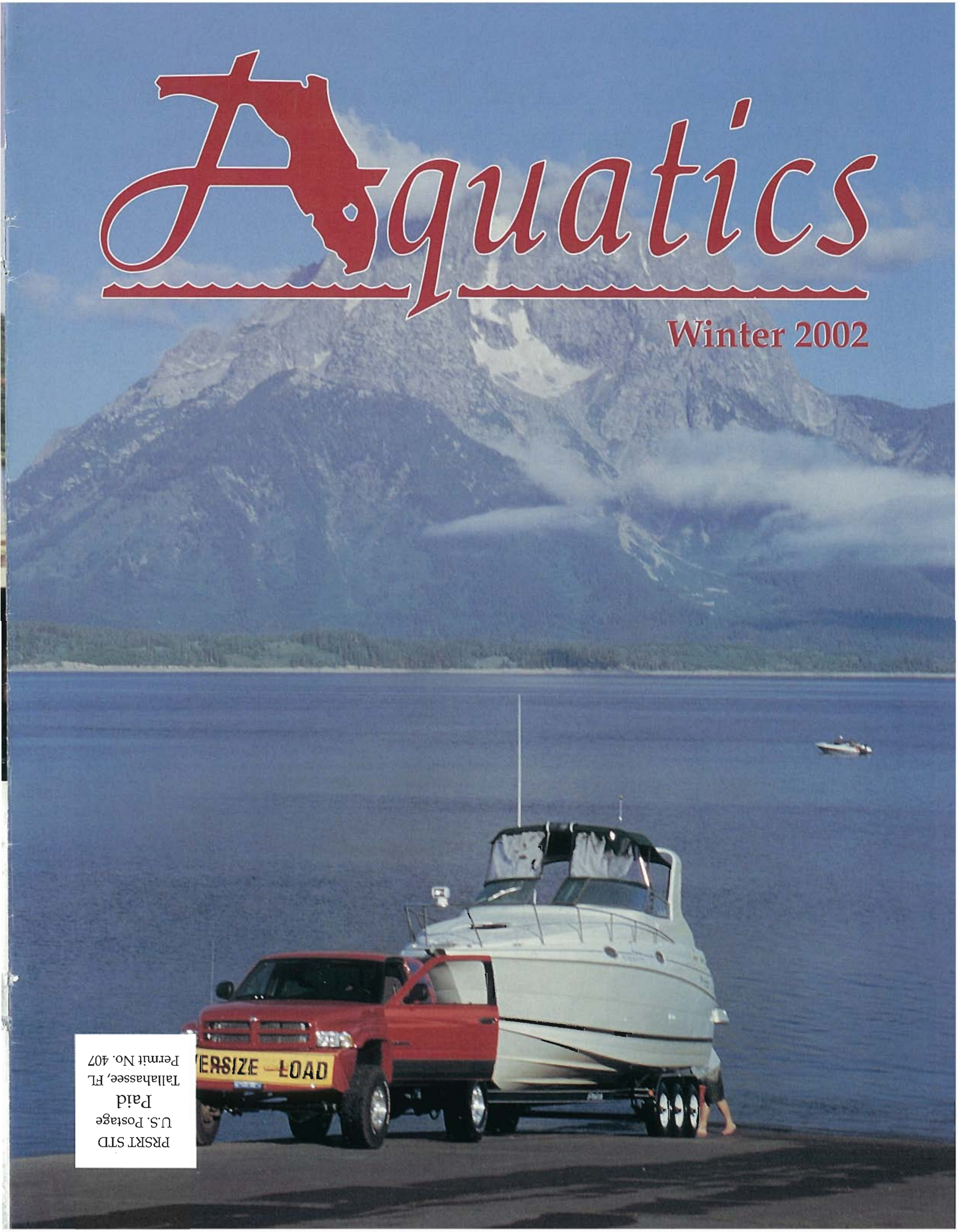
Aquatics

Winter 2002



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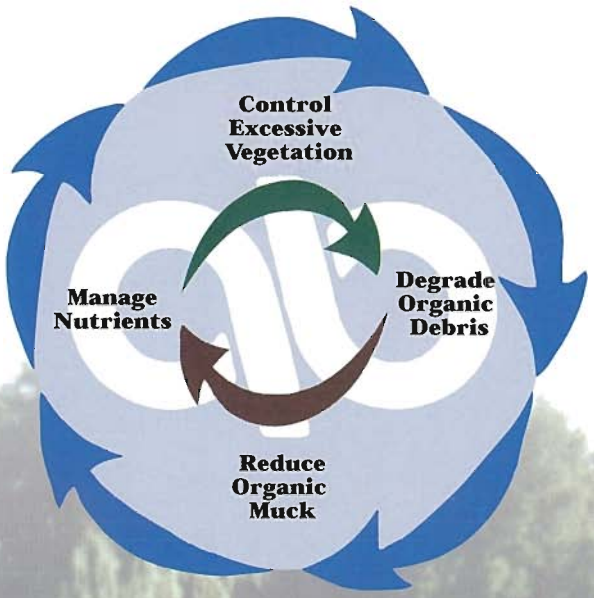

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Editorial

As promised in his November Keynote address at the FAPMS Conference in Daytona, Carlton Layne stepped down from the Pesticides and Toxic Substances Branch at EPA on January 3, 2003. Carlton served the Society as a Board Member and as President, but more importantly as a long-term role model for plant managers and regulators. He stressed the importance for herbicide applicators to act responsibly and professionally, constantly reminding us how each action of each plant manager reflects upon the public's opinion of all plant managers – and how only one mishap or label violation could unravel years spent gaining public trust. Likewise, he continually reminded regulators of the importance of common sense and flexibility in developing and enforcing pesticide policies and laws.

Carlton is easily the most influential and respected person in the evolution of Florida's aquatic plant management program over the past 25 years. He taught us all the importance of communication, fairness, and respect. If we learned, Florida's program will remain the premier example of invasive species management. We are fortunate that although his role with EPA has diminished, Carlton will remain active in the Society and will be available for consultation. Thank you Carlton Layne for the many years of friendship and support of aquatic plant management and managers in Florida.

By Jeff Schardt

FAPMS Website:
www.fapms.org

An Early morning start on Jackson Lake, Wyoming, in the company of Mt. Moran, Grand Teton National Park.

Photo by Jeff Schardt

Aquatics

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Characteristics of Pickerelweed

by Lyn Gettys, David Sutton, and David Wofford
University of Florida – IFAS, Department of Agronomy

Figure 2. Flower color variation in pickerelweed. From left to right: 'Singapore Pink', wild-type violet, white. Photo by David Sutton

Introduction

Pickerelweed (*Pontederia cordata* L.) is an attractive shoreline species frequently used in wetland mitigation and restoration projects and as an ornamental in water gardens. The showy purplish-blue or white inflorescences of this herbaceous perennial make pickerelweed a prime candidate for inclusion in water gardens; however, many growers have re-christened the species "pickerel-rush" to distance this attractive ornamental from the negative association that comes with having "weed" as part of a common name.

Pickerelweed's status as a native plant provides many opportunities for use in projects where ecosystem fidelity is critical. When used in wetland mitigation or restoration projects, pickerelweed provides a refuge and habitat for many types of fauna. For example, the diet of the endangered Everglades snail kite (*Rostrhamus sociabilis plumbeus*) consists entirely of apple snails (*Pomacea paludosa*), which frequently deposit egg clutches on the sturdy emergent stems. In addition, dragonflies and damselflies use the upright stems as perches to shed their final larval stage before reaching adulthood. The flowers produce nectar that attracts butterflies, skippers, and hummingbirds, and the fruits are an important food source for ducks and small animals; in addition, several authors state that fruits, leaves, and stems may be eaten by humans as well.

Classification, Origin, and Distribution

Pickerelweed was described by Linnaeus in 1753 and named in honor of Italian botanist Guilio Pontedera. The type specimen used by Linnaeus for the original description of the species was found in Virginia. The genus *Pontederia* is namesake for the family Pontederiaceae, which includes approximately nine genera and thirty species. The monocotyledonous family is of New World origin, and the family's center of diversity is thought to be lowland South America. The Pontederiaceae includes the notorious genus *Eichhornia*, whose member species waterhyacinth [*E. crassipes* (Mart.) Solms] is widely known outside its

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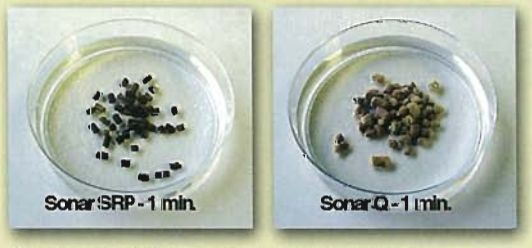

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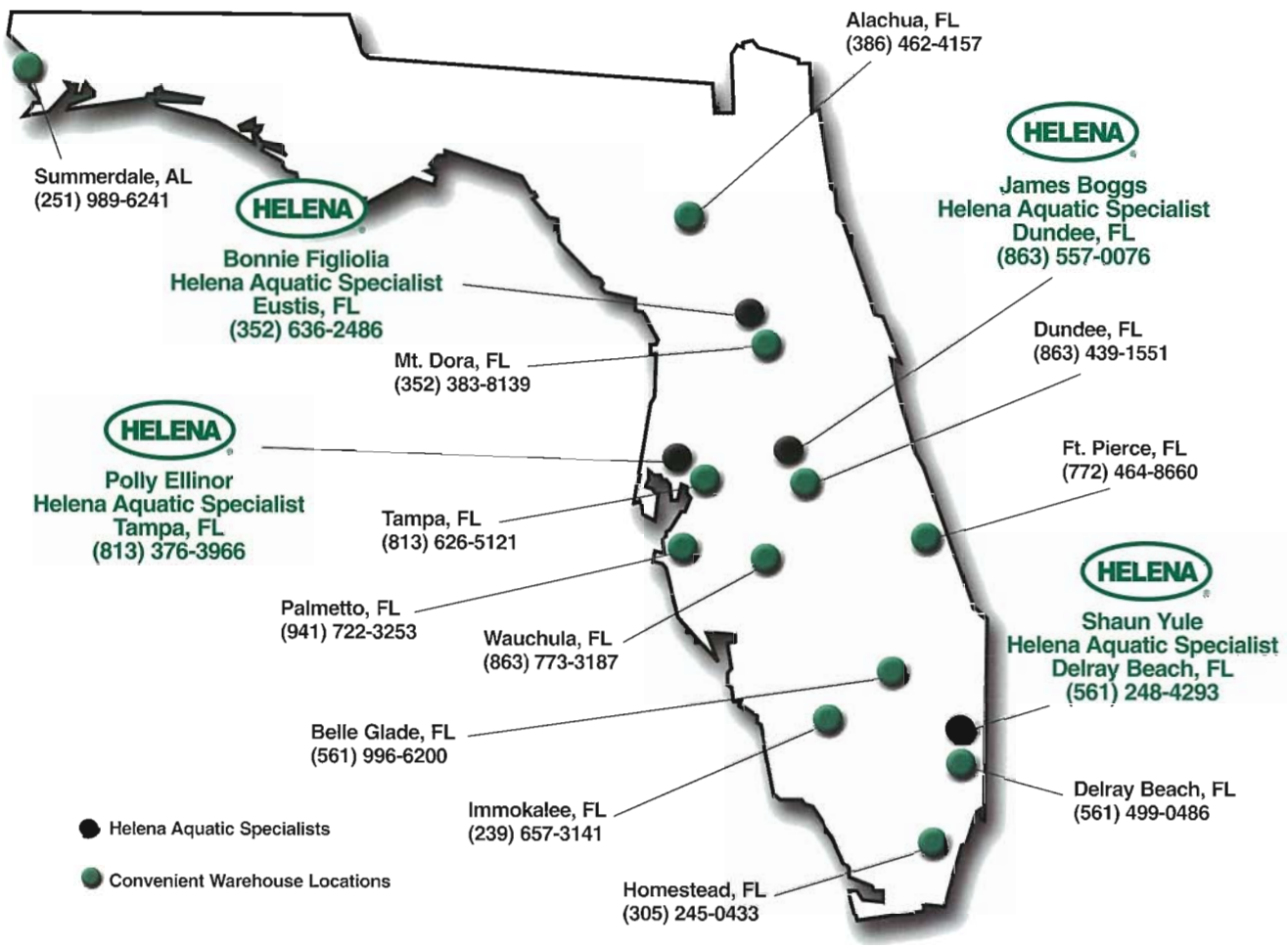

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native range for its ability to dominate aquatic habitats and render waterways impassible through prodigious production of floating vegetative mats. Other genera in the family include *Heteranthera, Monochoria, Eurystemon, Hydrothrix, Scholleropsis, Reussia,* and *Zosterella.*

Species in the genus *Pontederia* include *P. cordata, P. rotundifolia* L.f., *P. subovata* (Seub.) Lowd., *P. parviflora* Alex., and *P. sagittata* Presl.; however, only *P. cordata* is native to North America and is widely distributed throughout Florida and the eastern United States. Pickerelweed is classified as hardy in USDA Zones 4 to 11 and has a North American geographic range that extends from Prince Edward Island (Canada) to the Florida Keys and west to Texas; the species is also found in Central America, Brazil, the West Indies, and Argentina.

Emergent vegetation of this perennial dies back in colder regions of the country during the winter, but rhizomes survive the winter below frozen soil and produce new shoots once the weather warms in spring. Plants in more tropical climes like southern Florida remain green throughout the year and flower almost continuously, with peak flower production occurring during spring and summer. Pickerelweed is classified as an obligate wetland species but tolerates a wide range of moisture levels and may be useful in less saturated areas as well.

Morphology

Pickerelweed is an erect, emergent, herbaceous aquatic perennial and produces vegetative growth up to 5 feet tall. The species is found in marshes, swamps, streams, ditches, and in shallow water along margins of lakes and ponds. Pickerelweed is most common along shorelines and in flooded areas that are fairly still and shallow, and seasonal fluctuations in water levels do not adversely impact its growth. Pickerelweed reproduces by both seed and vegetative propagation. Single-seeded fruits are produced in large amounts and allow for dispersion of the species, while creeping rhizomes rooted in the substrate encourage the formation of large, extensive clonal colonies.

Leaves are glabrous, entire, basal, erect, and borne individually on long petioles. Blade size and shape is highly variable and ranges from hastate to lanceolate. The racemose inflorescence is borne at the distal end of a stem and is subtended by a single foliar bract. Each inflorescence measures from 2 to 8 inches in length and usually bears up to 250 individual flowers, although more than 450 individual flowers have been counted on a single inflorescence. Pollen is shed as flowers open in the morning. Each flower remains open for up to 8 hours, and an average of 20 individual flowers are open during the day on each inflorescence. The floral tube is composed of six petal-like tepals arranged in two whorls of three; tepals range in color from deep violet-blue to lilac to rarely white, with yellow nectar guides ("eye spots") marking the central upper tepal.

Each flower is zygomorphic, basally fused, and perfect, bearing one style and two sets of three stamens. Pollination occurs as bees collect nectar from the flowers.

The fruit has been described as a nutlet or utricle; the difference between the two classifications lies in the degree of attachment of the ovary wall to the seed. The wall of the fruit is formed from the floral tube and is ridged with a toothed crest. The fruit is composed of light aeriferous tissue that allows it to float for up to 15 days. The seed contained within the fruit is small, filled with starchy endosperm, and holds a linear embryo that traverses the entire length of the seed.

Healthy roots of pickerelweed are white, purplish, or fuchsia when young and may turn rusty red due to accumulation of oxidized iron. Rhizomes and roots account for a large percentage of total plant biomass at all times. Rhizomes narrow when growth slows in autumn and become wider when growth resumes in spring; these differing growth habits form a constriction and the rhizome is easily fragmented at the junction. Energy fixed during previous years is stored in the rhizome and subsidizes new growth when active growth begins in spring.

Variation in Pickerelweed

Many different forms of pickerelweed may be found in nature. A particular genotype or biotype will consistently maintain its set of characteristics regardless of environmental conditions, but may be markedly different in appearance from other genotypes. A wide range of unique shades of blue has been noted in the flowers of pickerelweed; these include light powder blue, medium blue, and deep violet. White-flowered plants of pickerelweed are less common than blue-flowering types, but are occasionally found in wild populations.

Leaf shape of *P. cordata* is highly variable (Fig. 1). Some plants may long and thin (lanceolate) leaves, while others produce leaves that are heart-shaped (cordate) to broad and deeply lobed (sagittate or hastate). Taxa with lanceolate leaves are commonly referred to as "lance-leaf pickerelweed" and are classified as a variety of *P. cordata* by some authors and as a distinct species [*P. lanceolata* (Muhl.) Torrey] by others. The primary characteristics used to distinguish between *P. cordata* and lance-leaf pickerelweed are lance-shaped leaves and persistent pubescence in the mature floral tube, but there is a considerable amount of natural variation in these characters, and many taxonomists are unconvinced that lance-leaf pickerelweed should be considered a distinct species.

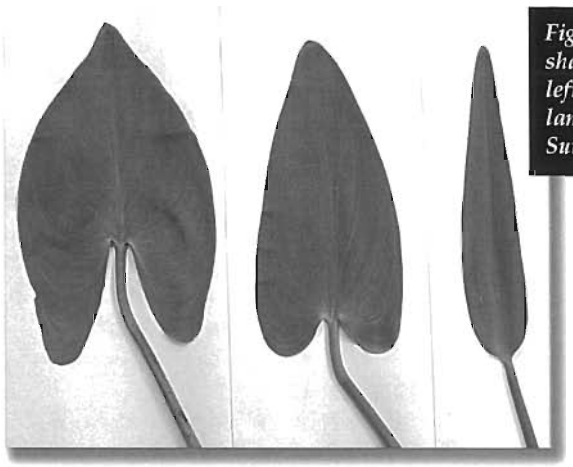


Figure 1. Variation in leaf shape in pickerelweed. From left to right: hastate, cordate, lanceolate. Photo by David Sutton

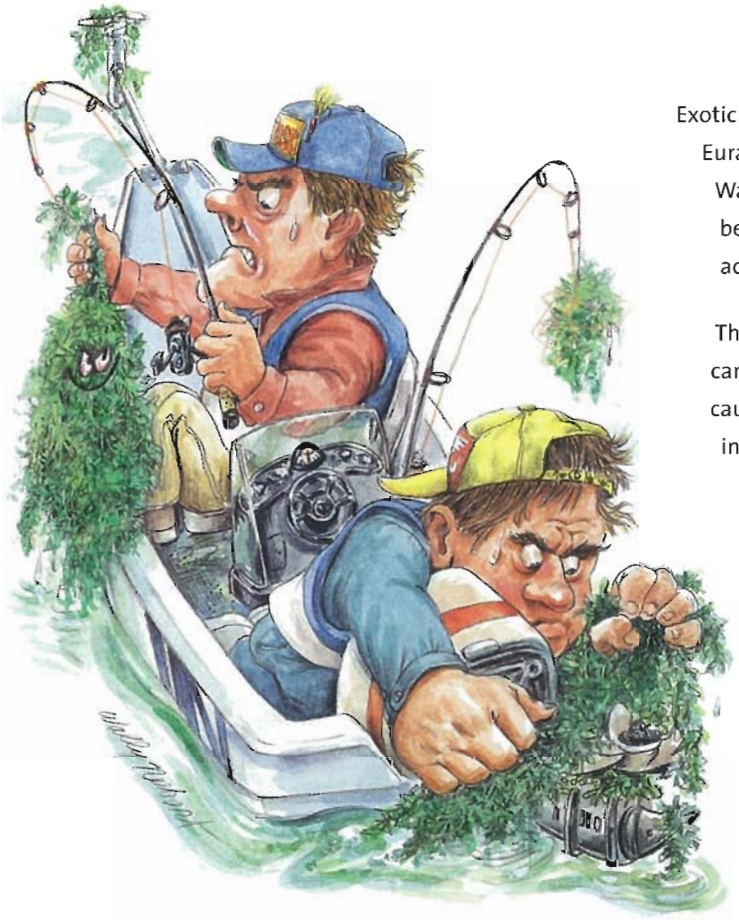
Differences in growth habit have been identified as well; some genotypes produce tall, upright growth, while others are more compact and spreading. The distinct flower color, leaf shape, and growth habit presented by a particular genotype will be maintained if the plant is propagated vegetatively by division of the rhizomes, as division results in the creation of a clonal copy of the genotype.

In addition to *P. cordata*, there is another type of pickerelweed available from large aquatic plant nurseries. 'Singapore Pink' is listed as a cultivar of *P. cordata* by some nurseries and as *Pontederia* sp. by others; however, the true relationship between 'Singapore Pink' and *P. cordata* is unknown. This form was reportedly found in Thailand and is propagated only by division or tissue culture. Floral and leaf shape characters suggest that 'Singapore Pink' may be genetically distinct from *P. cordata*. Flowers are pink (Fig. 2) and lack the deep purple pigmentation produced at the throat of blue, violet, and white flowers. In addition, this form produces hastate to sagittate leaves (Fig. 2), a trait not often seen in *P. cordata*. Anecdotal reports and our preliminary research suggest that 'Singapore Pink' is sterile when crossed with pickerelweed; the cultivar is also much less tolerant of high and low temperature extremes and direct sunlight than the species.

Culture

Pickerelweed may be easily grown as a greenhouse crop under conditions similar to those used for culture of terrestrial bedding or landscape plants. Growth and flowering of pickerelweed is optimized when a well-drained rooting substrate is used; studies have shown that Scott's Metro-Mix 500 is an excellent substrate for use in greenhouse production of pickerelweed. Adequate moisture can be maintained by placing nursery containers planted with pickerelweed in deep trays filled with 2 to 3 inches of water. The species responds well to heavy fertilization and grows most robustly when a fertilizer with micronutrients is utilized. Best growth is achieved by supplying seedlings with 1.25 ounces per gallon pot of a controlled-release fertilizer with micronutrients (e.g., Scott's Osmocote Plus 15-9-12). Our studies indicate that optimum growth occurs when fertilizer is incorporated into the substrate at the time of planting. Plants grown under full sun conditions are usually more compact than those produced in shade. Northern biotypes may require long days of 14 or more hours to induce flower production; long days can be simu-

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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lated during winter by using standard floodlights to mimic an extension in daylength, but a better solution is to utilize local-source stock that is adapted to regional environmental conditions.

Propagation by Seed

Many wetland plants require cold stratification, the presence of light, and an alternation of temperatures (such as 70/85 F) in order for germination to occur. These conditions are similar to those found in nature as winter ends and spring begins. Seeds produced during the summer may remain dormant throughout the winter, then germination occurs along the shoreline in spring as temperatures increase and seeds are exposed by falling water levels.

Conflicting information exists regarding germination of seeds of pickerelweed. Some studies suggest that seeds require a cold period after ripening to ensure adequate germination and are unaffected by presence or absence of light. Our preliminary research suggests that seeds may not require stratification and merely need to be flooded with 1 to 2 inches of water for 2 to 3 weeks for germination will occur. In addition, our studies have shown that light may promote germination. Freshly collected green fruits must be dried before germination can occur, which can be accomplished by placing the fruits in a protected area with warm temperatures, indirect sunlight, and adequate air circulation for a few days. Seeds may be removed from dried fruits by careful crushing prior to germination, but this procedure does not appear to increase the rate of germination when compared to intact fruits. Seedlings should be transplanted into a well-drained rooting substrate 3 to 4 days after germination; plantlets should be fertilized immediately and watered gently until they become sturdy and well-established.

Vegetative Propagation

Pickerelweed can easily be divided by cutting a rhizome section with 5 to 6 nodes from an actively growing plant. Stems and leaves may be trimmed back to 4 to 6 inches above the rhizome to allow easier handling of the division. The new plant may then be potted for greenhouse culture or planted in the aquascape. Rhizomes and rootstocks of pickerelweed do not require stratification to overcome dormancy, as plants begin to grow as soon as soil temperatures are above freezing. Rhizomes of dormant plants maintained in cold storage at 36 to 40 °F for 8 to 16 weeks typically produce new growth within 15 days after being removed from cold storage and placed in the greenhouse.

Conclusion

Pickerelweed is an attractive native perennial species that enjoys widespread use both as an ornamental in aquascapes and as an important component of mitigation and restoration projects. This shoreline aquatic is one of a select group of species prized for its beauty and for its contribution to native habitats. Pickerelweed is also easy to propagate and grow, making the species an ideal crop to include in nursery and greenhouse production systems.

Acknowledgements

This research was supported by the Florida Agricultural Experiment Station and approved for publication as Journal Series No. N-02269. Mention of a trademark or a proprietary product does not constitute a guarantee or warranty of the product by the Florida Agricultural Experiment Station and does not imply its approval to the exclusion of other products that may be suitable. A list of literature used to prepare this manuscript is available on request. We would like to thank Dr. Thai Van and Ms. Kathy Burks for their review and comments of a draft of this manuscript.

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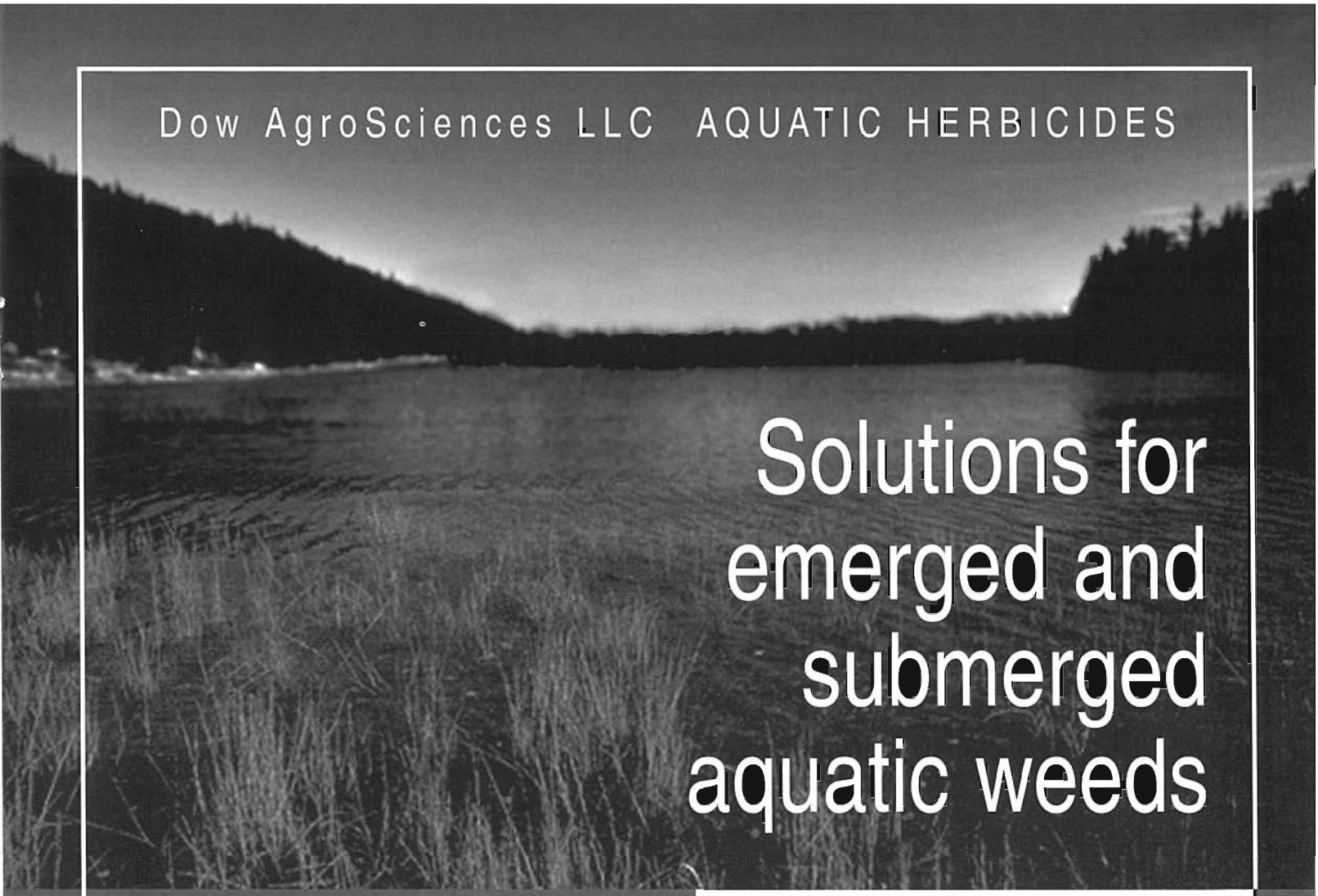

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Figure 1. Part of the 23 acres of Orange Lake bottom after it was mowed and tilled. Photo by Joe Hinkle

Figure 3. Part of the 50 acres of Orange Lake bottom after it was mowed. Photo by Joe Hinkle

Mowing and Rotovator Testing on Orange Lake, Florida

Joe Hinkle
DEP, Bureau of Invasive Plant Management

Purpose

The main purpose of this program was to find a technique that might help prevent the formation of floating islands. When normal water levels returned to Orange Lake after several years of low water in the 70's and 90's, floating islands became a serious navigation problem. Floating islands were a problem for approximately 6 years after the water levels returned in the 90's. Currently, approximately 10,000 acres of Orange Lake are again dry and many of these areas may form floating islands when water levels return to normal. Mowing would favor beneficial herbaceous species such as maidencane and discourage establishment of woody vegetation. Breaking up the muck and the existing root mass with a rotovator may help to prevent the formation of floating island when water levels return to normal. Rotovator work should also increase aeration and drying of the muck level promoting break down of organic material.

Methods

Thirty hours of mowing (Fig. 3) were conducted using a John Deer 5410 tractor (65 HP) four wheel drive with duel wheels in front and back. The mower was hitch mounted and 6 foot wide. This arrangement would mow in any area accessible by 4WD ATV and some that were not. Twenty hours of rotovator (Fig. 1) work were conducted with the same tractor using a Howard HR 20 rotovator with a 90 inch cut (Fig. 2). The Rotovator was workable in the same areas as the mower. Acreage mowed and tilled during these time frames were determined using GPS.

Vegetation

Prior to mowing, dryer portions of the lake bottom were dominated by dog fennel. Other plants present included maidencane, smartweed, and a few other upland species. In wetter locations near open water the dominant vegetation was smartweed. Also present were soft stem bulrush, primrose willow, maidencane, pickerelweed, and swamp fleabane.

After mowing, the dominant vegetation became maidencane. Other important species were soft stem bulrush, smartweed, and knotgrass. Minor species observed included slender spike rush, primrose willow, swamp fleabane, Bidens sp., Cyperus sp., pennywort, and upland thistles. General observations would suggest that cattle grazing was favoring the growth of maidencane.

Results

A total of 50 acres were mowed in the 30-hour period, or 1.7 acres per hour. In my opinion, this number could be increased by 50% by using a ten-foot wide mower rather than the 6-foot that was tested. The cost per acre was $45.

A total of 23 acres were tilled with the rotovator during the 20 hours, or 1.15 acres per hour. Muck was tilled down to about 12 inches. The cost per acre was $104.

Use of this equipment would be limited to areas where muck is less than 3 foot deep and sites where the soil is not saturated.

Figure 2. The Howard HR20 rotovator at work on Orange Lake. Photo by Joe Hinkle

Discussion

1. **Cost**. On a larger project the hourly cost of mowing or rotovator work would be the same or possibly less than $40 per hour. Using a ten-foot mower this would translate to about $20 per acre for mowing and $35 per acre for the rotovator.
2. **Methods.** It appears that mowing may not be needed before conducting rotovator work, especially in the drier locations on the lake.
3. **Prescribed Fire**. Burning either before or after rotovator tilling might be a good substitute for mowing and reduce organic material accumulation. The Division of Forestry looked at the site and did not have a problem with control burning as long as we keep smoke away from the major highways.
4. **Cattle.** Livestock grazing appeared to increase the longevity of control after mowing and favored domination by grasses on these areas. However, it would probably be difficult to work this into a management program.
5. **Habitat Diversity**. To increase diversity on the lake it may be beneficial to alternate between mowing, rotovator tilling, burning, and no control activities.
6. **Invasive Plants.** Herbicide control of wild taro will be needed in these control areas to prevent it from spreading.

Suggestions for Future Management

1. Enclosures need to be established in small sections of the tilled areas to determine the impact of cattle grazing.
2. Obtain a contract to do testing on a larger scale and include prescribed burning as a possible technique for enhancing the management program.

This bladderwort (Utricularia foliosa) is one of about 5 species of carnivorous aquatic plants in Florida, Photo courtesy of DEP, Invasive Plant Management.

Carnivorous Plants of the Florida Big Bend

by Gil Nelson

If you've ever wanted to see carnivorous plants in the wild, the Florida panhandle is definitely the place. Of the five families of carnivorous plants that inhabit the eastern United States, all are represented in a narrow band that stretches right through the middle of the Florida Big Bend, making this part of the Sunshine State one of the best places in North America to enjoy these fascinating plants. Most of these species are found in aquatic and wetland habitats.

The Venus Flytrap. The Venus Flytrap is perhaps the best known of these remarkable species. Its unique insect catching ability led Charles Darwin to call it "the most wonderful plant in the world." Though found naturally only in a small portion of North Carolina, during the last half of the last century an industrious botanist, perhaps dedicated to saving the plant from extinction, transplanted numerous small colonies to north Florida roadsides. Most of these small populations took well to local conditions and are still thriving.

The most obvious feature of the Venus flytrap is its leaves. Reclining close to the ground on stems that rarely exceed three inches long, their clamshell-like structure bears little resemblance to what we typically think of as a leaf. In fact, their colorful appearance often leads them to be mistaken for flowers. They are odd looking appendages that have been modified through the eons for their unique food-gathering role.

The leaf blades consist of two kidney-shaped lobes connected to each other by a slender hinge. Attached to their stalks on one end, they curve away from the stem, leaving the opening of their tiny jaws facing upward. The inner surface contains a small collection of diminutive trigger hairs which, when stimulated, cause the leaf to shut rapidly, capturing whatever insect might have been lured into its clutches. As the leaf closes, the stiff, needle-like guard hairs that line the leaf's outer edges overlap each other and insure that its prey cannot escape. Continued movement by the captured bug stimulates the leaf to close even more tightly and to begin its digestive processes.

The Pitcher Plants. If the flytrap is the most widely known of our

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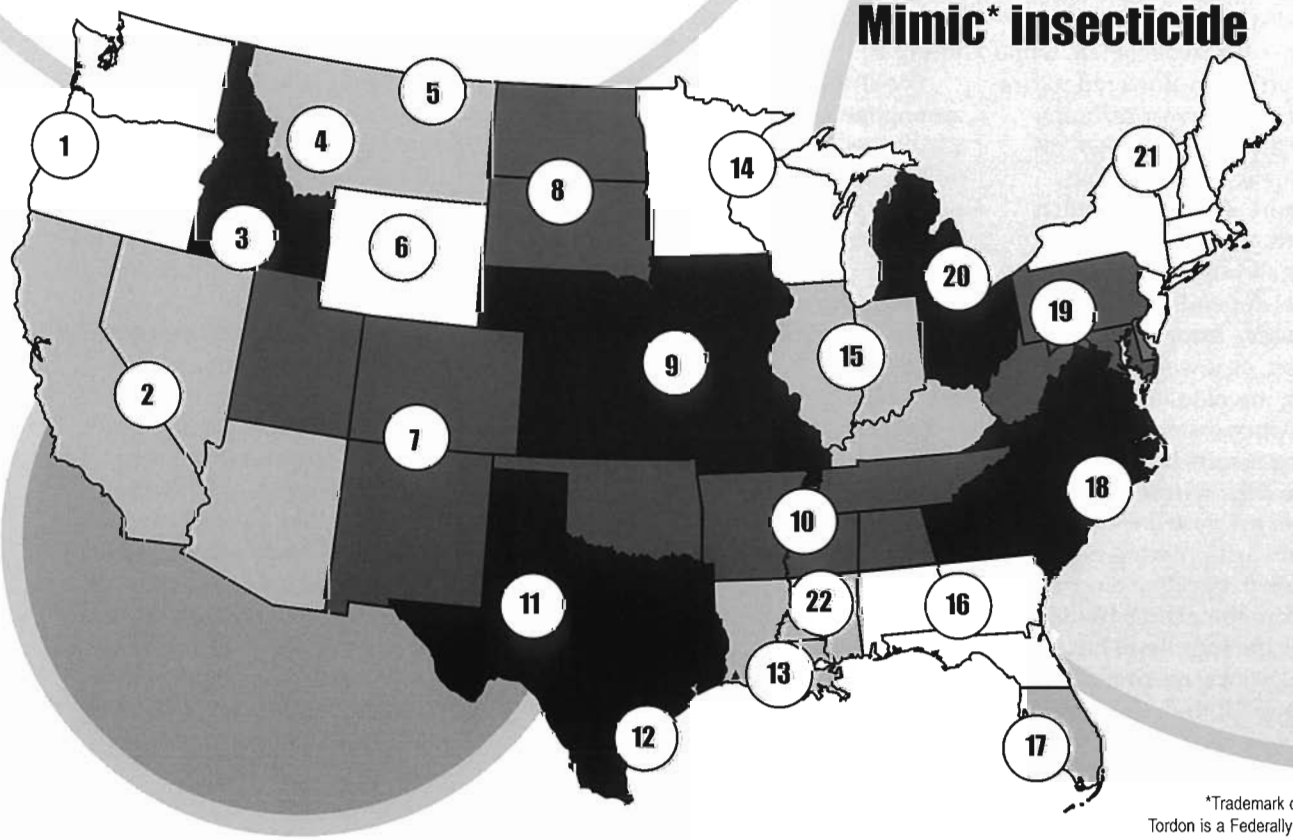

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Sarracenia flava - flower (pitcher plant) Photo by Gil Nelson

Drosera sp. - leaves (sundew), very close up, leaf cluster is less than a nickel in width. Photo by Gil Nelson

Pinguicula caerulea - flower (blue butterwort) Photo by Gil Nelson

Utricularia inflata (bladderwort) Photo by David Tarver

carnivorous plants, then the pitcher plants are certainly the most commonly seen, especially in the Florida panhandle. The funnel shaped leaves of the more obvious species, such as the yellow trumpet or white-topped pitcher, stand stiffly erect and sometimes grow to over two feet tall, while those of the little, red-flowered parrot pitcher are decumbent or reclining and those of the purple pitcher, or huntsman cup as it is sometimes called, are short and stubby with a gaping mouth.

Unlike the flytrap, the leaves of pitcher plants depend on passive rather than active trapping. They lay quietly in wait, as it were, for some unsuspecting insect to fall or fly into their orifice. Once inside, most cannot escape. Flying insects have too little room to open their wings and walking insects are prevented from retreat by tiny downward-pointing hairs, as well as by gooey digestive enzymes that exude from the plant's tissues. So effective is the trap that I have often seen huge swarms of the ubiquitous love-bug fill the yellow trumpet's tube to within one inch of its upper rim.

The Butteworts. Butterworts are among the more showy of our carnivorous species. Their pink, purple, yellow or deep blue flowers are obvious components in many roadside ditches or boggy meadows. Unlike pitcher plants, butterwort leaves are almost hidden from view. Their nearly flat, tightly packed rosettes of low growing leaves look like curled up babies' tongues.

But, the flowers are anything but hidden. They arise on thin, fuzzy stems that in some species can be up to eight inches in height. Attached near the top of the stem, they often droop toward the ground making them difficult to inspect without manipulation. But, inspect them you should, for the inside of the blossom is often exquisitely beautiful.

The Bladderworts. Like most carnivorous plants, the bladderworts take their name from the appearance of their leaves, which contain bladder-like pods that either float on or are submerged in water. Equipped with a trap door at one end, these pods pull small fish as well as aquatic insects into their grasp.

In the resting stage, the bladders are concave, or pinched in, and the pressure of the water outside the bladder is greater than the pressure within. The small opening, which serves as the trap door, is surrounded by numerous small hairs that float freely in the water and are sensitive to touch. When a passing insect or aquatic animal brushes the hairs, a tiny electrical charge is released that causes the trap door's tissue to relax and spring inward. Since the pressure inside the bladder is greater than that outside, water rushes into the trap, carrying the hapless victim with it. As the water pressure equalizes, the door springs shut rapidly in a foolproof trap from which there is no escape.

The Sundews and Dew Threads. The sundews include the smallest of our carnivorous plants and are the easiest to overlook. Their tiny rosettes of glistening leaves hug the earth, often well hidden among the ground cover and natural vegetative litter. Their petite flowers often arise only a few inches above the ground on ultra-thin stems that require close observation to find and inspect.

The sundews are most closely related to the Venus flytrap. However, the leaves of the two genera are nothing alike. Only their flowers belie their close relationship.

The upper surface and outer edges of sundew leaves are covered with pinkish-red tentacles, each of which terminates with a miniature gland that exudes a clear drop of sticky liquid. As visiting insects become mired in this gluey fluid, their desperate struggles only serve to stimulate the surrounding tentacles that bend over even more tightly to secure their prey. Once the insect is dead, the plant secretes digestive enzymes that break down the soft parts of the

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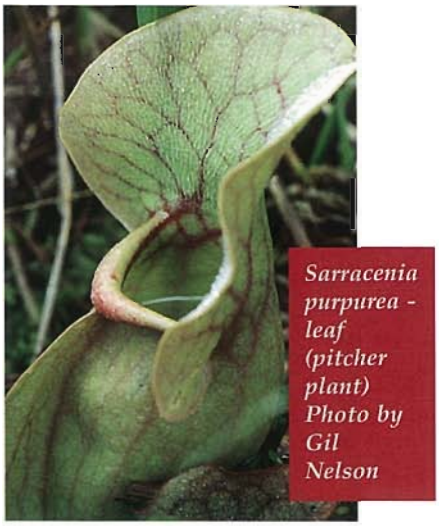

Sarracenia purpurea - leaf (pitcher plant) Photo by Gil Nelson

insect's body and absorb it into the plant's tissues.

Where To Go to see these plants

There are several good places to see carnivorous plants in panhandle Florida. But, be forewarned: It is illegal to collect these plants from public roadsides, parks, and forests. In addition, plants transplanted from the wild seldom live. So, be a good steward and enjoy them in their natural habitat.

Several highways through the Apalachicola National Forest are excellent for finding carnivorous plants. The best include SR 65 between Hosford and Sumatra, and SR 379 between Sumatra and SR 12. For more industrious travelers, the Osceola National Forest near Lake City is also a good place to search. U. S. 90 along the southern edge of the forest is excellent for butterworts and the edges of numerous forest service roads have the hooded pitcher.

Maps of both of these forests may be obtained from the U. S. Forest Service.

Gil Nelson is an author and naturalist in Tallahassee. His books about Florida plants includes *Ferns of Florida, Shrubs and Woody Vines of Florida,* and *Trees of Florida*, all of which are available in local bookstores and garden shops

AquaVine

FAPMS Board Meeting- all are invited!

January 14, 2003, Angie Huebner, angie.l.huebner@usace.army.mil

Moving On…

Nancy Allen, Aquatic Plant Management Supervisor with the US Army Corps of Engineers, has accepted a new planning position within the agency in Jacksonville. Nancy has had a long career with the USACE. In Florida, she was the biologist at Rodman Reservoir, then at Lake Rousseau. She was most recently supervisor of aquatic plant management for the Corps' jurisdiction of the St Johns River, in Palatka. **Chance Dubois** is the new supervisor for the Corps in Palatka. Good luck to both Nancy and Chance!!

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