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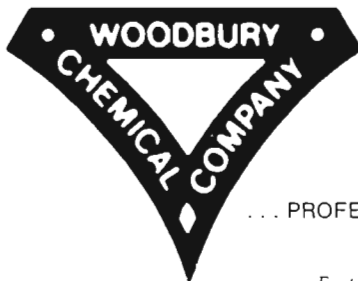
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Editorial

Paul C. Myers

Once again the annual meeting is close at hand. I encourage you all to attend, share your experiences and participate, helping to make this meeting our perennial success.

Herb Cummings has put together an aquatic weed control equipment display and demonstration that will be both enlightening and educational. Larry Maddox has done an outstanding job making local arrangements including what should be a first class barbecue. David Tarver has planned an excellent program with several panel discussions and many papers covering operations, permitting, research and safety. Eddie Knight, awards committee chairman, has been charged with determining the Applicator of the Year and for distributing a more than ample supply of door prizes (toasters, dental floss, etc.):

All in all we have another super meeting planned. There is only one thing missing to insure the success of the 5th Annual Aquatic Plant Management Society Meeting: Y O U.

Hope to see you there.

The Aqua-Vine Section of "Aquatics" has been added to provide information on current events and recent publications from industry and government to increase the dissemination of aquatic plant control techniques and regulatory changes. Complete copies of reports mentioned in this section can be obtained on request to the respective authors or the Editor of "Aquatics."

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

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Aquatics

SEPTEMBER 1981

VOLUME 3 • NUMBER 3

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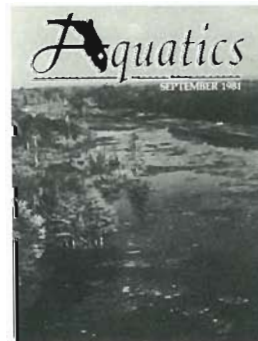
CALENDAR NOTES

Oct. 20-22 FAPMS Annual Meeting, Orlando



COVER

Withlacoochee River. Photo by Clarke Hudson.



AQUATICS: Published quarterly as the official publication of the Florida Aquatic Plant Management Society. This publication is intended to keep all interests informed on matters as they relate to aquatic plant management, particularly in Florida.

CORRESPONDENCE: Address all correspondence regarding editorial matter to Paul C. Myers, Editor, "AQUATICS" Magazine, 310 E. Thelma St., Lake Alfred, Fla. 33850.

The American Lotus

Nelumbo lutea (Willd.) Pers.

by
John A. Rodgers

The large circular leaves and the fragrant yellow flower of *Nelumbo lutea* (Willd.) Pers. makes it one of the most aesthetic aquatic plants in the United States. This native species has over 35 common names. The list includes the American lotus, yellow lotus, great yellow lily, sacred bean, water chinquapin, yocket-nut, rattle box, watering can, alligator buttons, pond-nut, and duck acorn. Webster defines lotus as a fruit eaten by the lotus-eaters (one of the people represented in the Odyssey of Homer) which consequently causes indolence and dreamy contentment. In Greek mythology, Odysseus was the Greek leader in the Trojan War who afterwards wandered for some 10 years before reaching home. Actually, the rhizomes and fruits of the lotus plant are quite edible. Chinquapin is the common name for the chestnut tree and its edible acorn-like nut, hence water chinquapin or pond-nut. Sacred bean is derived from the common name of *Nelumbo nucifera* Gaertn. or the sacred lotus of India. This Old World species has been worshipped since early times by the Hindu and Buddhist for its religious, medicinal, and aesthetic values. The common names rattle box and watering can reflect the shape and structure of the fruit receptacle (seed head).

Originally, *Nelumbo* was placed under the family Nymphaeaceae, which included the genera *Cabomba*, *Brasenia*, *Barclaya*, *Euryale*, *Nuphar*, *Victoria*, and *Nymphaea*. Nymphaeaceae, being a very heterogeneous family with many different specialized morphological characteristics, prompted a group of botanists to place *Nelumbo*, along with *Cabomba* and *Brasenia*, in different families. The family Nelumbonaceae would therefore consist of only one genus and two species. Botanists often disagree on the proper scientific name. Synonyms include *Nelumbo lutea* (Willd.) Pers., *Nelumbo pentapetala* (Walt.) Fern., *Nelumbium luteum* Willd. and *Nelumbium codophyllum* Raf.

The circular leaves of the American lotus are 30-80 cm. in diameter with veins radiating out from the centrally attached petiole. A cuticle covering the outer surface aerial cells provides a protective function along with preventing excessive water loss. The immature leaves, early in the growing season, float on the water surface. As the leaves mature, the petioles grow and become erect, extending the leaves 1-1.5 m above the water (soil) surface. The



The immature floating leaves of the American Lotus soon develop into centrally depressed, emergent leaves.



Lotus flowers stay active for two days, opening in the early morning and closing at night.

center of the aerial leaves soon becomes depressed, resulting in the formation of large bowl-shaped leaves.

Twenty or more similar shaped sepals and petals make up the large yellow flower. After the initial opening of the bud, the flower usually remains active for two days, opening in the early morning and closing at night. Numerous stamens, up to 200, surround the pistils, which are imbedded in a receptacle. Initially, this receptacle is a fresh, cream color, obconical shaped structure containing from 12-30 developing fruits. As the fruits begin to ripen, the stem (peduncle) slowly becomes desiccated and moves from an erect posture toward a 90 degree position. Throughout this development, the receptacle expands in length and in the radial directions. The receptacle slowly dries out and the fruit, shrinking to approximately one-third their original size, harden. When the portion of the stem just below the receptacle decays, the dried, brown color receptacle falls into the water. The light receptacle then floats away and the fruits are slowly dispersed. Each fruit is a

hard shell nut containing one seed. In fact, the nut is so hard that concentrated sulphuric acid is often used in laboratory studies to induce germination (by permitting the absorption of water). The hard coat prevents bacterial and fungal attack, but also inhibits the absorption of water for long periods of time.

Lotus seeds have been known to remain viable for over 50 years. An interesting anecdote occurred when the British Museum of Natural History was bombed in 1940 and numerous herbarium sheets were incidentally flooded. A 237-year-old herbarium press of a *N. nucifera* seed (collected in 1705 — Hans Sloane Collection) germinated two years later while still on the herbarium sheet. Germination of the lotuses are obviously very irregular. Seeds can germinate after the first winter or remain dormant and sprout years later. Long-term dormancy

American Lotus continued on page 8



The seed heads or receptacles contain between 12-30 developing fruits.



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Update on Sonar — Promising New Aquatic Plant Management Tool

In spite of increased effort and funding, certain aquatic weeds such as hydrilla continue to spread in Florida. Now, new chemistry from Elanco Products Company, a division of Eli Lilly and Company, may help turn the tide on hydrilla and other major aquatic weeds in Florida.

To find out the latest about Sonar we talked with Dr. Wendell Arnold, Aquatic Field Research Associate of the Lilly Research Laboratories at Boynton Beach.

Q. Dr. Arnold, tell us briefly about Sonar and why there's so much interest in it now.

A. Sonar is the first new chemistry to be developed for aquatic plant management in some time. It's a pyridinone compound which was discovered in the Lilly Research Laboratories. There's interest in it because it provides long-lasting control of hydrilla, has a wide margin of safety, doesn't adversely affect the environment, and is easy to use.

Q. What is its exact status now?

A. The Environmental Protection Agency has issued experimental use per-

mits (EUP) which allow us to use Sonar in ponds and lakes as well as conduct limited research in drainage ditches and canals.

Q. Can you tell us about the research conducted so far?

A. Aquatic research with Sonar began in 1975 at our Greenfield, Indiana, Research Laboratories. These efforts were largely screening tests to determine activity against various species of aquatic weeds.

We then began testing the compound at our Boynton Beach Research Station and started conducting trials in ponds in Florida and Michigan.

Q. Can you tell us specifically where you've researched Sonar in Florida?

A. Yes. We've worked with the South Florida Water Management District in drainage canals near Homestead and Lake Trafford at Immokalee. In Polk County we've set up trials with Paul Myers of Environmental Services, at Lake Pierce and Lake Marianna. Near Gainesville, we've worked with Dr. Bill Haller of the University of Florida to design experiments on Lake Lochloosa and Orange Lake.

Q. What weeds does Sonar control?

A. The following vascular aquatic weeds are listed on our experimental use label: hydrilla, milfoil, elodea, cattail, paragrass, torpedograss, and arrowhead. Research has shown that many other species are susceptible. Sonar is particularly effective against submersed weeds. Hydrilla, coontail, milfoil, and some of the naiads are most susceptible.

Preliminary results indicate that different rates can selectively control different species. In other words, it appears we can manage the kind of water plants we want by varying the rates of Sonar.

Q. Can you give us an example?

A. Well, if you have a lake with both hydrilla and eelgrass (*Vallisneria*), you can take out the hydrilla with a lower rate or both weeds with a higher rate. You can control about 60-80 percent of cattails with a normal rate of Sonar but take out more with a higher rate.

Of course, some plants in water are usually desirable. What we hope to determine, with more experience, is how to selectively control some species with Sonar so we can encourage other more desirable species.

Q. How does Sonar work?

A. Research indicates that the compound inhibits the precursor to carotenoid production, which is involved in the photosynthetic process. In hydrilla, the first symptom is the growing point turning to a reddish or pinkish color. Then the tip turns white and the leaves and stems begin to decay. This is a very slow process and may require four weeks or more, with open water returning after eight or more weeks.

The slow action of Sonar is a distinct advantage since the breakdown of organic matter is so gradual that dissolved oxygen is not depleted and fish are not adversely affected.

Q. What rates appear to be optimum?

A. Our research indicates that in ponds less than six feet deep ½ to 1 pound active ingredient controls all weed species listed on the label. In ponds deeper than six feet, 1 to 1½ pounds are needed for control. In lakes these are the suggested active ingredient rates per acre:

Less than 6 feet deep — ¾ to 1½ pounds

6 to 12 feet deep — 1½ to 3 pounds

Greater than 12 feet — 2 to 4 pounds

Rates required in drainage ditches and canals are now being determined by current research.

Q. What percent control does Sonar provide at these rates?

A. When the correct rate for the treatment area is used, we have obtained 99 to 100 percent control of hydrilla.

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Q. How long does Sonar control susceptible species?

A. Generally, recommended rates control water weeds for about one year. In some golf course ponds we've controlled weeds as long as 18 months. At Lake Pierce, where we applied Sonar in May, 1980, control was still good in July, 1981. Length of control appears to be influenced by the rate and method and time of application. Wider use of the product under the experimental use permit should give us more definitive answers.

Q. What methods of application have you tried?

A. We've applied the liquid from a boom over the bow of the boat and also with weighted trailing hoses in what we call BAF (bottom-acre-foot) applications. Both of these methods have proven satisfactory. However, we've found that if the boat speed is too fast, the trailing hoses rise. We've also tried invert applications of Sonar and have flown on liquid formulations with a helicopter. Only more research will tell us which methods are best.

Q. At what time of the year is Sonar applied?

A. In Lake Pierce we applied Sonar in the spring and in Lake Marianna we applied it in the fall. At Orange Lake and Lake Lochloosa we applied Sonar in winter, early spring, and just prior to hydrilla's topping out. We're now analyzing the results to determine the best application time. It appears at this time that applications made prior to late November in northern Florida may be satisfactory. Applications made in spring seem to provide the most dramatic results because plants are growing vigorously then.

Q. What about the safety of Sonar?

A. Any chemical should be applied carefully and according to label directions. Our research indicates that when applied as directed, Sonar is not harmful to the applicator, fish, or other life in the aquatic environment. Sonar has an LD 50 of 10,000 mg./Kg. in rats — a compound much less toxic than most herbicides. And as stated earlier, the slow action of Sonar does not deplete dissolved oxygen that could cause fish kill. Another important fact about Sonar is that it doesn't adversely affect the apple snail — an important food of the endangered Everglades kite.

Q. What is the waiting period after treating with Sonar?

A. On our current EUP label, the waiting period in lakes is only seven days. We're now collecting data from experiments and hope to get the waiting period reduced because of the compound's low toxicity.

Q. What portion of a pond or lake can be treated at one time?

A. Entire ponds can be treated. However, our EUP labels limit us to only 10

percent of lakes. With additional research we hope to remove the lake restriction.

Q. What additional research are you planning with Sonar?

A. We plan to expand our research in drainage ditches and canals as part of our EUP program. We'll also be investigating additional methods of application in lakes such as different inverts, use of polymers, or treating larger areas of lakes at lower rates. Δ

Sonar® (fluridone, Elanco)

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Fifth Annual Meeting Florida Aquatic Plant Management Society, Inc.

October 20-22, 1981

Where: Orlando, Florida
Howard Johnson's, I-4 & Lee Road
305-644-6100
Room rates: single \$28.00,
double \$32.00

Who: Professional Aquatic Plant Managers

Special Events: Equipment demonstration, Bar-B-Q, door prizes, awards, camaradery, and technology transfer.

Price: Preregistration \$15, if paid by October 9. Registration \$25.00 at the door.

Schedule:

Oct. 20	9:00-12:30	Registration
	12:30- 5:00	Administrative Session
Oct. 21	8:00-11:00	General Session
	11:00-12:00	Business Meeting
	2:00- 5:00	Equipment demonstration at Lake Apopka
	5:00- 7:00	Bar-B-Q
Oct. 22	8:00-12:00	General Session
	12:00-12:30	Business Meeting

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Preregistration Form

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Annual Meeting, October 20-22, 1981

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Organization _____

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AQUA-VINE



Frank Stafford Honored

Frank S. Stafford, Jr., retired Coordinator of Aquatic Plant Control, Sarasota County, was honored at the July annual meeting of the Aquatic Plant Management Society, Inc., in Jackson, Miss. Frank was presented with a plaque representing a Lifetime Honorary Membership. Frank is a charter member in the Florida Aquatic Plant Management Society, Inc., and many of us have benefited from his operational applied research expertise; as well as his fine music.

Recognition

David Tarver, Senior Biologist, Florida Dept. of Natural Resources, was author of "The 1980 Florida Aquatic Flora Survey Report" article in the June issue. Our apologies and thanks to him for the contribution. Δ

American Lotus continued from page 4

often allows seeds to delay germination during unfavorable conditions such as during extremely dry summers. An increase in dormancy would likewise permit lotus seeds to spread farther away from their parental stock.

Nelumbo also reproduces by the formation of runners. In optimum conditions, a single parent plant can extend runners out 20 meters in opposite directions in just one summer. Hall and Penfound calculated that there were approximately 45 miles of runners in one acre of lotus. This represented a growth rate of 7.6 cm per day for the entire summer. The apexes of these runners then develop into another plant. During the fall months, tubers start to form along several internodes. The tubers remain dormant until spring, at which time new sprouts arise.

The range of the American lotus is limited to the eastern half of the United States, Cuba, Puerto Rico, and northern South America. *N. nucifera* is native to India and Southeast Asia and has been introduced into the United States for ornamental planting purposes. It is known to occur in New Jersey and several ponds in South and North Carolina. Long and Lakela in *The Flora of Tropical Florida* (1971) state that this exotic lotus has escaped from cultivation and has become locally established. The term "locally established" is vague, but this species has not been reported in any recent Florida aquatic flora field surveys.

The American lotus can grow in water 6-8 feet deep, but thrives best in shallow water. Along lake margins and in marshes its runners can profusely spread and establish large colonies. During periods of low water, lotus plants can live and spread in moist soil. Occasionally, control of lotus with granular 2,4-D or dichlobenil is required in order to provide lake access or when a small pond becomes completely covered.

The floating leaves provide excellent shade and shelter for invertebrates and game fish, while the starch-containing runners are eaten by several types of mammals. Wood ducks and mallards occasionally feed upon the seeds, but only as a secondary food source.

The rhizomes of *N. nucifera* are frequently used in Oriental cooking. Cultivation of this species of lotus in the Far East has grown into the marketing of dried and canned rhizomes and seeds. The American Indian ate the seeds of the native lotus plant and made flour from the rhizomes. In the United States, both species and several hybrids are planted in water gardens. Recently, the seedheads have become popular in dried flower arrangements. In order to prevent the overcollection of lotus seed pods, the Florida Department of Natural Resources requires such persons to possess a valid aquatic plant permit. Δ



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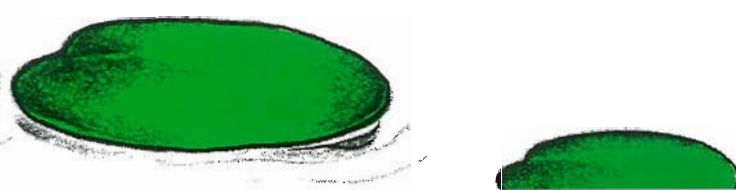
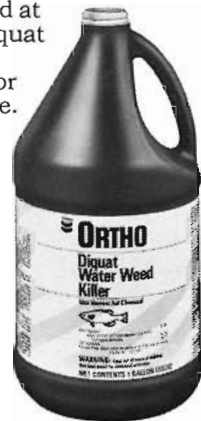
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by
 Len Bartos, Supervisor — John Kelso, Crew Leader — Joe Lang, Aquatic Weed Control Specialist
 SOUTHWEST FLORIDA WATER MANAGEMENT DISTRICT
 5060 U.S. Highway 41, South, Brooksville, Florida 33512

The Southwest Florida Water Management District is involved in aquatic plant control over a sixteen county area of Southwest Florida. While the District utilizes integrated methods (biological, chemical and mechanical) to control problematic species, our major emphasis is the use of aquatic herbicides to control nuisance weed growth.

Control efforts are aimed at providing navigation, reducing flooding, improving fishery habitat, providing fish spawning areas and improving recreational opportunities. Our operational goal is to achieve a viable maintenance program whereby there are neither too many nor too few aquatic plants. Eradication of any particular plant species is neither philosophically nor practically possible. A balanced population of various plants is essential if any water body is to maintain its environmental integrity.

Our program uses invert emulsions primarily for the control of submerged

plants such as hydrilla (*Hydrilla verticillata*) and Eurasian Watermilfoil (*Myriophyllum spicatum*). The herbicides inverted are either Aquathol K (4 gals. per acre) or a Diquat/Copper combination (2 gals./4 gals. per acre). The invert encapsulates the herbicide within an oil film. It is the same process by which mayonnaise is made and has a similar consistency. The advantages of using an invert system include a reduction in the quantity of herbicide needed for control (since we are treating on a surface acre basis rather than a volume basis) and the adhesiveness of inverts to plant tissue, which permits continuous release of the herbicide in close proximity to the target plant.

The standard District invert application system consists of a batch truck for chemical transport and an airboat/invert pump unit for actual application. The one ton batch truck carries a 200 gallon herbicide tank and 200 gallon inverting

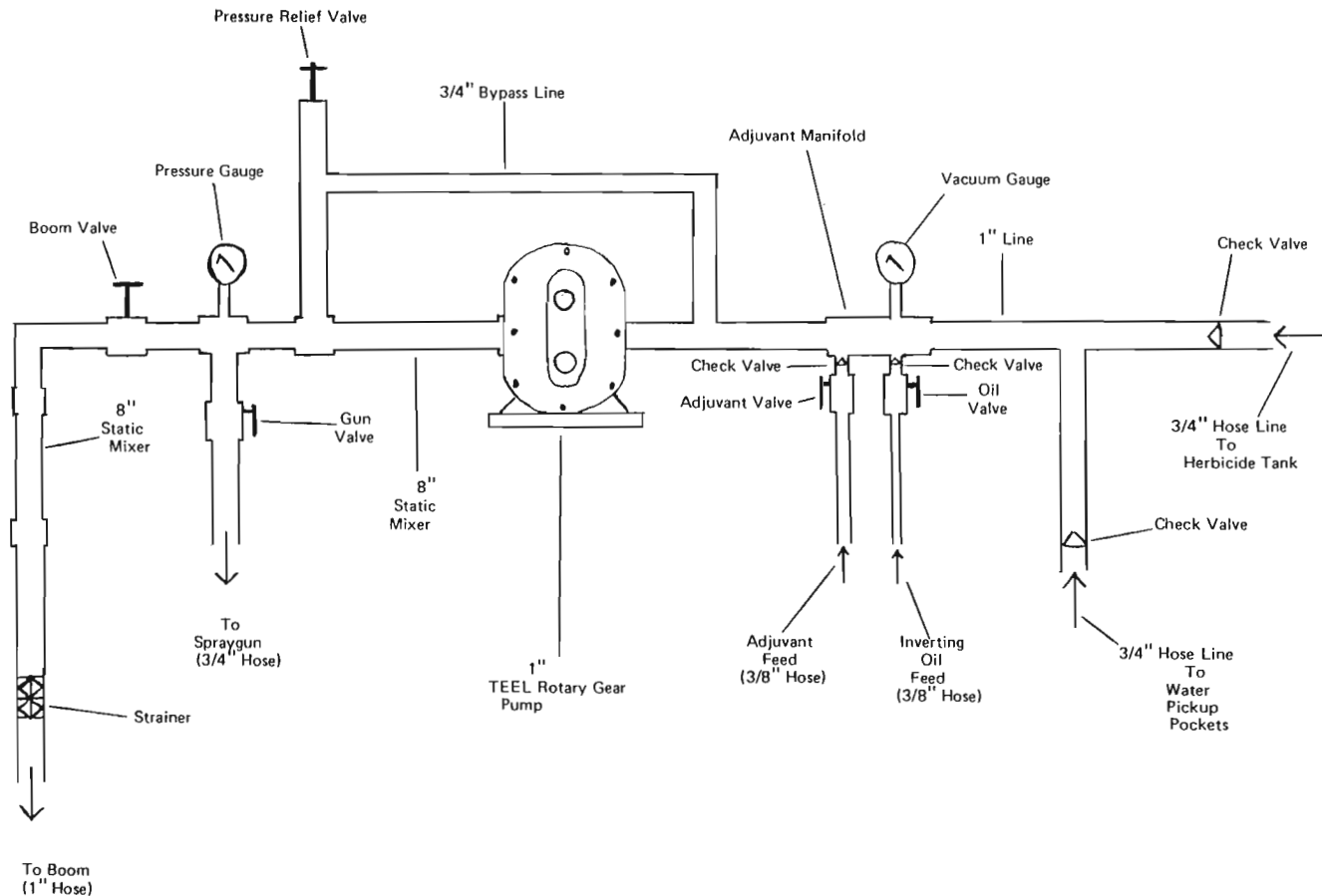
oil tank. A 100 gallon mix tank is also located on the truck to combine the herbicide and make-up water from the on-site batching area. The herbicide/water mix is then loaded into two 40 gallon saddle tanks on the airboat. Inverting oil is fed directly from the truck into the airboat's 20 gallon invert tank. The loaded airboat can treat two acres per batching.

The airboat pumping system inverts the herbicide at a 6:1 ratio of water phase (herbicide/water mix) to oil phase (inverting oil). A xylene/spraymate mixture (oil phase) is used at a 4:1 ratio to make the oil phase of the invert.

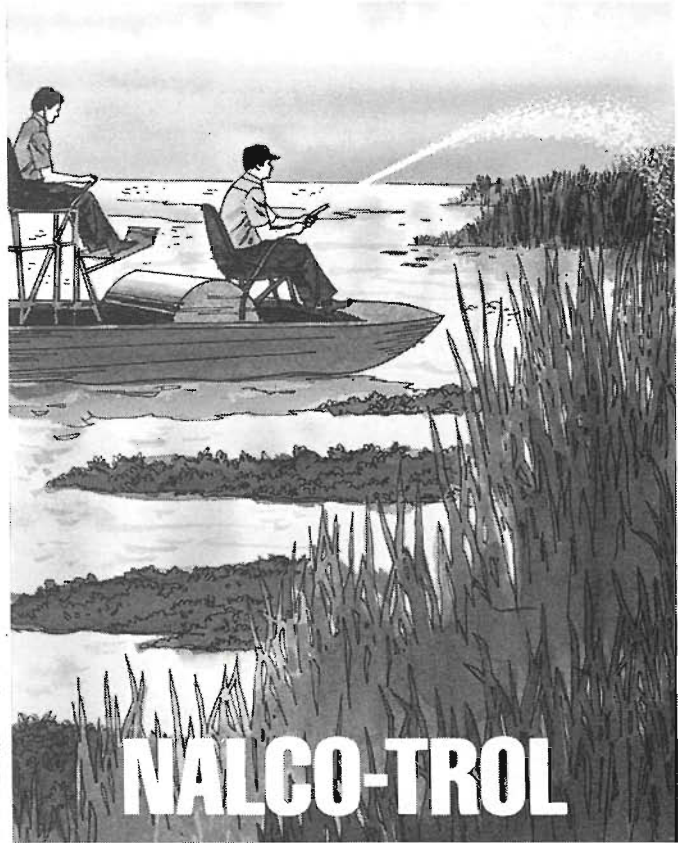
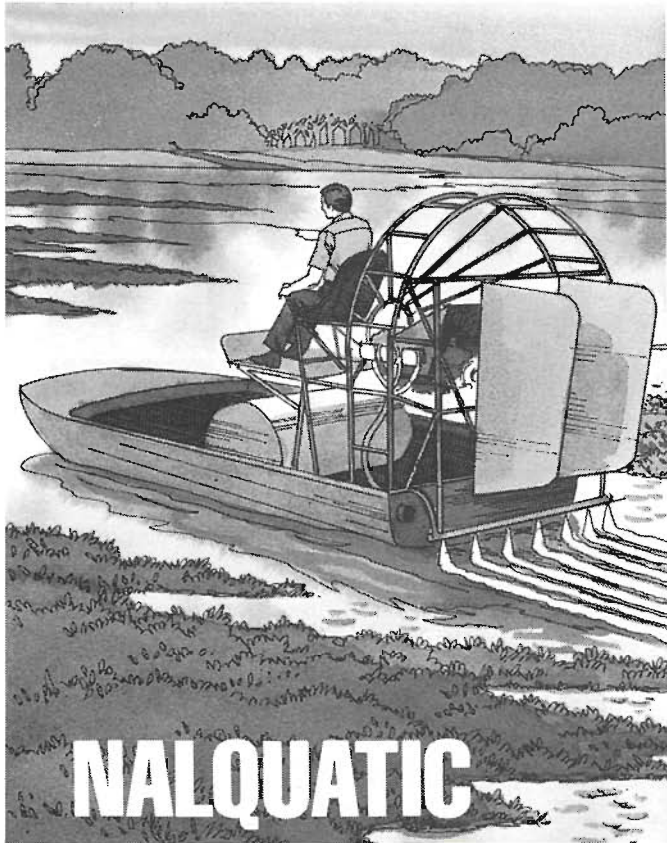
The invert was made using a Robco twin piston 5 G.P.M. pump with a static mixer. A total mix of 36 gallons per acre was applied through a T-Boom using 6-8 drop hoses. Each 18 inch drop hose had a raindrop nozzle with a #6 orifice plate.

This system was used routinely by District crews until approximately eighteen months ago when we started to look

Inverting System continued on page 12



GOOD NEWS FOR AQUATIC WEED FIGHTERS:



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aquatic herbicide carrier puts the herbicide on the weed surface and sticks it there for maximum contact effect.

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Inverting System continued from page 10

at different types of inverting oils. The change was based on several factors: 1) The availability of newly developed inverting oils, 2) A desire to reduce the safety hazard of storing and transporting xylene — a highly flammable product, and 3) An environmental concern — since xylene tended to irritate aquatic organisms, especially fish trapped in thick vegetation mats which could not easily escape contact with the invert during applications.

The new products tried were IVOD and 403 inverting oils. We immediately ran into problems with the new inverting oils. The invert pump system we were using could not form inverts using the new oils without our increasing the oil phase of the invert. The increased oil usage would substantially increase our treatment cost per acre. We decided to develop a different invert pump system that would lower our oil consumption to economically reasonable levels.

There were manufactured inverting systems that could meet our needs for reducing oil consumption, but the equipment was a comparatively costly (\$3,000 + per unit), large, heavy and complex unit. We wanted a relatively inexpensive, compact, lightweight and simple unit.

We put together several different pumping systems before we found one that fit our needs. The design (see figure)

settled on has been used for approximately a year with only minor modifications. The unit specifications and cost figures (see attachments) detail a system that has proved effective and economical in our field operations. The construction cost is low and repairs have been minor. We have been able to reduce our inverting oil cost per acre to a reasonable level (\$30-32 per acre) with no apparent difference in treatment efficacy compared to our original xylene/spray-mate system.

At this point, we are using the system routinely, but we are still working on modifications to improve our system's effectiveness and economics. Possible modifications include various engine/pump gear ratios and other types of pumps (pistons and centrifugal). The final design answer to meet our objectives could be this unit, but we believe that continued improvements can and will be found. △

SOUTHWEST FLORIDA
WATER MANAGEMENT DISTRICT
INVERT PUMPING SYSTEM
SPECIFICATIONS

- A COMPACT UNIT DESIGNED FOR INVERT EMULSION
- TEEL ROTARY GEAR PUMP
 - MAXIMUM PRESSURE 100 P.S.I.
 - BRONZE BEARING WITH ZERK TYPE GREASE FITTINGS
 - POSITIVE DISPLACEMENT

- 11 GPM CAPACITY @ 100 P.S.I. AND 900 R.P.M.
- BRIGGS & STRATTON ENGINE
 - 5 H.P., 4 CYCLE, GASOLINE
 - MANUAL START
 - 6:1 GEAR REDUCTION FOR DIRECT COUPLING TO PUMP
- TWO 8" STATIC MIXERS ON PRESSURE SIDE OF PUMP FOR INVERT FORMATION
- PRESSURE GAUGE — 0-200 P.S.I.
- VACUUM GAUGE — 0-30" Hg
- PRESSURE REGULATOR MOUNTED ON BYPASS
- MAIN LINE 1" AND BYPASS ¾"
- INLINE METERING ORIFICES ON ALL INTAKE LINES
- MANIFOLD FOR ADJUVANT ADDITION
- BRASS FITTINGS
- SHUTOFF VALVES ON ALL INTAKE AND OUTPUT LINES
- DIMENSIONS: 38" LONG
30" WIDE
15" HIGH
WEIGHT — 109 LBS.

INVERT PUMPING SYSTEM
COST ESTIMATE

• PUMP	\$ 98.80
• ENGINE	333.29
• PRESSURE GAUGE	2.59
• VACUUM GAUGE	4.76
• STATIC MIXER	100.00
• PRESSURE RELIEF VALVE	11.32
• VALVES, ORIFICES, FITTINGS, PIPE, ETC.	67.83
TOTAL	\$618.59
• MAN HOURS FOR ASSEMBLY	4 MAN DAYS

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Robert J. Gates is field operations chief for the Southwest Florida Water

Management District, "Alligator weed and pennywort are real problems in navigation work. We control 'em with Banvel 720. We also maintain our recharge areas, and it works beautifully there, too. Banvel 720 works on hardwoods and softwoods, where 2,4-D would only be effective on one species. The favorable ecological impact is another important reason for using Banvel 720. Without the Banvel, we would have some serious problems."

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*Consult the label for species controlled and rates required.
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NATIVE INSECT VERSUS NATIVE WEED

John R. Cassani
Lee County Hyacinth Control District
Post Office Box 06005
Fort Myers, Florida 33906

The classical approach to applied biological control of weeds has been the exploration for and introduction of exotic organisms for the control of non-native weeds. Several native plants are considered weeds usually resulting from human manipulation (e.g. cultural eutrophication). A good example of a native insect interacting with native weed and occasionally controlling it would be the so-called water-lily leaf beetle (*Galerucella nymphaeae* (L.)) and the primary host plant spatterdock (*Nuphar* spp.).

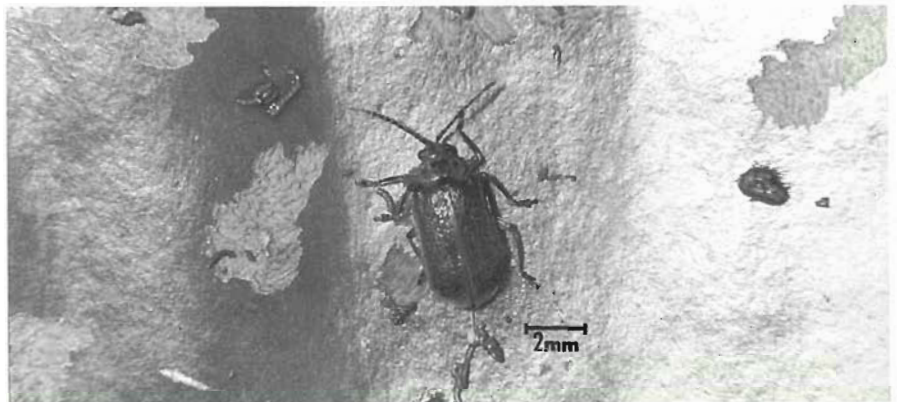
G. nymphaeae belongs to the beetle family Chrysomelidae also known as leaf beetles, many of which are pests of economically important plants. *G. nymphaeae* has a widespread distribution in North America, Northern Europe and has been observed on *Nuphar* in several areas of Florida.

A necessary requirement of any insect used as a biological control agent is that it must have a narrow host range or will not damage desirable species. *G. nymphaeae* has been reported from other aquatic plants namely *Nymphaea* spp., knotweed (*Polygonum*), sweet gale (*Myrica*) and water chestnut (*Trapa natans*) but it seems to prefer *Nuphar*.

In Florida, most of the observations to my knowledge of *G. nymphaeae* on *Nuphar* have been in the northern and central areas of the state, usually in lakes where *Nuphar* is very abundant. *G. nymphaeae* has been observed to reduce the density of *Nuphar* in Lake Gibson in Polk County by as much as 50-60 percent (Mr. Tom Drda, Florida Game and Fresh Water Fish Commission, personal communication). Lakes Pierce and Marion also in Polk County have had

populations of *G. nymphaeae* that have done considerable damage to *Nuphar* at one time or another (Mr. Paul Myers, personal communication). During April, 1980, I observed a population of *G.*

nymphaeae on *Nuphar* in Lake Eustis that caught my eye from a considerable distance. I could not find any specimens on plants in the area other than *Nuphar*. Mr. David Tarver of the Florida Depart-



Adult *Galerucella nymphaeae* on *Nuphar* leaf.



Eggs of *Galerucella nymphaeae*.

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ment of Natural Resources informed me that a population of *G. nymphaeae* had established on *Nuphar* at Lake Miccosukee in Jefferson County and despite an abundance of white water lily *Nymphaea odorata*, *G. nymphaeae* was observed only on the *Nuphar*. I have never observed *G. nymphaeae* in the southern region of the state and its distribution in Florida may be limited by climatic conditions or the effects of localized parasites or predators. I have observed small sparrow-like birds that effectively prey on insects on emerged and floating *Nuphar* leaves. Studies have shown that certain birds associate ragged leaves with the presence of insect food and this may be a factor that limits the distribution or abundance of *G. nymphaeae* in certain areas. Fish have also been reported to feed ravenously on the adults and larvae when they can be reached.

The larvae and adults of *G. nymphaeae* damage *Nuphar* by feeding on the leaf epidermis, usually the upper side, the stem and the flower. In extreme cases the entire leaf will be eaten away or damaged to the extent that fungal

pathogens deteriorate the remaining portion. All of the life stages (egg, larva, pupa and adult) can be found on the plant at one time. The adult female may lay as many as 115 eggs in masses of 6 to 12 over a period of 10 to 19 days. The larvae are black or dark brown above and yellow beneath and reach about 8mm at maturity. The length of the adult is about 6mm and is dark brown above with yellow margins. The pronotum or dorsal side of the thorax often has 3 black spots. It is thought to have 2 or 3 generations per year although relatively little is known of its seasonal occurrence in Florida. Adults are thought to winter in dead stems and under the bark of trees.

More research is needed on *G. nymphaeae* before it can be considered a safe and effective biological control agent for *Nuphar*. Details of its distribution in Florida, host range, seasonal population dynamics and laboratory rearing techniques are a few of the considerations that will have to be made. Also of importance are the natural factors that suppress populations of *G. nymphaeae* in

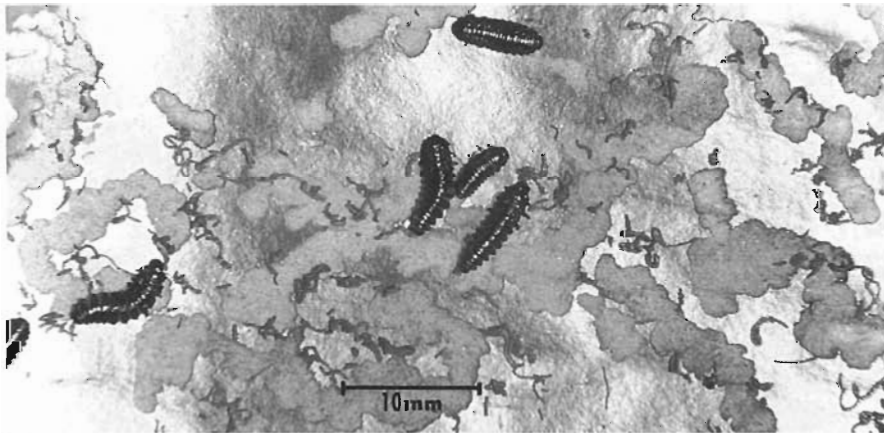
certain areas and not in others.

Several of these parameters are being investigated at the Lee County Hyacinth Control District in Fort Myers. The beetle is being investigated in caged and natural outdoor environments in an effort to determine some of the factors affecting population fluctuations. Methods for maintaining laboratory colonies are also under investigation and preliminary results indicate that it can be maintained for relatively long periods on *Nuphar* alone at various population levels. We have kept a colony in the laboratory for a period of at least 15 months.

In general, the beetle has several good aspects when considering it as a biological control agent. First of all it is a native insect which appears to be limited by certain controlling factors although not yet well understood. In other words, it is not likely to spread to every area having *Nuphar*. Secondly it is capable in certain situations of exerting significant damage to *Nuphar* at high densities but preliminary observations seem to indicate that it affects *Nuphar* populations more by reducing the density of plants rather than eliminating them. This is of course a desirable way of managing native aquatic plant species. Also, most of the reports I have heard indicate that the beetle seems to occur more often where *Nuphar* occupies large areas and is extremely dense. In such situations the high density and large area occupied by the plant can inhibit recreational activities. In canals *Nuphar* has been known to curtail even fast-flowing water.

On the other hand, *Nuphar* in certain situations is a valuable plant as it relates to fish habitat and the natural productivity of many freshwater areas. These considerations should be given careful attention before any attempt is made to manipulate *G. nymphaeae* on any scale.

△



Mature larvae of *Galerucella nymphaeae* feeding on *Nuphar* leaf.



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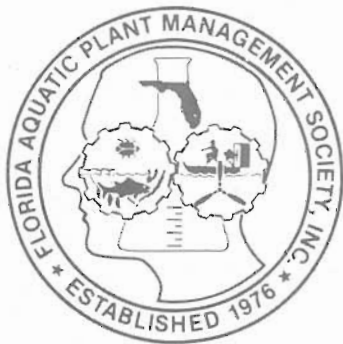


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