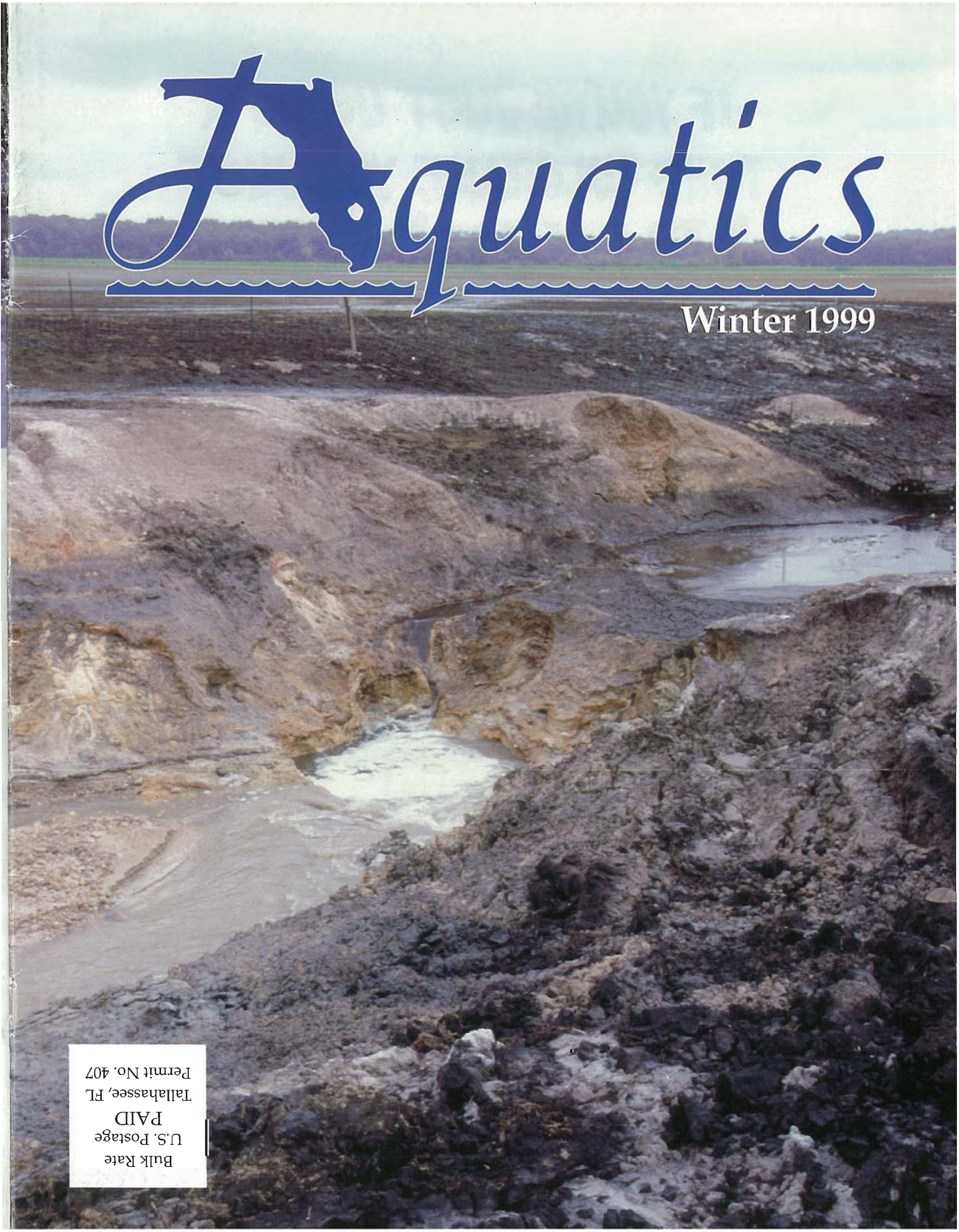
Aquatics

Winter 1999



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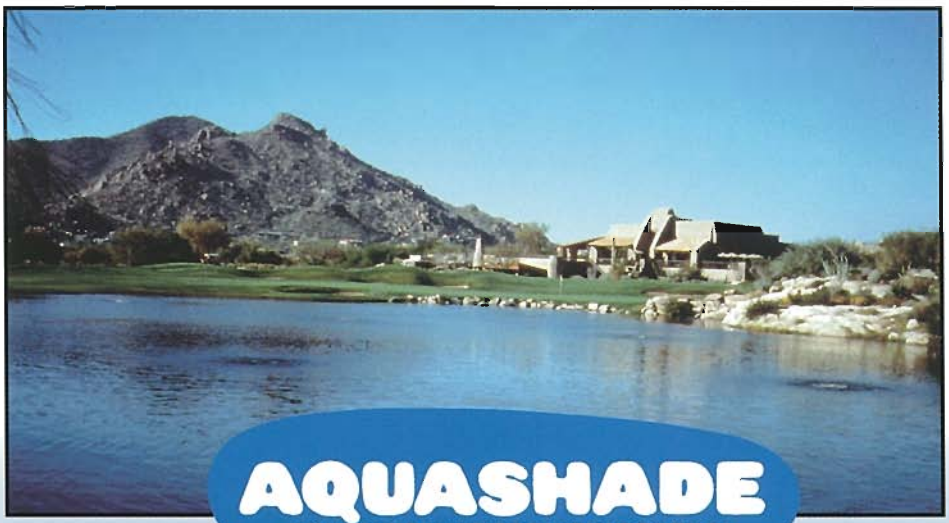

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Letter to the Editor

In reviewing Florida's first century of invasive plant management, it strikes me that 1976 was a landmark year. Not because this was my first year in aquatic plant control, but because of the communication and coordination issues introduced during the nation's bicentennial.

In 1976, aquatic plant managers from all levels of government joined with the private sector to form the Florida Aquatic Plant Management Society. Other venues addressed research and organizational needs, but only the FAPMS provided a forum for managers from all parts of the state to exchange field-tested solutions to aquatic plant problems. Florida's aquatic plant management program is often cited as the model for successful invasive species control. This effectiveness has more to do with communication and cooperation, fostered by FAPMS across multiple interests and jurisdictions, than with agency directives or responsibilities.

While FAPMS has helped to produce an educated, professional management force, more must be done to provide accurate information for Florida's 14 million other residents. Two Florida newspapers recently published articles on the environmental virtues of water hyacinth and hydrilla; species that once covered more than 250,000 acres of Florida waterways. Floridians simply are not aware of the destructive nature of invasive plants. Because plant management is not well understood by most Floridians, it took 12 years to secure public support and Legislative funding to effectively apply our crafts in public waters.

We also must do more nationally, at least regionally, to share experiences with others outside Florida. Texans seem destined to repeat the errors made in Florida by not aggressively controlling water hyacinth and hydrilla. As in Florida, this may cost Texas millions of dollars and thousands of acres of waters covered by invasive species. I was surprised to hear at a recent conference that zebra mussel managers have discovered that this introduced scourge of temperate waters can be contained, and impacts minimized, through frequent inspections and management. This maintenance control philosophy, the cornerstone of invasive species management, became **law** for Florida aquatic plant

Continued on page 18

Photo by Jeff Schardt.

Lake Jackson, Leon County Florida, the famous disappearing lake, has drained once again through a sinkhole. Its last disappearing act occured in 1982. Approximately ½ of this 4000 acre lake is now dry and restoration efforts are underway. **Look for a future article about this amazing phenomenon in Aquatics!**

Aquatics

Winter 1999/Vol. 21, No. 4

CONTENTS

AQUATICS (ISSN 1054-1799): Published quarterly as the official publication of the Florida Aquatic Plant Management Society Registration No. 1,579,647. This publication is intended to keep all interested parties informed on matters as they relate to aquatic plant management particularly in Florida. To become a member of FAPMS and receive the Society newsletter and Aquatics magazine, send $20.00 plus your mailing address to the Treasurer.

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University of Florida - IFAS

Skyflower

Introduction

Florida is a complex blend of many diverse habitats. Between the extremes of dry upland sandy hills and salty coastal areas lie various habitat types such as pine flatwoods, sand pine scrubs, hammocks, and wetlands. These radically different communities join together to create an environment unlike any other in the United States. Each of these communities plays a vital role in the ecological health of Florida's flora and fauna.

Wetland areas are particularly important ecosystems. Many thousands of acres of land in Florida are submerged year-round or for long periods of time. Plants growing in these saturated, flooded soils are interesting in their ability to survive and sometimes thrive under conditions that quickly suffocate most terrestrial plants. Since human activities have depleted almost half of Florida's original wetlands, an examination of the remaining flora and fauna is important in developing a clear understanding of the roles these wetlands play in Florida's ecological health.

A number of species present in Florida's wetlands are exotic flora that have found their way into the wild and in some cases have disrupted the natural balance of the ecosystems. Much effort is being directed to some of these invasive exotic plants in an attempt to find effective methods to manage their growth and reduce their damage to Florida's ecology; however, some of the native flora that thrive in the same neighborhood as these invasive exotics plants has been frequently ignored. One such interesting Florida native is skyflower (*Hydrolea corymbosa* Macbr. ex Ell.).

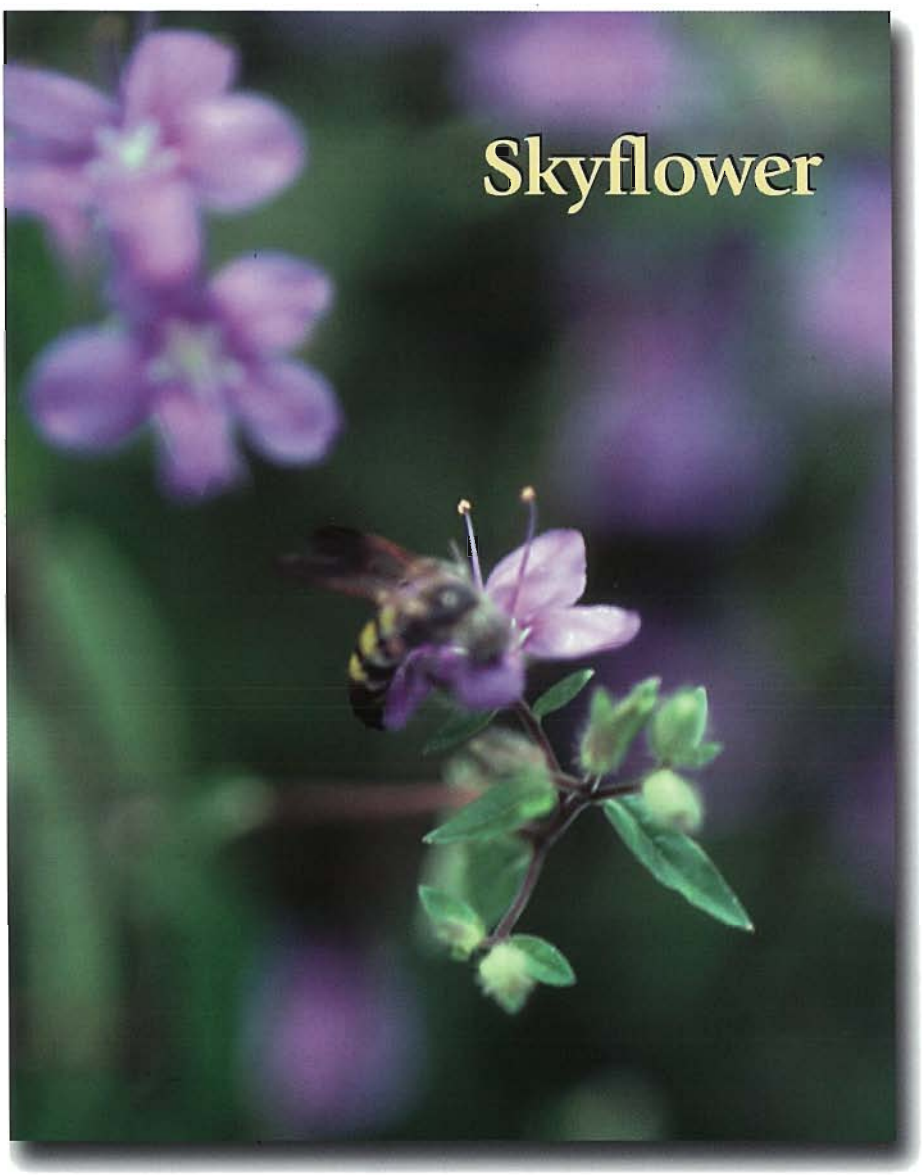

Figure 2. Pollination of Skyflower by a honeybee.

Skyflower, a member of the waterleaf family (Hydrophyllaceae), is a perennial dicotyledonous herb found in wetlands throughout Florida, Georgia, and South Carolina. This article provides basic information on skyflower in an attempt to increase the awareness and recognition of one of Florida's beautiful native wetland plants.

Family Characteristics

The Hydrophyllaceae family has 18 to 22 genera and about 250 species. The family is widely distributed and is represented on all continents, growing in climates ranging from tropical to temperate. While the family's Latin name translates to "waterleaf" in English, it is interesting to note that most grow terrestrially, and some annuals in this family have adapted to survive under desert and semi-desert conditions. The family name appears to have been derived from the appearance of very watery stems and petioles present in some species rather than for the ones that occur in aquatic habitats.

Only a few species of the Hydrophyllaceae family are of economical importance. Several species of the genera *Nemophila*, *Wigandia*, and *Phacelia* are used in

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the ornamental landscape industry. *Phacelia tanacetifolia* is cultivated in Europe for use in bee keeping. John's cabbage (*Hydrophyllum virginianum*) was eaten by Native Americans as a vegetable green. John's cabbage is now grown as an ornamental.

Members of the Hydrophyllaceae family grow as annual, biennial or perennial herbs, or may be found less frequently as shrubs; none occur as trees. Regardless of form, plants may be spiny, hairy, glandular, or bristly. One characteristic shared by all members of the family is that the leaves lack stipules, the leaf-like appendages found at the base of the petioles in some plants. Their leaf shapes are highly variable, and the leaves are arranged in many different patterns.

Flowers of the Waterleaf family are perfect; that is, each flower contains both the female (pistil) and male (stamen) parts. Pollination is accomplished by insects such as bees (Figure 2), wasps, and flies. The pistils and stamens ripen at different times to reduce the likelihood of self-pollination and encourage cross-pollination. The flower parts are radially symmetrical; that is, they extend from a central point outward similar to the spokes on a wheel. Flowers may be solitary and axillary to each other, or they may be grouped in an inflorescence called a 'cyme' that has a flat or round top. Parts of the flower with the exception of the pistil are in groups of five. Beginning at the bottom of the flower, the calyx (a collective term for all the flower's sepals) consists of five sepals that may be distinct or may be fused at the lower parts. The corolla (a collective term for the flower's petals) is found immediately above the calyx and has five petals that are united from the base of the flower to approximately the middle. The petals may be blue, purple, or white in color.

The androecium (a collective term for the male parts of the flower) is usually composed of five fertile stamens that arise from the base of the corolla and alternate with the petals. Filaments may be equal in length or may vary, and support bicellular anthers.

The gynoecium (a collective term for the female parts of the flower) typically has two carpels and a superior ovary with few to many ovules present.

Members of the Hydrophyllaceae family usually produce fruit in the form of a non-fleshy capsule that may or may not split when ripe. The seeds contained within may have a pitted or sculptured appearance and usually hold copious amounts of oily endosperm. Each seed also possesses a small, often straight, dicoyledonous embryo.

Genus Characteristics

Hydrolea, with 11 species, is the only aquatic genus of the family. The genus name is derived in part from the Greek "*hydro*" for water. Members of this genus are perennial herbs growing to 6 feet in height. They occur in Honduras, Mexico, Guatemala, Paraguay, Argentina, Brazil, Uruguay, Cuba, Jamaica, tropical Asia, Africa, the Philippines, Australia, and North America. Skyflower has the most limited distribution of the seven species known to occur in North America.

Stems of members of the genus range from smooth to covered with hairs, and are green, brown, purple, or black in color. Their leaves are ovate to lanceolate or linear in shape, and, like the stems, may or may not be covered with short hairs. The leaves are alternate on the stem, or sometimes opposite near the stem's base and alternate near the tip.

The five blue or occasionally white petals of the flower form a bell-shaped or wheel-shaped corolla, and flowers are borne in axillary or terminal cymes. Five stamens are present, with filaments longer or shorter than the corolla. Two styles are usually present, and may be much longer than the ovary or approximately the same length as the ovary. Large quantities of very small seeds are produced in the spherical capsule.

Individual species of the *Hydrolea* genus are distinguished from each other based on arrangements of their flowers, lengths of the styles, presence or absence of spines in the leaf axils, and morphology of the calyx lobes.

Figure 1. Overall view of Skyflower plants growing in standard 2-gallon culture containers at the Fort Lauderdale Research and Education Center. These plants growing in a well-fertilized media are about 3 feet tall.

Skyflower Characteristics

Skyflower is a perennial herb that grows to 2 feet or more in height (Figure 1). It over-winters as rhizomes or seeds. The plant has pubescent stems that range from green to brown and purple, and thorns are rarely found in the leaf axils. Leaves are lanceolate and usually measure between 0.75 and 2.5 inches long by 0.1 to 0.4 inch wide. Leaf margins are edged with small, sharp, forward-pointing teeth; the leaf surface may be covered with fine, short hairs or may be smooth.

Flowering begins in late spring and continues until early fall, and the flowers appear to be fairly persistent.

The flowers are borne in cymes or

leafy panicles. The calyx has lanceolate sepals that measure between 0.2 and 0.3 inch long and between 0.04 and 0.08 inch wide; these sepals are densely covered with fine hairs and appear fuzzy to the unaided eye. The corolla is composed of five blue petals that are up to 0.6 inch long by 0.3 inch wide (Figure 3). The true shade of blue color of the petals does not photograph well. The gynoecium has two blue styles that are generally between 0.2 and 0.4 inch long, while the androecium has five stamens present. Styles and stamens are blue, with gold to orange pollen borne on the anthers.

The measurements described above can generally be applied to specimens of Skyflower growing in the field; however, we have found plants that have been fertilized and grown under ideal conditions may experience accelerated or exceptional growth and may be considerably larger. We have also found that the seeds germinate readily without special treatment.

A Word About The Blues

Skyflower is a member of a small but elite group of plants that produce blue flowers. While shades of blue are not unheard of in the flowering plant kingdom, true blue flowers are uncommon. Another factor in the determination of flower color is perception; your vision of blue may be violet in my book!

Many plants produce flowers with blue "tones" - these flowers are "blueish" but tend to have undertones of red, which shifts them to the purple end of the spectrum. Notable examples of aquatic plants with "bluish flowers" include pickerelweed (*Pontederia cordata* L.) and the hybrid water-lily (*Nymphaea* 'Blue Beauty').

Plants bearing flowers with clear blue tones are less common; once again, it is important to note that blue is in the eye of the beholder.

Figure 3. Close-up of a flower of Skyflower showing it's five distinct petals. The true blue color of the petals does not photograph well.

Only a very few plants such as Lemon bacopa or blue hyssop (*Bacopa caroliniana* (Walt.) Rob.) and Skyflower produce flowers that are closer to "true blue" and are generally uncontaminated by shades of red.

So why do blue flowers appear blue, anyway? The answer can be found by consulting the biochemistry of pigmentation. Plant cells contain chemicals that determine flower color; these chemicals include anthocyanins, carotenoids, and co-pigments. Anthocyanins are usually responsible for shades of blue, purple, red, and pink; carotenoids produce brown, orange, red, and yellow, and co-pigments create a palette of pale-yellows to near-whites.

While each chemical is responsible for producing a different set of colors, flower color may also be influenced by cultural conditions, including fertilizer regimes, temperature, and pH. The mere presence of anthocyanins in a plant is not sufficient to elicit the production of blue flowers; in fact, many plants produce anthocyanins naturally but cannot utilize them because the plant is lacking the correct combination of chemicals, conditions, or other factors needed to bloom in true blue. The most important factor in determining whether a plant can actually use anthocyanins seems to be the pH of the plant's cell interiors.

This creates a problem for breeders attempting to respond to the public's demand for more choices when selecting landscape ornamentals. Gardening has become America's number one pastime, and consumers are enthusiastically seeking new and interesting plants that will make their gardens unique. While some species have responded well to genetic manipulation of cell pH levels, others have conditions that are far too acidic or basic to work with unless new genetic engineering methods are developed.

This brief overview of the complicated biochemistry responsible for the production of blue flowers may give you a new appreciation for beautiful and uncommon plants with cerulean blooms. Our native Skyflower is a perfect example of the blues in nature, so be on the lookout for this wonderful species. Incidentally, this plant appears to have the potential to become an excellent aquatic ornamental plant. Although Skyflower is a perennial, its flowering stalks die back in the winter and regrowth occurs from rhizomes in the spring. It may need to be replanted yearly from seedlings to maintain cultures of robust flowering specimens.

A Note from the Authors

We wish to nominate Skyflower as the official plant of the University of Florida - IFAS in light of its clear blue petals and bright orange pollen representing nature's true blue and orange colors of the "Florida Gators".

Acknowledgments

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References

Literature articles used in the preparation of this article may be obtained by contacting David Sutton. Mailing address: University of Florida - IFAS, Fort Lauderdale Research & Education Center, 3205 College Avenue, Fort Lauderdale, FL 33314; or e-mail: dlsutton@ufl.edu.

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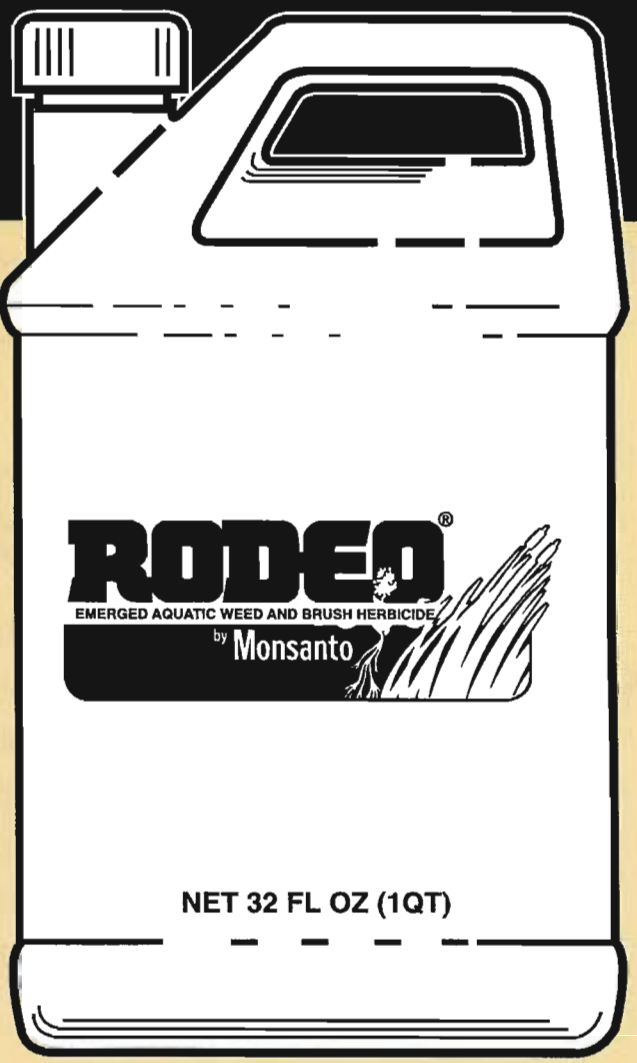


Will Copper Herbicides Control Willow Trees?

by John Rodgers
Department of Environmental Protection

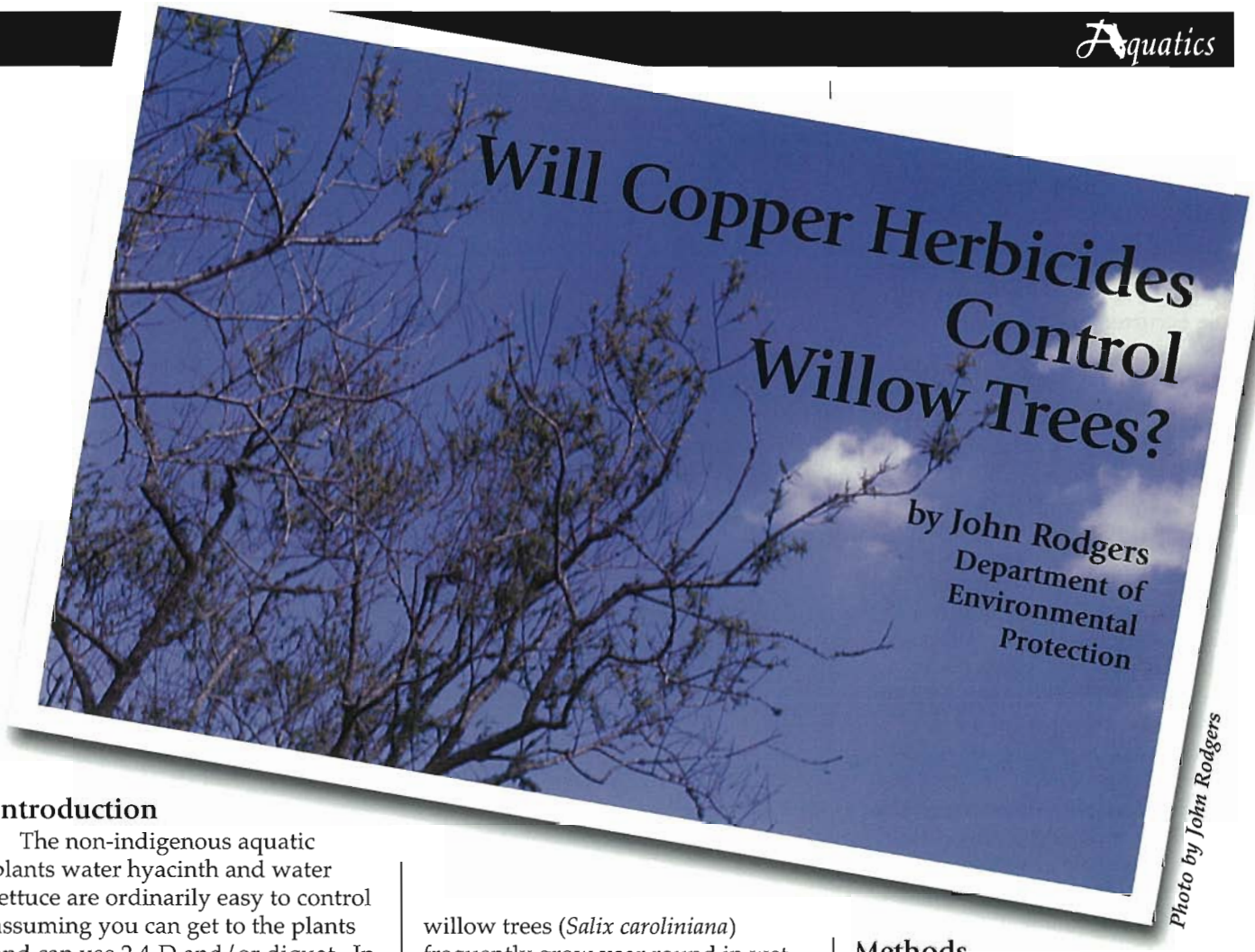


Photo by John Rodgers

Introduction

The non-indigenous aquatic plants water hyacinth and water lettuce are ordinarily easy to control assuming you can get to the plants and can use 2,4-D and/or diquat. In potable waters, however, there are restrictions on the use of both of these herbicides that often prevent aquatic plant managers from treating within specific distances from water intake pipes. These distances vary from 400 feet to one-half mile depending on the herbicide, the flow rate, and on the particular water utility responsible for a city's water supply.

Copper based herbicides have been used by a majority of water utility managers to control algae for many years because copper effectively controls algae and there are no water use restrictions. In recent years, because of the lack of water use restrictions and limited choices, copper herbicides have also been used to control water hyacinth and water lettuce in potable waters. Control of both species is usually achieved after two to three treatments conducted one week apart.

Along the Hillsborough River, willow trees (*Salix caroliniana*) frequently grow year round in wet soils to water four feet deep. Water hyacinth and water lettuce often grow intermixed among willow trees and this can make it difficult to control floating plants without some of the spray making contact with the leaves of willow trees. During 1997, about two dozen willow trees in the Hillsborough River died and many others were showing symptoms of stress (Fig. 1). These trees were located along the shoreline of the river and within Orange Lake. These areas are classified as Class I, potable water. Orange Lake is a small cove connected to the main river and is also important because it is a designated Audubon bird sanctuary. Herons and egrets commonly use the willow tree islands for nesting during the fall and summer months. Therefore, if herbicides caused the die-off, a change in application method or herbicide rate may be deemed necessary.

Methods

To determine if the copper based herbicide that Hillsborough Co. Aquatic Weed Control (the County) used to control water hyacinth and water lettuce also damaged the willow trees, a herbicide test study was conducted. On 2/25/98, 10 willow trees from four to 12 feet tall were sprayed with Komeen, a copper based herbicide manufactured by Griffin, and X-77, a surfactant manufactured by Chevron. The County uses copper at a 12 percent rate to control water hyacinth and water lettuce and therefore, this same rate was used for the test plots. Since it was unknown what type of damage copper could cause to willow trees, a test site was selected that was not in the river, but one growing in a similar type habitat. The treatment site was a canal located at Interstate Business Park, Highway 301, Tampa, FL. A solo backpack sprayer was used to apply the copper to the willow trees. All of the

leaves were sprayed until wet. This is unlike what normally occurs when the County sprays floating plants, but the purpose of the study was to determine if one could control willow trees with a copper herbicide provided willow trees were the target species. The only time rain occurred within 24 hours after a treatment was during the day of the third treatment when it rained eight hours afterwards.

Results

The willow trees were sprayed once a week for six weeks. A week after the initial herbicide treatment, 50 percent of the leaves had small brown spots. Two weeks afterwards, 75 percent of the leaves were completely brown. After three weeks, this percentage increased to 95 %, but the willow trees also started to display some regrowth. Regrowth continued and increased each week even though spraying occurred for another three weeks on the new leaves. The copper did not effect or defoliate the new leaves which were from one to two inches long when sprayed. After eight weeks, regrowth was prolific and the majority of the trees had 85 % of its original foliage replaced with new growth. The only damage was that about 2 percent of stems had their terminal ends, from one to three inches long, burned (resulting in dead wood). Three months after the first treatment, all of the willow trees basically appeared as they did before they were sprayed.

Primrose willow (Ludwigia octovalis), cattails (Typha latifolia), and soft rush (Juncus effusus) were also sprayed to determine if other aquatic species could be controlled with Komeen. Cattail leaves had brown spots on about a one-third of its leaves after the third week and remained the same throughout the study. It appeared that it would be difficult to control cattails with copper. Primrose willow had 75 percent of its leaves defoliated the first week, 90 percent the next week, and 98 percent the week after. But it also

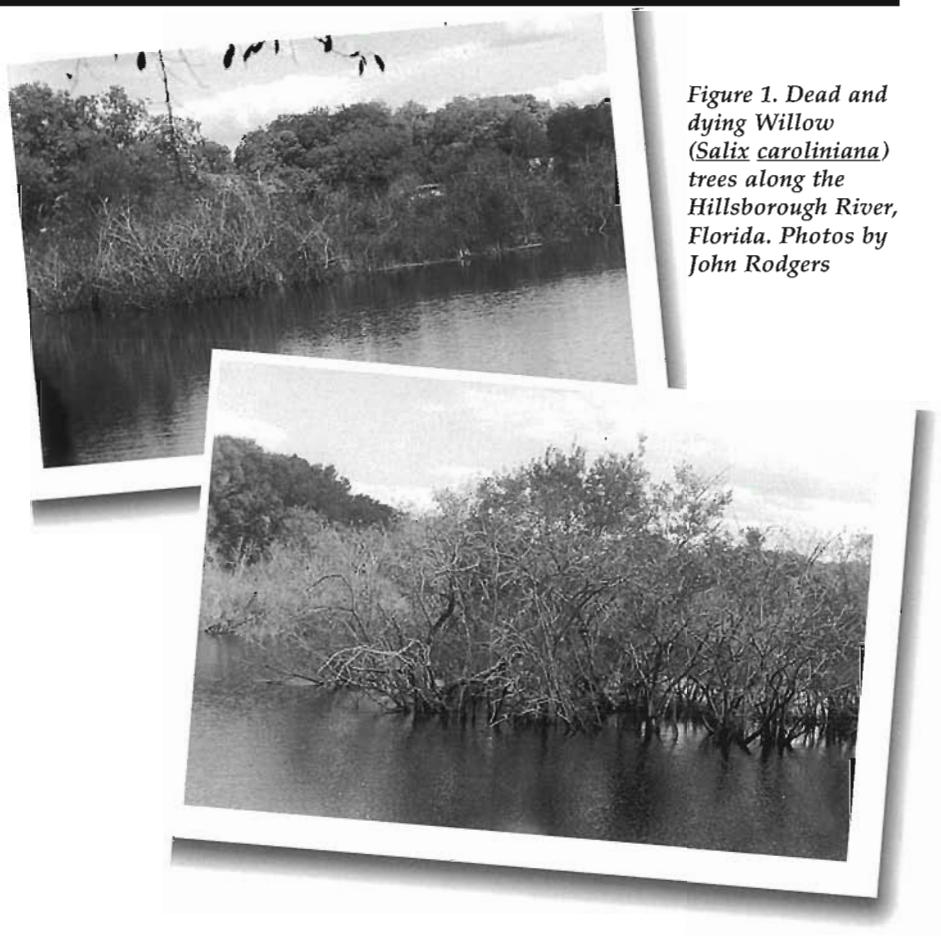
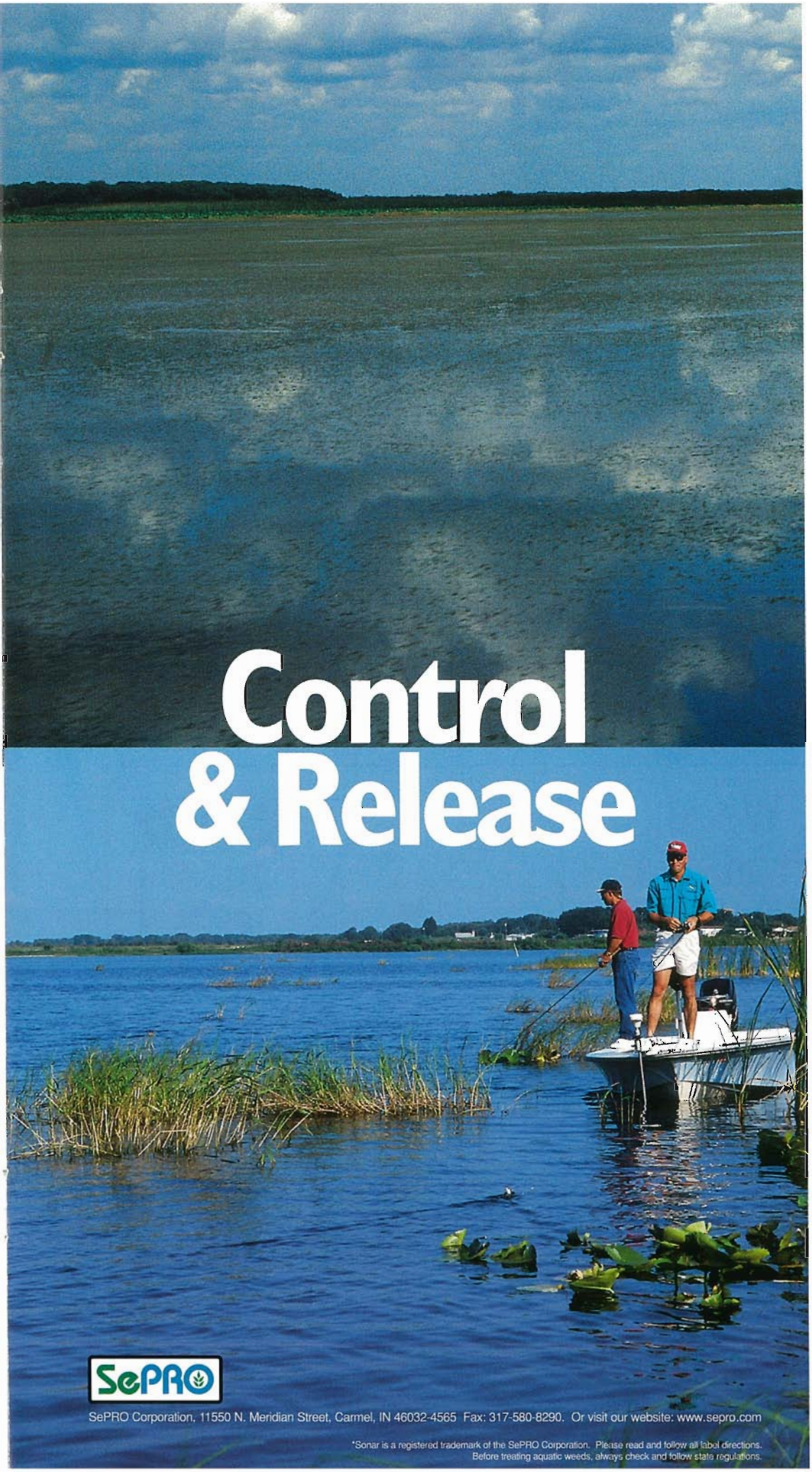


Figure 1. Dead and dying Willow (Salix caroliniana) trees along the Hillsborough River, Florida. Photos by John Rodgers



Every bass angler worth his salt recognizes and appreciates the value of structure. Aquatic vegetation plays an important role in providing structure for fish and wildlife. But exotic invasive plants like hydrilla and Eurasian watermilfoil crowd out the more beneficial native plants, thus disrupting a diverse habitat. This mixture or balance of plants and structure can improve both the number and quality of fish.

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showed regrowth along its stems during the third week. Regrowth continued and after the eighth week, 50 percent of the plants had new growth that replaced the defoliated leaves. Three months from the initial treatment, primrose willow had almost no signs of herbicide damage. Soft rush showed the most damage to its foliage. After eight weeks, 50 percent of the leaves were brown and 50 percent were green, but the plants were still alive. The condition of soft rush remained the same after three months.

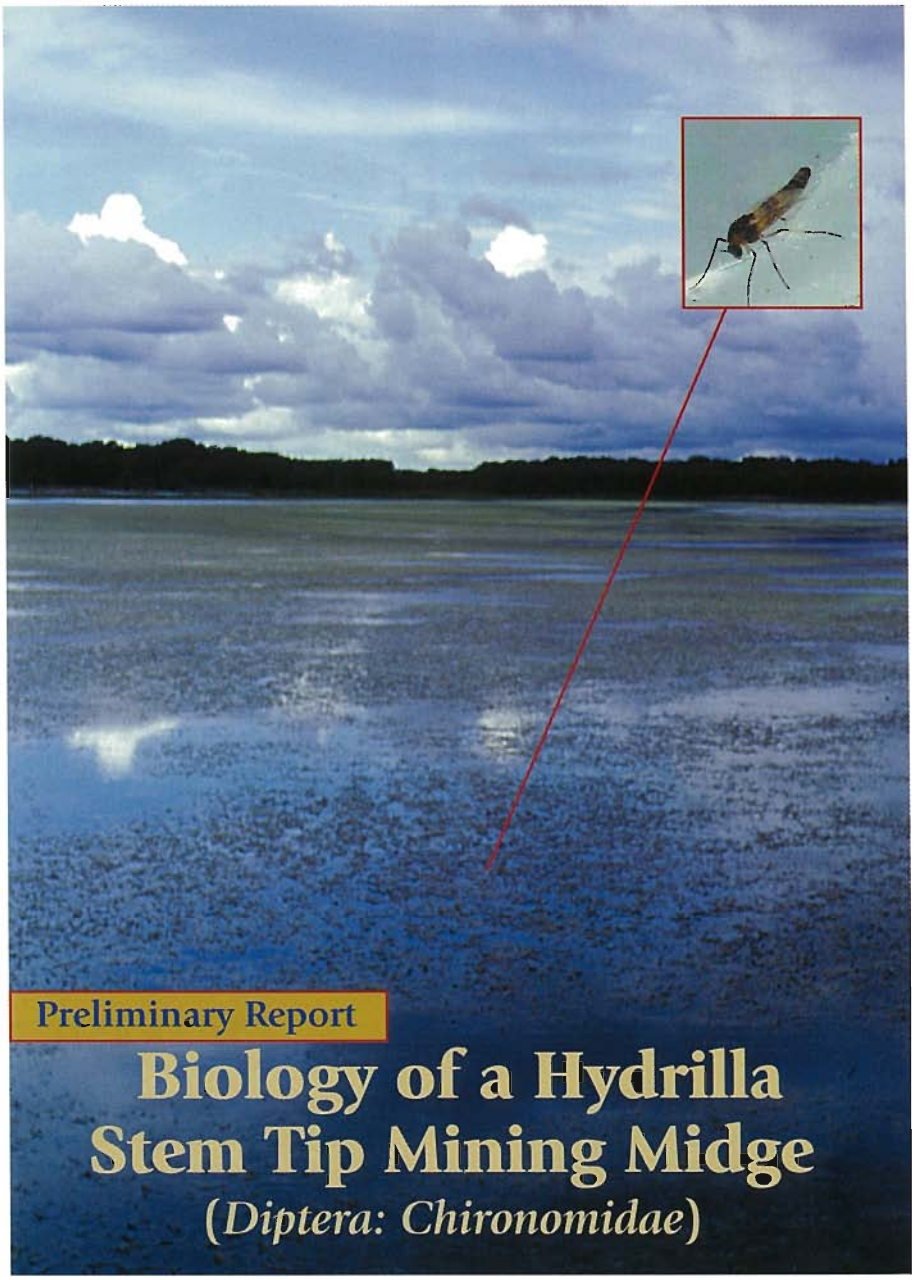
Discussion

This herbicide treatment test showed that Komeen will not control *Salix caroliniana*. So what caused the willow trees to die or become stressed in the Hillsborough River? While outside the scope of this study, several possibilities were investigated. A literature search of articles on willows trees implied that these trees can not survive after several years in standing water several feet deep unless these areas, at some time, experienced low water. Willow trees are often seen along lake shorelines, but not too far out into the water. Along rivers, willow trees can be found growing on submersed sand islands, but these areas most likely encounter low water levels at some time. Several reports and articles stated that willow trees can die because of extreme high water conditions over a period of several years. Along the Hillsborough River, there are willow trees that have grown year round for over 10 years in water 2-4 feet depth. Oxygen levels in the soil and water may play a key role in survivability. No attempt was made to determine why these willow trees have survived for so long in the Hillsborough River.

Stem borers have been known to damage the limbs of willow trees, but there appeared to be no signs of insect damage. Another possibility could be that the cumulative effects of copper in the substrate and the uptake of copper by the roots of willow trees has caused some damage. Farther upstream, however, in areas where copper has not been used by the County or the Tampa Water Department, there were willow trees with dead branches or an appearance of stunted growth. No copper analysis of the substate or the leaves of willow trees was conducted.

Could it be that some of the willow trees in the river finally began to exhibit the effects of high water over such a long period of time? Most of the willow trees that died were in the deeper water areas of the river. Since the mid 1990's, the Myakka River and the Peace River have also experienced high water conditions and both waterbodies have had willow trees that have died. In conclusion, it is the author's opinion that continuous normal to high water conditions over the past several years in the Hillsborough River has caused the willow trees to die.

By J. P. Cuda, B. R. Coon, J. L. Gillmore, University of Florida, and T.C. Center, U.S.D.A., Ft. Lauderdale



Background photo by Jeff Schardt, inset photo by J.F. Butler.

Introduction

Insects of the family Chironomidae, commonly known as midges, are often the most abundant insects inhabiting freshwater environments (Pinder 1986). Midges are fragile and mosquito-like in appearance but they do not bite. The larvae of most midges are aquatic and feed primarily on algae and decaying organic matter. A few species, however, are capable of mining the soft tissues of submersed plants and using the living plant material as a food source (Pinder 1986). Recently, this feeding strategy has been studied in some detail in the genus *Cricotopus* because of the realization that it could be exploited for the biological control of the alien aquatic weed Eurasian watermilfoil, *Myriophyllum spicatum L.* (MaCrae et al. 1990) and possibly hydrilla, *Hydrilla verticillata* (L.f.) Royle (J. P. Cuda, unpublished data).

Hydrilla is a submersed aquatic plant native to the Old World tropics that was introduced into Florida by the aquarium industry in the late 1950s from Sri Lanka (Langeland 1990). After its discovery in the Crystal River watershed in 1960, hydrilla continued to expand its range statewide and to increase in severity in water bodies already infested. The dense surface mats associated with severe hydrilla infestations cause problems because they hinder navigation and flood control, interfere with recreational activities, and reduce the biodiversity in aquatic ecosystems (Haller 1978). Between 1980 and 1993, approximately $39 million in state and federal funds was spent managing hydrilla in Florida waters with nonbiological control methods (Ferriter et al. 1997).

In 1992, USDA researchers noticed that larvae of a midge belonging to the *Cricotopus sylvestris* group (J. H. Epler, pers. comm.) were damaging the meristematic tissues of hydrilla in the Crystal River watershed in Citrus County, Florida (G. Buckingham, unpublished data). The hydrilla at one of the sites exhibiting evidence of midge feeding damage appeared short and unable to grow to the surface. Because previous research implicated midge larvae as causal agents of damaged stem tips on stunted hydrilla plants in Africa (Markham 1986), this tip mining midge may have some potential as a biological control agent.

Distribution and Life Cycle

The midge genus Cricotopus is represented in North America by four subgenera (Epler 1995). Two of these subgenera occur in Florida and contain at least eight species (Epler 1995). This particular *Cricotopus* midge was recently identified as *Cricotopus lebetis* Sublette (J. H. Epler, pers. comm.).

The actual distribution of C. lebetis will not be known with any certainty until it can be determined whether the midge is an immigrant that arrived along with hydrilla, or is an indigenous species that has expanded its host range to include hydrilla.

Male and female midges live from one to three days and do not feed. Male swarming behavior, which is a prerequisite for mating in many species of the Chironomidae, was not observed in this species. Instead, adults mate on a suitable substrate in daylight. Shortly after mating, the female oviposits on the water surface. The female inserts the tip of her abdomen beneath the water surface where she deposits a single ribbon-like egg mass surrounded by a gelatinous matrix and dies soon afterwards. The egg stage lasts 36 to 48 hours.

Larval hatching is synchronous. The neonates are very active but remain inside the tubular gelatinous matrix for several hours, crawling from one end to the other. Eventually, they exit the gelatinous matrix from one of its ends, or occasionally from the middle. As the larvae at this stage of their development are free-swimming and vulnerable to predation, emergence from the gelatinous tube usually occurs under low light conditions. Their translucent color and small size also may afford them some protection from predators until they can enter a shoot tip. Once inside the plant, the larvae mine and feed on the vascular tissues of the apical meristems of the hydrilla shoots. As they develop to maturity, their feeding activity creates a 1-2 cm tunnel inside the stems which eventually kills the shoot tips and induces their abscission. The tunnels created by the developing larvae inside the shoot tips probably protect them from predators but also function as pupal cases. The larvae complete their development in 9 to 22 days.

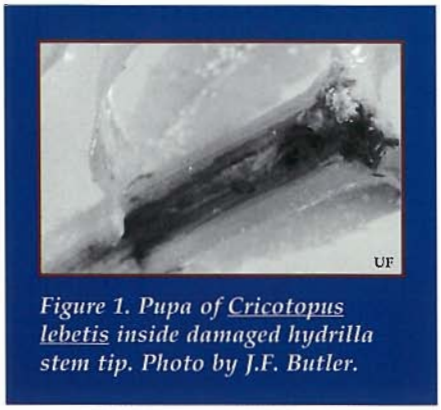


Figure 1. Pupa of Cricotopus lebetis inside damaged hydrilla stem tip. Photo by J.F. Butler.

Pupation occurs inside the hydrilla stem (Fig.1). Before pupating, the mature larva completely severs the tip of the shoot to create an escape route for the fully developed pupa, and caps the opening of the tunnel with plant fibers excavated from the stem wall. The preparation of pupal case by the last instar larva is what actually induces abscission of the shoot tip. The pupal stage lasts 24 to 48 hours. Adult emergence occurs after the sedentary pupa exits the stem by repeatedly undulating its abdomen to break through the fibrous cap, and slowly swims to the surface aided by an air bubble released inside the pupal skin.

Description

Adult. The adult midge is small, only 3 to 4 mm in length, and very fragile. Both sexes are pale green with black markings on the thorax and a pair of adjacent dark bands on abdominal segments 2 & 3 and 5 & 6 (Fig. 2). The black markings on the thorax and the coarse banding pattern on the abdomen give the midge a darker appearance. The sexes can be readily distinguished by the condition of the antennae and the shape of the abdomen (Fig. 2). In females, the antennae are short and the abdomen is as wide as the thorax. In contrast, the males possess long antennae with distinct whorls of hair and have a narrow, tapering abdomen.

Egg. The egg mass is linear, and contains from 50 to 250 eggs diagonally arranged in one or two rows encased in a sticky gelatinous tube (Fig. 3(A)). The eggs are white in color when first laid, and resemble a string of pearls. Within 24 hours the eggs that have been fertilized turn grayish-brown, and red eyespots of the fully formed embryo appear just prior to hatching.

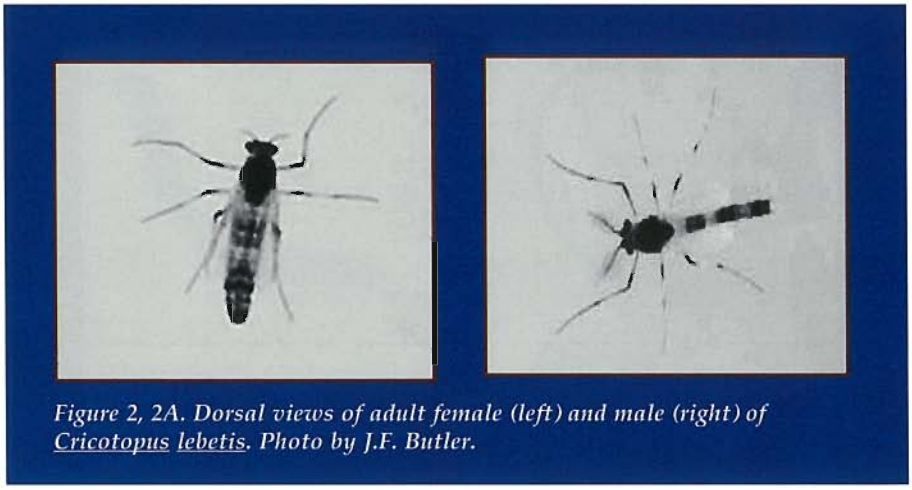


Figure 2, 2A. Dorsal views of adult female (left) and male (right) of Cricotopus lebetis. Photo by J.F. Butler.

Larva. The larvae of *C. lebetis* can be identified by the color and general appearance of the body. Live or freshly preserved specimens have a characteristic green body color with a broad dark blue band around the thorax (Fig.3(B)). After the body color fades in preserved specimens, the larvae can be separated from other midge larvae by the presence of a pair of lateral setae on each abdominal segment.

Pupa: The pupa is a non-feeding stage. The wings and other adult features that have been developing internally become visible. Breathing horns or 'trumpets' that are usually

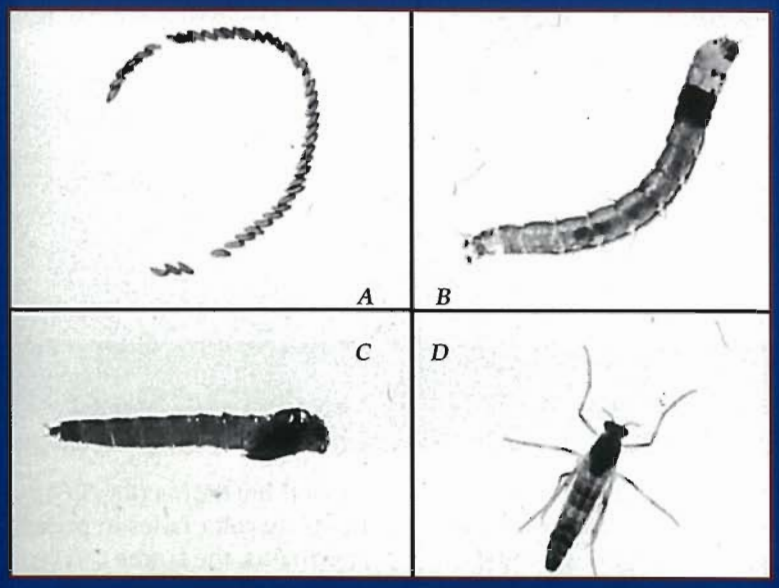


Fig 3. Life Cycle of Cricotopus Midge a- Egg Mass, B-Larva, C-Pupa, D-Adult. Photo by J.F. Butler.

present on the prothorax in species that have free-swimming pupae are lacking. A pupa destined to become an adult female will have a full complement of eggs apparent in the abdomen (Fig. 3(C)).

Importance

Cricotopus lebetis may have some potential as a biological control agent of hydrilla. The larvae of this herbivorous midge mine the meristematic tissues of the plant and in the process disrupt shoot growth. By severely damaging or killing the apical meristems, the developing larvae may prevent new stems from reaching the surface. This type of damage is desirable for managing hydrilla because it would eliminate most of the adverse effects caused by the formation of the dense surface mats, such as changes in biodiversity, water chemistry, circulation and temperature.

Acknowledgments

We thank G. R. Buckingham for his guidance and valuable suggestions, T. D. Center for funding the project, J. F. Butler for providing the photographs, and J. H. Epler for identifying the midge. We also thank D. H. Habeck and J. H. Frank for reviewing the manuscript. This research was conducted under the USDA/ARS-University of Florida/IFAS Cooperative Agreement No. 58-66299-7-010. Florida Agricultural Experiment Station Journal Series No. N-01717.

References available upon request.

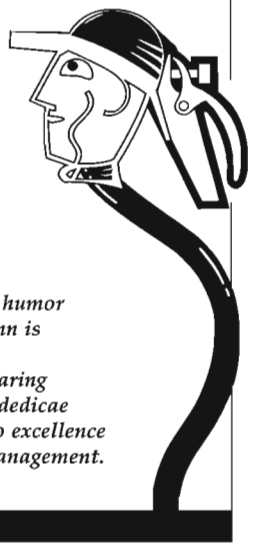
You might be a "nozzlehead" if:

Your idea of a plant press involves a hip pocket and a bar stool.

Your select name for a new herbicide is either "rambo juice" or "green be gone."

You always drive your truck through the car wash three times "cause it ain't clean 'til its triple washed."

The bug deflector on your airboat is primarily for coots and their jet stream.



Hopefully to be considered as light humor by most, this column is written for all the hardworking and caring professionals who dedicae their work afield to excellence in aquatic plant management. David Tarver

Editorial *continued from page 3*

managers in 1976. Imagine the cost and resource savings if maintenance control of invasive species had been practiced across the country since 1976.

Speaking of 1976, dust off your October 1976 issue of *National Geographic*. Pages 538-559 address imported plants and animals invading Florida more than 20 years ago. While piecemeal programs have been developed to cope with most of them, federal organization was nearly nonexistent until February 1999 when President Clinton signed an Executive Order requiring federal agencies to develop a national invasive species strategy. The driving force behind this initiative? Florida invasive species managers; many of them members of FAPMS.

The common thread among these issues is that sustained, collective efforts to manage and provide information about invasive aquatic plants have produced spectacular results. Examples include the recurring $25 million to control invasive aquatic plants passed by the 1999 Florida Legislature, and Governor Bush proclaiming the first week of October 1999 as invasive species awareness week. Little good has come from fragmented attempts to manage invasive species.

Like invasive species control, information must be continually updated and applied. New residents arrive daily and political bodies change after each election. A unified FAPMS is uniquely qualified to inform Floridians about invasive aquatic plants. FAPMS members hail from businesses and regulatory agencies, are among the world's leading experts in invasive species management, and have first-hand experience with the economic and environmental necessities of invasive species control. I therefore challenge FAPMS to become a leader in education and outreach related to invasive species management. This is not only in our best interest, it is the right thing to do.

Jeffrey D. Schardt

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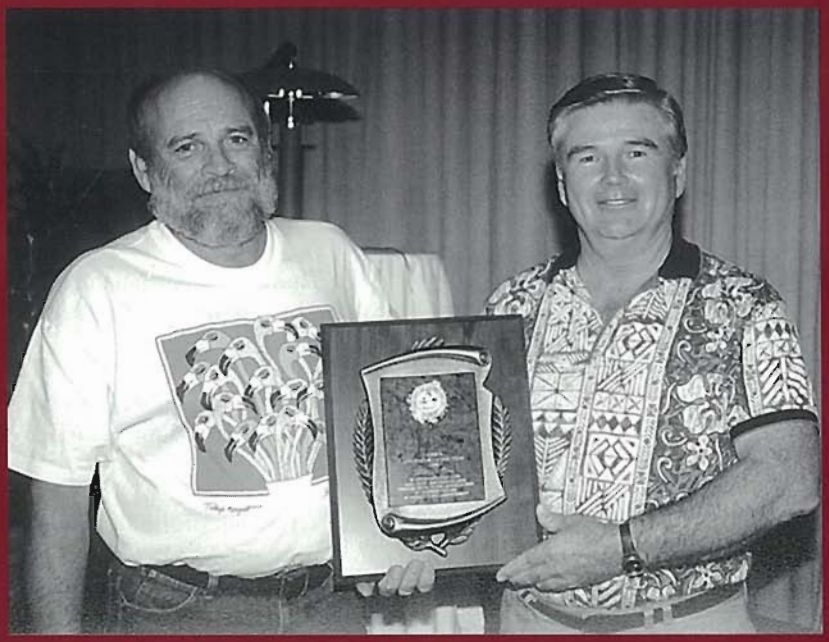
On August 24, 1999, eight FAPMS members provided Representative Paula Dockery and Representative Adam Putnam a tour of the hydrilla problem on the Kissimmee Chain of Lakes. These legislators were instrumental in appropriating significant recurring funds for invasive plant management starting in 2001. The purpose of the tour was to see the problem firsthand. Highlights of the tour included a helicopter inspection of the Kissimmee Chain of Lakes, and a "hands-on" look at hydrilla via airboats.

Top photo from left, Ernie Feller, Representative Paula Dockery, Judy Ludlow, Mike Hulon.
Bottom photo from left, Dean Jones, Mike Mahler, Legislative Senior Attorney Christine Hoke, Representative Adam Putnam

Photos by Don Doggett



The 1999 FAPMS Applicator of the Year Award was presented to David Register (left) and John Mason (right). These dedicated individuals manage plants on the St. Johns River for the U.S. Army Corps of Engineers in Palatka, Florida. Congratulations David and John! Photo by Don Doggett.

AQUAVINE

Congratulations to the FAPMS 1999 Annual Award Winners!

Applicator of the Year Award: John Mason and David Register, USACE, Palatka

Applicator Olympics Award: Volusia County Mosquito Control Team

Applicator Paper Award: Andy Price, Vegetation Management Consultant, Orlando

First place Booth Exhibitor Award: SePRO Corp.

Presidential Award: Andy Price, Vegetation Management Consultant, Orlando

Golf Tournament: Winning Team was Steve Kammerer, Michael Owen, and Bob Oneal; Closest to the Pin winner was Jim Brewer and Charles Ashton; and the Lousiest, Most Miserable, Just Dreadful, Actually Rotten, Down Right Abysmal, Often Fed Up, Worthless Team was Catherine Johnson, Nancy Allen, George Gallagher, and Charles Ashton. Special thanks to the sponsors of the golf tournament. The money raised at the golf tournament goes to the FAPMS Scholarship Fund. Thank you for your support!

Fishing Tournament: The FAPMS fishing tournament was canceled due to bad weather.

Photo Contest Awards:

Scenes Category:

First Place, Keith Mangus
Second Place, Eric Hertel
Third Place, Charles Nohejl

Operations Category:

First Place, Bill Morgan Jr.,
Second Place, David Farr
Third Place, Eric Hertel

The Grand Prize winner of the 60 HP Mercury Outboard, compliments of **Mercury, Elf Atochem**, and **American Cyanamid** was Robbie Lovestrand, or shall we say Luckstrand, DEP, Floral City

MEETINGS

FAPMS Board Meeting
January 19, 2000, Tallahassee,
Jeff Schardt 850-488-5631

Results of the Local Arrangements Questionnaire

Thank you for participating. Out of 227 survey sheets collected, the results in parenthesis are as follows (those highlighted have the highest score):

1. What is the maximum per night guestroom rate you are willing to pay to attend the annual FAPMS Conference?
   a) $60-$70 (82) **b) $70-$80 (93)** c)$80-$90 (48)

2. To which of the following regions would you travel to attend the annual FAPMS Conference (circle as many as apply)?
   a) south (Miami to Sarasota) (126)
   b) central (Sarasota to Daytona) (194)
   c) north (Daytona to Jacksonville) (138)
   d) panhandle (Tallahassee to Destin) (88)

3. Would you stay in an "overflow" motel if the conference hotel had insufficient rooms to house all the members?
   a) yes (149) b) no (78)

4. How far would you commute from an "overflow" motel to the conference site?
   a) less than one mile (85)
   b) 1-2 miles (46)
   c) 2-5 miles (47)
   d) I would not attend if I had to stay in an "overflow motel" (45)

5. Would you attend the annual FAPMS Conference if the meeting and banquet rooms were in off-site facilities?
   a) yes (165) b) no (62)

6. What is the highest rate that you would pay for annual FAPMS Conference registration?
   a) $40 (74) **b) $50 (85)** c) $60 (38) d) $70 (8) e) $80 (17)

7. During which month would you prefer to attend the annual FAPMS Conference? (circle or fill in one)
   a) September (39) **b) October (131)** c) November (22)
   d) other (22)

8. Should the FAPMS Conference banquet be: (circle one)
   a) the current more formal, sit-down affair (126)
   b) a walk-around social gathering? (100)

9. Should awards be distributed at: (circle one)
   a) the banquet (147)
   b) during the general sessions (45)
   c) during the business meeting (30)

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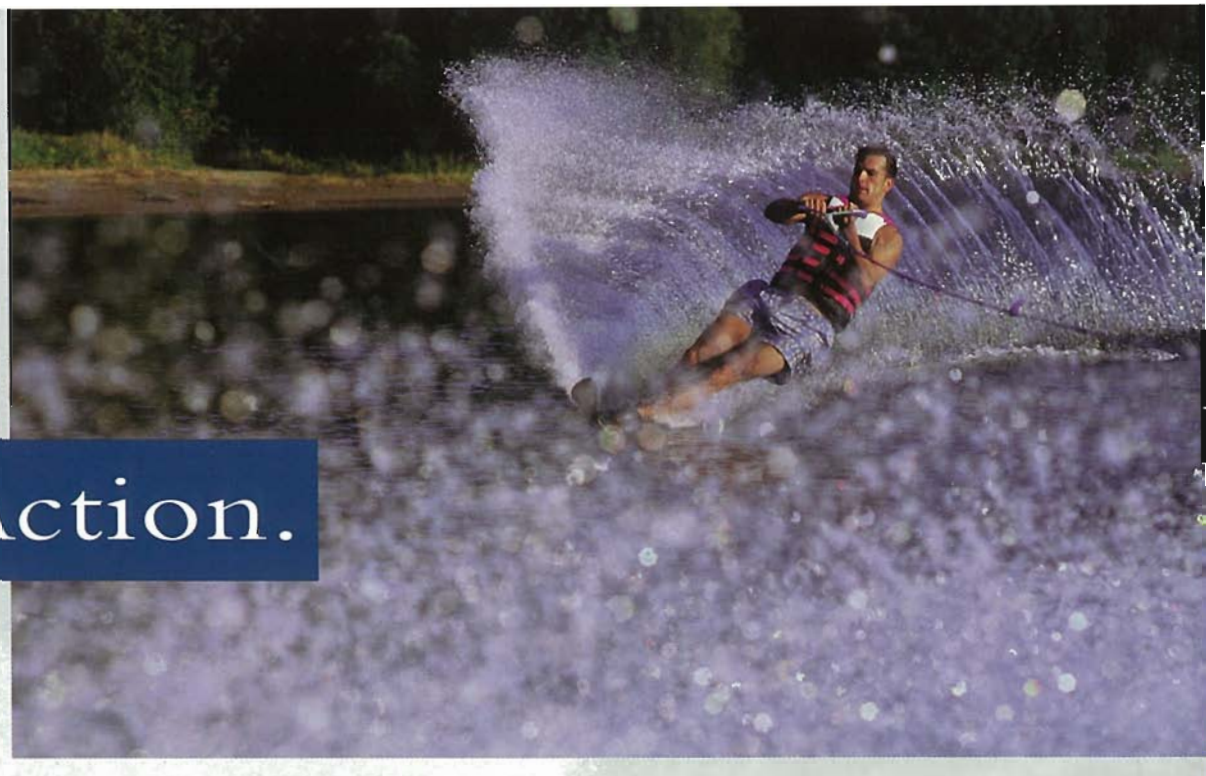

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