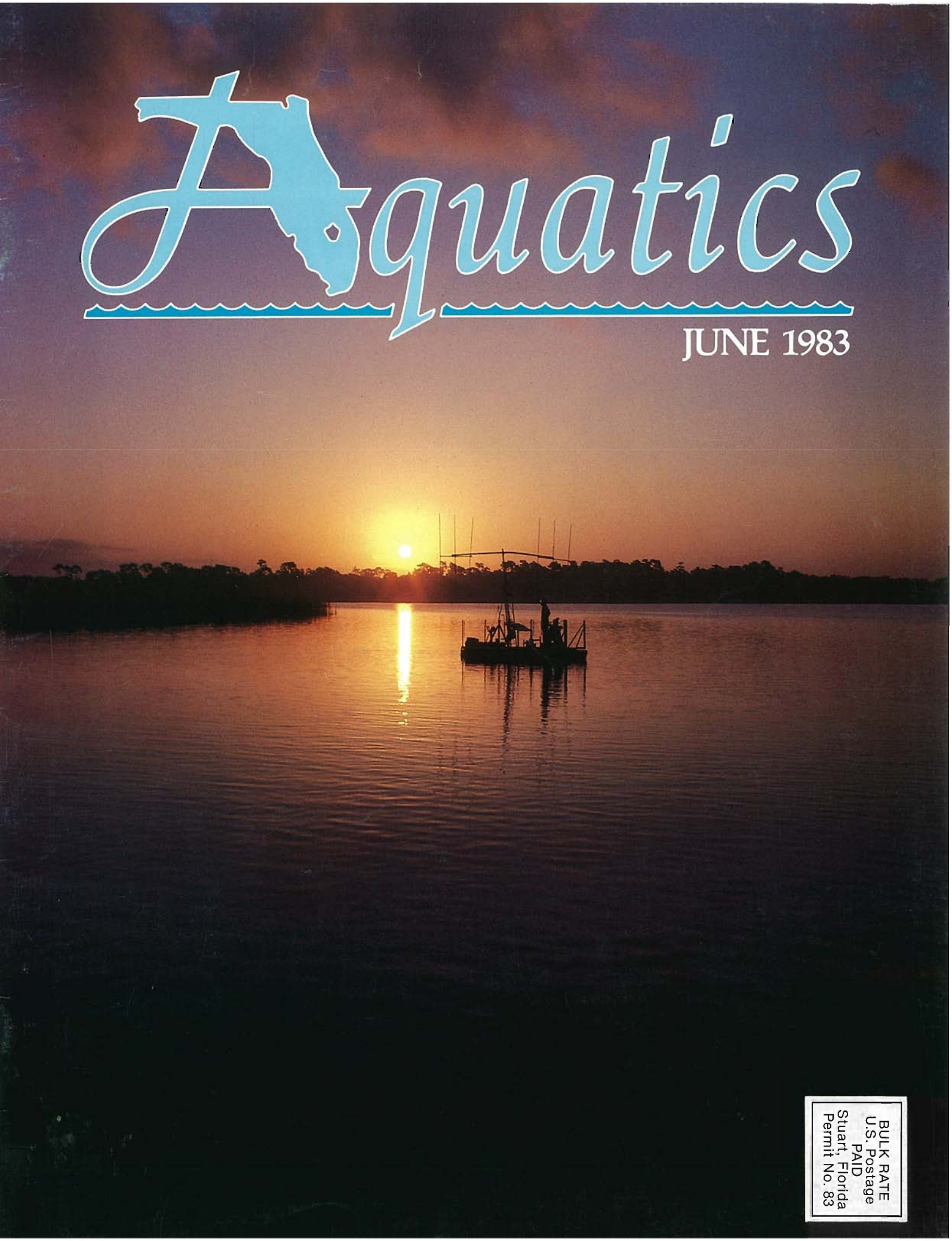
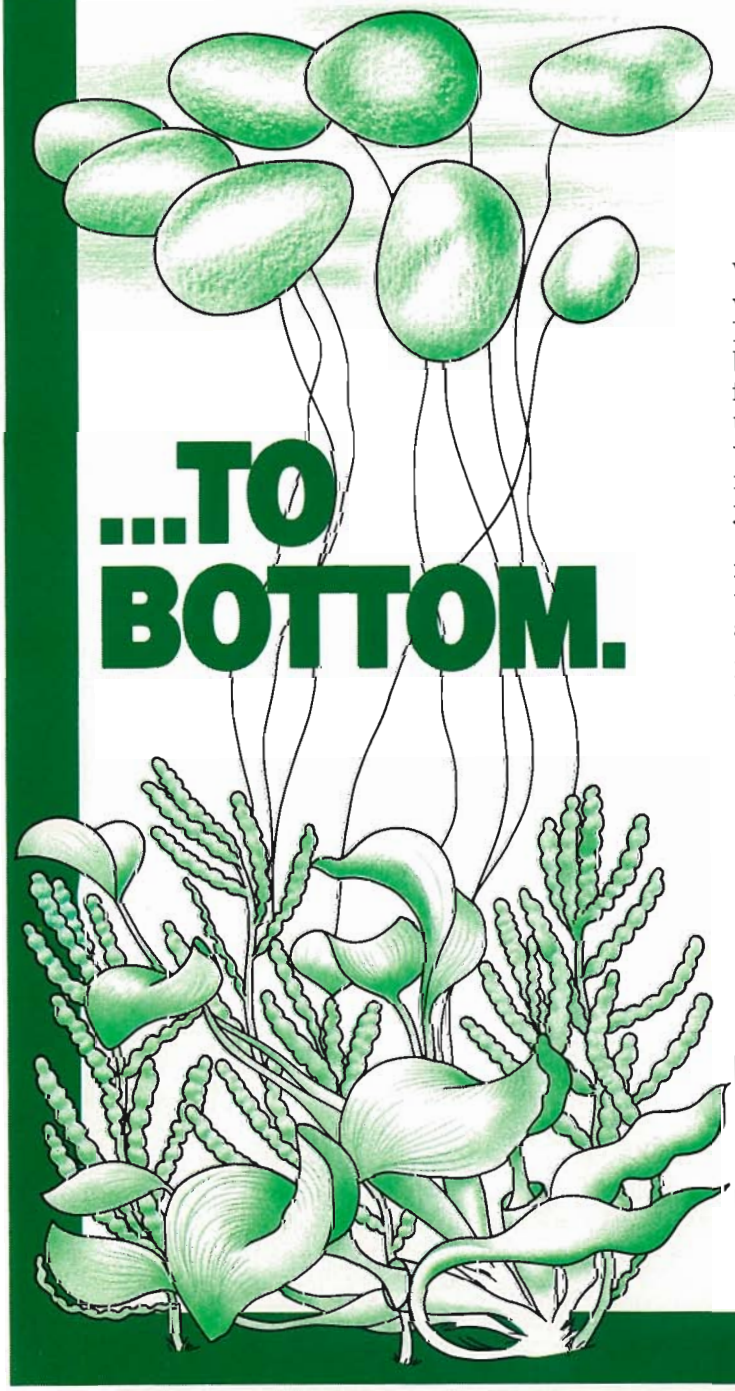


DIQUAT CLEARS OUT WATER WEEDS FROM TOP...



...TO BOTTOM.

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

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

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EDITORIAL

When most of us think of Florida, we picture beautiful lake sunsets, palms, sandy beaches, orange groves, big fish, clean air and lush tropical vegetation. However, for those who work in aquatics, this last item is often too lush and nearly always of true tropical origin. No one really knows how many exotic aquatic plant species have been introduced in Florida. Actually, the number is of no great significance — it's the specific plants that makes the difference. It only takes one Hydrilla *or one water hyacinth to threaten this beautiful image.*

DNR's Rule Chapter 16C-19 was established to control importation, transportation and cultivation of noxious aquatic plants within Florida. In the past, DNR committed four biologist with law enforcement training in a separate section to airport inspections and permitting various activities of the Aquarium Plant Industry. Recent reorganization of the Bureau of Aquatic Plant Research and Control has reduced this number to one position in the research section. Emphasis on the inspection program has been greatly reduced.

Meanwhile water spinach, Ipomea aquatica, *seeds are being sold throughout the state.* Hygrophila *and* Limnophila *continue to be cultivated and sold daily, even though public funds are used for treating problematic sites. What is the current status of Rule 16C-19? Is it an effective legislative tool which clearly and legally regulates noxious aquatic plant importation, cultivation and transportation?*

Florida Statute 403.271 states "No person shall knowingly transport or transfer aquatic plants, whether indigenous or a species not native to the state, between bodies of water within the state without having first obtained a permit from DNR". Yet in a February, 1982 letter to an Aquarium Industry member DNR writes, "The Department will hereafter recognize the Industry's rights to cultivate restricted and prohibited aquatic plants in private waters, owned entirely by industry persons, for exportation outside the state. Documentation that these plant species were introduced to Florida prior to 1982 will help the Department monitor the introduction of new species into Florida". Look out other states! What happens when the next hurricane hits in Florida and washes these undesirables elsewhere? Certainly the Aquarium Plant Industry doesn't want to introduce potentially noxious aquatic weeds into the State, anymore than aquatic plant managers want additional weed problems to contend with.

Statutory and rule changes are past due. Florida's water resources demand unquestioned protection from additional exotic pests. If a non-indigenous species is known to be a potential weed then importation, transportation, cultivation and possession *should be prohibited. If little is known concerning its potential a joint funding structure could be devised to test the plant in quarantined research facilities. Not in private ponds or for sale in other states.*

David P. Tarver

THE COVER

A beautiful sunrise silhouettes an aquatic plant biomass sampler barge on Lake Conway, Orlando, Fla.

Photo by Jeff Schardt

Aquatics

JUNE 1983/VOLUME 5, NO. 2

CONTENTS

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 David P. Tarver, Editor, "AQUATICS" Magazine, 2416 McWest St., Tallahassee, Fla. 32303

THE 1982 AQUATIC PLANT SURVEY

by
Jeff Schardt
Biologist Supervisor II
Dept. of Natural Resources

In 1982, a survey was conducted to assess the aquatic plant coverage in Florida's public lakes and rivers along with their navigable tributaries. Canal systems were included if they provided public access or if they were maintained to provide flood control for the benefit of the general public. No lake size restrictions were incorporated into the 1982 survey as in 1979 and 1980 when manpower was more limited. Inspections which began on March 1 and concluded on November 15, were carried out primarily by the six regional biologists as part of their routine examinations while issuing aquatic plant control permits. The timing was selected to observe aquatic plants at or near their maximum concentrations. No attempt was made to estimate biomass or standing crop.

The 1982 report presents data for the aquatic plant manager on both a regional and statewide basis. The primary purpose is to estimate vegetation coverage in public water. Management efforts may then be directed toward areas of greatest need. After building a consistent data base and by comparing these data through time, the relative success of Florida's aquatic plant management programs can then be determined. Working toward this end, management programs were recorded as being funded at the private, local, state or federal level or as receiving no funding at all.

Aquatic systems have been divided into three general categories; lakes, rivers and canals. Within each of these systems, distinctions were made between types of aquatic plant communities. The four basic communities were: 1) submersed plants or those growing primarily below the water surface; 2) floating plants which were those with no rooted attachment to the hydrosoil; 3) emersed plants which were rooted to the hydrosoil with the stems and leaves extended into the air; and 4) floating-leaved plants which were attached to the hydrosoil with the leaves floating on or suspended just above the water surface. Water-lilies were included in the fourth category. A density rating of light, moderate or heavy vegetation was noted for each species to assess, to some degree, the importance of an individual aquatic plant species to a particular water body. Finally, a distinction was made between native and exotic plants to trace the origin of the aquatic vegetation present in Florida's public waters. Of primary importance to the Bureau of Aquatic Plants are the troublesome exotic species which, for the most part, have evolved in tropical or subtropical climates and have become quite competitive. When introduced into Florida's warm nutrient rich waters, many species quickly outcompete native vegetation and dominate entire water bodies. Three of the ten most abundant aquatic plants found during the 1982 survey are exotic in origin and accounted for 31% of all vegetation found in public waters (Table 1).

Acreages of noxious aquatic plants listed in the survey are not necessarily estimates of the problems associated with individual water bodies. Ongoing management programs significantly reduce the abundance and distribution of problem aquatic plants in many areas. The survey is therefore a reflection of these management programs. For example, more than 1400 acres of hydrilla (*Hydrilla verticillata*) were recorded on Lake Trafford (Collier County) on May 5, 1982; however, approximately 40 acres remained when the lake was reinspected in December 1982. The decline was a result of experimental herbicide plots along with the ongoing control efforts of the Collier County Aquatic Plant Control Department. The Corps of Engineers conducted control operations on 24,500 acres of water-hyacinths (*Eichhornia crassipes*) and nearly 10,000 acres of water-hyacinths mixed with water lettuce (*Pistia stratiotes*) during 1982, but fewer than 8,500 acres of live water-hyacinths plants were observed during the survey (Table 1). Season variations in temperature, rainfall, light and nutrient availablility also affect aquatic plant growth and influence the time and location that different species reach their peak abundance. Since there was no way to determine these peaks beforehand, the survey should be considered as an estimate of the aquatic plant coverage of both beneficial and problem species in Florida's public waters.

The following discussion

TABLE 1

Ten Most Abundant Aquatic Plant Species Found in Florida's Public Waters (427 Water Bodies Surveyed)

	PLANT SPECIES	PLANT ACREAGE	ORIGIN*	NUMBER**
1	Hydrilla verticillata	42,026	E	176
2	Typha spp.	14,774	N	327
3	Eichhornia crassipes	8,466	E	239
4	Potamogeton illinoensis	7,846	N	52
5	Nymphaea odorata	7,837	N	117
6	Nuphar luteum	7,743	N	248
7	Panicum repens	6,883	E	302
8	Vallisneria americana	6,810	N	95
9	Paspalidium geminatum	6,652	N	71
10	Panicum hemitomon	5,960	N	311

* E = exotic, N = Native
** Number = number of water bodies in which the plant was present

TABLE 2

Ten Most Abundant Aquatic Plant Species Found in Florida's Public Lakes (300 Lakes Surveyed)

	PLANT SPECIES	PLANT ACRES	ORIGIN*	NUMBER**
1	Hydrilla verticillata	34,725	E	87
2	Typha spp.	12,650	N	240
3	Nymphaea odorata	7,574	N	110
4	Potamogeton illinoensis	7,470	N	35
5	Paspalidium geminatum	6,652	N	58
6	Nuphar luteum	6,211	N	184
7	Vallisneria americana	5,987	N	69
8	Eichhornia crassipes	5,281	E	155
9	Panicum hemitomon	4,966	N	253
10	Scirpus validus	4,497	N	27

* E = exotic, N = native
** Number = number of water bodies in which the plant was present

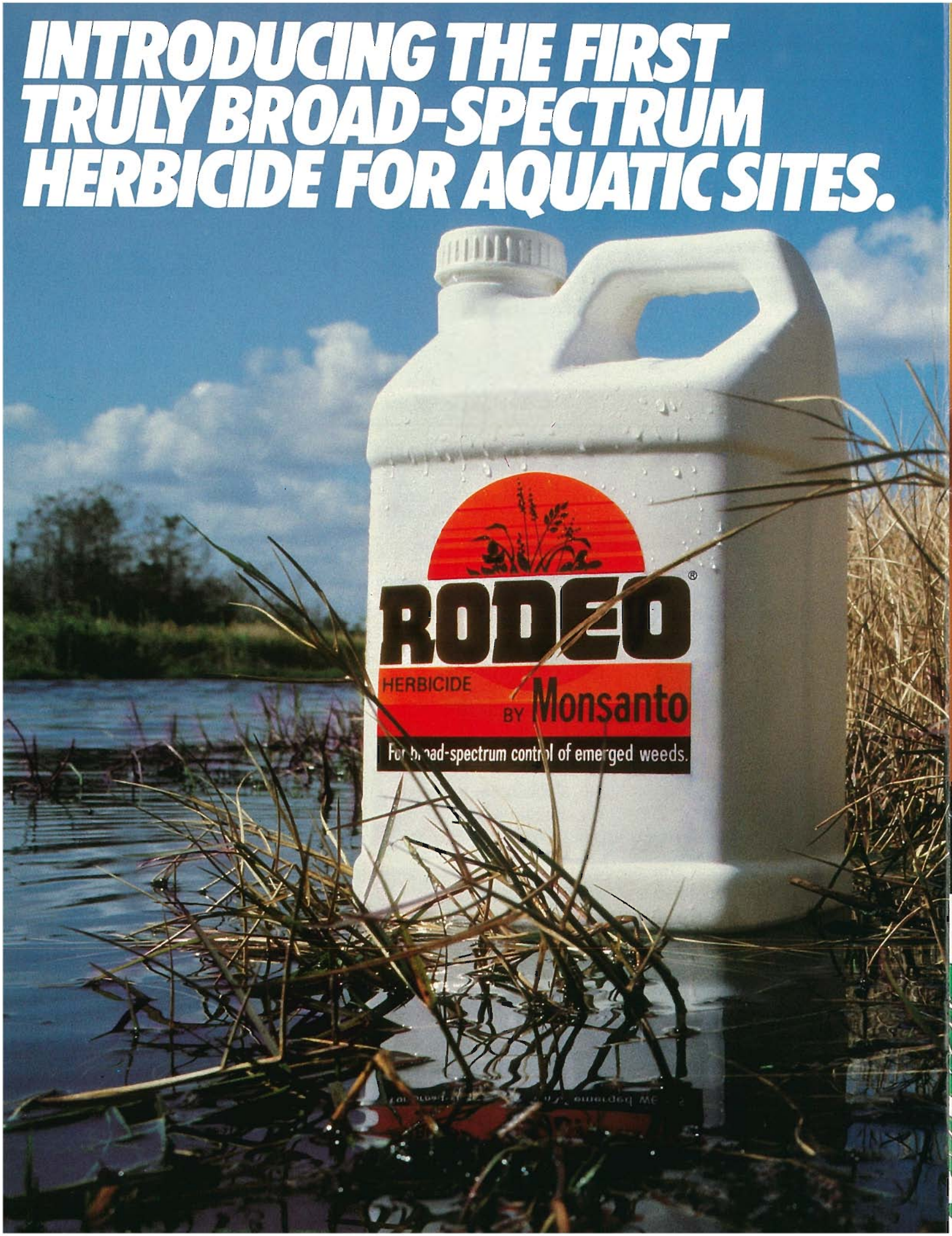
presents an overview of the project's results. A total of 1,235,123 acres of fresh water was surveyed encompassing 300 lakes, 55 rivers and 72 canal systems. This represents approximately 49% of Florida's reported 2.5 million acres of fresh water. One hundred twenty-nine aquatic plant species were identified. Forty-four species, mostly emergent, shoreline plants, were each reported to cover fewer than ten acres statewide. Nearly one half of the 183,475 acres of aquatic plants recorded was comprised of six species (Table 1). Thirty exotic species were identified totalling 70,305 acres or approximately 38% of the coverage of all species observed. Note that although 183,475 acres of plants were recorded, total water surface coverage was much less because of overlapping ranges. For example, a three acre water body could support a three acre coverage of submerged hydrilla underneath three acres of water-hyacinths totalling six acres of plants. No record was kept of net water surface coverage.

Table 1 lists the ten most abundant species by origin (native or exotic) and the number of water bodies in which the plant was found. Tables 2,3 and 4 list the ten most common species by lake, river and canal respectively. Hydrilla continues to be the state's most abundant aquatic plant and the number one problem facing the aquatic plant manager. Statewide coverage amounted to greater than 42,000 acres. Although ten species were found in more water bodies than the exotic hydrilla, including the beneficial native plant *Nymphaea odorata*, none possesses the inherent capabilities to dominate a water body as quickly and extensively as hydrilla. Hydrilla occurred in 176 (41%) of the water bodies surveyed; 44% of the rivers, 29% of the lakes and 90% of the canal systems. Hydrilla was present in 36 counties with the greatest abundance in Central to South Florida. Figure 1 shows the relative coverage of hydrilla by county. Figure 2 presents the same data in a three-dimensional form for easier comparison. The thirty most common species or groups of plants will be presented in this manner as well as by water management district in the 1982 survey. *(See page 10.)*

The second most abundant group of aquatic plants, and most common aquatic plants in terms of water body presence, were the native cattails (*Typha* spp.). Cattails were most prevalent in lakes, including 6,678 acres reported in Lake Okeechobee, but were considered to be more of a nuisance in canal systems by impeding water flow. Cattails occurred in 77% of all waters surveyed. By habitat type, cattails were present in 65% of the rivers, 80% of the lakes and 71% of the canals inspected.

Water-hyacinth, another exotic species, covered nearly 8,500 acres of Florida's fresh water. Fifty-six percent of the rivers, 74% of the canals and 52% of the lakes supported water-hyacinths making

continued on page 8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continued from page 5

TABLE 3

Ten Most Abundant Aquatic Plants Found in Florida's Rivers (55 Rivers Surveyed)

	PLANT SPECIES	PLANT ACREAGE	ORIGIN*	NUMBER**
1	Hydrilla verticillata	3,603	E	24
2	Eichhornia crassipes	1,916	E	31
3	Pistia stratiotes	1,238	E	17
4	Myriophyllum spicatum	1,216	E	7
5	Typha spp.	826	N	36
6	Vallisneria americana	812	N	23
7	Nuphar luteum	749	N	33
8	Ceratophyllum demersum	715	N	20
9	Juncus spp.	672	N	14
10	Lemna spp.	545	N	21

* E = exotic, N = Native
** Number = number of water bodies in which the plant was present

them the second, fifth and eighth most common aquatic plants, respectively, in these systems.

Illinois Pondweed (*Potomageton illinoensis*) and eelgrass (*Vallisneria americana*) both native, submerged aquatic plants, were the fourth and eighth most abundant aquatic plants reported. Each of these plants are considered to have excellent wildlife value and are not often considered to cause navigational or water flow restrictions. Pondweed and eelgrass ranked as the 17th and 37th most abundant plants respectively in canal systems.

Pondweed was the 26th most prevalent plant in rivers, but ranked as number four in lakes, covering nearly 7,500 acres (65% of which was in Lake Okeechobee). Eelgrass was the sixth most prevalent species found in rivers, present in 42% of those surveyed, and the sixth most abundant plant found in lakes with a 23% frequency of occurrence and a coverage of nearly 6000 acres. Lake Okeechobee contained approximately 3000 acres of eelgrass.

Two native water-lilies, fragrant water-lily (*Nymphaea odorata*) and spatter-dock (*Nuphar luteum*) were the fifth and sixth most abundant aquatic plants reported. Together, they totalled nearly 13,800 acres in lakes, 1,000 acres in rivers and nearly 800 acres in canals (783 acres of spatter-dock were found in canals). Fragrant water-lily was found in 117 water bodies — spatter-dock was reported in 248. Although these two species comprised the majority of the floating-leaved plants found in Florida, a total of 19,055 acres of water-lilies were reported statewide including such species as water shield (*Brasenia shreberi*, 2,125 acres), American lotus (*Nelumbo lutea*, 842 acres), yellow water-lily (*Nymphaea mexicana*, 318 acres), and banana lily (*Nymphoides aquatica*, 190 acres).

The grasses, torpedograss (*Panicum repens*), knotgrass (*Paspalidium geminatum*) and maidencane (*Panicum hemitomon*) were the seventh, ninth and tenth most abundant aquatic plants found in public waters. Together they inhabited almost 19,500 acres of fresh water. Maidencane, a native species was the most common of the three, occurring in 73% of the water bodies surveyed. This species was encountered most often in lakes (84%), totalling 4,966 acres. The exotic torpedograss, which was found in 71% of the surveyed waters was most abundant in canals, occurring in 90% and totalling approximately 3,700 acres. Knotgrass was as abundant as maidencane and torpedograss, but was only found in 17% of the surveyed waters. Greater than 90% of the 6,652 acres of knotgrass recorded was encountered in just three water bodies; West Lake Tohopekaliga — 2,800 acres, Lake Kissimmee — 2,040 acres and Lake Okeechobee — 1,196 acres. This species did not present the water flow restriction problems associated with maidencane and torpedograss since knot-

TABLE 4

Ten Most Abundant Aquatic Plants in Florida's Canals (72 Canal Systems Surveyed)

	PLANT SPECIES	PLANT ACRES	ORIGIN*	NUMBER**
1	Panicum repens	4,010	E	73
2	Hydrilla verticillata	3,698	E	65
3	Filamentous algae	2,086	N†	52
4	Typha spp.	1,298	N	51
5	Eichhornia crassipes	1,269	E	53
6	Najas guadalupensis	996	N	27
7	Pistia stratiotes	967	E	43
8	Nuphar luteum	783	N	31
9	Panicum hemitomon	670	N	36
10	Utricularia inflata	606	N	11

* E = exotic, N = Native
** Number = number of water bodies in which the plant was present
† = some exotic species may be included.

grass was rarely found in canals or rivers. As with fragrant water-lily and spatter-dock, these three species comprised the majority of the grasses; however, ten additional species were identified raising the total acreage to approximately 21,100 acres.

Although this list represents the ten most abundant species in Florida, several other genera and closely related plants merit mentioning. Water-lettuce, an exotic, was reported to cover 4,278 acres spread over 109 water bodies. Encountered most often in canals (60% of those surveyed), water-lettuce ranked seventh among all aquatic species with a coverage of approximately 970 acres. The bullrushes (*Scirpus validus* and *S. californicus*) and spikerushes (*Eleocharis cellulosa* and *E. interstincta*) covered greater than 11,500 acres. Six species of bladderworts (*Utricularia* spp.) covered more than 4,800 acres, primarily in quiet lakes and slowly flowing canals. The native coontail (*Ceratophyllum pemersum*) covered 4,182 acres of Florida's fresh water. Filamentous algal species inhabited more than 3,800 acres of water, predominately in canals — possible as a response to the intensive macrophyte control. A combined surface acreage of 3,850 acres was reported for the duckweeds (*Lemna* spp.) and the floating ferns (*Salvinia rotundifolia* and *Azolla caroliniana*). Five milfoil (*Myriophyllum*) species totalled 3,750 acres of coverage. Eurasian watermilfoil (*Myriophyllum spicatum*) was the third most abundant aquatic plant found in the rivers (1,216 acres) due to the 750 acre coverage in Round Bay of the Apalachicola River system. The fanwort species (*Cabomba caroliniana* and *C. pulcherima*) covered 3,524 acres, naiad (*Najas* spp.) totalled 3,324 acres and the macrophytic algae (*Chara* spp. and *Nitella* spp.) covered slightly more than 2000 acres. □

A more thorough report of the vegetation in Florida's waters is presented in the 1982 Aquatic Flora Survey Report. The survey is available by writing to:

Department of Natural Resources
Bureau of Aquatic Plant Research and Control
3900 Commonwealth Boulevard, Room 304
Tallahassee, Florida 32303

THE 1982 AQUATIC PLANT SURVEY

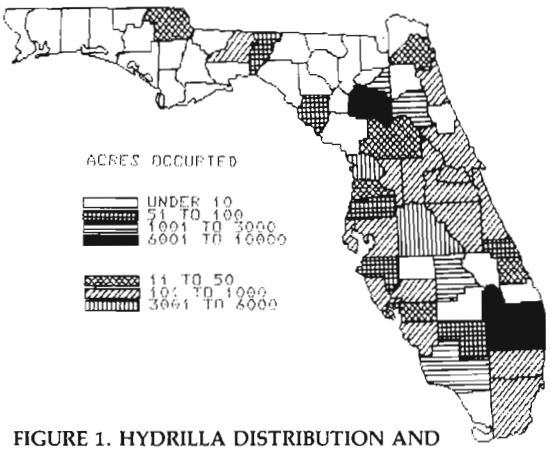


FIGURE 1. HYDRILLA DISTRIBUTION AND ABUNDANCE BY COUNTY

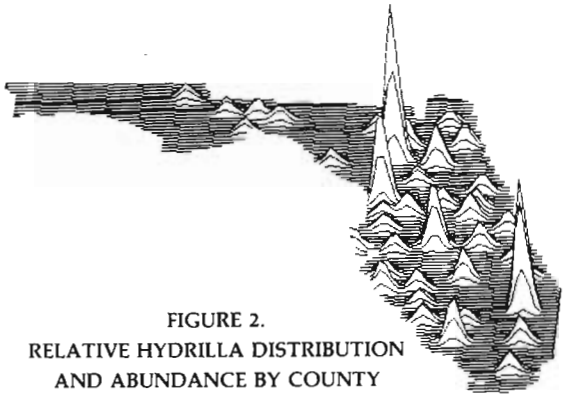
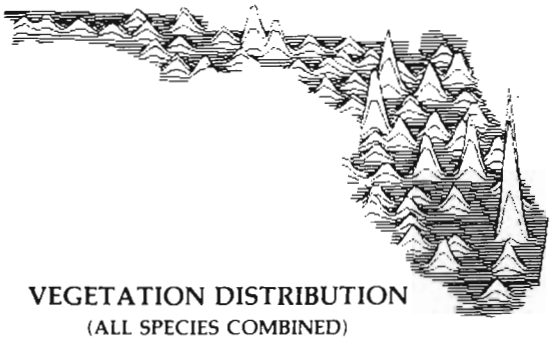
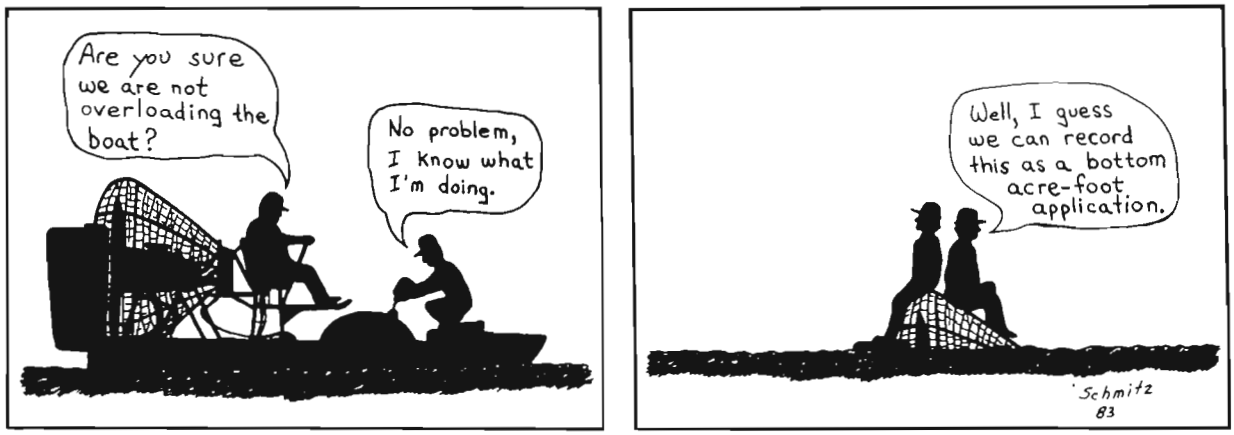


FIGURE 2.
RELATIVE HYDRILLA DISTRIBUTION AND ABUNDANCE BY COUNTY



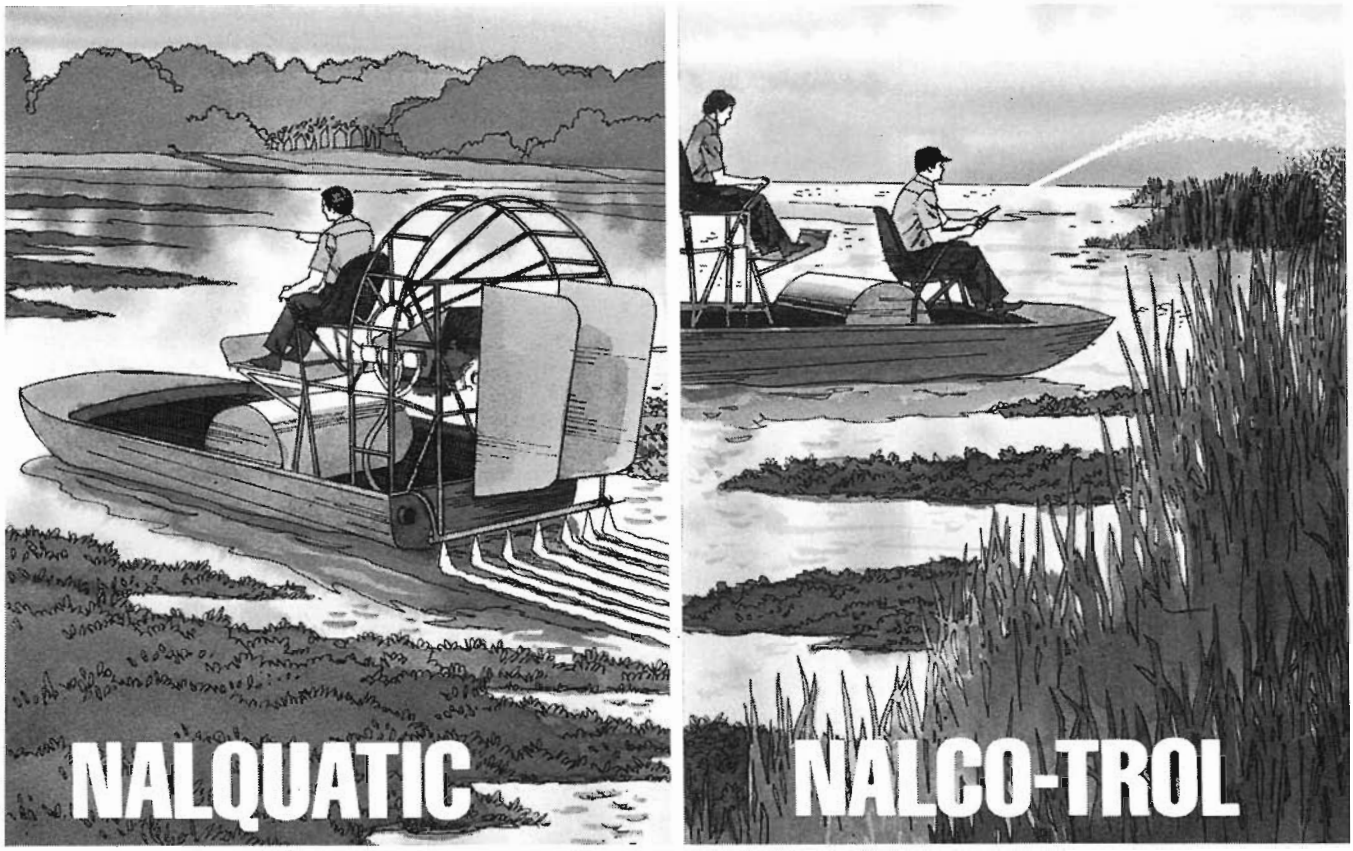
VEGETATION DISTRIBUTION
(ALL SPECIES COMBINED)

WEED LYIN'



From the Editor: In the attempt to name our new cartoon series only a couple of suggestions were received. I've given it the name "Weed Lyin' " — I feel it's 95% accurate.

GOOD NEWS FOR AQUATIC WEED FIGHTERS:



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ARROWROOT

***Thalia* spp.**

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

The family Marantaceae, also known commonly as the arrowroot family has approximately 26 genera and over 400 species. All of the species in this family are tropical with the exception of *Thalia*. Two species of *Thalia* occur in North America, they are *Thalia geniculata* L. sometimes referred to as arrowroot, arrowroot lily or swamp lily and *Thalia dealbata* Roscoe, commonly known as powdery-*Thalia*. The name arrowroot is a poor designation for *Thalia*. The tropical plant *Maranta arundinacea* furnishes the true arrowroot starch for which it is cultivated and is more properly recognized as arrowroot. *Zamia floridana* a plant unrelated to *Thalia* is referred to as Florida arrowroot. Hence, the best way to commonly refer to *Thalia* is just "Thalia".

T. geniculata has a rather limited distribution in North America occurring most commonly in South (subtropical) Florida and only rarely in North Florida and South Carolina. The southern range of *T. geniculata* extends through the Greater Antilles to Argentina.

T. dealbata is distributed along the coastal plain from South Carolina to Texas, Oklahoma and northward to southeastern Missouri where it is designated as an endangered species.

Both *Thalia* species are perennial herbs arising from thick rhizomes. The starchy rootstock is supposedly edible and when boiled turns a coral pink on the inside, but it is reported to have a swampy flavor. Remember this next time you forget your lunch out on the airboat.

The most striking characteristic of *Thalia* is the large lanceolate shaped leaves up to 0.8 meters long, which are the largest of any native plant other than the palms. A good picture of *Thalia* is on the cover of the March 1983 "Aquatics" in a typical swamp habitat of South Florida. *T. geniculata* is the tallest of the two species growing up to 3.5 meters. The flowers of both species are born on a long loosely branched panicle. Flowers occur in pairs, are bisexual and have three distinct purple petals subtended by two downy mostly purplish bracts. The flowers are arranged in intervals along the rachis in a zig-zag or bent-knee pattern, hence the name *geniculata* derived from the word for knee.

T. dealbata can be separated from *T. geniculata* by the presence of a white powdery substance on the leaves. The specific name *dealbata* means white-washed. Also, the flowers of *T. dealbata* are more crowded together and are shorter and broader than those of *T. geniculata*. *Thalia* occurs in a variety of wetland habitats including swamps, marshes, edges of ponds, lakes, and rivers as well as roadside ditches. *Thalia* can often be found growing in a transitional zone circling the outer margin of the pond formed in the center of many cypress domes. This zonation is especially evident when viewed from the air or aerial photographs. In other marsh type environments a stand of *Thalia* may cover several acres. Emergent plants found growing in association with *Thalia* are pickerelweed (*Pontederia lanceolata*) and *Sagittaria* spp., among others. In Florida *Thalia* has been reported growing in the littoral zone of Lake Okeechobee, along the floodplain of the Kissimmee River and the St. Johns River System. *T. geniculata* is also common in ditches through South Florida where it is occasionally controlled. The extreme height that this herb attains in mid to late summer can occasionally present problems along roads where the view of oncoming traffic can be obscured, although I have seen this situation only once.

I have observed *T. geniculata* at several sites in Lee County for several years. Of interest, although not understood very well, is the competitive relationship *Thalia* exhibits with associated plants. Water level fluctuations play a large part in these inter-species relationships. During particularly dry winter and spring seasons in South Florida, the vegetative portion of the plant will become extremely dry, breaking down and almost completely disappear from the site. At this time other plant species more tolerant to dry conditions establish themselves. As the wet season starts *Thalia* regrowth from underground rhizomes begins and dominance is re-established by June or July. During a wet spring season, much of the vegetative portions remain green and regrowth begins earlier. Figure 1 exemplifies some of these transitional periods.

Flowering usually starts in June or July depending on the condition of the vegetative portion of the plant as determined by a variety of environmental factors, the most important seems to be the amount

Fig. 1. From left to right is *Thalia* regrowth from winter die-back, summer growth and winter-spring transition at the same site.

of rainfall. Above normal rainfall in the spring usually initiates early flowering. Flowering activity and plant height peak during August and September, declining noticeably in December and January.

The fauna associated with *T. geniculata* is diverse and an entire community of insects, spiders and lower vertebrates are typically associated with this plant in some way. The flower portions of *T. geniculata* are the host of a small plume moth caterpillar and a variety of sucking bugs which lay their eggs in long rows on the flower petioles. A pyralid moth that rolls the leaf to provide a suitable micro-habitat is also evident during the fall months. Nymphs of the sucking bugs also utilize this folded leaf micro-habitat in a sort of symbiotic relationship that benefits both species. Large argiope spiders among others attach their webs between panicles and keep many of the plant feeding insects from becoming over abundant. Green tree frogs (*Hyla cinerea*) are especially common in the *Thalia* community and can be seen drowsing during the day attached to the shady portion of a large *Thalia* leaf.

Conservation of the *Thalia* community as well as other wetland areas needs to be stressed especially in South Florida where urban sprawl and its negative effect on water resources is occurring at an unprecedented rate. It's not hard to realize that eliminating a stand of wetland plants through whatever means can also eliminate an entire assemblage of other organisms that cannot readapt as fast as wetlands are being altered or eliminated. The eventual impact of these consequences may be irreversible.

If you don't mind the occasional noisy retreat of a water snake or spider web in your face, a few hours with a camera and a pair of waders in a *Thalia* stand can be a fascinating experience. □

FAPMS CERTIFICATION PROGRAM

by Jim McGehee

The FAPMS has accepted Jim Brewer's suggestion for a Society sponsored training and certification program for aquatic plant management personnel. The program will not replace the State's EPA certification program but will offer more specific training on aquatic plant management. Completion of the training, however, should be more than adequate preparation for passing the state test for certification. Participation will be on a strictly voluntary basis.

The program as it is presently planned will consist of two parts. These are a correspondence type course with a training manual and tests, and a practical demonstration of elemental skills. The tests will be administered by the participants' supervisors.

The course will cover: (1) the basic principles of aquatic plants' interrelationship with the aquatic environment, (2) identification of common weed plants, (3) descriptions of the various methods of control, (4) selection of control methods, (5) practical use of control methods, (6) calibration of equipment, (7) laws and regulations, (8) safety. The practical demonstration will include: (1) boat handling skills, (2) emergency procedures, (3) proper biological, chemical, or mechanical control application, (4) maintenance, repair, and calibration of equipment. Upon satisfactory completion of the program the Society will issue a certificate and a cloth FAPMS certification patch.

President Carlton Layne has appointed Jim McGehee to act as coordinator for the development of the program. Jim is to have a preliminary outline of the program ready for the Board's review and approval at the next Board meeting scheduled for 3 August 1983. If you have any comments or suggestions or you would like to contribute to the development of the Society's training and certification program please contact:

Jim McGehee
P. O. Box 212
Macclenny, FL 32063

Phone: 904-791-2218 work
904-259-6658 home □

WHAT HAPPENS AFTER YOU SPRAY?

by Dan Thayer, Biologist Supervisor I
Department of Natural Resources

Early weed control efforts centered around the use of hand held tools such as hoes and rakes. Advances made in England during the 1730's harnessed animal power to pull cultivators — later, mechanically powered cutters were developed. Early chemical control efforts included using sea salt as a total vegetation control. Not until about 1900 were purified chemicals, such as iron sulfate, copper sulfate, and sodium arsenite, used in an attempt for more selective weed control.

The early 1940's brought about a revolution in chemical weed control efforts with the development of 2,4-dichlorophenoxy acetic acid (2,4-D). Shortly after the synthesis and success of 2,4-D as a herbicide, the use of chemicals for weed control rapidly increased. Today there are several hundred chemicals being used as herbicides. Before any herbicide can be utilized by the public, federal law requires manufacturers to supply extensive data on efficacy, toxicology, residue determination, tolerance levels, fate and impact of the herbicide on the environment. This involves thorough testing through years of research and investments of millions of dollars to assure that the product is safe as well as effective.

Despite the years of research required to register a new pesticide on the market, the effectiveess and safety of any program ultimately rests in the hands of the applicator. It is important that a pesticide applicator is knowledgeable about the chemicals he applies to assure that effective weed control results with minimum adverse impact of the environment. Equally as important, in respect to the ever-increasing concern over environmental issues, is that those who deal with the public must be knowledgeable about the actions of herbicides once they are placed in the environment.

The following summary briefly discusses what happens to several commonly used aquatic herbicides after they are sprayed.

Once a herbicide is applied, several methods exist for its dissipation and degradation in the aquatic environment. Volatility may be a problem where herbicides evaporate readily and drift in the vapor form. This problem is almost exclusively confined to the ester formulations of 2,4-D. Physical drift may be a problem with any surface applied herbicide where wind velocity is such that spray particles are moved from the target site. Once the herbicide enters the water column, natural dissipation will occur and is dependent on several factors including: herbicide rate, formulation, distinctive characteristics of individual chemicals, spray tank additives, water depth, circulation and flow, plant density, and overall lake morphology. The natural microorganisms of the hydrosoil are responsible for decomposing many herbicides into commonly occurring soil components. Photodegredation is a major decomposition process for many aquatic herbicides. Metabolism of herbicides by fish and resistant plant species may also play an important role in the degradation of applied herbicides.

Among the earliest used chemicals for aquatic weed control was copper sulfate. First used in the early 1900's, copper sulfate can be employed as a general algae control agent, and in mixtures with other herbicides, as an aid for control of submersed aquatic macrophytes. Copper disrupts the cell membrane and plant enzymes primarily affecting the photosynthetic system. Copper sulfate persists for about seven days before the free copper is precipitated to insoluble forms and remains an inactive precipitate in bottom muds; however, copper may return to solution if bottom sediments become anaerobic. Chelated coppers can be used where hard water may precipitate uncomplexed forms of copper too rapidly.

The phenoxy herbicides (2,4-D compounds), are systemic herbicides used primarily for boadleaf weed control. Phenoxy herbicides may be formulated in a variety of ways; however, the amine formulations are more popular due to reduced vapor drift and desirable water solubility characteristics. The 2,4-D's are absorbed by both leaves and roots. They are then translocated throughout the entire plant to actively growing tissue where abnormal growth and cell division results in a twisted, curled appearance. The primary means of 2,4-D degradation is microbial decomposition. Although some photodecomposition and metabolism by resistant plant species occurs, it is extremely limited. Eleven species of naturally occurring microorganisms are known to break down 2,4-D. Decomposition takes approximately 70 days in waters which have never been treated with 2,4-D and approximately 30 days for systems where 2,4-D was previously sprayed. This decreased breakdown time is due to a build-up of the microorganisms responsible for decomposition. Breakdown time is further decreased by warm, well oxygenated water. Under optimum conditions decomposition may require as little as seven days. The products of 2,4-D breakdown are carbon dioxide, water, ammonia and chlorine. For example, a two pound per acre rate of 2,4-D amine will break down into one pound carbon dioxide, ¼ pound water, ¼ pound ammonia, and ½ pound chlorine.

Endothall, first applied for aquatic plant control in 1948, is used on a wide spectrum of submersed aquatic plants. Endothall appears to have the action of a contact herbicide, but is taken up over a period of several hours and translocated toward the leaves causing browning of the foliage and rapid desiccation. Endothall is metabolized by resistant plant species; however, microorganisms are the predominant means of degradation. Microorganism breakdown is rapid, with an average disappearance from water in 16 days and from the hydrosoil in seven days.

Diquat, a contact herbicide, is a general vegetation control agent first developed in 1955. The diquat ion is very rapidly absorbed by foliage because the double positive cationic charge of the herbicide is adsorbed to the negative charge associated with leaf surfaces. Organic and clay based soils, which are also negatively charged, will rapidly adsorb the diquat ion

making it completely unavailable as a herbicide. Nonionic surfactants are therefore required when used with diquat. In the presence of light, oxygen, and during plant photosynthesis, the diquat ion is converted to hydrogen peroxide (H_2O_2) which is the actual toxicant. Photodecomposition of diquat may occur on plant surfaces and in clear aqueous solutions when exposed to ultraviolet light; however, when diquat is tightly adsorbed to soil, breakdown is very slow. Microbial breakdown does occur, but the extent of breakdown is limited.

Fluridone, developed for aquatic use in 1976, controls many floating, emersed, and submersed aquatic weeds. Fluridone is foliar and root absorbed, then translocated through the plant to actively growing tissue, often requiring four to eight weeks for control. Inhibition of carotenoid synthesis results in photo-destruction of the chlorophyll (green) pigments, producing a bleached appearance. Because the herbicidal activity of fluridone occurs slowly, dissolved oxygen content of the water does not change appreciably. Fluridone remains in the hydrosoil from 16 to 52 weeks. Metabolism by resistant species and microbial breakdown may occur; however, photodegredation is the primary means of breakdown.

Glyphosate, a new herbicide for aquatic use, is essentially nonselective, giving control of perennial and annual grasses, as well as many broadleaf plants. Glyphosate is very mobile and translocates throughout the entire plant. Interference with essential amino acid biosynthesis slowly kills the plant in one to three weeks or longer, depending on plant species and the time of year the treatment occurs. Glyphosate must be applied to plant foliage to have any herbicidal activity. The chemical is inactivated when applied directly to the soil or into the water column. Glyphosate is primarily degraded by microorganisms into natural products (carbon dioxide, water, nitrogen and phosphate) over a period of several months.

By knowing more about the chemicals you depend on to manage aquatic plants, your program will run more efficiently and effectively and you will have more confidence when confronted by concerned citizens. The end result will be a smoother program, less controversy and improved public relations. □

Call For Papers

It's that time again. Time to become involved and participate in the 1983 FAPMS meeting in Plant City, Fla. Let the entire aquatic community know what you've been up to. Send in your paper title early to make certain of a slot on the program. Mail To:

Mrs. Deanna Brown
10307 South Indian River Dr.
Port St. Lucie, Fla. 33452

From Citrus County Aquatic Plant Control — *You know it's really gonna be a bad day when...*

1) *You do a 360° turn on a full plane and find your partner missing.*
2) *You push your boat off the trailer and remember the key is back at the shop.*
3) *Your harvester picks up air tanks and snorkels, etc.*
4) *You toss your anchor over and forgot to tie the rope.*
5) *Your chewing tobacco turns out to be something else.*
6) *Your invert oil winds up being 10W-30 oil.*
7) *You reach for a cigarette only to find them floating in your mix tank.*
8) *You realize after the boat's off the trailer, that you forgot the plug.*
9) *That banging noise was the prop.*
10) *The island you've been pushing all day has a trailer on it.*
11) *You pull into the dock and Al Nichols asks "What's new".*
12) *The only fish caught that day were in your tank mix bail bucket.*

WEED CONTROL SPECIALISTS URGED TO BECOME POLITICALLY INVOLVED

by Kelly O'Brien*

It's a rare event where the EPA, NACA, and members of the Weed Science Society of America find themselves in agreement, but that's just what happened at WSSA's recent annual meeting, which was held this year in St. Louis. At the general sessions, featured speakers from these organizations urged the industry to "sell" weed control to the media, legislators and consumer groups.

WSSA President T.J. Sheets opened by urging greater political involvement from WSSA members. He pointed out that Section 208 of the 1972 federal Water Pollution Control Act requires states to develop water pollution control plans for animal wastes, sediment, nutrients and pesticides. If weed scientists don't get involved in deciding what weed management practices are best, he warned, someone with little knowledge of the principles and practices of weed control will end up making the decisions.

His warning was underlined by John W. Hernandez, acting administrator of the EPA, who said that recent books such as *The Pesticide Conspiracy*, and articles like the series called "A Chemical Harvest" in the *Washington Post*, have significantly affected attitudes and actions on Capitol Hill. In fact, according to Hernandez, the recent changes in EPA's policies have come about in spite of media influence on Washington legislators and tremendous pressure from special interest groups.

Hernandez said he expects to see congressional action on the regulation of pesticides again this term. And while he's not in favor of abolishing FIFRA, he notes, "We're not doing a good job of selling the benefits of weed control to society. Ignorance and fear must not win out over science and intelligence."

Local Issues

In a special section of the program devoted to regulatory affairs, Jack Early of NACA examined the changes that have taken place at EPA. Early noted that the agency has become more responsive to issues than ever before, but sees a bigger problem than regulatory issues looming on the horizon: the shift in focus of special interest groups from the federal to the state and local level.

About three years ago, Early said, special interest groups realized they were having less and less impact at the federal level, and began to shift their focus to local issues. Seizing on everything from gypsy moth control to rights-of-way vegetation management, these groups have now turned their attention to state and local regulations. Early pointed out that one of the problems NACA has in following this kind of anti-pesticide activity is the sheer speed of events — unlike Washington, things can happen very quickly at the state and local levels.

According to Early, about 30% of the manpower at NACA is now allocated to monitoring state and local issues. In addition, governmental affairs persons from various member companies provide additional manpower in the effort to track and assess the impact of what's going on.

Early also addressed the issue of public attitudes toward pesticides. "The industry has an image problem and it's going to be hard to turn it around," Early said, supporting his assertion with data from a recent pesticide attitude survey. Where *Scientific American* ranked pesticides 27th in a list of factors causing or contributing to mortality, business leaders ranked them 14th, the League of Women Voters ninth and college students fourth.

Presidential Concern

Addressing the meeting, Secretary of Agriculture John Block emphasized the continuing importance of chemical weed control to American food production. While the American farmer today can feed himself and 77 other people, Block noted, "He couldn't do it if he didn't have chemical weed control." He said he encourages research that will produce more efficient formulas or methods for weed control, reduce frequency or cost of applications, or improve the return on the farmer's herbicide investment.

In a press conference held before he addressed the WSSA meeting, Block expressed an overall optimism about agriculture in 1983. While he's not counting his chicks before they're hatched, he has high hopes for the payment-in-kind (PIK) program, and anticipates that as the national economy turns around, so will the agricultural economy. He cited the current annual 2-4% increase in inflation and recent improvement in livestock prices as encouraging indicators.

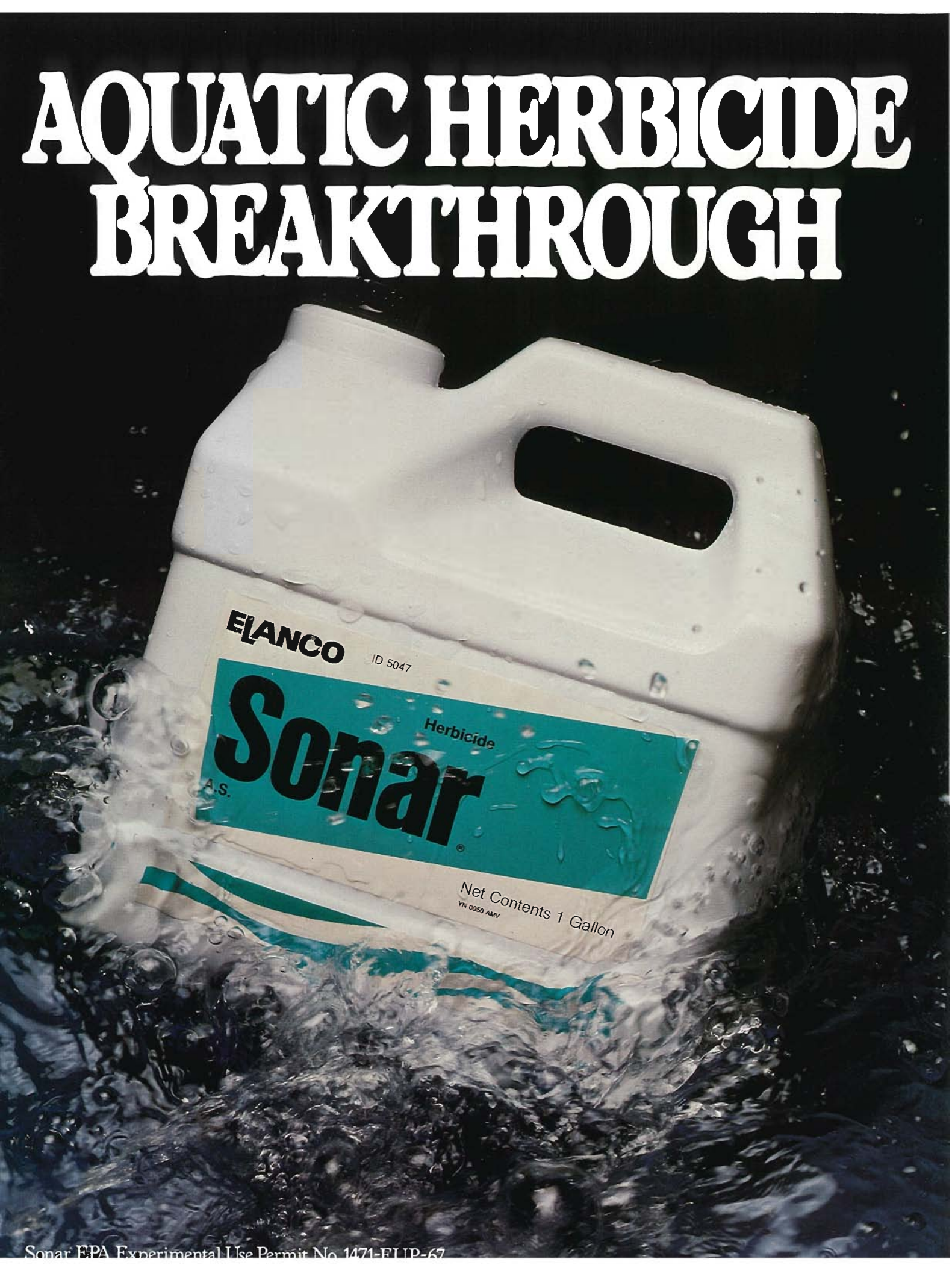
But, he adds, what encourages him the most is the president's genuine concern. Block recalled a recent cabinet meeting where President Reagan passed him snapshots of agricultural land erosion and wanted to know what could be done about it. Block said they discussed conservation tillage.

"He asked me about things like that," said Block. "I think this administration really cares about agriculture."

The WSSA meeting was attended by more than 1040 scientists in academia, government and industry; more than 250 papers were presented. The 1984 WSSA meeting is scheduled for Miami. □

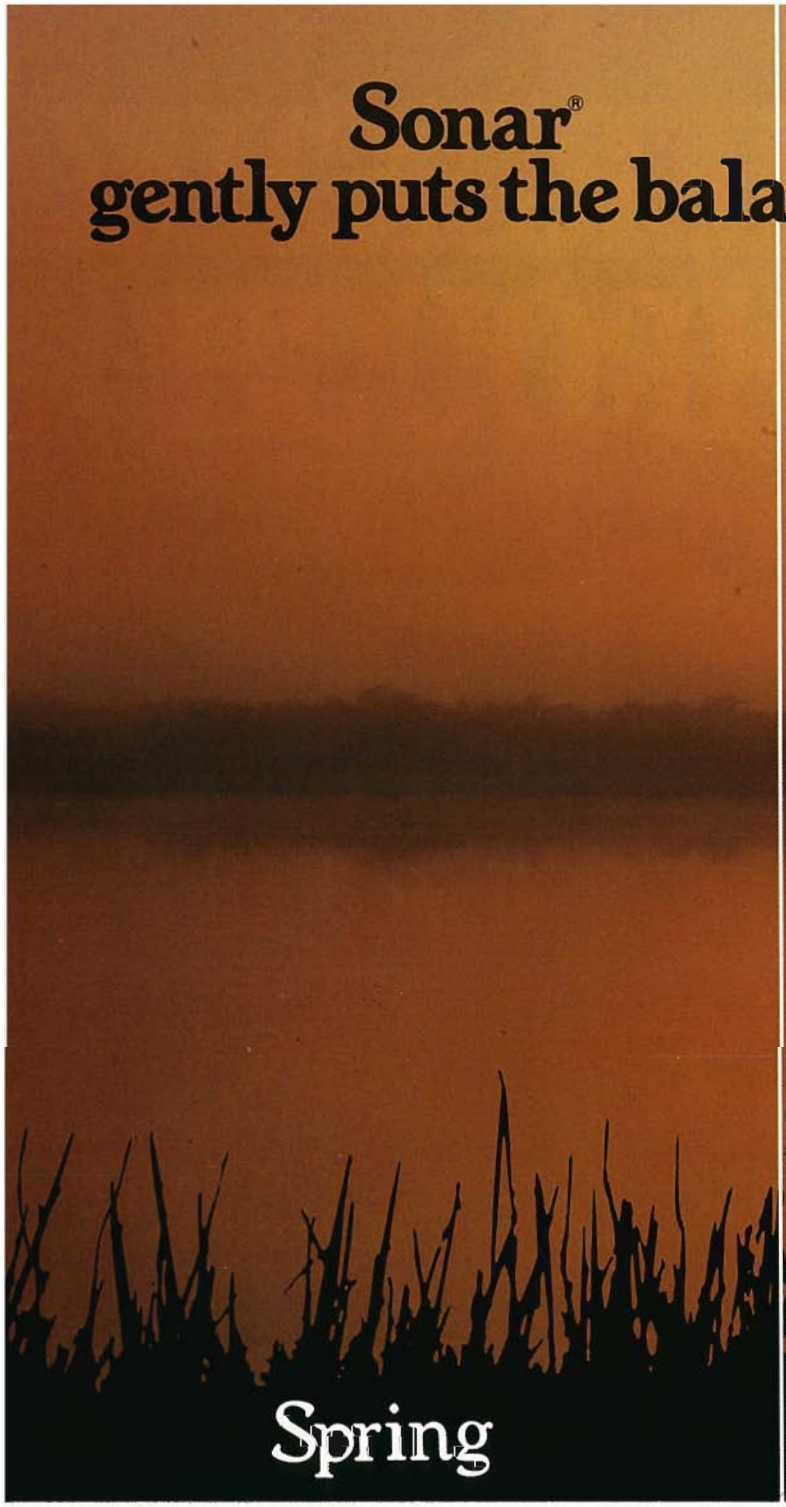
Reprinted with permission from "Agrichemical Age" April, 1983

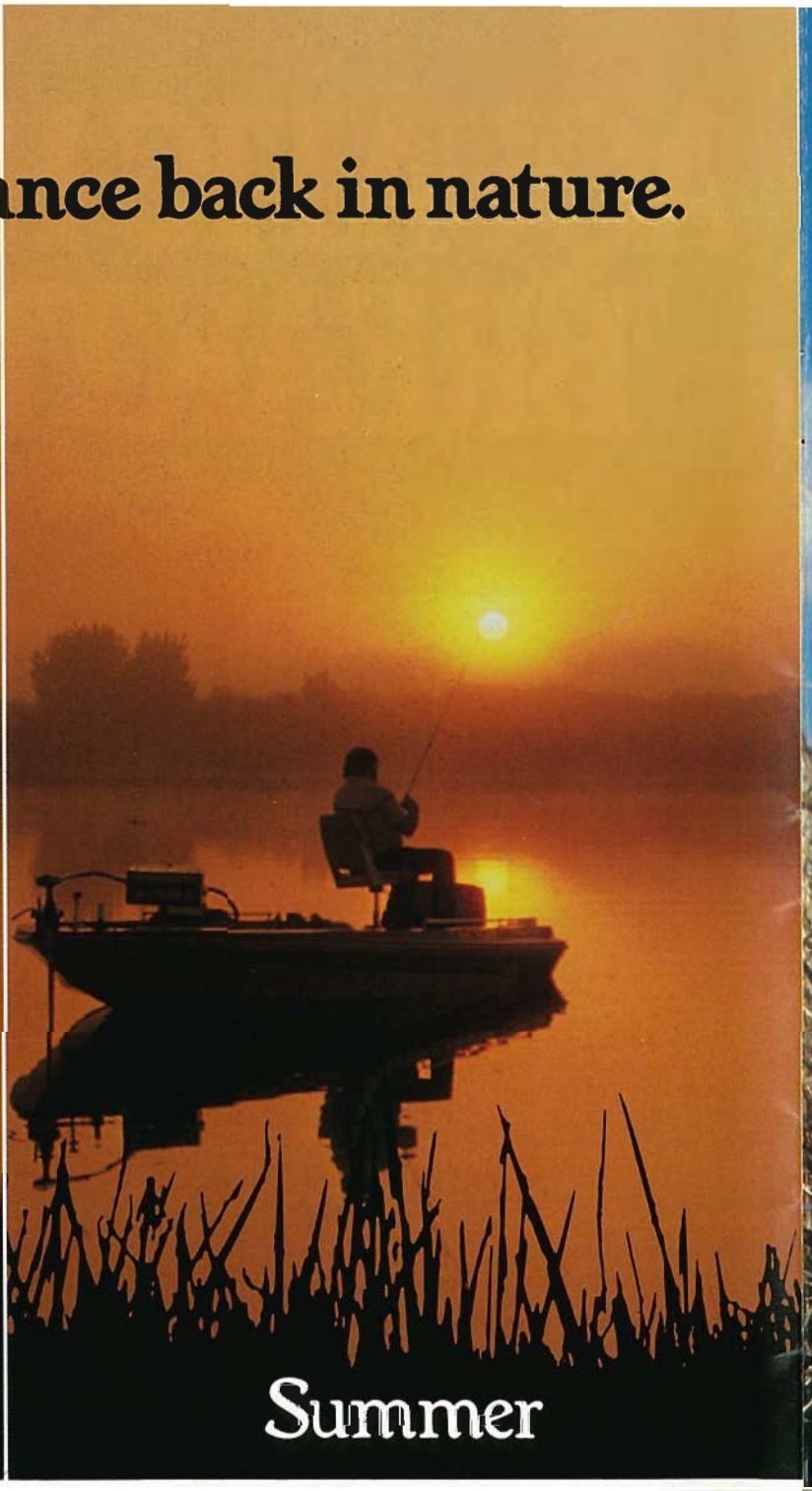
AQUATIC HERBICIDE BREAKTHROUGH



Sonar EPA Experimental Use Permit No. 1471-EUP-67

Sonar®
gently puts the balance back in nature.





At last there's a new generation aquatic herbicide that manages a host of undesirable vascular plants without mismanaging the good life. Sonar® from Elanco.

Weed management.

One treatment of Sonar provides control during the critical growing season of many submersed and emersed aquatic weeds. Weeds controlled include hydrilla, elodea, water milfoil, pond weeds, torpedograss, paragrass, southern naiad and numerous other troublemakers.

Hydrilla

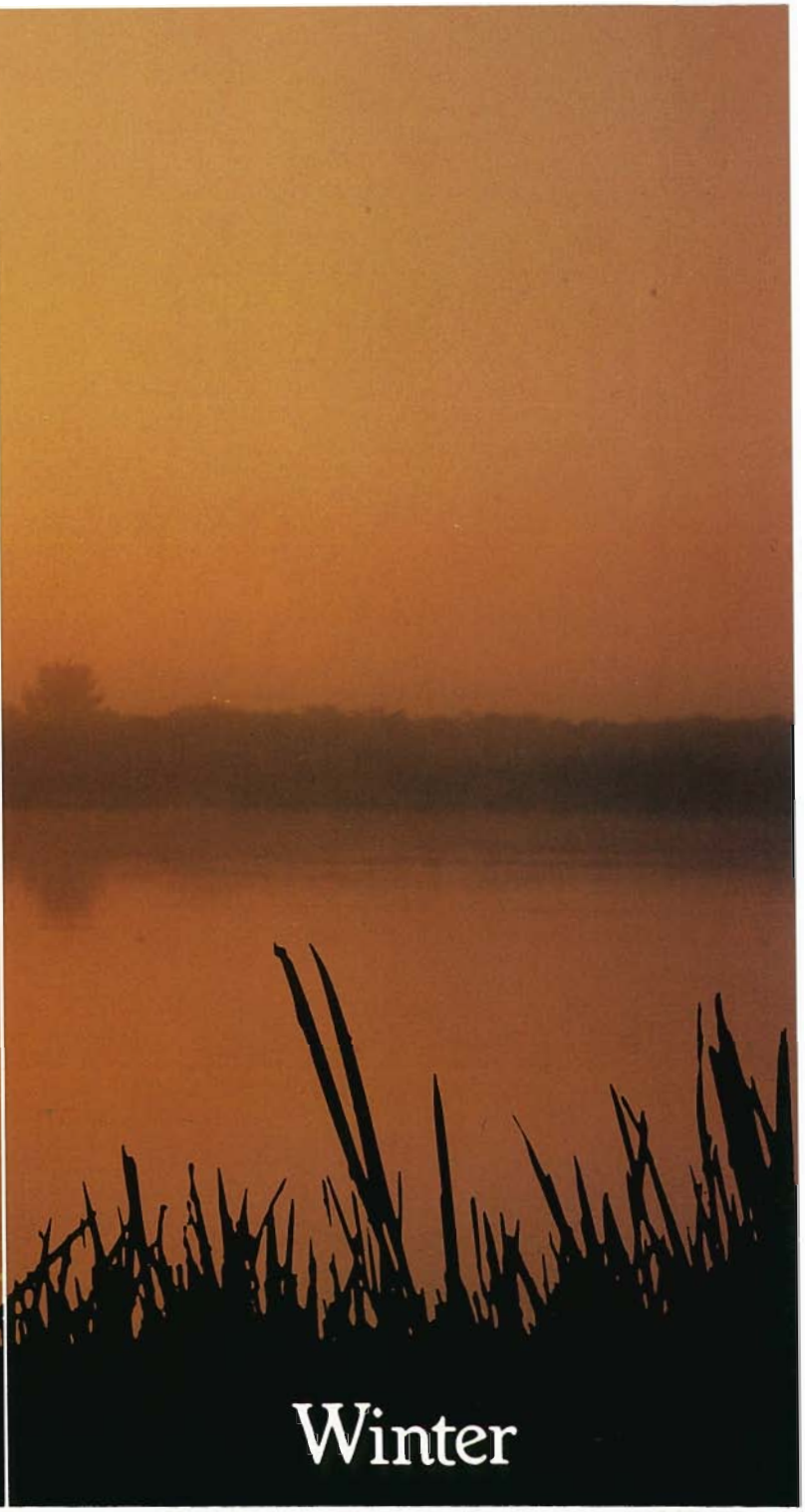
When you make Sonar part of your weed control program, you get effective management of your valuable water resources.

Slow but sure action.

Four to six weeks after treatment, Sonar takes its toll on undesirable vegetation. And because of its slow action, there is no rapid oxygen depletion. This makes Sonar highly compatible with the aquatic environment and makes fish kills a thing of the past. Applied as directed, Sonar will not harm fish,

Elodea

Water milfoil



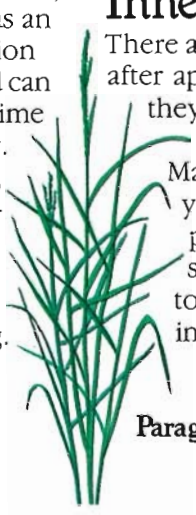
wildlife, or nearby trees and shrubs.

Flexible application.

Sonar can be applied to the entire surface of a pond or up to ten percent of larger bodies of water. Depending on existing equipment and user preference, Sonar is available as an aqueous suspension or 5% pellet and can be applied any time during the year. For best results, the label recommends applying Sonar when weeds are actively growing.

Pond weeds

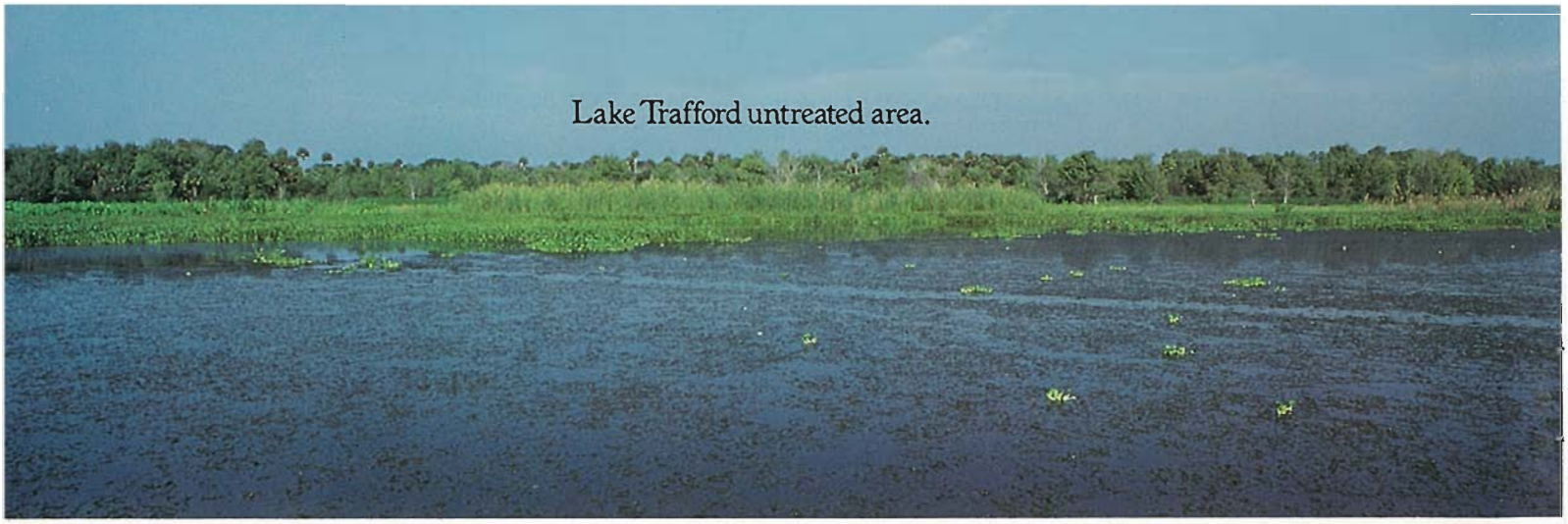
Torpedograss



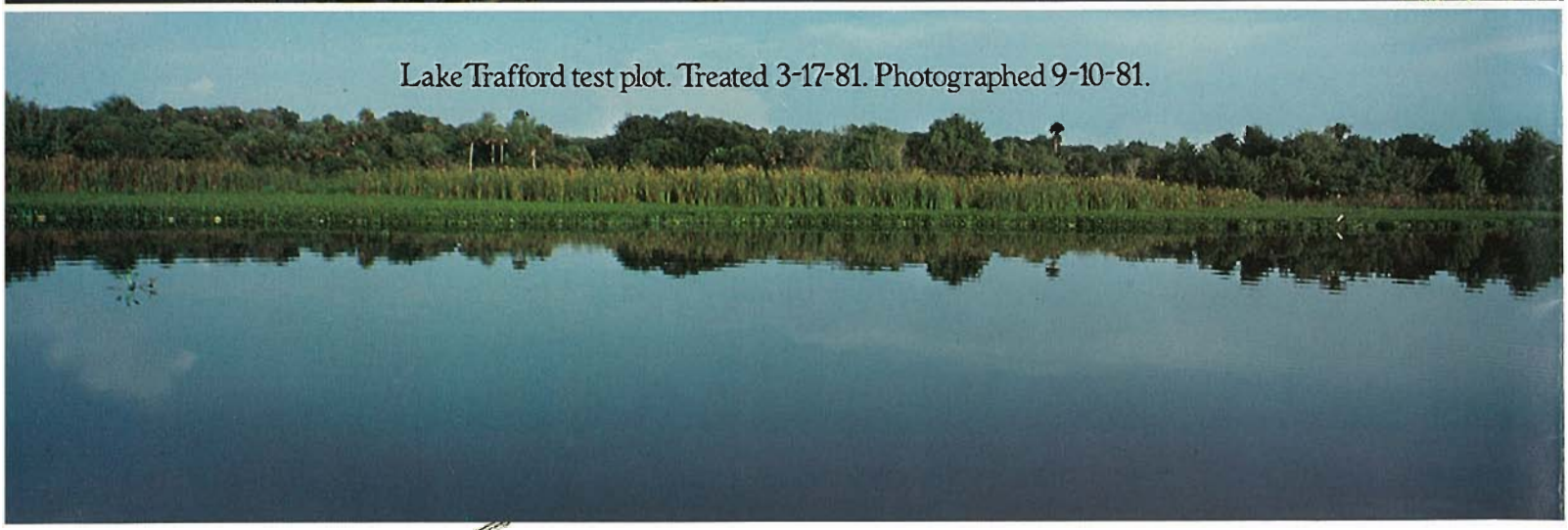
Paragrass

Inherent value.

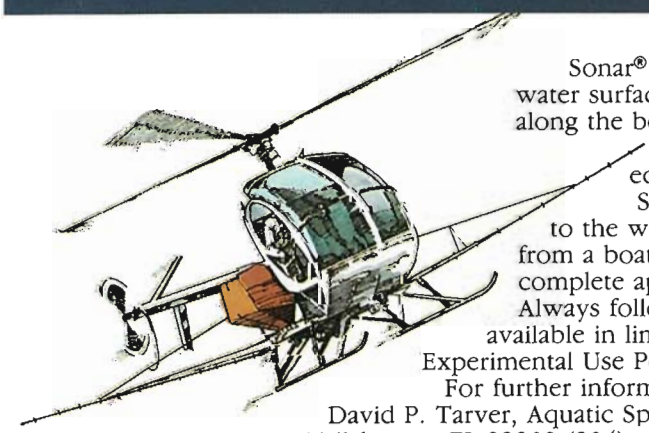
There are few restrictions after application, and they are detailed on the product label. Make Sonar part of your management program. It's the simple, gentle way to put nature back in balance.



Lake Trafford untreated area.



Lake Trafford test plot. Treated 3-17-81. Photographed 9-10-81.



Sonar® aqueous suspension can be applied to the water surface or under the water surface or placed along the bottom of the water just above the hydrosoil. Any conventional application equipment can be used.

Sonar 5% pellet can be applied to the water surface from the shore or from a boat. Refer to the Sonar label for complete application instructions.

Always follow label directions. Sonar is available in limited quantities under EPA Experimental Use Permit No. 1471-EUP-67.

For further information write or phone:
David P. Tarver, Aquatic Specialist, 2416 McWest Street, Tallahassee, FL 32303 (904) 562-1870

Elanco Products Company, A Division of Eli Lilly and Company, Indianapolis, IN 46285, U.S.A.

AQUA-VINE

Editor Gets Letter From Game and Fish Commission

April 29, 1983

Dear David:

Since there have been a number of articles and a few advertisements for the grass carp in *Aquatics* over the past two years, I would like to point out some of the problems associated with its use.

(1) The grass carp is illegal from both a state and federal standpoint, see Lacy Act Amendment.

(2) The grass carp is not the most economical hydrilla control method. Diuron has been used to control (and oftem eliminate) hydrilla for a chemical cost of ten to twenty dollars per acre. It is also illegal — just like the grass carp!

(3) The grass carp was never as successful as popularly believed. I have seen almost all of the sites stocked under research and rule 16C-21. An overall 50% success rate can be attributed to the grass carp.

(4) Most, if not all, grass carp research lakes were/are in reality integrated control lakes.

(5) In my opinion, grass carp have escaped out of research lakes into other bodies of water and are in both the St. Johns and Kissimmee River Systems. We can only hope that populations are so sparse that spawning is of a low probability.

(6) Weed control using fish is not as simple as believed, i.e.: stock a few fish and wait a few weeks.

(7) Most often the grass carp is an all or no control situation. This is undesirable in most lakes in which fishing is a major use of the water. Fine tuning stocking models to achieve the desired level of control would at best require years to complete and be very costly.

(8) The questions on grass carp reproduction and detrimental effects on fish and waterfowl habitats are much like looking down the barrel of a .44 Magnum and pulling the trigger to see if the bullet is good and the gun works. Have you ever heard of unspawning a fish population after the fact? At stake are river systems and most connecting fresh water lakes.

(9) In a nutshell we (the scientific and professional community) have gambled using the ecology of the St. Johns River, Kissimmee River, Withlacochee River and associated lake systems for the benefit of boating and water skiing interests on a few relatively small bodies of water using an organism that probably has at best a 50% to 70% chance of solving the problem in the lake where it was introduced. I consider it unethical at best to use these other people's chips without making them aware or asking their consent. They (the users of these potentially affected systems) were never even given an opportunity to ask these questions.

(10) The Florida Game and Fresh Water Commission operates a Wildlife Alert Program whereby one can report any suspected violations of fish and wildlife codes (such as stocking restricted fish) and possibly receive a reward. Anonymity is assured. For information or to report suspected violations call toll free:

Lakeland	1-800-282-8002
Ocala	1-800-342-9620
West Palm Beach	1-800-432-2046
Lake City	1-800-342-8105
Panama City	1-800-342-1676

Safer aquatic weed control alternatives are now available and I believe our research and management efforts should be directed toward refining and developing them in a responsible manner. As professionals we owe it to the people we serve (the entire state and tourist populations) to proceed in a prudent and responsible manner working with the safest tools available with a sane and professional attitude. Ignoring the possibility of damage to others and/or adverse consequences in the future is not considered by most people to be "professional" behavior.

Your efforts in promoting and maintaining a professional posture among members of the Florida Aquatic Plant Management Society through the *Aquatics* magazine are encouraged. I hope this letter will be helpful in this matter.

Sincerely,
Lowell Trent
Aquatic Botanist
Fla. Game and Fresh
Water Fish Commission □

Personnel Changes

Bill Maier has recently moved to Gainesville to accept a DNR Interim Position Assignment working in conjunction with the Aquatic Weed Research Center. Bill will be involved with the transfer of technical aquatic plant control information from researchers to user groups.

CALENDAR NOTES

Short Course - "Design of Water Quality Monitoring Networks" / June 13-17, Fort Collins, Colorado

PLANT GROWTH REGULATOR ANNUAL MEETING / June 19-23, East Lansing, Michigan

AQUATIC PLANT MANAGEMENT SOCIETY ANNUAL MEETING / July 10-13, Lake Buena Vista, Fla.

FAPMS BOARD MEETING / August 3, Plant City, Fla.

AMERICAN SOCIETY OF AGRONOMY ANNUAL MEETING / August 14-19, Washington, D.C.

SOUTH CAROLINA AQUATIC PLANT MANAGEMENT SOCIETY ANNUAL MEETING / August 25-26, Clemson, S.C.

FAPMS ANNUAL MEETING / October 12-14, Plant City, Fla.

APPLICATOR STUDY SHOWS NO ADVERSE EFFECT FROM LIFETIME 2,4-D EXPOSURE

How much 2,4-D enters the body of an average 175-pound worker who applies this herbicide 30 days a year for 30 years? According to a recent study by the United States Department of Agriculture (USDA), less than one gram — about the weight of one-half of a dime — is absorbed and excreted over an applicators's lifetime. To put this in perspective, this is several hundred times less than the acceptable daily intake (ADI) total for the same person and time period, as established by the Food and Agriculture Organization of the United Nations.

This conclusion is based on a recently released study that measured the amount of 2,4-D (2,4-dichlorophenoxyacetic acid) in the urine of workers involved in ground or aerial applications, undertaken by R.C. Nash, P.C. Kearney, S.N. Fertig, J.C. Maitlen, and C.R. Sell — all of the USDA.

"The present study gives us an estimate of exposure for a segment of the population in closest contact with 2,4-D," Nash said in a recent press release. Because users of 2,4-D consider the herbicide to have a low order of toxicity, they are less likely to wear protective clothing than when applying other pesticides. Therefore, these amounts can generally be interpreted as the upper limit of exposure.

The study was conducted in the Spring of 1980 among two groups of workers who applied 2,4-D to wheat fields in two areas of the country: ground applicators from North Dakota and aerial applicators from Washington.

The herbicide 2,4-D has been used widely and safely for more than 35 years to selectively control broad-leaved weeds in crops, rangeland and pastures, lawns and turf, and utility rights-of-way among other areas.

Reprinted from *Chemically Speaking* - April 1983

APMS MEETING

The Aquatic Plant Management Society will hold its annual meeting at the Dutch Inn, Lake Buena Vista, Florida on July 10-13, 1983. Keynote speakers will be Plant Taxonomist Dr. C.D.K. Cook from Switzerland and Dr. K. Opuszynski, Fish Biologist from Poland. Both Scientists have traveled extensively throughout the world and will present talks covering their respective areas of interest. Registration will be around fifty dollars. There will be a Bar-B-Q dinner Monday evening and Banquet and entertainment on Tuesday evening. This will be the last National Meeting held in Florida for 3 years, so we hope to see many FAPMS members present.

KEN LANGELAND MOVES ON

Dr. Ken Langeland has accepted an aquatic and industrial weed research and extension position at North Carolina State University in Raleigh, N.C. effective in Mid-June. Ken has worked at the IFAS Center for Aquatic Weeds since 1980 and received his Ph.D. in Agronomy in December 1982. He has been active in FAPMS for the past 2 to 3 years and we extend to him our best wishes in his new Assistant Professor role at N.C. State.

NOTICE

Effective on May 31, 1983 most aquatic applicators certifications expired. Everyone who was previously certified should re-take both the core and aquatic examinations. For information on testing and the certification program contact:

Dr. Vernon Vandiver
3205 S.W. College Avenue
Fort Lauderdale, Florida 33314
305-475-8990

LAST CALL FOR PAPERS

To avoid the last-minute rush, the 1983 FAPMS program will be finalized by July 15, 1983; therefore, NO REQUESTS TO MAKE A PRESENTATION WILL BE CONSIDERED UNLESS IT IS POSTMARKED ON OR BEFORE JUNE 30, 1983.

Presentations are not to exceed 25 minutes and each will have a 5-minute question and answer period (a timer and alarm will be used).

TITLE: _____

AUTHOR(S): _____

ORGANIZATION: _____

ADDRESS: _____

ABSTRACT, PLEASE GIVE SPECIFICS. NO LIMIT ON OUTLINE. USE ATTACHMENTS IF NEEDED.

SUBMIT THE ABOVE TO:

Deanna C. Brown
10307 South Indian River Drive
Fort Pierce, FL 33450

Aquatic Plant Control Permits

Region	Active	Cancelled
Northwest	23	0
Suwannee	9	0
St. Johns	154	39
Southwest	167	24
South Florida	261	22
Total	614	85
Average days to issue permits	4/9/82 — 4/9/83	21.5
	4/9/82 — 11/1/82	28.1
	11/1/82 — 4/9/83	15.4

Extension Services

Alterations to submitted work plans	224
Consultations with public	5,814
Personal visits	792
Letters written	1,111
Phone calls	3,911
Water bodies surveyed	1,052
Water acres surveyed	1,446,601

Enforcement Actions

Cease and Desist Letters issued	20
Operations without a permit	17
Herbicide misuse	1
Operations without a permit and herbicide misuse	2
Letters rescinded because investigation proved no violation occurred	1
Herbicide misuse cases pending (under investigation - samples taken a turned over to ACS)	11
Number of consent orders issued by DER	4
Amount of financial penalties assessed by DER	$6,850
Number of warning letters issued by ACS	2

From the Department of Natural Resources

The permitting rules of Chapter 16C-20 were in effect for one year as of April 9, 1983. Prior to promulgation of the new rules, permits took up to two months for issuance. During the past year, 614 permits took slightly more than three weeks to issue — the average time has now been reduced to approximately 15 days. The goal for turning the average permit around during 1983 is 14 days. The integrity of the program will not suffer as a result of this goal as all sites will continue to be inspected prior to permit issuance and many sites will be reviewed during the year.

The tables to the left present the accomplishments of the permitting program and the regional biologist extension services.

Position Vacancies

The Fla. Dept. of Agriculture and Consumer Services has several positions available in its Pesticide Enforcement Section. For more specific information contact Mr. Steve Rutz, Division of Inspection, Tallahassee, Fla. 904-488-3314

NEW AQUATIC WEED?

In the 10 years or so that I have been involved in aquatic weed control in Florida it has been rare that a new plant problem (?) occurs three times in the same week. The mystery plant is *Potamogeton pusillus* as identified by Dr. David Hall at the University of Florida Herbarium. Ken Langeland found rather extensive areas of it at the FPL Martin County Cooling Reservoir, Jim Wilmoth found it covering and growing to 15 feet of depth in a clear water 45 acre lake near Jacksonville, and I found small clumps of it in Rodman Reservoir in North-Central Florida. The 1979 and 1982 Florida Aquatic Survey Report (DNR) makes no mention of this species in the areas in which the survey covers. Godfrey (1979) lists P. *pusillus* as widespread throughout much of the U.S., Canada and Mexico. It is most commonly found in ponds, streams, drainage ditches and canals. Identification of the pondweeds is very difficult, but the best description I know of is that the plant looks like southern naiad with a profusion of small brown seeds and seed heads.

Bill Haller

Before and after treatment for control of hydrilla with AQUATHOL® K Aquatic Herbicide.

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