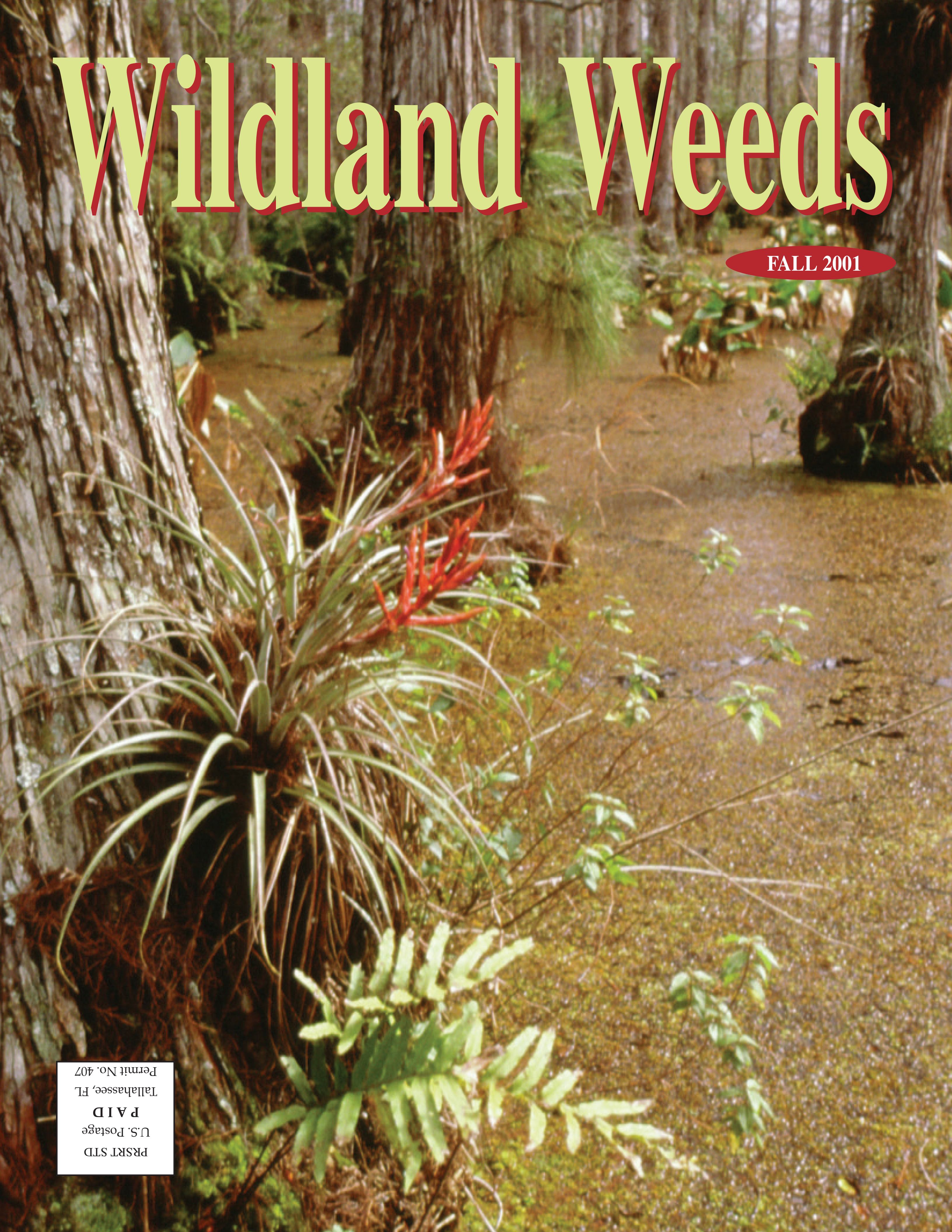
Wildland Weeds

FALL 2001



Seapro 4/c Control and Release P/U

Wildland Weeds

FALL 2001, Volume 4, Number 4

Table of Contents

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Cover: Hopefully, Dan Austin will remember the swamps of Southwest Florida as he explores the deserts of the Southwestern United States (see article, p.18). Photo courtesy SFWMD.

FLEPPC Research Grant Competition Update

Last year, FLEPPC conducted its first annual competitive research proposal program for the study of invasive non-indigenous plants in Florida. The FLEPPC research committee reviewed a large number of submitted proposals and subsequently recommended four of the proposed research projects for funding. Following are brief reports on the progress of the four funded projects.

The effect of *Lygodium microphyllum* on wildlife forage and predation in South Florida *Taxodium* Swamps

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Center for Aquatic and
Invasive Plants

Old World climbing fern (*Lygodium microphyllum*) is a non-native fern in Florida with dark brown or black, wiry rhizomes and climbing, twining fronds of intermediate growth, to 30 meters long. *L. microphyllum* was reportedly introduced to Florida in the Loxahatchee River Basin in southern Martin and northern Palm Beach Counties and originated from Africa to southeast Asia, and south Pacific islands and Australia. The exponential spread of *L. microphyllum* in South Florida is beginning to be recognized by many public and private land managers. Near the origin of introduction, the Loxahatchee National Wildlife Refuge reported nearly 17,000 acres of fern blanketing entire tree islands by 1995. Sporadic patches of *L. microphyllum* totaling more than 300 acres have also been discovered in Everglades National Park and are currently undergoing aerial herbicide control. It is a common perception that invasive, non-native plant species such as *L. microphyllum* negatively impact native vegetation and other higher trophic levels within the ecosystems invaded. However, there is little quantifiable evidence of how these plant species affect other vegetation, insects or wildlife. We are currently conducting a study examining the effects of *L. microphyllum* on wildlife predation and forage in three South Florida cypress swamps, Corbett Wildlife Management Area, DuPuis Preserve and the Corkscrew Regional Ecosystem Watershed land. We will be identifying predator species and level of predation in cypress understories with and without *L. microphyllum* as well as in understories where *L. microphyllum* has been treated with herbicide. In addition, we will examine the amount of preferred and usable forage in these same study sites.

Genetic variation within *Melaleuca quinquenervia* in Florida, and its effect on performance of biological control insects

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Florida International University
USDA, ARS Invasive Plant
Research Lab, Fort Lauderdale, FL

Melaleuca quinquenervia (broadleaved paperbark, niaouli) was first imported into the United States from Australia during the 1880s. Horticultural nurseries near Sarasota, Florida, and San Diego, California, imported this species (then known as *M. leucadendron*) as a landscape tree because of its showy cream-colored bottlebrush flowers and spongy peeling white bark. During the subsequent 40 years, 10 more introductions occurred in Florida from 5 different sources including botanical gardens in France (3x), Italy (1x), and Australia (4x), and plantations in Australia (1x) and Madagascar (1x). By the mid-1920s, the plant had become naturalized on both coasts of southern Florida, invading diverse habitats within the Everglades ecosystem including freshwater and brackish wetlands as well as pine flatwoods. Preliminary isozyme analyses show that these naturalized weed populations differ genetically from one another. Chromatographic profiles of leaf essential oils show that these genetic differences partially result from the presence of two primary chemical varieties (called chemotypes) of *M. quinquenervia* in Florida. The essential oils of chemotype I plants contain the terpenoid *trans*-nerolidol as their principle constituent, whereas chemotype II plants contain the terpenoids 1,8-cineole and viridiflorol as their primary constituents. Laboratory bioassays with the biological control agent *Oxyops vitiosa* suggest that the insects currently in Florida may be better adapted to type I than type II plants. For instance, survivorship of *O. vitiosa* larvae fed type I plants was threefold greater than larvae fed type II plants. Also, adults reared on the type I plants weighed 40% more than those reared on type II plants. Similar decreases in fecundity have been noted. Studies are underway to determine the impact of these differences on *O. vitiosa* population dynamics at field sites in Florida.

Dispersal, reproduction and physiological ecology of two invasive non-indigenous fern species, *Lygodium microphyllum* and *Lygodium japonicum*

Michael S. Lott and
John C. Volin
Florida Atlantic University

One of the greatest threats to the integrity of native ecosystems is their invasion by non-indigenous species. Nowhere else in the continental United States is this threat more conspicuous than in Florida. *Lygodium microphyllum* and *L. japonicum* are two recent invaders that are currently spreading through Florida's native ecosystems. Once established in a community, these two species appear to displace native species and alter local fire ecology. *L. microphyllum*, in particular, can completely dominate a native habitat with time, causing the collapse of the natural community. We are studying both their reproductive strategies and their relative growth rate at different light levels. The results indicate that both species are capable of intragametophytic selfing, which supports the hypothesis that the reproductive strategy partially explains the continuing spread of both species. Since spores are dispersed readily by wind, the ability of a single spore to form a sporophyte will aid in the ability of both species of *Lygodium* to rapidly infest new habitat. In addition, *L. microphyllum* is capable of intergametophytic crossing. The results of the study suggest that outcrossing is promoted via the production of an antheridiogen pheromone. These pheromones are produced by mature female gametophytes and promote maleness in neighboring gametophytes. Early results also show that both *Lygodium* species have a growth advantage in low light irradiances compared to native species, the causes for this apparent advantage in low light are still being determined. With these studies, we expect to increase our understanding of the ecology and physiology of these highly invasive species. This, in turn, may assist land managers in developing strategies to prevent and control their rapid spread.

Predicting the potential distribution of a plant invader: integrating field studies and climate matching approaches

Robert Pattison, Richard Mack and R. Alan Black
Washington State University

Accurate prediction of the potential distribution of invasive species is important to their control. Field studies and a computer model (CLIMEX) were used to predict the potential distribution of the invasive Chinese tallow tree, *Sapium sebiferum*. Seedlings of *S. sebiferum* were planted in 4 microhabitats in a factorial design of open and closed canopy and upland and lowland microhabitats at 7 sites along a coastal (1,300 km) transect and an inland (400 km) transect in the southeastern U.S. These transects extend beyond the current geographic range of *S. sebiferum*. A reduced competition treatment was applied to half of the seedlings in each microhabitat at each site. Seedling survival and growth rates were measured 1-2 years after planting. In predicting the potential U.S. distribution of this invasive tree, model parameters for CLIMEX were based on greenhouse studies of seedling tolerances to key environmental conditions and on climate matching of the known global distribution of *S. sebiferum* with U.S. climatic records. Average seedling survival ranged from 20 to 100% and was 100% in at least one microhabitat at all sites. Average seedling basal diameter ranged from 3.3 to 7.5 mm with the largest seedlings occurring in open microhabitats and in sites beyond the present southeastern distribution of *S. sebiferum*. Reduced competition increases survival and growth rates particularly in upland microhabitats. Computer predictions match field results and suggest that *S. sebiferum* has yet to occupy its entire new range in the U.S.

(This year's competition is currently under way, however, if you are interested in conducting studies related to invasive exotic plant management in Florida, we strongly encourage you to submit a proposal for the next competition in spring 2002. For more information please contact John Volin at jvolin@fau.edu.)

Damn the **Torpedograss!**

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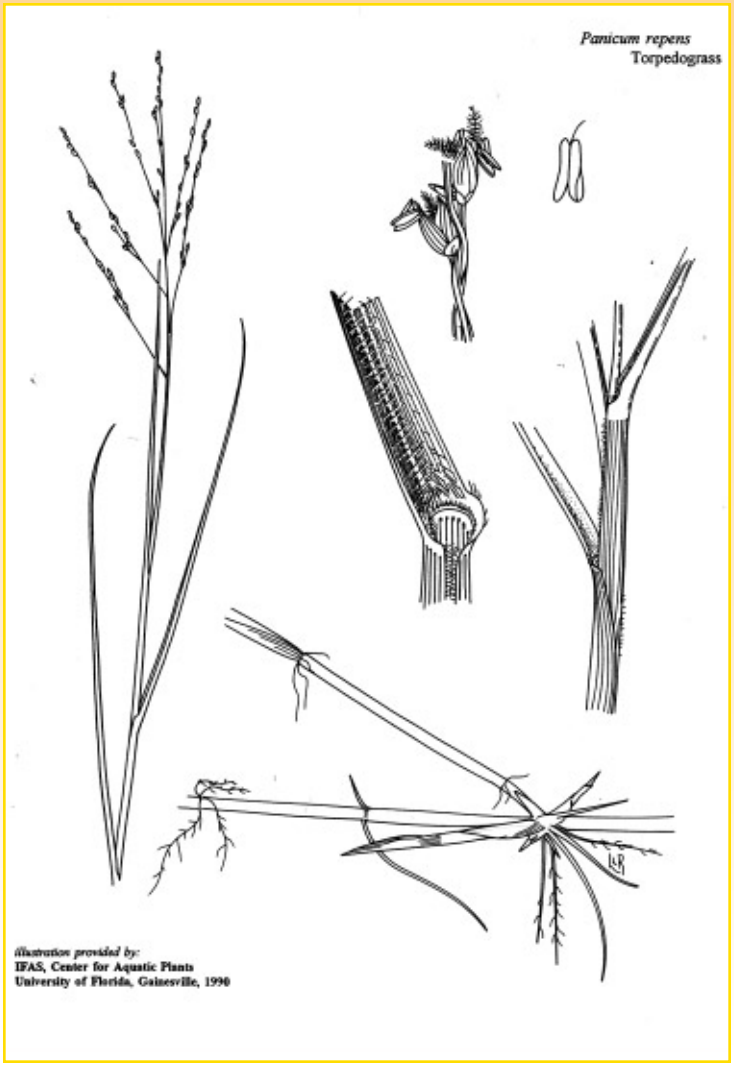
Introduction

Torpedograss, native to Old World Eurasia, is well established as one of the world's worst weeds (Holm et al., 1977, Panchal, 1981, Chandrasena and Dhammika, 1988). It was introduced to the U.S. in the early 20th century either as an accidental ballast pollutant or as a potential forage grass for the southeastern states (Tabor, 1952). Although cattle will use it as forage, it is now considered invasive in Florida. In 1950, the University of Florida warned, "Torpedograss is a serious weed when established in farm and grove land and indiscriminate planting without regard to future crops or adjoining land is dangerous" (Hodges and Jones, 1950).

Botanical description

Torpedograss [Panicum repens (L.) Beauv.] is in the Poaceae family. Culms are rigid, 40-100 cm high, erect and/or decumbent. Culms originate from sturdy, robust rhizomes which have many nodes. Bladeless overlapping sheaths may wrap the culm base. Upper leaves are numerous with loosely overlapping sheaths. Sheaths, as a rule, are pilose along the margin, but may be glabrous. The ciliate truncated membranous ligule is approximately 1 mm long. Blades are linear, 4-15 cm long and 2-5 mm wide coming to a point. The leaf is stiff and rigid, flat or somewhat involute and spreading. The upper surface is usually scantily pilose but may be glabrous. The panicle is open, approximately 12 cm long and can be terminal or axillary. Spikelets are ovate, glabrous and 2-5 mm long (Hitch cock and Chase, 1910). Seed production and viability is variable (Whyte et al., 1968; Peng and Two, 1984; Wilcut et al. 1988a).



The rhizome system is extensive. Rhizomes are 3-5 mm in diameter and 7 m or more in length, ending in a sharp, "torpedo-like" apex which can easily penetrate soil. Rhizomes can grow to a depth of 7 m, however most of the rhizomes are located in the top 60 cm of soil (Bor, 1960; Manipura and Somaratne, 1974). Active and dormant axillary buds occur along the entire length of the rhizome (Chandrasena and Dhammika, 1988). Rhizomes are noted for bulbil-like thickenings, which contain abundant carbohydrate reserves (Somaratne, 1952; Manipura and Somaratne, 1974). Substantial carbohydrate reserves yield the capacity for rapid regeneration from axillary buds when rhizomes are fragmented or cut. (Chandrasena and Peiris, 1989). Rhizomes are the principal means of dissemination, method of persistence, and cause of difficulty for control (Wilcut et al., 1988b).

Distribution and Habitat

Torpedograss occurs in 70% of Florida's public waters (Schardt, 1994) and

Kissimmee chain of lakes

Torpedograss is a serious problem in East Lake Tohopekaliga shorelines, in the areas where cattle do not forage. In other areas, management by cattle is a tremendous boon in Kissimmee chain of lakes. They feed on torpedograss during winter low pool, when Bahia grass is senescent. Cattle have effectively managed torpedograss in many areas of the Kissimmee chain.

Torpedograss is a recurrent problem during FWC lake restorations involving extreme drawdowns and muck removal, as it is often among the first pioneers to emerge when restoration work is done. During the 2000 drawdown and restoration project of Lake Alligator, 80 acres of torpedograss required treatment. FWC staff expects serious problems during 2002 drawdown/restoration of Lake Tohopekaliga.

SePRO full page

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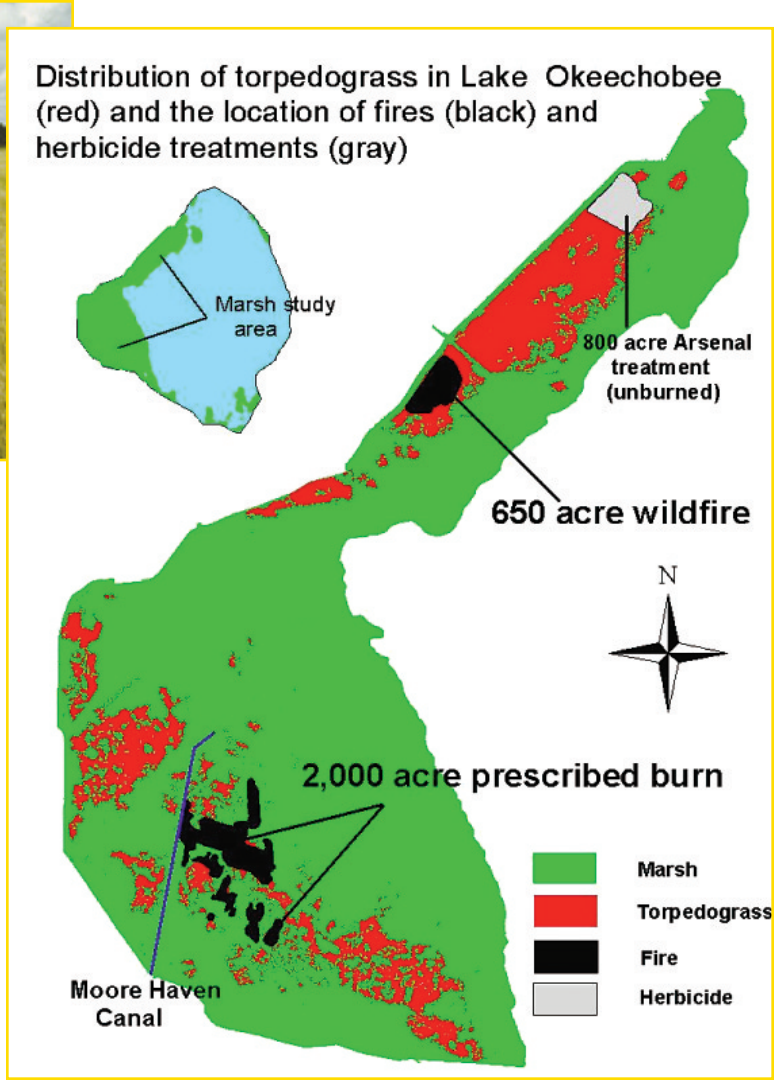
Prescription

P/U from Summer Aquatics

Dense torpedograss has overtaken many shallow areas of Lake Okeechobee's western marsh where fragrant water lily formerly bloomed. Here the torpedograss nearly dwarfs SFWMD researchers.



is naturalized in 57% of Florida's 67 counties (Wunderlin, 2000).

The preferred habitat for torpedograss is a warm to hot climate with sandy soils, plentiful moisture, and full sun (Holm et al., 1977). Sensitivity to prolonged cold temperature limits the spread of torpedograss in upper latitudes or altitudes. In the tropics, torpedograss is more commonly found in low coastal areas. Wilcut et al., (1988b) reported that exposing torpedograss rhizomes for 24 hours to 4.5 C was lethal and concluded that, due to lack of cold hardiness, torpedograss is restricted to regions with mild winters. In cool climates, torpedograss is less aggressive and is easily displaced by temperate species.

Torpedograss grows in many soil types from sandy, well-drained soils to heavy waterlogged soils. It grows best in soils that are poorly drained and have some degree of waterlogging (Holm, et al., 1977; Changrasena and Dhammika, 1989a). Torpedograss is drought-resistant, and the rhizomes can survive prolonged periods of water stress (Lubke et al., 1981). Interestingly, Wilcut et al. (a988b) reported that air-drying torpedograss rhizomes to 35-60% of the original weight had no significant effect on the regenerative capacity. This indicates that although torpedograss grows best in a moist environment, it can persist without water, adding further to its "weedy" characteristics. It thrives well in full sunlight, but can grow in partial shade (Holm et al., 1977).

Economic uses

Torpedograss serves as a soil stabilizer along ditchbanks, canals ,and rice paddies during periods of high water or heavy runoff (Tarver, 1979; Panchal 1981). It has also been used as a forage (Tarbor, 1952; Manipura and Somartne, 1974; Siregar and Soemarwoto, 1976). Tarver (1979) reported plantings of torpedograss throughout southern Florida and in many counties in North Florida . However, it was later found that torpedograss did not have the nutritive qualities of other forage grasses (Whyte. et al. 1959).

Control Methods

Several herbicides, both alone and together with physical treatments including burning and disking (Smith, 1993), have been investigated. Also, attempts have been made to control the plant with fungal innoculants (Thayer, 1990). SFWMD research has shown that the best current control technology should combine fire with herbicide treatments. This combination yields the best and most-reproducible results. Fire reduces plant biomass and stimulates new plant growth, which is often more susceptible to herbicide than unburned plants. Increased susceptibility may result from both better herbicide contact, as new torpedograss growth is more exposed after burning has consumed previous mature torpedograss thatch, and herbicide effectiveness increases as more herbicide penetrates through the immature cuticle of young shoots.

Current coverage in Lake Okeechobee

Torpedograss has displaced more than 16,000 acres of the 100,000 acres of native plant habitat in Lake Okeechobee's marsh. Torpedograss has demonstrated a wide range of tolerance to moisture. It is capable of withstanding, and even growing, under flooded conditions in the lake's marsh. As a consequence, torpedograss persists at virtually all stages in the lake.

Prescribed burning consumes thick torpedograss mats and stimulates new growth. The new growth is more susceptible to herbicide treatments.

Resource Management Goal and Objectives for Lake Okeechobee

The Goal of the torpedograss management program is to protect the health and diversity of Lake Okeechobee's natural plant and animal communities from the ecological degradation caused by torpedograss.

Objectives

- Achieve an overall reduction of torpedograss so that Lake Okeechobee's native communities are no longer dominated by torpedograss and annual maintenance costs are minimized.
- Implement an effective public information awareness program that will encourage support for torpedograss management.

Lake Okeechobee Torpedograss Management Efforts

Fire

In the lake, prescribed fire is the most appropriate available physical

Management recommendations for Lake Okeechobee

- Encourage continued funding for the continued treatment of dense and outlier populations of torpedograss in Lake Okeechobee
- Encourage torpedograss control programs for other publicly-owned natural areas in Florida.
- Continue funding of research program in the Lake to identify and optimize the most effect methods to control torpedograss.
- Transfer the results from continued torpedograss control research to other natural areas in Florida.
- Seek partnerships with concerned citizen groups to support torpedograss management programs.
- Continue investigations into sound management options.
- Use the support and resources of organizations such as the Florida Exotic Pest Plant Council to organize a network of professionals to lobby the State Legislature and U.S. Congress to support and enact laws encouraging the management of torpedograss and other exotic pest plants
- Cooperate with agencies and organizations such as Florida's water management districts, the Florida Department of Environmental Protection, the IFAS cooperative extension service, and the Florida Native Plant Society in the production and dissemination of information intended to educate the public about the problems associated with nuisance exotic plants such as torpedograss.

Above: Torpedograss covered this area of Lake Okeechobee's northwest marsh. After the entire area burned in early 2001, torpedograss has not yet regrown where herbicides were applied after the fire (blackened area).

Below: Five-acre torpedograss blocks were treated twice in four years. Several native plant species are colonizing these blocks.

method. Burning removes old torpedograss thatch and stimulates new growth which is more susceptible to subsequent herbicide treatment.

SFWMD costs for prescribed burning have included staff time, helicopter time and other equipment and materials. Staff support for fire management has also come from other Regional Fire Council member agencies.

When fires occur in the areas currently infested by torpedograss in Lake Okeechobee, water levels usually remain no more than two or three inches below ground level. During such water regimes, fire stimulates torpedograss growth. It recovers very rapidly and vigorously and new growth sprouts from previously dormant nodes. The use of prescribed fire as a precursor to herbicide treatment, is effective in breaking apical dominance and increasing herbicide efficacy.

Torpedograss grows in wet to moist areas where its rhizomes are generally protected from damage by fire when aerial portions burn. During extreme drought periods, water levels may recede two to three feet below the surface of the ground. Fire then destroys not only the aerial vegetation but also the upper, dry, compacted peat layers to a depth of three or four inches. Torpedograss is generally killed when its rhizomes are burned, which is determined by depth of rhizomes and depth of burning. In 1990, during a prescribed fire and in a 1997 wildfire, water levels had receded below the surface of the ground, with resultant torpedograss mortality.

Herbicides

Herbicide treatments with ARSENAL® herbicide have been adopted as the most effective available treatment. Such treatments cost approximately $170 per acre, with 90% control lasting, in some cases, up to one year. Therefore, about $2.72 million would be needed to treat 16,000 acres.

Biological control

Attempts to limit growth of torpedograss in Florida by inoculation of native fungi has shown little promise except for populations growing under conditions of stress (Thayer, 1990).

To date, the United States Department of Agriculture (USDA) has not conducted any torpedograss biocontrol investigations. Grasses have traditionally been considered "off limits" as biocontrol research targets, however, more recent work has found potential for selective biocontrol in the grass family. Great care must be exercised, but grasses that occupy a unique habitat, like lake margins, are more likely than wider-ranging upland species to have specific feeders. No funds are currently available for such research (Ted Center, personal comm).

Funding

The DEP Bureau of Invasive Plant Management granted $309,000 to SFWMD for torpedograss management in the lake (FY 2000). Both agencies aim to continue torpedograss management with DEP grants likely to continue as a funding source.

Other potential sources

Preliminary discussions with staff from the US Army Corps of Engineers Aquatic Plant Control Operations Support Center do not hold promise for financial support. Their primary program mandate is to maintain navigation and torpedograss infestations do not typically threaten navigation.

Funds may become available from Lake Okeechobee Protection Act and the Water Supply Contingency Plan programs.

Research needs

Seasonality of treatments

Questions remain regarding whether better control can be achieved in particular season or time of the year. To date, effectiveness of treatments has not shown a clear relationship with time of treatment during the year.

Flooding responses

Research contracted by SFWMD with the US Army Corps of Engineers is ongoing to evaluate response of torpedograss to different water levels. Initial findings include the potential for torpedograss expansion during periods of low water levels.

DuPuis Preserve

Dupuis provides an excellent opportunity to conduct torpedograss studies on a smaller scale and in an area that is readily accessible. Several large isolated wetlands are nearly 100% torpedograss. Qualitative observations at DuPuis Preserve have seemed to show competition between maidencane (*Panicum hemitomon*) and torpedograss. Maidencane seems to act as a barrier to the spread of torpedograss. It is unknown whether this barrier effect is reproducible, and if it is a result of physical, chemical or other function. However, it deserves further investigation. Studies could include seeding or planting maidencane in conjunction with herbicide, fire or other management techniques. It is unlikely to be practical to attempt this on a large scale such as throughout the Lake Okeechobee littoral zone.

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Kissimmee River system

Torpedograss has not been a problem species on the Kissimmee River. Before re-flooding along outer elevations of Rattlesnake Hammock in Pool A, torpedograss was initially dominant. It has subsequently remained only as a component of the wet prairie community. It has recently expanded in some newly reflooded portions of the Pool C floodplain. District researchers are not convinced it will become a nuisance requiring management. Further, it may not necessarily exert negative impacts even if dominant along the peripheral wet prairie. Ongoing monitoring will reflect its coverage over time and some associated functional values including fish and wildlife habitat.

A Case of Mistaken Identity

Native and Exotic "Boston Ferns" and "Sword Ferns" (*Nephrolepis spp.*)

Figure 1. Florida's native sword fern, also known as wild Boston fern, is a dominant feature of south Florida hammocks and a popular native landscape plant (*Nephrolepis exaltata*). Shown here in DuPuis Preserve (Palm Beach/Martin County).

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Introduction

Florida's native sword fern, also know as wild Boston fern, (*Nephrolepis exaltata*) (Figure 1) and giant sword fern (*Nephrolepis biserrata*) (Figure 2), were highly admired by early botanists, naturalists, and horticulturists (Small 1918a, 1918b, Simpson 1920, Foster 1984). Charles Torrey Simpson (1920) wrote: "But the real glory of the hammock is the two species of *Nephrolepis*, one being the well known "Boston" fern." According to Foster (1984) "—they [*N. exaltata*] could be seen in homes and public buildings almost everywhere. They were the most desired plants of growers and yearly sales soared in the hundred thousands." In 1894, a cultivar of N. exaltata was discovered in a shipment from a Philadelphia grower to a Boston distributer and named N. exaltata cv. 'Bostoniensis', hence the commonly used name Boston fern (Foster 1984). Other derivatives of N. exaltata cv. 'Bostoniensis', ranging from 1-5-pinnate, and with such descriptive names as *N. exaltata* cv. 'Florida [Fluffy] Ruffles' were developed and are still known from Florida (FNA Editorial Staff 1993). The native sword fern and giant sword fern are still highly recommended for use as indoor and landscape plants (Broschat and Meerow 1991, Haehle and Brookwell 1999), but non-native, similar appearing species of *Neprholepis* now are also sold and confused with our native species.

Figure 2. Fronds of Florida's native giant sword fern (*Nephrolepis biserrata*) are often 2 m long. Shown here in Fern Forest, Pompano Beach (Broward County).

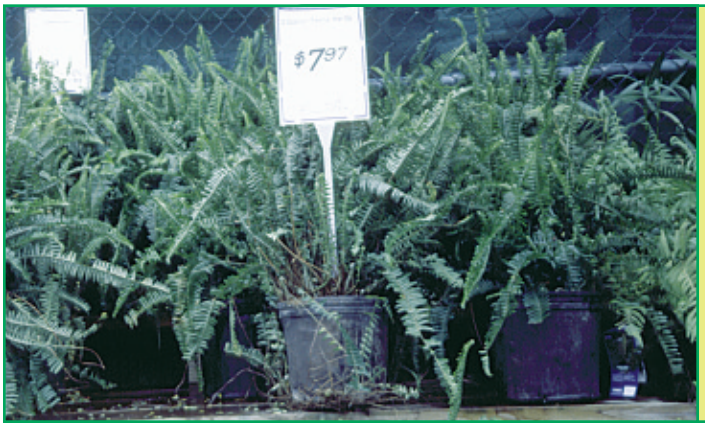

Figure 3. Tuberous sword fern (*Nephrolepis cordifolia*) can be confused with the native sword fern and is commonly available for sale in retail nurseries.

Tuberous sword fern (*Nephrolepis cordifolia*) (Figure 3), not native to Florida, was found growing on a roadside in Sumter County, Florida in 1933 (Ward 2000) and in cultivation in Floral City, Florida in 1938 (Ward 2000). It is now found naturalized in pine rocklands, flatwoods, marsh

edges, and hammocks of conservation areas of south Florida and as far north as Georgia (Langeland and Burks 1998). It was included on the Florida Exotic Pest Council's (FLEPPC) "1995 List of Florida's Most Invasive Species" in Category I, which means that it is invading and disrupting native plant communities in Florida. Tuberous sword fern is sold in the nursery and landscape trade, which may contribute to its further spread into native plant communities. However, the Florida Nurserymen and Growers Association (FNGA) and FLEPPC, in a 1999 joint decision, encouraged phase-out of tuberous sword fern from the growing and landscape market (Aylsworth 1999). Asian sword fern (*Nephrolepis multiflora*) (Figure 4), also not native to Florida, was found growing and "driving out all other plants" on Sanibel Island, Lee County, Florida in 1954 (Ward 2000) and in Boca Chica, Monroe County, Florida in 1965 (Ward 2000). It was included on the Florida Exotic Pest Council's (FLEPPC) "1993 List of Florida's Most Invasive Species" in Category II and moved to Category I in 1999.

Native sword fern and giant sword fern are similar in appearance to the non-native invasive tuberous sword fern and Asian sword fern. Tuberous sword fern is sold under various names

Table 1

	N. cordifolia (Tuberous sword fern)	**N. exaltata** (Native sword fern)	**N. multiflora** (Asian sword fern)	**N. biserrata** (Giant sword fern)
Tubers	**Sometimes present.**	Never present.	Never present.	Never present.
Frond	To 1.0 m tall.	To 1.5 m tall.	To 1.5 m tall.	To 2.5 m tall.
Petiole	Dense, spreading, pale brown scales.	Sparse to moderate pale to reddish-brown scales of single color or slightly darkened at attachment, with expanded base bearing small marginal hairs.	Covered with appraised, dark brown scales with pale margins.	Sparse to moderate reddish to light brown hair-like scales.
Rachis	Pale hair-like scales on upper surface with **distinctive bases much darker than the scales.**	Moderately spaced hairlike scales that have expanded bases bearing small, marginal hairs.	**Clothed with linear two-colored, very hairy scales, giving hairy appearance to rachis.**	Moderately spaced scales of one color.
Pinnae (medial)	To 4.8 cm long, .9 cm wide, typically attached<1cm apart. **Bases often overlapping the rachis. Mostly straight but sometimes slightly curved with blunt tips.** Basal lobe on the upper facing edge overlapping the rachis above and the lower portion of the next pinnae. Glabrous	To 7.4 cm long, 1.8 cm wide attached .7 to 2.1 cm apart. Bases usually not overlapping the rachis. **Slightly curving to decidedly sickle-shaped near apex** acute to attenuate tips. Basal lobe on the upward facing edge sometimes overlapping the rachis. Sparsely to moderately scaly near midvein and base with pale brown scales	To 12.3 cm long, 1.8 cm wide, attached to 2.4 cm apart. Margins singly or doubly toothed. Scaly and pubescent below with pale brown hairs. **Central vein with dense short, erect hairs on upper surface.**	To 23 cm long, 2 cm wide attached to 3.5 cm apart. Margins finely double toothed. Densely pubescent below. Apices long pointed. **Central vein with dense erect hairs, short matted hairs, or rarely glabrous on upper surface.**
Indusia	**Kidney- to crescent-shaped to rounded-triangular.**	Kidney- to horseshoe-shaped.	Circular to horseshoe-shaped indusia.	Circular to horseshoe-shaped.

Dow Agroscience Ad
B/W p/u

(e.g. Boston fern, hardy fern, large fern, erect sword fern) and names are often interchanged among the different species. Tuberous sword fern is most often confused with and sold in some stores as the native sword fern. The purpose of this article is to help consumers, distributers, growers, and land managers to distinguish between these species. Fishtail sword fern (*Nephrolepis falcata*), is non-native to Florida and escaped from cultivation (Wunderlin and Hansen 2000) but is not considered invasive. It is easily distinguished from the other species by its 1- to 3-dichotomously forked pinnae and will not be discussed further. Petticoat fern (*Nephrolepis hirsutula*), also sold in the nursery trade, is not known to have escaped cultivation and likewise will not be discussed. Avery's sword fern (*Nephrolepis x averyi*) is a natural hybrid of *N. biserrata* x *N. exaltata*.

Identification

Use the narrative below, the dichotomous key (adapted from Nauman 1981), or Table 1, which compares characteristics of the four species of *Nephrolepis*, to distinguish them. A glossary is provided to help understand terminology used in the key and table. Photographs for key characters can be seen in "Natural Area Weeds: Distinguishing Native and Non-Native Boston Ferns and Sword Ferns (*Nephrolepis* spp.), available on http://eids.ifas.ufl.edu. The interested reader will also find the following publications useful:

• Coile, N. C. 1996. *Which Boston Fern Is It?* The Exotic Nephrolepis cordifolia (L) Presl, or the Native Nephrolepis exaltata (L.) Schott. Botany Circular No. 32. Florida Department of Agriculture and Consumer Services, Gainesville, Florida. 3 pp.

• Nelson, G. 2000. *The Ferns of Florida.* Pineapple Press, Sarasota, Florida. 208 pp.

• Wunderlin, R. P. and B. F. Hansen. 2000. *Flora of Florida*, Volume 1, Pteridophytes and Gymnosperms. University Press of Florida, Gainesville. 365 pp.

Glossary

Appressed	Lying flat or close against.
Attenuate	Gradually narrowed to a long point at the apex.
Acute	Sharply angled, the sides of the angle essentially straight.
Frond	A large divided leaf.
Glabrous	Without hairs.
Indusia	An outgrowth of tissue that covers the spore producing structures in ferns.
Medial pinnae	Referring to those pinnae of the central portion of the frond.
Pubescent	Hairy.
Pinnae	Primary division of a compound leaf or frond of a fern.
Rachis	The central prolongation of the frond stalk.
Scale	An outgrowth of the epidermis having cell dimensions in two planes.
Tomentose	Densely covered with short matted hairs.
Trichomes	A hairlike outgrowth of the epidermis.
Tuber	A thickened, solid portion of an underground stem.

Tuberous sword fern, as the name implies, sometimes produces tubers and it is the only one of the four species that is capable of producing them. Therefore, if tubers are present on

the plants, this alone is a positive identification for this species. The presence of scales on the upper side of the rachis that have a point of attachment that is distinctively darker than the rest of the scale also will distinguish tuberous sword fern from the other three species. Another good characteristic to distinguish tuberous sword fern is that the pinnae (medial) are close together, the lobes overlapping the next closest pinnae, and the pinnae (medial) bases overlap and hide the rachis underneath. Tuberous sword fern is the smallest of the four species, having shorter fronds and pinnae. The fronds of tuberous sword fern are more erect than those of the native sword fern, the latter usually having long and weeping fronds. The pinnae of tuberous sword fern are usually straight and blunt compared to those of native sword fern, which are mostly sword shaped (falcate) and gradually narrowing to a point at the apex. Finally, if indusia are present, those of tuberous sword fern are more kidney- to crescent-shaped or triangular-rounded than those of native sword fern, which are more kidney- to horseshoe-shaped.

Asian sword fern and giant sword fern can be distinguished from tuberous sword fern by the presence of short stiff hairs that occur on the central vein of the pinnae of Asian and giant sword fern. These can be observed best by bending the pinnae and looking at the curve created while holding it up to light. The most distinguishing characteristic for Asian sword fern is a dense covering of dark brown, appressed scales with pale margins on mature petioles. In contrast: 1)The petiole scales of tuberous sword fern are dense, spreading, and pale brown; 2)those of native sword fern are sparse to moderate, reddish-brown, of a single color or slightly darkened at the point of attachment, and have expanded bases with small marginal hairs; and 3)those of giant sword fern are sparse to moderate, reddish to light brown and hair-like. Other features that will help distinguish the species are: 1)The hairy appearance of the rachis of Asian sword fern, owing to abundant two-colored, hairy scales, and 2)the fronds and pinnae of giant sword fern, which are much longer than of the other species.

Control of Tuberous Sword Fern

Hand pulling can be used to remove some of the fern plants but the plants will break off, leaving plant parts in the ground from which regrowth will occur. Because some plants are difficult to up-root and the rachis can cut the skin, wear heavy gloves. Do not dispose of these or other invasive plant species where they cause new infestations.

Plants can be killed with herbicide products that contain the active ingredient glyphosate. A foliar application of a product that contains 41.0% glyphosate diluted to 1.5% v/v of product provides control. Follow-up applications are necessary. Several products are available from garden and agricultural supply stores. Products that contain glyphosate will kill desirable plants that it contacts so follow all instructions on the herbicide label and apply carefully.

Acknowledgments

Appreciation is expressed to the following individuals for their assistance: David Black, South Florida Water Management District; Bobby Hattaway, Florida Park Service; Monica Ribaudo, Nikki Hochberg, Fern Forest Nature Center; and Richard Moyroud, Mesozoic Landscaping, Inc. Richard's nursery has my personal certification as invasive *Nephrolepis* species-free.

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1. Tubers present . . . . . *N. cordifolia*
1. Tubers absent
   2. Central vein on upper surface of medial pinnae glabrous (sometimes with a few scales); indusium kidney- horseshoe- or crescent-shaped, ca. 1.2 mm or more wide.
      3. Pinnae sword-shaped with acute to attenuate tips; plants never bearing tubers; rachis scales appearing as one color or obscurely two-colored . . . . . *N. exaltata*
      3. Pinnae mostly straight or slightly sword-shaped with blunt tips; plants often bearing tubers; rachis scales pale with a distinctly dark point of attachment . . . . . *N. cordifolia*
   2. Central vein on upper surface of medial pinnae sparsely to densely covered with short erect hairs (often also with scales); indusium circular, ca. 1.0mm wide.
      4. Petioles (mature) covered with dark brown, appraised scales with pale margins . . . . . *N. multiflora*
      4. Petioles not covered with dark brown, appraised scales, but often with a few loose, reddish to light brown scales or scales absent, central vein on upper surface of medial pinnae densely pubescent to tomentose (rarely glabrous), with short, dense trichomes . . . .*N. biserrata*

Far, far in the forest, before I think where I go,
Solitary smelling the earthy smell, stopping now and then in the silence,
Alone I had thought - yet soon a troop gathers around me…
Collecting, dispensing, singing in spring, there I wander with them…
Here! Lilac, with a branch of pine,
Here, out of my pocket, some moss which I'd pull'd off a live-oak in Florida, as it hung trailing down,
Here some pinks and laurel leaves and a handful of sage…
And twigs of maple and a bunch of wild orange, and chestnut,
And stems of currants, and plum-blows, and the aromatic cedar;
These, I, compassed around by thick cloud of spirits,
Wandering, point to, or touch as I pass, or throw them loosely from me…
I will give of it - but only to them that love, as I myself am capable of loving.

- Walt Whitman, "Leaves of Grass"

Florida's Exotic Plant Godfather Heads West

Over the past 30 years, quite a few lucky folks in Florida have wandered in the woods behind a loping gnome by the name of Dan Austin. Many of these outings have been to Fakahatchee Strand in the Big Cypress area of southwestern Florida. The Fakahatchee harbors North America's greatest concentration and diversity of orchids along with a myriad of other rare tropical and sub-tropical plants. There, Dan has truly been in his element, sharing his wonder and knowledge, somehow in a sort of curmudgeonly manner, as if he were spreading a benevolent natural history virus.

In 2001, Dan is vacating his biological sciences chair at Florida Atlantic University in Boca Raton. His wife, Sandy, and he are leaving Florida's permanent damp for the drier clime and pinion scrub near Tucson, Arizona, where they have already spent many summers.

Other rumors (including his spontaneous generation from an unfurling morning-glory blossom) to the contrary, Daniel F. Austin was born May 18, 1943 in Paducah, Kentucky. With age, his youthful interest in frogs, snails and slime never waned. While earning his bachelor's degree at Kentucky's Murray State University, he focused botanical studies on the mint family (Lamiaceae). Graduate work at Washington University in St. Louis, Missouri led to his master's and doctoral degrees. During graduate school, he focused on the Convolvulaceae, and today remains a world-renowned expert on the morning-glory family. Specimens from around the world continue to pour in for his analysis. He also developed a special interest in ethnobotany; the human uses of plants. This was almost a defensive reaction to repeated questions like, "What good is that plant anyway?"

He strongly supported many environmental movements in Florida, often because he saw, more clearly than most, how quickly Florida's wild wonders were disappearing. He helped found Florida's environmental sensibility both philosophically and concretely by being there at the start of the Florida Native Plant Society and its local chapter in Palm Beach County, the Florida Exotic Pest Plant Council, Florida's Endangered Plant Advisory Council and the Society for Economic Botany. His 1985 work with Dr. Grace Iverson, "Inventory of Native Ecosystems of Palm Beach County," laid the logical framework for the County's acquisition of more than 22,000 acres of environmentally sensitive lands. These lands were saved through a $100 million bond referendum approved in 1992.

And how does one value the impact of the thousands of students Dan has educated during his career, many of whom have carried his torch into environmental work in the private sector, government and academia?

During the early days of the Florida Exotic Pest Plant Council, his frank nature landed him in the driver's seat

for development of FLEPPC's list of invasive plants. Having seen an early stab at such a list, he quipped, "This list stinks! It is totally inadequate!" Of course, that led to his designation as "Listmaster," and his resultant list has had impacts including State and County legislation and landscape code changes, and pledges from Florida's horticultural industry association to stop producing and distributing dozens of listed plants.

Another instance where Dan's frankness rebounded on him a little involved the doubtful (in his mind) identification of the Asian temperate-zone plant, kudzu (*Pueraria lobata*), in the sub-tropical Everglades in the 1990s. "Kudzu just couldn't make it down here," he pronounced. So he headed into the field, convinced of finding a similar, but tropical, vine, like cow-itch (*Mucuna deeringiana*). But once there, he scratched his head, muttered something, but readily acceded that it was, in fact, kudzu, and helped formulate a management strategy. Such occasions clearly illustrate that Dan Austin is nothing if not an empirical scientist! (Note: It turned out that, in the 1950s, a County soil service had planted kudzu in the Everglades on a flood levee as a soil erosion experiment. It had been mown quarterly for forty years, until mowing frequency was decreased as a belt-tightening measure. Then, the persistent kudzu rootstocks sent their vines out across the Everglades landscape.)

At Florida Atlantic University, Dan Austin's presence was felt far beyond the classroom. During his 30 years living in South Florida he saw the landscape change from a narrow Atlantic coastal corridor of development to strip malls and subdivisions sprawling miles westward. Of course, in the process, vast areas of natural Florida disappeared. He fought for, and succeeded, in establishing a 90-acre natural preserve on the FAU campus. The preserve is a true refuge for remnant populations of endangered plants and animals, as well as a convenient field learning laboratory. But it has repeatedly been proposed as a great place for more pavement and its future seems clouded. Dan's colleagues, students, and friends will continue fighting for its preservation. (Although the odds of winning against the latest proposal seem daunting; the FAU administration wants an alumni-warming football stadium erected there).

Dr. Austin also established an herbarium at FAU which comprises one of the Florida's most valuable and comprehensive plant collections. Lately, botany, unlike football, hasn't attracted as much fanfare, and funding, as many other collegiate pursuits. The future of the herbarium likewise seems uncertain.

Dan's received countless awards from thankful folks in Florida. We know we'll miss him. He feels that the greatest threats to our natural areas are people, and he fears that encroachments will continue with population increases. It will be difficult for many Floridians when Dan and Sandy take up permanent residence in Arizona. However, feel free to stop in for a *fajita* when you're in the area. You can even bring along unidentified plant specimens. Just remember that Dan doesn't do grasses. -Mike Bodle and Ray Miller.

Notes from the Disturbed Edge

Chapter 2

...Can we break freeee from Lygodium... A car whizzed by the intersection, ten feet from her hindquarters. These were the outer reaches indeed, the northern edge of a cypress swamp that stretched south for a mile. Somewhere out there he was pulling Brazilian pepper seedlings, while she reconned the perimeter, carefully applying herbicide to pillars of Old World climbing fern that reached 30, 40 feet into the canopy. Within two weeks the horrible insidious plants would be dead, spirits returned to their native range, leaving masses of wiry stems and desiccated leaves to decay. Long days — she slipped back into her role as temptress nightingale, draped in a flowing veil of climbing fern, blowing in the wind (of course, her wafting garment would be silken, faux fern, for she could only guess the range of windborne alien spores). I can feel something inside me say, I really don't think I'm strong enough... another car flew by, and she heard the next one stop. A designer-clad remnant of a woman cast a sideward glance her way from the tinted depths of a red camaro, and she heard the door locks click. Oh yeah? Climb that guardrail Gucci girl, jump this ditch, and humble yourself as you enter my world, you vehicle-impaired Jezebel — I rule on this side of the curb! The painted lady raised her eyebrows, grimaced and pulled away as the light turned green. Man, did I say that out loud? she wondered, as taillights faded. Maybe she had been out too long... Oh well, another day, another piece of mother earth to reclaim from the exotic invasion. What am I supposed to do, just sit around and wait for you, well I can't do that, cause there's no turnin' back... she danced on to the next hideous mass of climbing fern — Yes, you would definitely look good in brown. Meanwhile, far south, he bent to pull the millionth seedling. You weed you weed, whoah oh ho, ain't you gotta go... Some folks are just meant to be together.

- J.A.

An excerpt from "The Adventures of Hack Garlon and his buxom sidekick Squirt."

FNGA urges Florida's Nursery & Landscape Industry to Phase Out 34 Invasive Plants

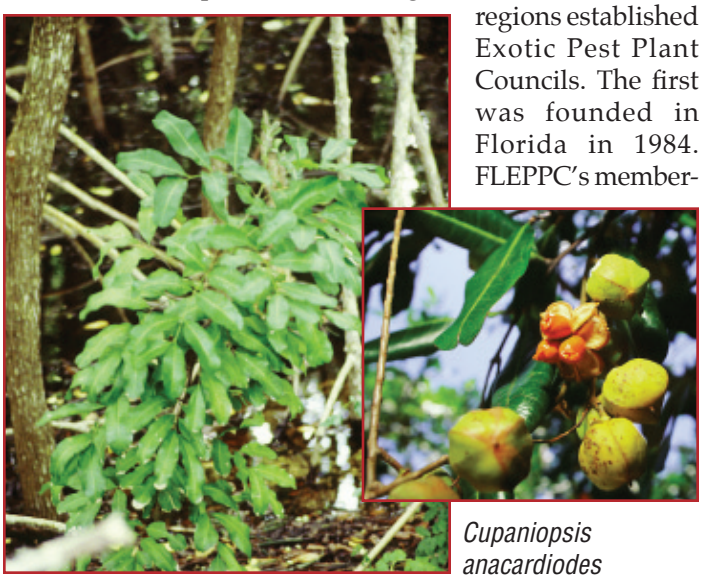
ORLANDO — The Florida Nurserymen and Growers Association (FNGA) is urging Florida's nursery and landscape industry professionals to phase out production, sale and use of 34 plants thought to be invasive. This is in addition to the voluntary ban on 11 other plants announced by FNGA in 1999.

FNGA and the Tampa Bay Wholesale Growers (TBWG), in cooperation with the Florida Exotic Pest Plant Council (FLEPPC), is asking Florida nursery growers, landscape professionals and garden center retailers to voluntarily stop propagating, selling, and using these species after joint talks overseen by the Florida Department of Agriculture & Consumer Services resulted in agreement the plants are becoming invasive in Florida's natural areas.

Over the years, such plants were introduced by the government for forage, erosion control, and other agricultural uses, as well as by nursery growers for their horticultural value and through accidental introduction. Widely known invasive plants are Brazilian pepper, Australian pine, carrotwood, Chinese tallow, hydrilla and melaleuca.

"FNGA is aware how destructive invasive plants are to Florida's special environment. We have chosen to be leaders in protecting these valuable resources," says FNGA President Joe Cialone, Tropical Ornamentals, Lake Worth. "We are joining with land managers and researchers to stop the spread of these plants which displace and destroy native plant communities. We will exercise leadership in this battle."

In response to the significant management challenges and expense of controlling numerous invasive species in natural habitats, public land managers in several states and regions established Exotic Pest Plant Councils. The first was founded in Florida in 1984. FLEPPC's membership numbers more than 300 public and private land managers, university faculty, citizens, and businesses. FNGA represents more than 2,200 of Florida's leading nursery growers, landscape professionals, garden center retailers and allied suppliers. TBWG represents 86 Hillsborough County-based grower members.



Cupaniopsis anacardiodes

FLEPPC Chair Ken Langeland said, "Our organization is pleased to continue working with Florida's nursery & landscape industry in identifying invasive species having ecological effects that should no longer be commercially available. We appreciate this proactive working relationship to address the invasive species problem in Florida's natural areas."

The FNGA/FLEPPC/TBWG task force meetings focused on the identification of plant species which have become established in natural areas and, generally, are not economically significant to the statewide nursery & landscape industry. Also reviewed were the mode of spread and reproduction of the plant; specific varieties of plant species believed to be invasive (where differences among varieties exist); and, potential alternatives as substitute plants.

As a result of these in-depth discussions, FNGA's Board of Directors voted unanimously in March 2001 to urge that these 34 species, along with the 11 already identified species, no longer be propagated, sold or used in Florida.

"This decisive action underscores the role and commitment of Florida's nursery and landscape industry in ensuring the continued natural beauty of Florida's environment." says Ben Bolusky, FNGA Executive Vice President.

The Florida Nurserymen & Growers Association represents Florida's environmental horticulture industry, with a $5.4 billion value-added impact on Florida's economy. For more information, contact FNGA at 1533 Park Center Drive, Orlando, Fla. 32835 or call 407/295-7994; e-mail info@fnga.org; www.fnga.org.

Those 34 species agreed upon by the group are:

Adenanthera pavonina	red sandalwood
Agave sisalana	sisal hemp
Aleurites fordii	tung oil tree
Alstonia macrophylla	devil-tree
Alternanthera philoxeroides	alligator weed (Prohibited by DEP)
Anredera leptostachya	Madeira vine
Aristolochia littoralis	calico flower
Broussonetia papyrifera	paper mulberry
Callisia fragrans	inch plant
Casuarina cunninghamiana	Australian pine (Prohibited by DEP)
Cereus undatus	night-blooming cereus
Dalbergia sissoo	Indian rosewood
Enterolobium contortisliquum	ear-pod tree
Flacourtia indica	governor's plum
Flueggea virosa	Chinese waterberry
Hiptage benghalensis	hiptage
Leucaena leucocephala	lead tree
Melinis minutiflora	molasses grass
Merremia tuberosa	wood-rose
Myriophyllum spicatum	Eurasian watermilfoil (Prohibited by DEP)
Ochrosia parviflora	kopsia
Oeceoclades maculata	lawn orchid
Passiflora foetida	stinking passion vine
Pteris vittata	Chinese brake fern
Rhynchelytrum repens	Natal grass
Ricinus communis	castor bean
Sesbania punicea	purple sesban
Solanum diphyllum	2-leaf nightshade
Solanum jamaicense	Jamaica nightshade
Syszygium jambos	rose-apple
Terminalia catappa	tropical almond
Tribulus cistoides	burrnut
Triphasia trifoliata	limeberry
Urena lobata	Caesar's weed

The 11 plants originally agreed upon by the group as invasive are:

Albizia lebbeck	woman's tongue
Bauhinia variegata	orchid tree
Bischofia javanica	bischofia
Cupaniopsis anacardioides	carrotwood (Prohibited by DACS)
Macfadyena unguis-cati	cat's claw vine
Melia azedarach	Chinaberry
Nephrolepsis cordifolia	sword fern
Psidium guajava	guava
Rhoeo spathacea	oyster plant - large variety
Syzgium cumini	Java plum; jambolan
Thespesia populnea	seaside mahoe

Internodes XenoNET

Florida Exotic Pest Plant Council List Server

Would you like to participate in electronic exotic plant discussions? Join the Florida EPPC List Server! Topics include impacts, biology, and management of exotic species.

Posting/subscribe/unsubscribe instructions:
To SUBSCRIBE to this list, send a message to:
imailsrv@fleppc.org
and in the BODY of the message, type:
subscribe FLEPPC YOUR_FIRST_NAME YOUR_LAST_NAME
(Replace with your actual first and last name!)

To UNSUBSCRIBE from this list, send a message (from the same account used to initially subscribe) to:
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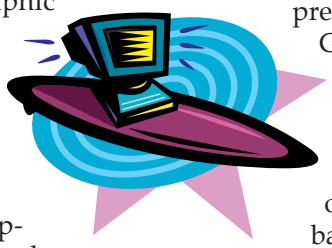
ForestryImages

Over 3,300 images of more than 800 insects, diseases, plants, wildlife, and management practices taken by over 150 photographers are now available. Most images were digitized from high-resolution 35mm slides. Multiple levels of jpeg format images are downloadable and may be copied and used for any non-profit, educational purpose with appropriate credit and copyright notice.

ForestyImages.org utilizes a fully searchable, relational database-driven system to track and provide scientific, descriptive and photographic credit information. Several search and browse options are available to help locate images, including: scientific and common names, and "key word" searches of descriptive information about the image. Although most images are North American in nature, the system also contains images of organisms that are "Non-U.S. Natives" or are considered to be "U.S. Invasives." The images are in this system to be used!

Visit ForestryImages.org at: http://www.ForestryImages.org/ for more information and to access the system. Since ForestryImages.org is an ongoing project supported by The USDA Forest Service, Forest Health Technology Enterprise Team and Washington Office, Forest Health Protection Staff, look for many images and new features to be added in ensuing months.

New South Florida Website Now Online



The Miami based non-profit, The Institute for Regional Conservation (IRC), has just launched a new website (www.regionalconservation.org), prepared by local botanists George D. Gann, Keith A. Bradley, and Steven W. Woodmansee. Among other things, it features "The Floristic Inventory of South Florida Database," a great resource for the plants of southern Florida. Users can obtain information on native and naturalized plants of South Florida, and print plant lists for individual South Florida parks, counties, and habitats. If you find the site useful, please consider making a donation to help IRC maintain and improve the site.

MARK YOUR CALENDAR

16th Annual Symposium, Florida Exotic Pest Plant Council, **September 12-14, 2001**, St. Augustine, FL. Contact: Kathy Burks, kathy.burks@dep.state.fl.us

11th International Conference on Aquatic Invasive Species, **October 1-4, 2001**. Hilton Alexandria Mark Center, Alexandria, VA. Contact: Contact: Elizabeth Muckle-Jeffs, profedge@rencigs.net, www.aquatic-invasive-species-conference.org.

28th Annual Natural Areas Conference, 2001: A Spatial Odyssey, **October 3-6, 2001**. Radisson's "Resort at the Port," Cape Canaveral , FL. Contact vickie.larson-1@ksc.nasa.gov, www.natareas.org.

SER 2001: Restoration Across Borders, **October 4-6, 2001**. Sheraton Fallsview Hotel, Niagara Falls Ontario, Canada. Contact: www.ser.org.

48th Annual Systematics Symposium, Biological Invasions, **October 12-13, 2001**. Missouri Botanical Garden, St. Louis, MO. Contact: P. Mick Richardson 314/577-5176, mick. richardson@mobot.org, www.mobot.org/mobot/symposium.

The Wildland-Urban Interface: Sustaining Forests in a Changing Landscape, **November 5-8, 2001**. University of Florida Hotel and Conference Center, Gainesville, FL. Contact: Mary Duryea 352/846-0896, 846-0886, mlduryea@ufl.edu.

55th Annual Southern Weed Science Conference, **January 28-30, 2002**. Hyatt Regency, Atlanta, GA. Contact: www.weedscience.msstate.edu/swss.

Weed Science Society of America Annual Meeting, **February 10-13, 2002.** Reno Hilton, Reno, NV. Contact: www.wssa.net/

Griffin 4/C New

Synngenta 4/c bleed P/U