. Southern Division of the American Fisheries Society, pp. 386-390.

[10] Manning, J. H. 1974. *Effects of water fluctuation on vegetation and water quality of Black Lake, Louisiana.* MS thesis, Northwestern State University, Louisiana.

[20] Manning, J. H. and R. E. Johnson. 1975. *Water level fluctuation and herbicide application: an integrated control method for hydrilla in a Louisiana reservoir.* Hyacinth Control Journal 13:11-17.

[21] Manning, J. H. and D. R. Sanders, Sr. 1975. *Effects of water fluctuation on vegetation in Black Lake, Louisiana.* Hyacinth Control Journal 13:17-21.

[22] Martz, R. 1976. *Progress report monitoring of Pleasant Grove Reservoir drawdown.* South West Florida Water Management District, Environmental Section Technical Report 1976-7.

[23] Richardson, L. 1975. *Water level manipulation: A tool for aquatic weed control.* Hyacinth Control Journal 13:8-11.

[24] Stanley, R. A., E. Shackelford, D. Wade and C. Warren. 1976. *Effects of season and water depth on Eurasian watermilfoil.* Journal of Aquatic Plant Management 14:32-36.

[25] Tarver, D. P. 1980. *Water level fluctuation and the aquatic flora of Lake Miccosukee.* Journal of Aquatic Plant Management 18:19-23.

[26] Wegener, W. and V. Williams. 1974a. *Fish population responses to improved lake habitat utilizing an extreme drawdown.* Proceedings of the 28th Annual Conference of Game and Fish Commissioners, pp. 144-161.

[27] *Wegener, W. and V. Williams. 1974b. Extreme lake drawdown a working fish management technique.* Unpublished Report, Florida Game and Fresh Water Fish Commission, Tallahassee.

[28] Wiebe, A. H. 1960. *The effects of impoundments upon the biota of the Tennessee River system. In:* Seventh Technical Meeting, International Union for Conservation of Nature and Natural Resources, Greece, 1958, Natural Aquatic Resources 4:101-117.

[29] Williams, V. and E. Moyer. 1978. *Lake Tohopekaliga drawdown and long-term fishery management proposal.* Unpublished Report, Florida Game and Fresh Water Fish Commission, Tallahassee.

Reunion in Florida — Hydrilla, a Weevil, and a Fly

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Nineteen eighty-seven will be remembered not only as the year of the bicentennial celebrations of the United States' Constitutional Convention and of the ''Black or Bloody Monday'' stock market crash, but also as the year insect natural enemies were first introduced to control a submersed aquatic weed. Although not as earth-shaking and as memorable an event as the first two, the latter may have more long-lasting consequences, Cacti have been controlled by introduced insects; shrubs have been controlled by introduced insects; thistles, weedy flowers, vines, and floating aquatic plants have been controlled, but never has a submersed weed been controlled.[1] ''Never say never,'' however, is as American as apple pie and almost a national motto. It thus seems right that the first attempt was made in the United States and in the state where hydrilla achieved its American foothold — Florida.

The first insect reunited with hydrilla was the Indian weevil, or snout-beetle, *Bagous affinis* Hustache (Figure 1). It was released by the United States Army Corps of Engineers (COE) at Lake Tohopekaliga, Osceola Co., Florida, on 30 April. A second insect, the Indian fly, *Hydrellia pakistanae* Deonier (Figure 2), was subsequently released by COE personnel on 29 October at Lake Patrick (also called Lake Lenore) near Frostproof, Polk Co., Florida. Al Cofrancesco, Waterways Experiment Station, COE, Vicksburg, MS, coordinated the releases, which were minor media events receiving both TV and newspaper coverage. Helping Al find suitable sites for the weevil release was Ed Moyer, Game and Freshwater Fish Commission, Kissimmee, Florida, and for the fly release was Mike Mahler, Polk County Environmental Sciences, Bartow, Florida. Agricultural Research Service, USDA, personnel led by Ted Center, Ft. Lauderdale, Florida, will monitor releases and make or organize subsequent releases.

Why this weevil and this fly?

The road from India to Florida was a long one for these new immigrants. Both were first discovered on hydrilla in Pakistan in the early 1970s (fly, 1971; weevil, 1974). The fly was unknown to science at that time, and although the weevil was known, it remained unidentified until 1985. They were discovered by scientists at the Commonwealth Institute of Biological Control (CIBC), Rawalpindi. The CIBC scientists were asked to survey hydrilla through a Public Law 480 project. (PL480 projects are funded by monies owed to the

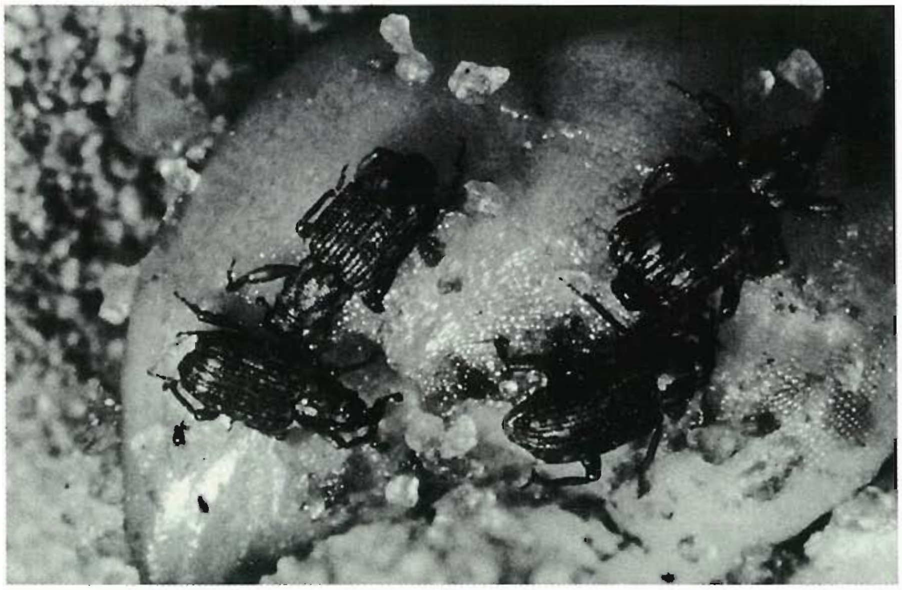


Fig. 1 — The hydrilla tuber feeder, *Bagous affinis*.

United States by the host country which must be spent in that country. These projects contributed greatly to many United States biocontrol programs.)

The Pakistani scientists discovered ten species of hydrilla-eating insects, made field observations on their biologies and host plants, and conducted limited host-range tests. The project highlighted three insects for possible further study.[2] One was a weevil that attacked the submersed stems but pupated (resting stage when the larva changes to an adult) on land; one was a weevil that attacked the tubers when the soil was exposed by receding waters; and the other was a fly that attacked the submersed leaves.

The fly appeared to be the most promising of the three species, and in 1975 Neal Spencer, ARS/USDA, Gainesville, requested permission from the federal Working Group on Biological Control of Weeds to import it into quarantine for testing. The request was denied with the suggestion that further studies be conducted in Pakistan. Unfortunately, that was not possible, since attempts to arrange research in India and Pakistan were unsuccessful. No attempts were made to import the weevils into quarantine at that time because there appeared to be little use for an insect that attacked tubers out of water or for one that had to pupate out of water. Personnel changes also occurred in 1977 which disrupted the hydrilla program for a few years.

The hydrilla foreign research program started anew in 1981 when Dr. Joe Balciunas, a researcher with the University of Florida, Institute of Food and

Agricultural Sciences (IFAS), Ft. Lauderdale, traveled to southeast Asia to survey hydrilla. Dr. Balciunas (working in cooperation with ARS/USDA and with funds from the Waterways Experiment Station, COE, Vicksburg, MS), collected specimens of weevils and flies on hydrilla near Bangalore, India. When he returned from his trip, the specimens were identified to genus, and the weevils were chosen for initial testing. On his return trip in 1982, he sent live weevils to Gainesville. At the same time, he observed the leaf-mining fly, which had been denied entry into quarantine in 1975, extensively damaging hydrilla. A new request for entry into quarantine based upon the information presented in the earlier request was submitted to the Working Group in 1984, but this time approval was obtained early in 1985.

The weevils

Four species were hand-carried to Florida by Dr. Balciunas' assistant, Marc Minno, and were colonized in quarantine. Two species were destroyed in the second generation when they were identified as species studied previously in Pakistan. One of them, *Bagous vicinus* Hustache, was destroyed because its larvae only tunneled hydrilla stems stranded along shorelines and because it was reported from Pakistan on other host plants. The other, *Bagous dilgiri* Vazirani, was destroyed because it also was reported from Pakistan on other host plants and because we were able to rear small numbers on a native pondweed mixed with hydrilla. (This was the species highlighted by the Pakistan PL480 project which attacked submersed hydrilla stems but pupated in exposed soil along the shore. Perhaps this species should be studied in greater detail someday when studies are completed on the more promising candidates.)

The other two species that we colonized fed on tubers in exposed soil. Initially we were unaware of that fact since the adults had been collected on submersed hydrilla during the wet season. By the time we guessed their correct biology and changed our techniques, their small numbers had so declined that we lost both species after the second generation. Later we learned that both of these species had been reared from hydrilla tubers by CIBC scientists but the differences between them were not recognized. They had been reported as a single species which was highlighted for further study.[2]

The next year, 1983, CIBC scientists at Bangalore, India, collected adults of both tuber feeders and sent several shipments of them via

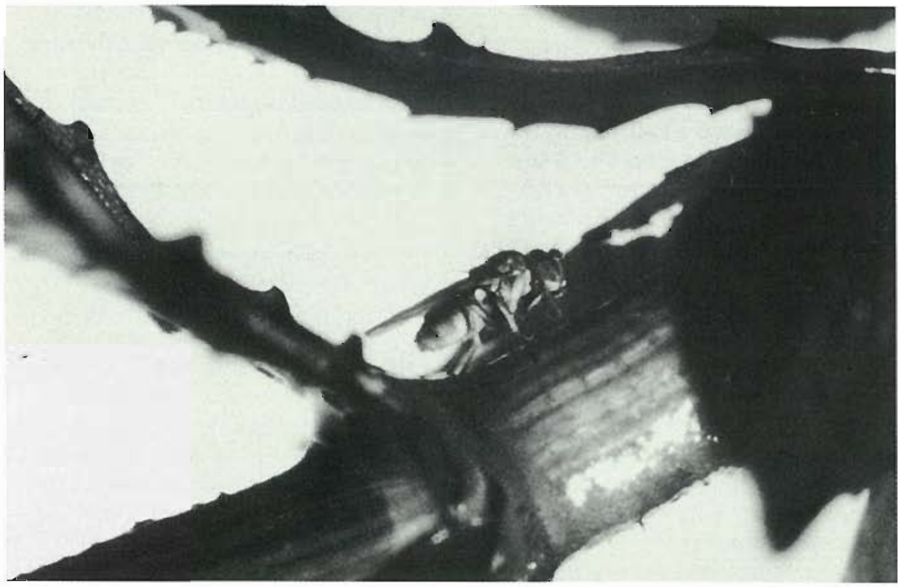


Fig. 2 — The hydrilla fly adult, *Hydrellia pakistanae.*

air freight to Gainesville. Both species were successfully colonized. We initially concentrated our studies on the species which colonized most readily, thus providing greater numbers for testing. That species, which is still undescribed, readily attacked and developed on hydrilla, but we found that it developed even better on sago pondweed, *Potamogeton pectinatus* L., turions. The colony was killed after intensive testing, but the species may eventually be of interest as a biocontrol agent for sago pondweed in western canals. The other tuber feeder was the one eventually released, *Bagous affinis*. We had almost completed testing it during 1985 and hoped to release it during 1986. However, I decided that some high-risk plant species should be retested using new larval test methods adopted after a visit to India in 1985[3]. Since these methods increased the yield of adults in our hydrilla controls, it was prudent to make doubly sure that the weevil larvae would not attack the test plants. The new tests confirmed our original results about the safety of this species, so we submitted a request for release.

Tuber weevil adults feed on submersed hydrilla stems and on stems stranded along the shoreline during periods of high water. I suspect that many may also rest quietly in the soil or under stones. As waters recede during dry periods or drawdowns, females feed on the exposed hydrilla stems and probably oviposit in the stems, in moist wood, and in soil. Soft wood collected from lakes was preferred in our studies. Newly hatched larvae crawl through the soil until they encounter a hydrilla tuber which they enter and eat until mature. If only one or two larvae are present, they pupate inside the tuber, but if multiple larvae are present, as often was found in our laboratory colonies, they pupate in the soil. New adults rest a day or two inside the tuber and then emerge and tunnel to the soil surface. Adults can fly but not when they are in the reproductive phase. (At that time their wing muscles are reduced in favor of eggs.)

At one site studied in Pakistan by CIBC scientists, 45% of the tubers were infested during May, and almost all tubers were infested during June. Although the rains come in August, no hydrilla regrowth was observed by the end of December at that site.

In our laboratory studies, total development took about 22 days at 80° F, adults lived for several months, and females laid 200-300 eggs. Larvae were reared by burying tubers and moist wood containing eggs in sandy soil in terra-cotta vases. Moderate soil moisture levels in the vases were important for success.

The Fly

Flies were collected by Chris Bennett and me during a trip to India and Pakistan in 1985 and were hand-carried to Gainesville for colonization.[3] Additional flies were received that year from the CIBC in Bangalore. Tests were initiated almost immediately and were completed in mid-1987. The differences between the times spent in quarantine by the fly and by the tuber weevil indicate how difficult it is to predict how long it will take to colonize and study insects for release.

The tiny fly adults, 1.5 mm, usually sit on hydrilla or other floating vegetation although they can sit or walk directly on the water surface, if necessary. When they fly it is usually within a few inches of the surface.

Females glue single eggs or small clusters of eggs to the plant material. The newly hatched larvae, even when on hydrilla, usually wander before burrowing into hydrilla leaves. They eat the leaf contents before exiting, leaving behind a transparent leaf. Generally all leaves in a whorl are eaten but stems are not damaged. A larva eats 9-12 leaves before pupating at the base of a leaf where it obtains air through two spine-like breathing tubes inserted into the stem. New adults float to the surface in air bubbles. Complete development took 18-27 days at 80° F, adults lived about 10 days, and females laid about 75 eggs. The flies were easily reared in gallon jars in the greenhouse.

Fly larvae and pupae are heavily parasitized in their native range by small wasps. By leaving these wasps behind, we have given the populations the opportunity to increase rapidly in this country. Although we do have native wasps that may eventually attack them, the natives will probably not be as efficient as the Asian wasps.

Will the Flies and Weevils Eat other Plants?

Insects released for biological control of weeds must be intensively tested against a range of plant species before being released. The fly was tested against 50 plant species and the weevil against 52 plant species. The two criteria that I weigh most heavily when choosing test plants are the presumed evolutionary relationship to the target plant and the host range of insects related to the test insect. Of course, rice is always tested.

Because the damaging stage of the fly, the larva, is entirely restricted to the aquatic environment, only aquatic plants were tested and submersed species were emphasized. Interestingly, the majority of known host plants for the fly's relatives are also in the hydrilla family or in two of the families closet to hydrilla — the arrowheads and pondweeds. For that reason eight species of pondweeds (*Potamogeton*), three species in the arrowhead family, and six species in the hydrilla family were among the test plants. Females prefer to lay eggs on hydrilla but will lay some on all plants since their larvae are mobile. Small portions of test plants with five eggs were placed into each of ten test tubes with the respective test plant. Some plant species, especially those in which development occurred, were tested multiple times.

Larvae developed to adults only on 4 pondweeds, southern naiad, and elodea. Very few larvae developed on those species. The largest number, averaging 8%, developed on the important introduced weed, curly-leaf pondweed, *Potamogeton crispus* L. Although curly-leaf pondweed is an associate of hydrilla in India and Pakistan, the fly was never found on it by CIBC scientists. I do expect fly larvae to be found in pondweeds by researchers and others searching for the hydrilla fly, but most will be larvae of native flies. For example, sixteen species of *Hydrellia* are native to Florida and three of the 7 Florida species for which host plants are known attack pondweeds. Pondweeds are also hosts of many of the other 48 species native to the United States. Incidental attack by the hydrilla fly, if it occurs, should be overshadowed by that from native flies.

The weevil testing program was more difficult than that for the fly because both adults and larvae feed and because both aqautic and non-aquatic plants, including vegetables, had to be tested. Again, plants closely related to hydrilla were emphasized, but unlike the fly's, the weevil's relatives feed on a broad range of plants and thus their feeding habits did not suggest any group of plants for extensive testing. Both pondweed and arrowhead turions were extensively tested. Species with fleshy roots that would survive drawdowns were also tested, for example, cattails, smartweed, iris, spatterdock, waterlily, etc. After Chris Bennett and I discovered first hand how dry the waterbodies in India were when beetles were present,[3] we increased our tests to include root crops that might be at risk from weevils produced in nearby irrigation canals, for example, potatoes, radish, carrots, turnips, etc.

A few weevils emerged from watercelery (*Vallisneria*), a close relative of hydrilla, which was held out of water and kept artificially moist. However, watercelery plants exposed to air in a natural situation would dry quickly and would not be potential hosts. In fact, we had great difficulty keeping the plants alive for the duration of our experiments. Only a few individuals, less than 3% in any experiment, emerged from turions of three pondweeds tested intensively.

Who Approved Them?

When the tests were completed and when we were convinced that the insects were safe, a report was submitted to the federal interagency Technical Advisory Group (TAG) for biological control of weeds requesting permission for field release. Permission to import insects into quarantine must also be requested from them. (This group was called the Working Group before a recent restructuring.)

The TAG includes 4 members from USDA agencies, 4 from the United States Department of Interior, 1 from the Corps of Engineers, 1 from EPA, 1 from the Weed Science Society of America, and 1 from the National Plant Board. It operates under the direction of the Animal and Plant Health Inspection Service (A.P.H.I.S.), USDA, to advise A.P.H.I.S. which makes the final decision and issues permits and shipping labels.

Before permits are issued, however, the researcher must also have permission from the Department of Agriculture in his state. In Florida, we have an Arthropod Introduction Committee, similar to the TAG, which advises the Division of Plant Industry, Florida Department of Agriculture and Consumer Services, on whether or not to approve introductions into quarantine and releases from quarantine. The time lag from submission of the release request to receipt of the final permit and labels was four months for both hydrilla insects.

What Now?

Our newest hydrilla insect, an Australian weevil, *Bagous* sp., was imported into quarantine in April 1987. It was intensively tested in Australia by Dr. Balciunas and found to be relatively specific. We are attempting to determine if it presents a risk to any of our native plants. The biology is relatively complicated since the adults lay eggs in stems of both submersed hydrilla and hydrilla stranded on shore. The feeding adults cut the submersed hydrilla stems which float to shore carrying the developing larvae and mix with the stranded hydrilla. The mature larvae exit from the stems and pupate in the soil.

Another fly, *Hydrellia* sp., will be imported from Australia within the next few months for intensive testing. Although its biology should be similar to that of the Indian fly, we hope that it might be more cold-hardy than the Indian fly. Field collections by Dr. Balciunas have demonstrated that it is specialized on hydrilla with only occasional emergences from other hosts.

Other insects that may someday be candidates for introduction into quarantine are several Australian caterpillars being studied by Dr. Balciunas, an African midge that has been associated with stunted tips of hydrilla, and additional leaf-mining flies from the cold mountain lakes of Kashmir, India. Cold-adapted insects are needed for use in the northern United States, but there have been no surveys yet of hydrilla in the temperate areas of Asia.

It takes time to discover and test new insects. Field surveys will require at least 1-2 years for preparation, completion, and insect identifications. Then each insect candidate will probably require 2-3 years of quarantine study before a request for release can be prepared. Biological control of hydrilla by insects might be successful within a few years or might require many more years of effort before it is successful. This effort, however, does not seem so great when one considers the total effort that has been expended over the past 20 years to control hydrilla, which, in spite of that effort, has continued to expand both its range and acreage.

References

1. Buckingham, G. R. 1984. *Biological Control of Weeds by Insects.* J. Georgia Entomol. Soc. 19(3) (Second Supplement) :62-78.
2. Baloch, G. M., Sana-Ullah, and M. A. Ghani. 1980. *Some Promising Insects for the Biological Control of Hydrilla verticillata in Pakistan.* Tropical Pest Management 26(2):194-200.
3. Bennett, C. A. 1986. *My Trip to Pakistan and India — Weeds, Weevils and Worries.* Aquatics 8(2) 9-11.

Corbin '87

HALLER's HISTORICAL HIGHLIGHTS

Who is John A. F. Eichhorn?

Certainly you have heard people talk about water violet, water lily, water lilac and water hyacinth. No doubt you know that these are all names for different plants. Well, you are wrong. As these are only 4 of dozens of common names given to what we know as water hyacinth (*Eichhornia crassipes*).

Common names of plants are useless to botanists, no one really knows what plant one may be describing or doing research on. Botanists at the time of Plato (400 years B.C.) first began to develop plant classification systems. We shall leave the history of plant classification to taxonomy textbooks, but everyone should recognize that scientific names of plants are essential to all of us.

Water hyacinth was first collected *and* described in the mid-1700s. At this time they were "placed" in the genus *Pontederia*. In 1842, there were enough plant collections that the German botanist, C. S. Kunth, separated a new genus, *Eichhornia*, from the *Pontederia*. Kunth named his new genus in honor of the Prussian Minister of Education, Culture, and Medicine, John Albert Friedrich Eichhorn (Gopal 1987). The species name *crassipes* is likely derived from the Latin crassus, meaning stout, fat or thick. Thus, *Eichhornia crassipes* is named after a government official and in descriptive terms of its bulbous petiole.

Scientific names given to plants follow elaborate guidelines developed by International Botanical Congresses. The International Code of Botanical Nomenclature develops these rules and publishes approved scientific names.

Now that's a bit of history.

■ **Bill Haller**

W.A.T.E.R. (Wonderful And Total Extinguishing Resource)

By
Agri-Business Reporter,
a publication by Agri-Business Council of Arizona, Inc.,
August, 1987

"Imperial Chemical Industries of Australia has announced the discovery of a new firefighting agent known as W.A.T.E.R. (Wonderful And Total Extinguishing Resource). It is particularly suitable for dealing with fires in buildings, timber yards and warehouses, and is cheap to produce. It is intended that quantities of about one-and-a-half million gallons should be stored in open ponds or reservoirs near urban areas and installations of high fire risks.

"W.A.T.E.R. is already encountering opposition from safety and environmental groups. One group member has pointed out that if anyone immersed his head in a bucket of W.A.T.E.R., it should prove fatal in as little as three minutes. Each of the proposed reservoirs will contain enough W.A.T.E.R. to fill half a million three-gallon buckets. Each bucketful could be used a hundred or more times, so there is enough W.A.T.E.R. in one reservoir to kill the entire population of the United Kingdom.

"It has been reported that W.A.T.E.R. is a constituent of beer. Does this mean that firemen could become intoxicated from fumes when they use it to put out a fire?

"The 'Friends of the World' said they obtained a sample of W.A.T.E.R. and found it made clothes shrink. It shrank cotton, so what would it do to people? In the House of Commons, the Home Secretary was asked if he would prohibit the manufacture and storage of this lethal new material. A full investigation was needed, he said. A group was formed to file a report."

AQUAVINE

WEEDS IN THE MONEY FLOW

There is a new publication in the latest issue of the "North American Journal of Fisheries Management" that evaluates the influence a major infestation of hydrilla has on fishing and related expenditures. In the study, as hydrilla levels exceeded 80% of the study lake there was an 85% reduction in fishing effort and a 90% loss in associated revenue.

For reprints contact: Douglas Colle, Department of Fisheries and Aquaculture, 7922 NW 71st Street, Gainesville, Florida 32606. Reference Journal Series Number 6580.

APMS

Don't miss this year's annual meeting (July 10-13) of the Aquatic Plant Management Society in New Orleans. Many special events have been planned and it's guaranteed to be an exciting meeting.

Submit paper titles to:
Richard Couch
Biology Department
Oral Roberts University
Tulsa, OK 73171

THE IMPORTANCE OF RUBBER GLOVES

A study, recently reported on in "Chemically Speaking," measured the deposition of pesticide residues on various parts of the body of applicators who used gloves versus those who did not. The results indicated that those who did not wear gloves dermally exposed themselves to 40 times the pesticide levels of those who protected their hands. Also, those who did not wear gloves ultimately exposed other portions of their bodies that the gloved applicators avoided.

FAPMS CALL FOR PAPERS

You're probably asking yourself, a call for FAPMS annual meeting papers already? Well, if you plan now, you can prepare an interesting, informative paper of your own. Ken Langeland is Program Chairman again for this year's annual FAPMS meeting, and he is actively recruiting applicators (chemical and otherwise, private and commercial) to present papers at this year's meeting in Daytona. If you are interested in communicating your ideas, work projects, innovations, etc., to help expand our knowledge of water resource management, contact Ken. Believe me, Ken will be happy to provide some project ideas and guidance. So if you have ideas, and need direction, or if you just need ideas, call Ken at 904-392-9613.

APPLICATOR OF THE YEAR AWARD

Attention Managers and Supervisors! It's time to start thinking about those special employees who are members of your staff. You know, the ones who can always be counted on to do a professional job, the ones who carry more than their share of the work without complaining, who keep the work flowing smoothly in your absence, who project a good public image and, in essence, make your job a lot easier. We all know the importance of good field personnel and now is your chance to have these individuals recognized for their excellence. For your convenience, a standard nominating form will be printed in an upcoming FAPMS Newsletter. So, please, keep an eye out for the nomination application and take a few minutes to let us know who your most deserving employee is.

■ Nancy Allen

SUPER AGENCY

The Florida Senate has proposed a bill that would create a new agency to be entitled the Department of Environmental and Resource Management. The new department would include; a division to coordinate the various water management districts in the management of water as a state resource, the transfer of the Department of Natural Resources, the Department of Environmental Regulation and the Division of Forestry.

NEW HERBICIDE

The Dow Chemical Company was recently awarded an experimental use permit (EUP) for the herbicide Garlon. Garlon can be used in most aquatic sites and is labeled for ditch bank brush control, water hyacinth, Eurasian watermilfoil, and others. Contact your local chemical dealer or Dow sales representative for a sample label.

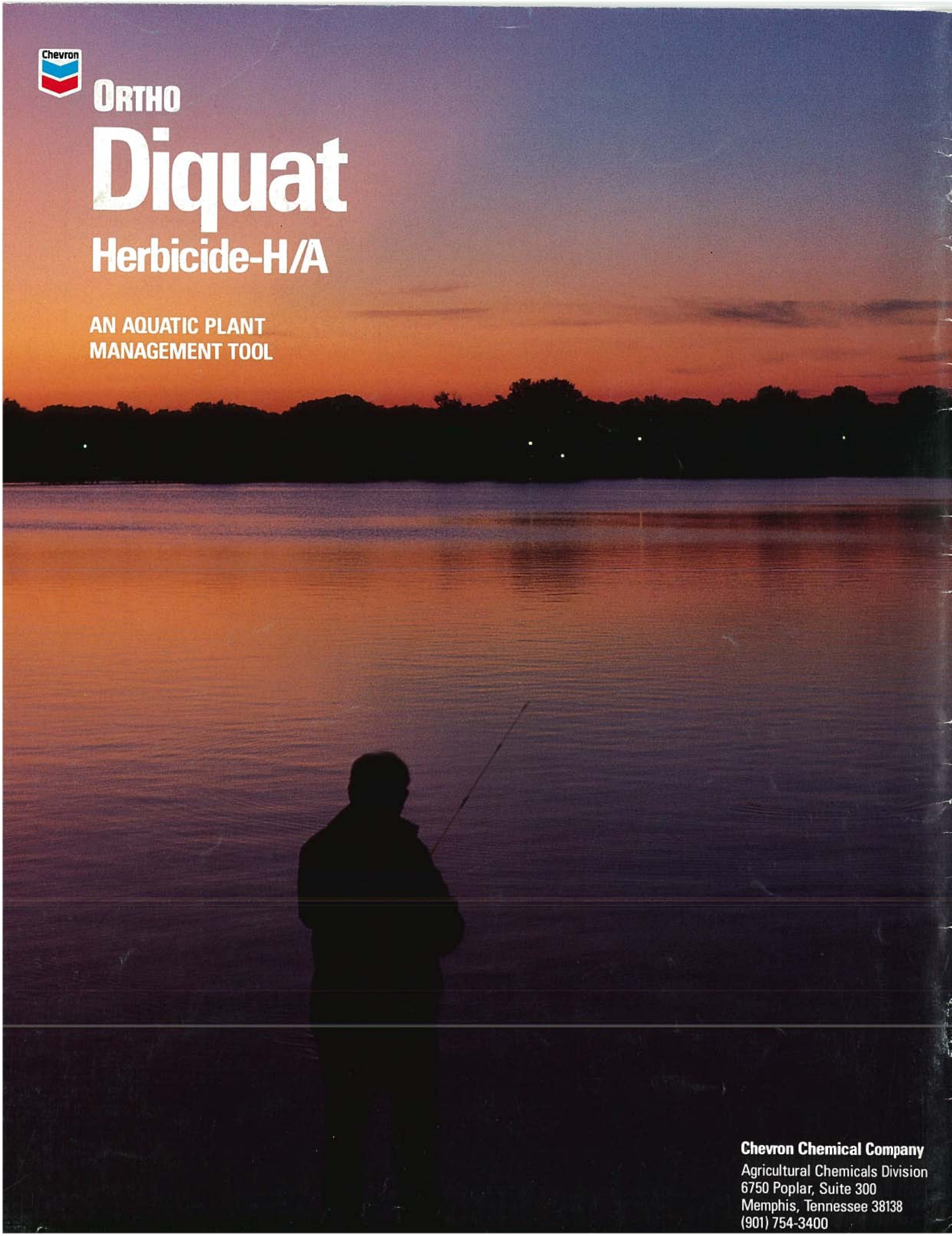
WANTED — PHOTOS

The 1988 FAPMS Photo Contest is now accepting entries. Please support your organization and participate. Photographs submitted should represent "Operations" or "Aquatic Scenes". Please send 8X10's only. Attach to your entries; your name, address, phone number, subject, and title of photograph. Do not write directly on photos. Send entries to Nancy P. Allen, U.S. Army Corps of Engineers, P.O. Box 188, Inglis, FL 32649. Deadline for accepting photographs is October 1, 1988. Winners and awards will be presented at the 1988 FAPMS Convention Oct. 25-27 at the Holiday Inn Surfside in Daytona Beach. Good luck!

SPECIMENS REQUESTED

A taxonomic and biogeographical study of *Lyngbya* is currently underway at Clemson University. In order to examine *Lyngbya* mats from diverse locations throughout the southeast, researchers are asking for your assistance in collecting additional specimens. Anyone able to assist is asked to send specimens of *Lyngbya* (a handful sealed in a plastic bag), accompanied by a description of the site and any habitat information (such as known nutrient inputs or water management practices). Samples will be preserved and permanently housed within the Clemson University Herbarium.

Send samples to:
Barbara Speziale
Research Associate
Department of Biological Science
Clemson University
Clemson, S.C. 29634-1903


Chevron
ORTHO
Diquat
Herbicide-H/A
AN AQUATIC PLANT MANAGEMENT TOOL
Chevron Chemical Company
Agricultural Chemicals Division
6750 Poplar, Suite 300
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