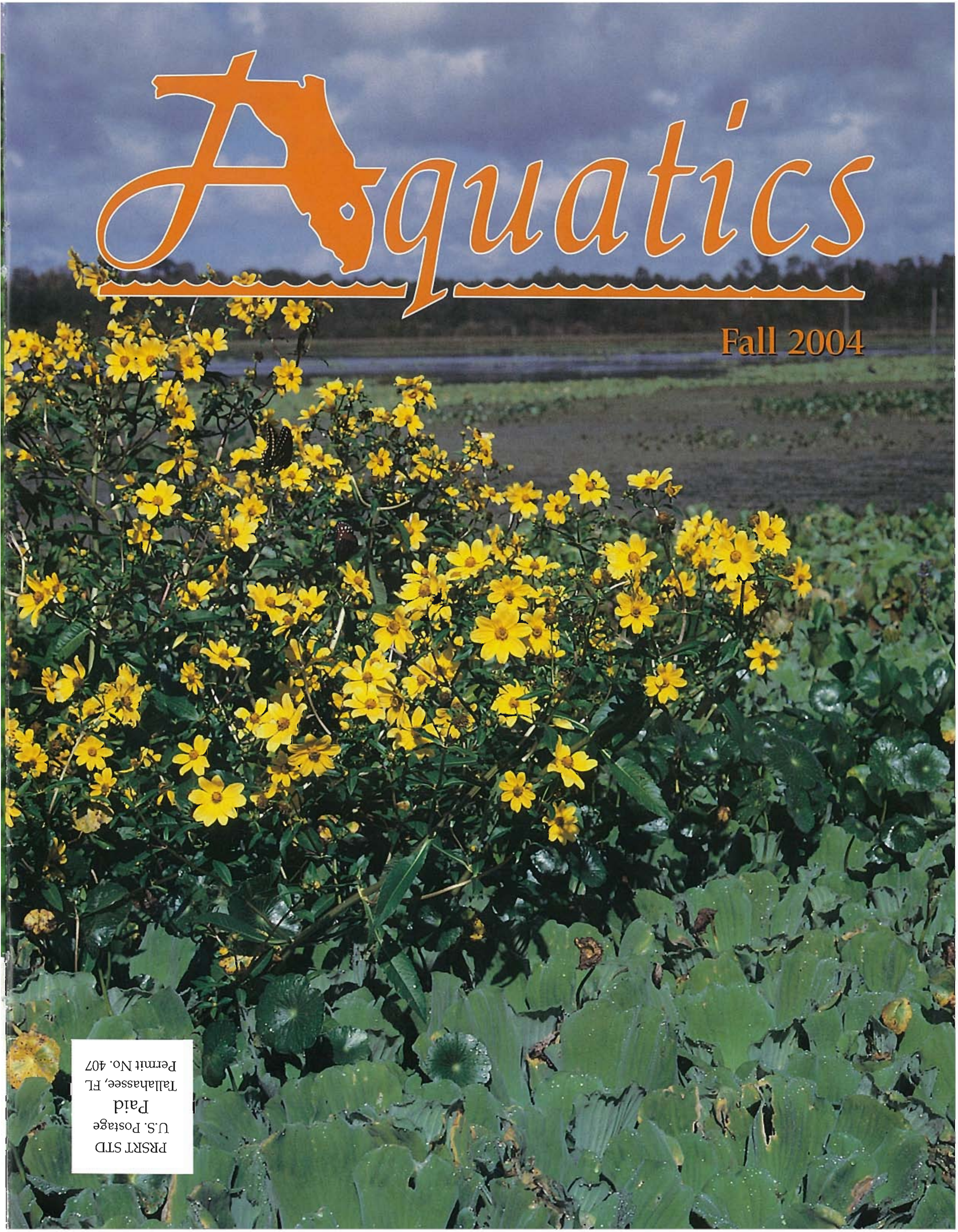
Aquatics

Fall 2004



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Editorial

This issue of *Aquatics* is my last as editor, and as I think about the previous editors which infused *Aquatics* with their expertise and style (Bill Maier, Paul Myers, Dave Tarver, Dan Thayer, Mike Bodle, and Ken Langeland) I am very honored to have the opportunity to be part of that team. As editor of the FAPMS magazine, I have met many people and have learned more about aquatic plant management in Florida, the nation, and occasionally places overseas. I've gained much from that experience.

The invasive plant management community is made up of a diverse mix of applicators, educators, biologists, managers, scientists, policy makers, and citizens and we all benefit from the strength this diversity creates. That variety has always been reflected in *Aquatics* magazine.

Because we are fortunate to work in and for the environment, our challenges are continuously evolving; sometimes subtly, sometimes overnight. Whereas in the past we were concerned about crisis management or lack of adequate funds, we are now challenged with the need to incorporate the science of plant resistance into the "language" of aquatic plant management. Even though our tools may be limited, the invasive plant management community always rises to the test!

Aquatics is one medium we have that lets us share our ideas, products, observations, and results in response to our challenging environment, and for that, I sincerely thank the people and companies who have contributed articles, advertisements, and pictures to *Aquatics*. I also thank the "behind the scenes" publishing team for their outstanding production of this magazine. It is only with everyone's support that *Aquatics* can continue its 25-year tradition of disseminating interesting educational material for those involved in aquatic plant management.

Thank you for the opportunity to serve the Florida Aquatic Plant Management Society as *Aquatics* Editor. I've thoroughly enjoyed it, and I look forward to working with you in the future!

Judy Ludlow

FAPMS Website: www.fapms.org

Fall, on Rodman Reservoir. Photo by David Tarver

Aquatics

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Aquatic plants and nutrients in Florida lakes

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Introduction

It has been well established in Florida and elsewhere that for many lakes the amounts of plankton algae in the water are closely related to the concentrations of plant nutrients, and this relationship has formed the basis for many lake restoration programs. The idea has been to reduce or eliminate large point sources of nutrients that enter lakes in order to reduce nutrient concentration in the water and hence the concentration of plankton algae. Reductions in phytoplankton will also increase water clarity unless other factors like resuspended sediments or water color are also important in reducing light penetration.

It has not been established whether increases or decreases in nutrient inputs to lakes will also impact the emergent, floating leafed, and submersed aquatic plants in the same way. Some authors have suggested that increases in nutrient inputs will lead to increases in the biomass of aquatic plants at least up to a point. Others have proposed that at higher nutrient levels, periphyton growing on the surfaces of the aquatic plants will deprive them of sunlight and lead to their loss from the lake, or that high plankton levels will shade them out. On the other hand reducing nutrients and improving water clarity has led to the establishment of plants. There are few studies addressing this issue and most have been conducted in deep, northern lakes with winter ice-cover and not in the shallow, subtropical lakes of Florida. In a recently published study (Bachmann et al. 2002) we tried to answer the question of whether the concentrations of phosphorus and nitrogen in the water of Florida lakes determine the abundance of aquatic plants.

Methods

To find the answer to this question and others related to the factors controlling the abundance of aquatic plants in Florida lakes, we sampled the aquatic plants in 319 lakes between 1983 and 1999. Some were sampled more than once, so we had 434 lake-years to analyze. For each lake on each sampling date we determined the percent area covered (PAC) and the percent volume infested (PVI) by macrophytes. We determined the surface areas of the lake occupied by the emergent and floating leafed plants as well as the areas occupied by submersed aquatic vegetation (SAV) and also determined the average wet weights and species composition of the plants in each zone. Water quality data for most lakes were obtained from the Florida LAKEWATCH volunteer monitoring program (Canfield et al. 2002) and from other research projects on these lakes. In general the nutrient content and aquatic plant abundance in our sample lakes

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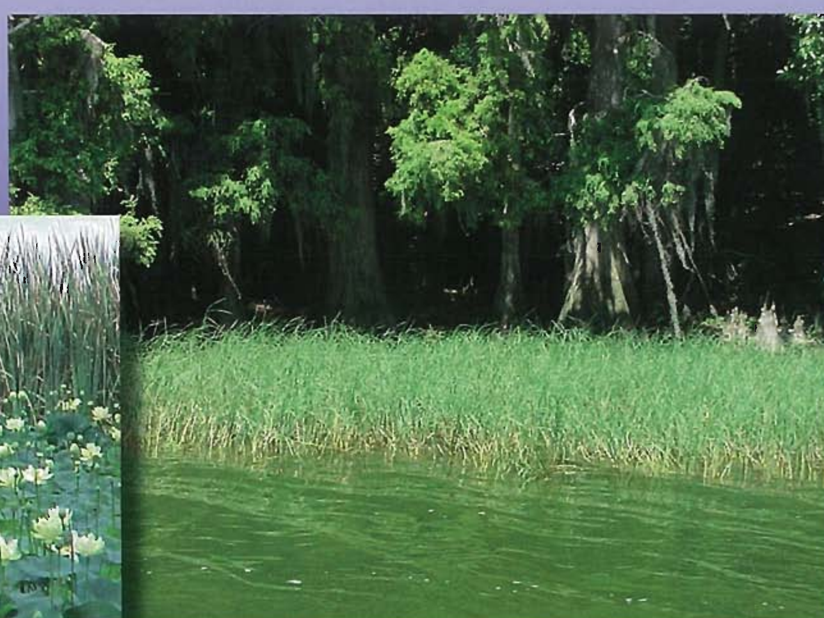
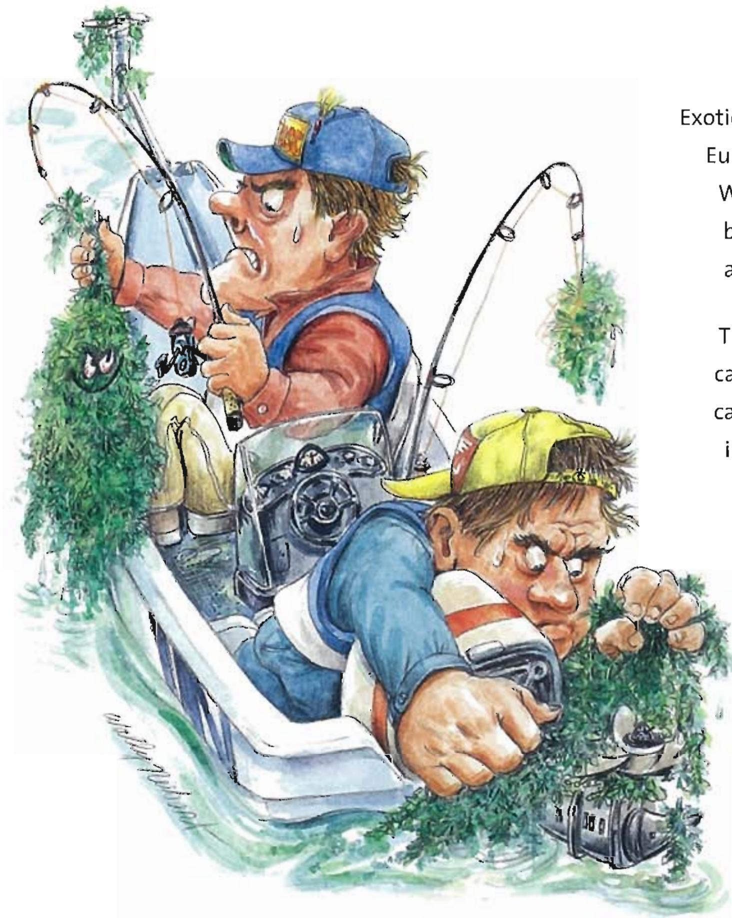


Photos courtesy of DEP, Bureau of Invasive Plant Management

Too Many Weeds Spoil the Fishing



Exotic invasive aquatic plants such as Hydrilla, Eurasian Watermilfoil, Curlyleaf Pondweed, Water Chestnut and Water Hyacinth can be detrimental to a healthy fishery in lakes across the country.

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covered a broad range, so the lakes' trophic states went from oligotrophic to hypereutrophic.

Results and Discussion

When we analyzed our results, we found no good relationship between the amounts of plant nutrients in lake water and the abundance of aquatic plants. For example in Figure 1 we show a plot of the PVI for submersed aquatic plants and the concentration of total phosphorus. A logarithmic scale was used to spread out the points. While at the extremes the highest PVI values were found at a lower total phosphorus concentration and at the highest total phosphorus concentration the PVI was low, the scatter of points resembled a shotgun pattern and there was no statistical correlation between the two variables. This says that Florida lakes with high levels of total phosphorus in the water had on average no more or fewer submersed aquatic plants than those lakes with lower levels of total phosphorus. In our report we showed either a very weak correlation or a lack of a relationship between total phosphorus, total nitrogen, chlorophyll and Secchi depths and the densities of aquatic plants in kilograms per square meter, PVI and PAC. This was true for submersed aquatic plants, emergent plants, and floating leafed plants.

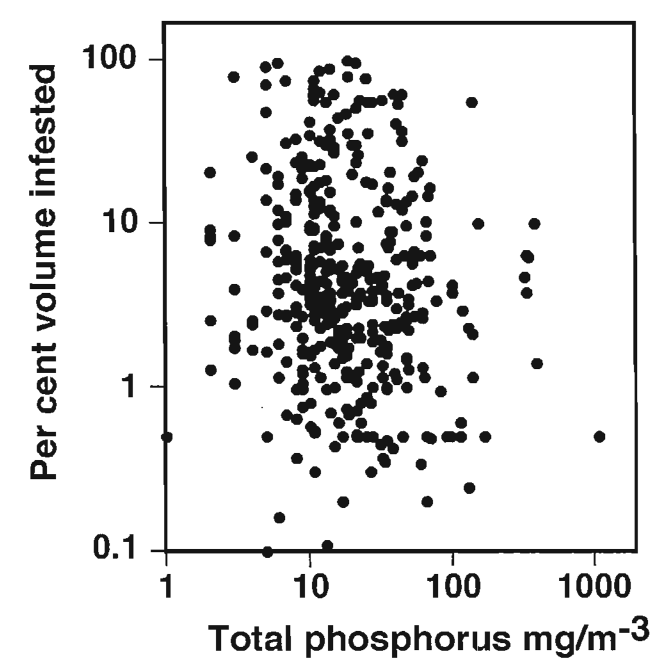

Figure 1. Percent volume infested (PVI) with aquatic plants for several Florida lakes versus total phosphorus concentration in the water. A double logarithmic scale is used to spread the points.

The conclusion is that aquatic plants in these Florida lakes do not respond to nutrients in the water in the same way that the phytoplankton do. In some ways this is a surprising result, for we are used to thinking of high nutrient levels in lakes being associated with high levels of biological productivity at all levels. Most likely the reason for this finding is that many aquatic plants can get their essential nutrients from the sediments rather than directly from the water, so that the nutrient supply is not necessarily tied to the concentration of nutrients in the water column itself. Because all lakes ultimately deposit some of the nutrients from the water column into the sediments, even a low-nutrient lake can accumulate a store of nutrients in the sediments given enough time. Thus some lakes that never have very much phytoplankton due to low nutrient supply can have a rich population of aquatic plants. The end result is that there is no correlation between the nutrients in the water and the aquatic plant abundance.

Table 1. Distribution of total phosphorus and total nitrogen concentrations (mg per cubic meter) as percentiles for lakes with and without submersed aquatic vegetation (SAV) present.

Percentile	Total phosphorus		Total nitrogen	
	SAV present	SAV absent	SAV present	SAV absent
0 % (minimum)	1	5	43	261
10 %	6	15	277	516
25 %	10	21	443	688
50 % (median)	14	28	616	899
75 %	26	63	878	1278
90 %	47	159	1170	1880
100 % (maximum)	166	1043	3750	3789

We also looked at the data in other ways to understand how these shallow lakes functioned. It has been proposed that above a certain phosphorus level the submersed aquatic plants would disappear due to shading by the phytoplankton. We had 85 lakes with no SAV present versus 234 with SAV. We made a comparison of the concentrations of total phosphorus, total nitrogen, chlorophyll and Secchi depth for these two groups of lakes in order to determine if there was such a cutoff. The comparison for total phosphorus and total nitrogen are given in Table 1. The highest total phosphorus concentration for a lake with SAV present was 166 mg/m3. There were a few lakes in our sample (many of which had grass carp added for vegetation control) with higher total phosphorus values that had no SAV present. The interesting finding was that in this analysis the median concentration of total phosphorus in those lakes with SAV present (14 mg/m3) was less than that for the group of lakes with SAV absent (28 mg/m3). This is the opposite of the theory that higher total phosphorus levels would lead to higher aquatic plant levels. Similar differences were found for the median concentrations of total nitrogen (616 vs 899 mg/m3) and chlorophyll (6 vs 21 mg/m3) for lakes with and without SAV. For Secchi depths the lakes with SAV had deeper median readings (2.0 m) versus the lakes without SAV (1.5 m). We also found that the average concentrations of total phosphorus, total nitrogen and chlorophyll and the average Secchi depths for the lakes with and without SAV were significantly different from each other. The important point is that there was a great overlap of values for all these variables (Table 1) in the lakes with and without SAV, so none of these variables could be used for predictive purposes.

There are probably a couple of reasons for this finding. First, many aquatic plants and/or the periphyton algae that grow on their surfaces can remove nutrients from the water. This would tend to reduce the concentrations in the water and thus decrease phytoplankton chlorophyll and increase Secchi depths in those lakes that had SAV present. Secondly, beds of aquatic plants reduce the ability of the wind to develop large waves that can promote vertical mixing of the water column and resuspend sediments in shallow lakes. This would reduce the recycling of nutrients and particles from the sediments back into the water column. These two processes could explain the results we found.

Perhaps we looked at the question the wrong way. Rather than the nutrients in the water determining the amount of aquatic plants in the lake, the presence of the plants will tend to reduce the concentration of nutrients in the water and hence the concentration of chlorophyll and increase the Secchi disk transparency. Support for this idea is given by the example of Lake Baldwin, near Orlando (Shireman et al. 1985). Grass carp (*Ctenopharyngodon idella* Val.) were used in an aquatic weed control program that reduced the submersed vegetation coverage from 69% to 0% in 2 years. At the same time the concentration of total phosphorus increased by 3 times, the plankton chlorophyll by 5 times and the Secchi depth decreased from 5 m to 1.5 m. The result is that the loss of the aquatic plants resulted in an increase in the nutrients and the phytoplankton in the water column with no known changes in the nutrient loadings.

Photo by Jeff Schardt

Rather than the nutrients in the water determining the amount of aquatic plants in the lake, the presence of the plants will tend to reduce the concentration of nutrients in the water…

What happened in Lake Baldwin illustrates a concept that has recently been formalized by European researchers called Alternative Stable States (see Scheffer 1998). It says in part that many shallow lakes can be found in one of two states depending on which plant community dominates. Macrophyte dominated lakes have a significant part of the lake occupied by SAV and tend to have clear waters. The alternative state is one where there are few aquatic plants and the lake is dominated by phytoplankton algae. Lakes in the algal state tend to be turbid with phytoplankton algae and resuspended sediments.

These are called stable states because a lake in one of these states tends to stay that way and resists change to the other state. In the macrophyte state the aquatic plants outcompete the phytoplankton for nutrients and also prevent wind-driven sediment resuspension. In the algal state the turbid waters prevent sufficient light from reaching the lakebed to allow substantial growths of macrophytes. It takes some major event to cause a lake to make a switch such as the addition of grass carp to Lake Baldwin. In some lakes removal of the bottom deweling fish can cause a turbid algal lake to switch back to a clear macrophyte state, while in other lakes increases in water levels can cause a loss of the macrophytes and switch the lake to a turbid algal state.

Lake Apopka in central Florida is a good example of a lake that switched from a macrophyte-dominated state to a turbid, algal dominated state starting in 1947. As far as we know the lake had been filled with SAV for at least the previous century. In 1947 a rapid loss of macrophytes started in one corner of the lake and soon most of the plants were gone. One theory is that a tornado associated with a hurricane in September 1947 uprooted a sufficient amount of plants to allow waves to build up and remove the rest of the plants (Bachmann et al. 2001). Others argue that nutrients from nearby farms initiated the loss. Regardless of the cause the lake has been in the turbid algal state for 57 years. A layer of flocculent sediments termed fluid mud has developed on the lakebed to a thickness of 46 cm and portions of this are frequently resuspended by wind-driven waves and the activities of bottom dwelling fish. This plus dense phytoplankton growths help to keep the lake in the algal state.

Light is a key component of the theory of Alternative State States. The poor penetration of light due to phytoplankton and resuspended sediments limits the reestablishment of macrophytes to only the shallowest areas of a lake. An earlier study in Florida related the maximum depth of SAV to the Secchi disk depth (Canfield et al. 1985). Others have related the depth of plant growth to the regions where at least 1% of the surface light penetrates. This allows us to determine the regions in a lake where there is sufficient light for plants to grow, however it does not mean that plants will actually be found there. For each lake in our studies we found the maximum depth that submersed aquatic plants were found. If light were the only factor determining the distribution of plants in that lake, then our PAC values should have matched the percent of the lake that had water depths that deep or shallower. Instead we found that this was true in only 16% of our lakes where the predicted coverage was from 90 to 100% of that predicted. On average the predicted coverage was only 50%

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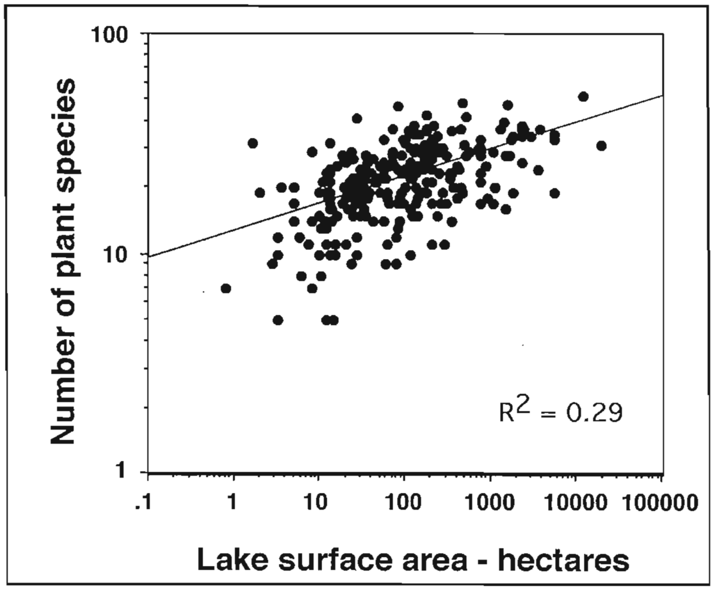

Figure 2. Number of aquatic plant species found in several Florida lakes versus lake surface area. A double logarithmic scale is used and the relationship is statistically significant.

of that expected and in 31% of the lakes the predicted values ranged from 3% to 30% of the predicted values. Clearly there are factors other than light that are playing important roles in the distribution of aquatic plants on the lakebed. For example in Lake Apopka in 1999 it was determined that there was sufficient light for the plants to grow over 6500 ha of the lakebed, however, surveys showed that the plants actually only covered 2.5 ha of the lake area (Bachmann et al. 2001). Aquatic plants were missing from large areas of the lakebed with sufficient light for plant to grow in. In this case it might be that the flocculent sediments that cover about 90% of the lake might be too unstable to support the growth of aquatic plants.

We were also interested in learning if the diversity of aquatic plant species was influenced by the nutrient content of the water or other trophic state indicators. We ran statistical tests of correlation between the number of species of aquatic plants in each of the lakes and the concentrations of total phosphorus, total nitrogen, and chlorophyll and also the Secchi disk depth. We found no significant correlations with any of the four variables. We did find a significant relationship between the logarithm of the number of plant species and the logarithm of the lake areas (Figure 2). In other words the larger the lake the greater the number of plant species. This is in agreement with other studies on Florida lakes that have shown that larger lakes have greater numbers of species of both fish and aquatic birds.

Summary

In our studies we have learned that the amounts of aquatic plants are only weakly related to the amounts of nutrients in the water column and that no predictive relationships can be developed to determine aquatic plant abundance based on nutrient content. We have also shown that aquatic plants most likely play a role in determining the amounts of plant nutrients in the water, rather than the other way around. Alternative stable states where shallow lakes can exist either in macrophyte-dominated states or algal-dominated states also play a role in determining the abundance of plants in Florida lakes. We also concluded there is still much more to be learned about aquatic plants in Florida lakes.

We also note that nutrient removal programs like that at Lake Alice on the University of Florida campus cleared the waters, however, this caused the expansion of plant growth and created a major plant management problem.

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Photo by Jeff Schardt

In our studies we have learned that the amounts of aquatic plants are only weakly related to the amounts of nutrients in the water...

Even in a wetland environment, newly planted seedlings benefit from a long drink of water. Volunteer "gardeners" spent a few days in May planting and watering 3,200 young trees at the Loxahatchee Impoundment Landscape Assessment project.

Gardening . . . in the Everglades

by Barbara Ross, Senior Writer
South Florida Water Management District

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A little dirt under the fingernails, a pink nose from the sun and flattened hair from hours under a hat could pretty much describe any backyard gardener. But it also describes the 25 volunteers who spent a few days in late May planting 3,200 trees on the northern fringe of the Everglades—at the Loxahatchee Impoundment Landscape Assessment project, better known as LILA.

LILA is an outdoor scientific laboratory on a 64-acre scale. Designed by the South Florida Water Management District and located in the Loxahatchee National Wildlife Refuge, LILA is four side-by-side marshes, called macrocosms. Each macrocosm has been sculpted to resemble the Everglades landscape, with wide and narrow paths for water flow, shallow and deep pools—including simulated alligator holes—and small rises of land called tree islands.

That's where the gardeners come in. Tree islands are an important part of LILA. In the natural Everglades, they provide some of the only dry land in the vast River of Grass. Many dozens of plant and animal species use tree islands for habitat, food and/or shelter. "Everglades tree islands are biodiversity hotspots," said Fred Sklar, chief scientist at the District and LILA's principle designer. "In a sense, they are like miniature tropical jungles."

Water levels strongly influence the specific types of plants, wildlife and even soils found on tree islands. Human impacts—such as urban and agricultural development, drainage for flood protection, and increased water use—have disrupted water flows in the Everglades, including its wet and dry seasonal rhythms. Restoring historic water patterns is one of the primary goals of Everglades restoration. With LILA's electric pump and re-circulating water system, scientists can control flows and levels across the simulated landscape, evaluating specific restoration plans before applying them on a large scale.

Planting a Tree Island

Over the course of three days, 3,200 tree seedlings of eight common Everglades species were planted on the tree islands, thanks to the 25 volunteers led by LILA Site Manager Eric Cline. Red maple, coco plum, pond apple, dahoon holly, buttonbush, wax myrtle, sweet bay and Carolina willow joined the grasses and other plants that sprouted after LILA's construction.

Because this is a living laboratory, the 10-inch seedlings were not just plunked into the ground wherever volunteers thought they might look attractive. Scientific goals, which include extensive monitoring, guided the planting effort. Like a meticulous gardener, Cline set out a specific grid pattern with wooden stakes and twine, even adding color-coded flags to mark each row.

Then the crews got to work. With 1.5-meter poles as spacing guides, they used bladed tools to form planting holes, strong hands to fill in dirt around the seedlings and big watering cans to give the plants a long drink. Any gardener knows the routine.

But most gardeners won't be studying their handiwork with satellites. In several years when the trees are much larger, satellite images of the LILA tree islands will provide a "signature" for each of the Everglades species growing there. Their distinct color and pattern—when viewed by satellite—will be used to locate and identify these trees in the vast Everglades environment. Even before then, scientists will be studying the trees on the islands, evaluating their growth rates and survival as water levels change.

Those Nuisance Nibblers

The goal, of course, is to get the trees to grow and flourish. But tender, nursery-raised seedlings are an appetizing meal to wildlife. Cline's sleuthing efforts, which included a motion-activated camera and flash, revealed what most gardeners already know is a nemesis to young plants: rabbits. It's no different in the Everglades.

Marsh rabbits can easily swim across LILA's short stretches of water to reach the tree islands. They nibble the seedling's leaves and soft stems almost to the ground. To foil them, the team anchored coffee-can size plastic pipe around each plant, which will allow the trees to mature beyond seedling size.

Seedlings planted at this outdoor laboratory by the South Florida Water Management District will provide information about tree growth and survival in South Florida's wetlands. Scientists will use this information to improve water flow and timing during Everglades restoration.

A Healthy Everglades

When completed next year, LILA will start providing scientists and water managers with essential information needed to restore and revitalize the Everglades—and to sustain its health once that is achieved. "LILA is unique in the world for its ability to evaluate the large-scale ecological effects of water flow and flooding," said Dr. Sklar. "By recreating the Everglades landscape in one controlled setting, we can explore ideas, test strategies and solve problems before putting specific projects into place during the restoration effort."

LILA is a proving ground of sorts, ultimately aimed at ensuring that Everglades restoration will be a success. It is also a planting ground, as the recent volunteers discovered. And they have the dirty fingernails and pink noses to show for it.

Visiting LILA: LILA is located at the Arthur R. Marshall Loxahatchee National Wildlife Refuge. A visitor's kiosk describes the LILA site in further detail, and a nearby observation platform provides an elevated view. To get to the Refuge, take I-95 or the Florida Turnpike to central Palm Beach County, exiting at Boynton Beach Boulevard (State Road 804). Travel west to US-441, turn left (south) and travel 2 miles to Lee Road. Turn right (west) and continue 0.3 miles into the Refuge's entrance and the visitor's center on the right.

***The South Florida Water Management District** is a regional, governmental agency that oversees the water resources in the southern half of the state – 16 counties from Orlando to the Keys. It is the oldest and largest of the state's five water management districts. The agency mission is to manage and protect water resources of the region by balancing and improving water quality, flood control, natural systems and water supply. A key initiative is cleanup and restoration of the Everglades. Learn more at www.sfwmd.gov*

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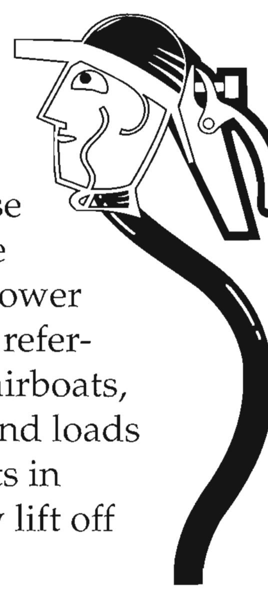

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You use the same term, "power load" in reference to airboats, 30-06 hand loads and coots in the early lift off stage.

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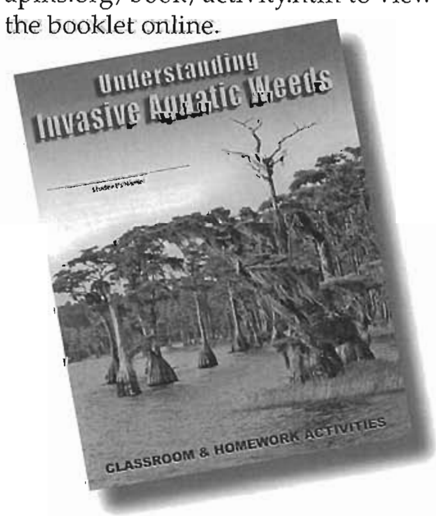
School is back in session!

This is an excellent opportunity for you to contact your local 4th – 7th grade teachers about including the APMS Understanding Invasive Aquatic Weeds booklets in their curricula. These booklets are free for the asking for teachers and all of the APMS Chapter presidents have ample supplies – or contact jeff.schardt@dep.state.fl.us for packets of 30 booklets or boxes of four 30-copy packets per box. Click on www.apms.org/book/activity.htm to view the booklet online.



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Archaefructaceae Discovered

Edited with permission from AQUAPHYTE ONLINE *Summer 2002 (the newsletter of the Center for Aquatic and Invasive Plants, Wetland and Invasive Plant Information Retrieval System (APIRS) of the University of Florida IFAS.)*

Using the oldest, most complete fossil angiosperm on record, Dr. David Dilcher, a palaeobotanist with the Florida Museum of Natural History at the University of Florida, recently announced the discovery of a new basal angiosperm family of aquatic plant, *Archaefructaceae*. The announcement was published in the journal ***Science*** with coauthors Ge Sun of the Research Center of Palaeontology at Jilin University, Qiang Ji of the Geological Institute of the Chinese Academy of Geosciences at Beijing and three others (full citation below).

The new family consists of a single genus, *Archaefructus*, with two species, *A. liaoningensis* and *A. sinensis* sp. nov. from the Yixian Formation in Liaoning, northeastern China. The fossils are believed to be at least 124.6 million years old and possibly as old as 145 million years (corresponding with Lower Cretaceous to the uppermost Upper Jurassic periods). A specimen is deposited with the Geological Institute of the Chinese Academy of Geosciences at Beijing. Five nearly complete fossil plant specimens in various stages of reproductive maturity were examined. When all characters of the two species were analyzed using a combined matrix of morphology and molecular data, it was determined that a new family of flowering plants was required, *Archaefructaceae*, which should be considered a sister taxon to extant angiosperms.

The *Archaefructaceae* are believed to have been aquatic plants because of the long, thin, herbaceous stems that would have required water for support. The finely dissected compound leaves also suggest an aquatic habitat. In addition, the leaves have a swollen petiole base, especially the leaves closest to the reproductive organs and farthest from the base of the plant. This feature would have provided buoyancy to the plant and aided in supporting the reproductive organs above the water during pollination and possibly seed dispersal. Numerous fish (*Lycoptera davidi* Sauvage) are preserved with the fossil plants, further supporting the conclusion that *Archaefructus* was aquatic.

The researchers state that *Archaefructus* is part of a complex basal group in angiosperm evolution and does not represent the original angiosperm. They suggest that the original angiosperm may have been a submerged aquatic plant such as some Nymphaeales.

See ***Science*** Vol. 296 (3 May 2002):899-904, *Archaefructaceae, a New Basal Angiosperm Family* by Ge Sun, Qiang Ji, David L. Dilcher, Shaolin Zheng, Kevin C. Nixon, Xinfu Wang.

For further information, contact Dr. Dilcher at the University of Florida, Florida Museum of Natural History, POB 117800, Gainesville, FL 32611; E-mail: dilcher@flmnh.ufl.edu

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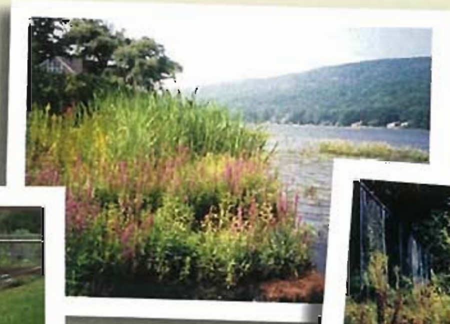

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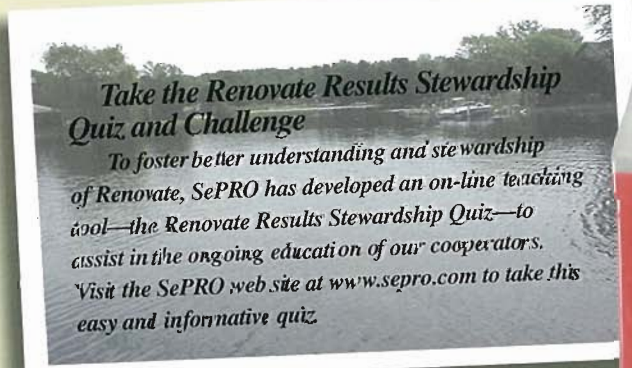

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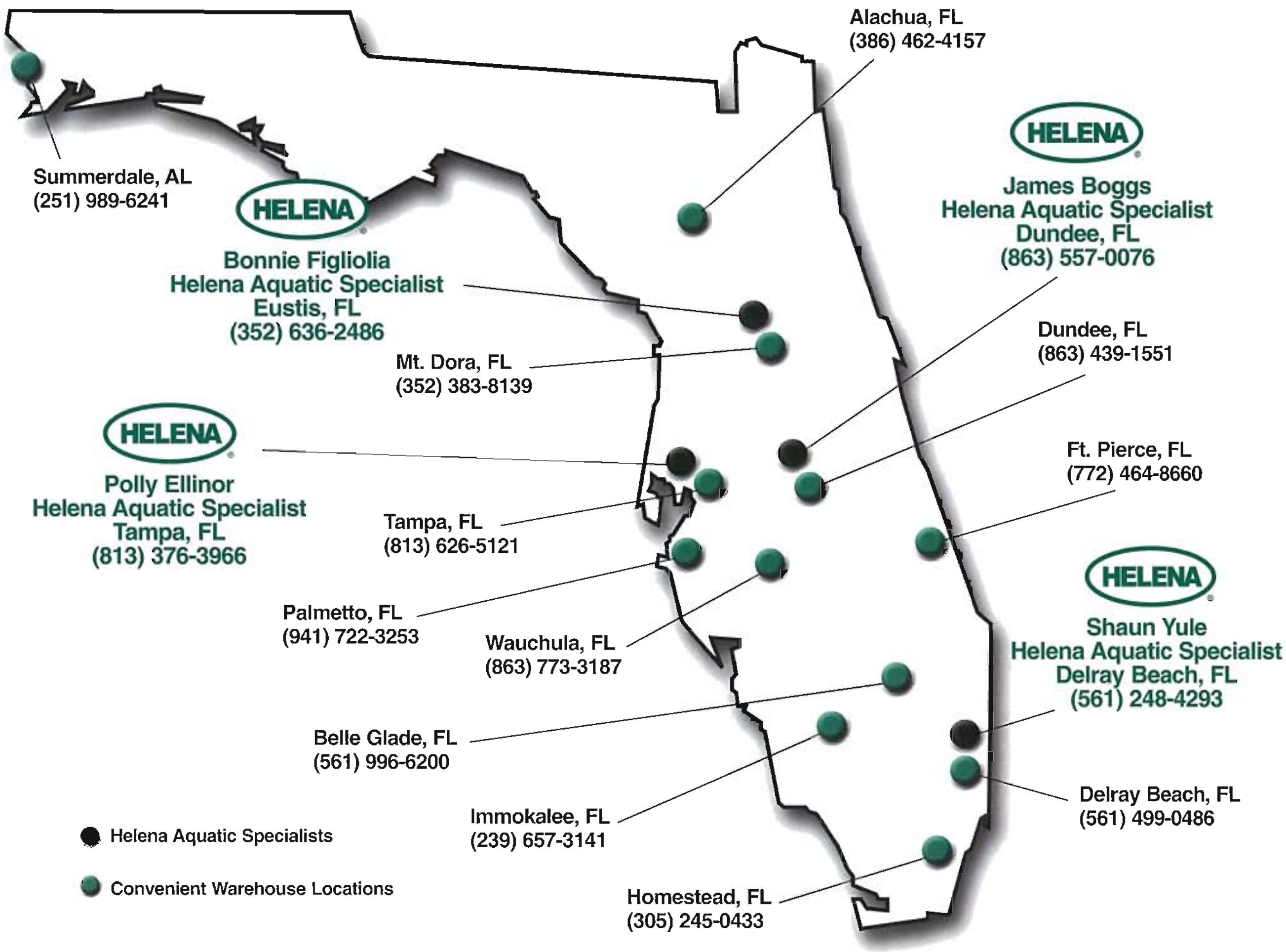

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Notable Nautical Nomenclature

The origin of many words and phrases in the English language is fascinating and many are rooted in maritime history. Below is just a sampling of some of these terms. You can find many more at these and other sites on the internet.

www.psych.su.oz.au/vbb/woronora/maritime/Glossary.html
www.history.navy.mil/trivia/trivia03.htm
www.fortogden.com/nautical-terms.html
www.geocities.com/cjstein_2000/dictionary.html

To Know the Ropes
There were miles and miles of cordage in the rigging of a square rigged ship. The only way of keeping track of and knowing the function of all of these lines was to know where they were located. It took an experienced seaman to **know the ropes.**

Groggy
In 1740, British Admiral Vernon ordered that the sailors' daily ration of rum be diluted with water. The men called the mixture "grog." A sailor who drank too much grog was "groggy."

Bitter-end
That part of the cable which stays within-board round about the bitts when a ship is at anchor. If all of the anchor cable has been *payed out* you have come to the bitter end.

To pay away or pay out
To slacken a cable or other rope, so as to let it run out for some particular purpose

Toe the Line
When called to line up at attention, the ship's crew would form up with their toes touching a seam in the deck planking.

Slush Fund
A slushy slurry of fat was obtained by boiling or scraping the empty salted meat storage barrels. This stuff called "slush" was often sold ashore by the ship's cook for the benefit of himself or the crew. The money so derived became known as a slush fund.

The Devil to Pay -
To pay the deck seams meant to seal them with tar. The devil seam was the most difficult to pay because it was curved and intersected with the straight deck planking. Some sources define the "devil" as the below-the-water-line-seam between the keel and the adjoining planking. Paying the Devil was considered to be a most difficult and unpleasant task.

To pay
To daub, or cover, the surface of any body with pitch, tar, etc. in order to prevent it from the injuries of the weather.

Taken Aback
A dangerous situation where the wind is on the wrong side of the sails pressing them back against the mast and forcing the ship astern. Most often this was caused by an inattentive helmsman who had allowed the ship to head up into the wind.

At Loggerheads
An iron ball attached to a long handle was a loggerhead. When heated it was used to seal the pitch in deck seams. It was sometimes a handy weapon for quarrelling crewmen.

Athwart the fore foot
When any object crosses the line of a ship's course, but ahead of her it is said to be athwart her fore foot.

Avast!
The command to stop, or cease, in any operation.

Batten
A thin piece of wood. Batten down the hatches, is to nail battens upon the tarpaulins, which are over the hatches, that they may not be washed off.

Bight of a rope
Any part between the two ends.

Broadside
A discharge of all the guns on one side of a ship both above and bellow.

To careen
To incline a ship on one side so low down, by the application of a strong purchase to her masts, as that her bottom on the other side may be cleansed by *breaming*, and examined.

Breaming
Burning off the filth from a ship's bottom.

Purchase
Any sort of mechanical power employed in raising or removing heavy bodies.

Caulking
Filling the seams of a ship with *oakum*.

Oakum
Old rope untwisted and pulled open.

Dog-watch
The watches from four to six, and from six to eight, in the evening.

Dolphin
A group of piles driven close together and bound with wire cables into a single structure

Even keel
When the keel is parallel with the horizon.

Fathom
A measure of six feet.

Fish
A large piece of wood. Fish the mast, apply a large piece of wood to it to strengthen it.

Flaw
A sudden breeze or gust of wind.

To Founder
To sink at sea by filling with water.

Handsomely
Gradually, as in Lower Handsomely

Horse
A rope under the *yards* to put the feet on.

Yards
The timbers upon which the sails are spread.

Jack
The union flag.

To labour
To roll or pitch heavily in a turbulent sea.

Leeches
Are the sides of the sails.

Lizard
A bight of a small line pointed on a large one.

Magazine
A place where gunpowder is kept

Monkey
- An iron sliding ram used for driving in armor bolts in ironclad ships.
- A small cannon
- A small wooden cask to hold rum.

Muster
To assemble

Poop
The deck next above the quarter-deck.

Sending
The act of pitching precipitately into the hollow between two waves.

Ship shape
Doing anything in a sailor-like manner.

Shivering
The state of a sail when fluttering in the wind.

Slack-water
The interval between the flux and reflux of the tide, when no motion is perceptible in the water

To stem the tide
When a ship is sailing against the tide at such a rate as enables her to overcome its power, she is said to STEM THE TIDE.

Swab
A kind of large mop, made of *junk*, to clean a ship's deck with.

Junk
Old cable, or old rope.

Tell-tale
An instrument which traverses upon an index in the front of the poop deck, to show the position of the tiller.

Thus!
An order to the helmsmen; to keep the ship in her present situation, when sailing with a scant wind.

Trying
The situation in which a ship, in a tempest, lies-to in the trough or hollow of the sea, particularly when the wind blows contrary to her course.

Under-foot
Is expressed of an anchor that is directly under the ship.

Would
To would, is to bind round with ropes; as, the mast is woulded

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Full EPA Approval for PAK™27 Algaecide

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The North American Lake Management Society 24th International Symposium

November 3-5, 2004, Victoria, BC Canada, visit www.nalms.org/symposia/victoria for more information.

Third International Conference on Invasive *Spartina* San Francisco, California, USA, November 8th-10th, 2004

The Third International Conference on Invasive *Spartina* is soliciting original papers and posters on all scientific and technical aspects of invasive *Spartina*. The Organizing Committee is especially interested in submittals that speak to the theme of the conference: "Integrating the Science and Management of Invasive *Spartina*" For abstract submittal instructions, registration details, conference program, and other information, visit: www.spartina.org/2004conference.

Full EPA Approval for GreenClean PRO Algaecide

BioSafe Systems announced that GreenClean PRO has officially received US EPA registration. For more information visit www.biosafesystems.com

Maine Maintains Hydrilla-Free Status

Surveys in a pond near Limerick, on the Maine-New Hampshire border, have revealed that control efforts were successful in limiting the spread of *Hydrilla* into Maine. A local resident found hydrilla in the pond in 2002 and fluridone was applied last summer. According to John McPhedran, biologist with the Maine Department of Environmental Protection and NEANS Panel co-chair, only two viable tubers were found after taking 95 samples at 10 locations in the 46-acre pond. McPhedran warns that the weed may have escaped monitoring, and the DEP will continue surveys into June before deciding if another application of the herbicide is needed. For the full story, see http://www.boston.com/news/local/new_hampshire/articles/2004/04/29/hydrilla_infestation_appears_to_be_on_the_wane.

Florida Native Plant Society Call To Action: Ask Albertson's for Florimulch

Due to a collection of happy circumstances, Albertsons has a contract with Forestry Resources Inc. the producers of Florimulch; (see; www.gomulch.com), a by-product of Melaleuca eradication and a Florida-friendly alternative to Cypress mulch.

As a consumer of Florimulch®, you not only protect Florida's native cypress trees, but support continued removal of Melaleuca from the state's wetlands. Supporters of Florimulch® as a cypress mulch alternative include the Friends of the Everglades, the Florida Native Plant Society and the late Marjorie Stoneman Douglas. Use of non-cypress mulch is also endorsed by Florida's Water Management Districts' Waterwise Guide and the Florida Yards and Neighborhoods Program's Guide to Environmentally Friendly Landscaping

As we join forces to encourage the big chains like Albertsons to offer alternatives to cypress mulch, let's not forget those retailers already onboard. If you're lucky enough to live in an area where local businesses regularly offer Florimulch, make sure to continue to thank them with your pocketbook and verbal support. In the case of independently-owned businesses, this conscious choice to "do the right thing" is especially laudable.

For more information please visit the Florida Native Plant Society Website at: www.fnps.org/

USGS Launches Nuisance Aquatics Species Alert System

The USGS Nonindigenous Aquatic Species Program has launched an alert system that allows users to register to receive e-mails of new aquatic introductions in the United States. The system also allows users to review and query archives of alerts that are sent. To register to receive e-mail alerts visit: http://nas.er.usgs.gov/alertsystem/register.asp To view alert archives visit: http://nas.er.gov/alertsystem/

Missing *Aquatics* Summer 2004?

If you have not yet received your summer 2004 *Aquatics* magazine, please contact Dr. Ken Langeland at 352-392-9614. He can mail you an extra copy. We apologize for any inconvenience this may have caused.


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