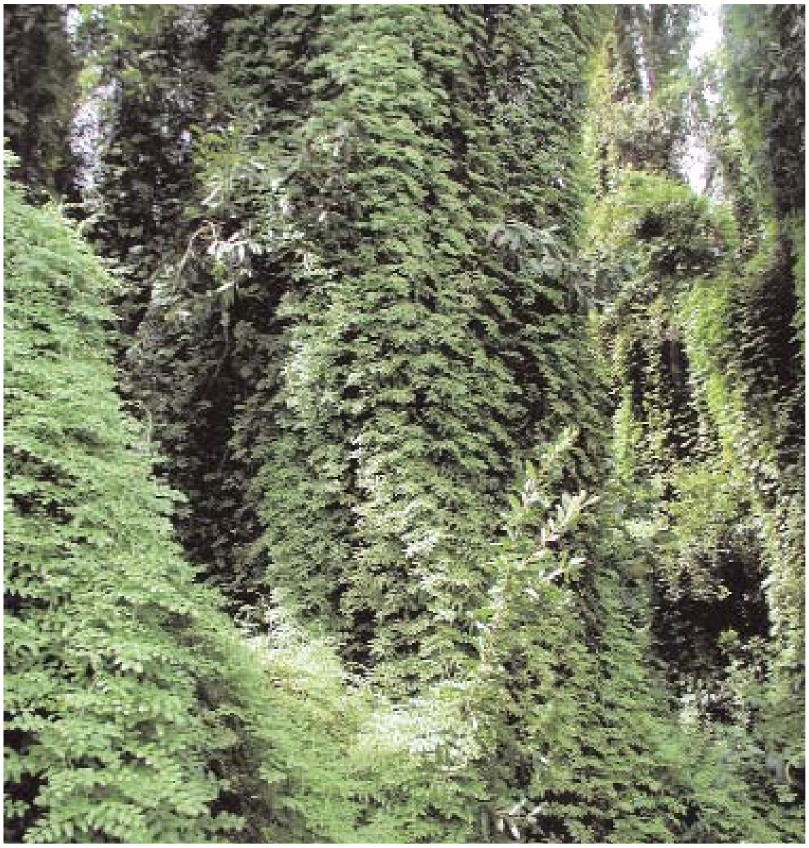
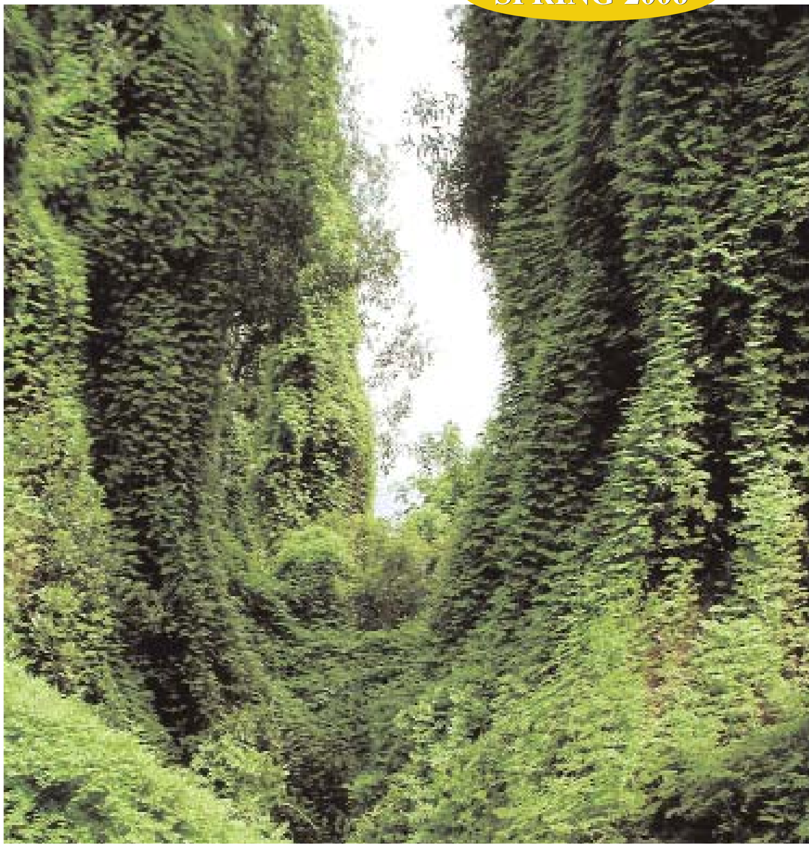
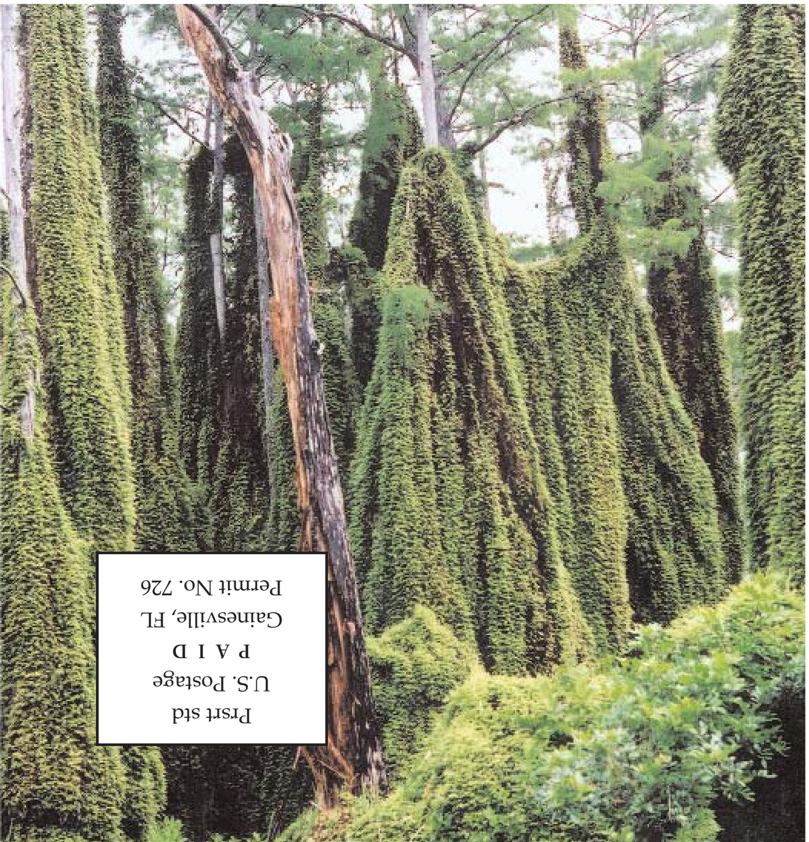
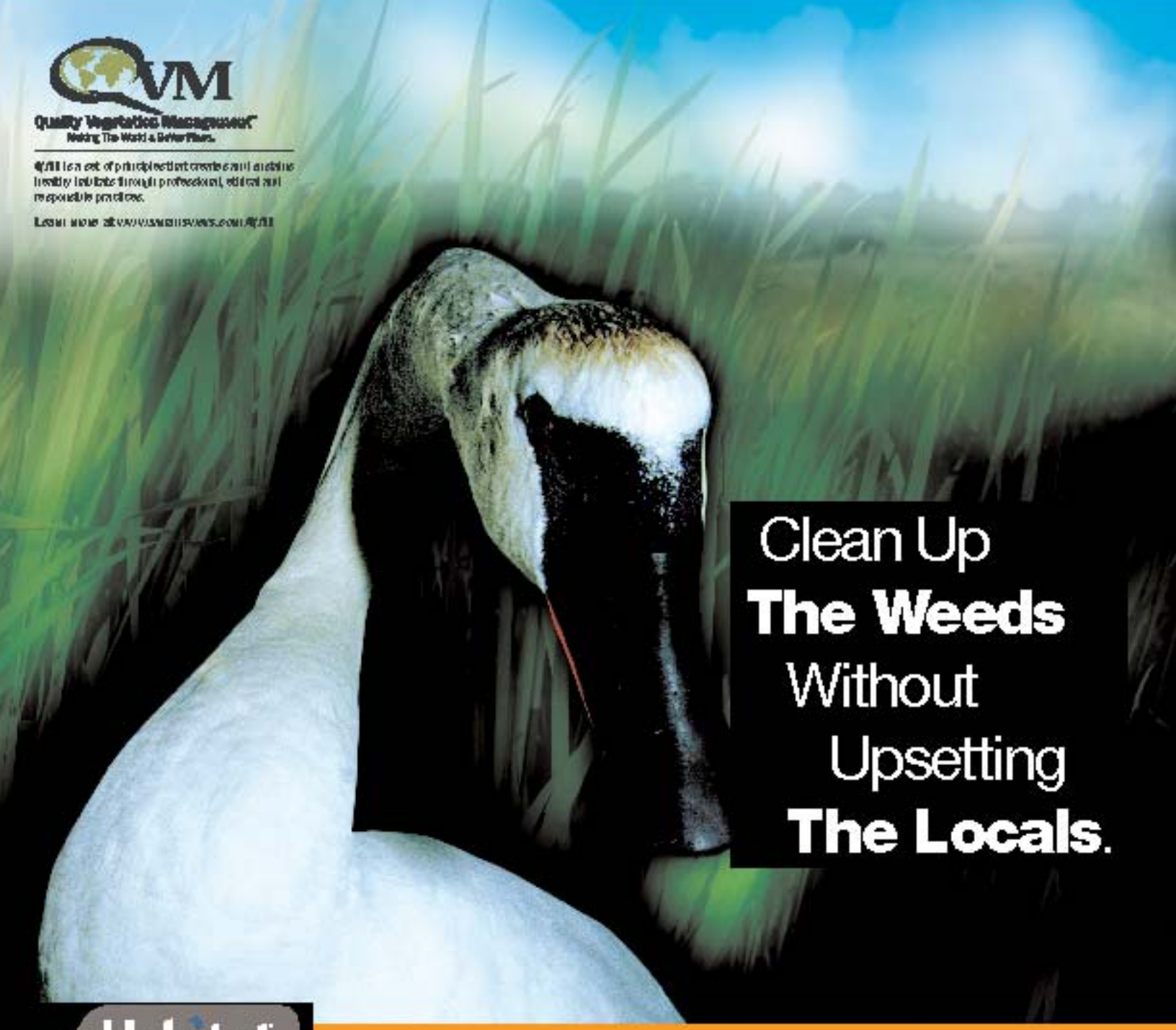
Wildland Weeds

SPRING 2006









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SPRING 2006, VOLUME 9, NUMBER 2

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The mission of the Florida Exotic Pest Plant Council is to support the management of invasive exotic plants in Florida's natural areas by providing a forum for the exchange of scientific, educational and technical information.

An **exotic plant** has been introduced to Florida, either purposefully or accidentally, from a natural range outside of Florida. A **naturalized exotic plant** is one that sustains itself outside of cultivation (it is still exotic; it has not "become" native). An **invasive exotic plant** not only has become naturalized, but it is expanding its range in Florida plant communities.

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Direct all editorial and advertising inquiries to:
Karen Brown, Editor
Wildland Weeds
7922 NW 71st Street
Gainesville, FL 32653
352/392-1799; FAX 352/392-3462
kpbrown@ifas.ufl.edu

Editorial Committee:
Kathy Craddock Burks
Jim Cuda
Ken Langeland
Michael Meisenburg

Direct address changes to:
Jackie Smith
DEP - Invasive Plant Management
9737 Gumbo Limbo Lane
Jensen Beach, FL 34957
561/722-2479
jackie.c.smith@dep.state.fl.us

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On the Cover: Top: Department of Transportation Rights-of-Way in South Florida (*photos by Tony Pernas*). Bottom left: Jonathon Dickinson State Park in Martin County (*photo by Mike Lott*). Bottom right: Applicators "poodle-cutting" lygodium are easily contaminated with spores (see p. 13) (*photo by Jeffrey Hutchinson*).

Lygodium in Florida

AN OVERVIEW

by John C. Volin, Florida Atlantic Univeristy

Florida made international headlines recently when a large exotic Burmese python was found dead after swallowing a native six-foot alligator in the Florida Everglades. Such dominant exotic species are becoming more common and increasingly threaten Florida's fragile ecosystems. Public awareness of invasive species is heightened when they are as large and noticeable as the Burmese python. However, there are more insidious invasive species that may cause even greater harm to native ecosystem processes and functions, but rarely garner the same attention among the public. This is particularly true when the invasive species is a plant, and the plant makes the habitat look like a lush jungle paradise.

This special edition of *Wildland Weeds* is focused on the invasion of Florida's environment by two introduced climbing ferns, *Lygodium microphyllum* and *L. japonicum*, commonly known as Old World climbing fern and Japanese climbing fern, respectively. They both sound like something in a Carl Hiaasen novel; if only they were fiction. Like the Burmese python, they both choke and smother their victims. Like so many of Hiaasen's characters, they are opportunistic, ruthless and ready for a fight—a fight they are apparently winning.

Both ferns are quickly becoming among the worst invasive plant species to enter the Florida peninsula. *Lygodium microphyllum*, a native to wet tropical and subtropical regions of the Old World, was first observed as a naturalized plant on the southeast coast of Florida in 1966 (Beckner 1968) and has since spread to a variety of habitats. It is particularly known for its dominance and subsequent collapse of numerous tree islands in Arthur R. Marshall Loxahatchee National Wildlife Refuge. *Lygodium microphyllum* is currently estimated to occupy roughly 300,000 acres of natural lands across central and southern Florida (see *An Explosion in Slow Motion*, this issue).

A landscape model developed in my laboratory at Florida Atlantic University shows that, in the absence of aggressive control measures, *L. microphyllum* infestations could exceed the current combined coverage of the top five most invasive species in Florida by 2014 (Volin et al. 2004). The annual freezing temperatures in northern Florida will likely limit its spread inland, although this species could become established along both northern coasts. *Lygodium japonicum*, on the other hand, is more "at home" in the central and northern part of Florida as well as north into the Carolinas and west to Texas. Nonetheless, it is only a matter of time before this more temperate species gains a foothold in southern Florida. Of the two species, *L. microphyllum* has been studied more intensely because of its more immediate threat to the native Florida ecosystems.

This issue of *Wildland Weeds* is a snapshot of the work that land managers and scientists are currently conducting to gain insight into these two species. Amy Ferriter (Boise State University) will discuss a landscape scale monitoring (SRF) program and will include the most up-to-date monitoring results for the central and south Florida region. Kristina Serbesoff-King (The Nature Conservancy) will introduce the Central Florida Lygodium Strategy and outline the project's objectives. Bob Pemberton (USDA Agricultural Research Service) will provide an update on lygodium biocontrol releases and discuss some exciting new biocontrol prospects. Results from a recent cross-site spore contamination study will be presented by Jeff Hutchinson (University of Florida). Jonathan Taylor (Everglades National Park) will discuss the National Park Service's experiences dealing with remote infestations. Chris Lockhart (Florida Natural Areas Inventory) will discuss the FNAI region-wide treatment survey. Finally, Andi Van Loan (Florida Division of Forestry) will provide an overview of the issues concerning *L. japonicum* in northern Florida. Additionally, the revised 2006 *Lygodium micophyllum* Management Plan is provided on the CD-ROM included with this issue.

Since 1998, my colleagues, students and I have conducted a series of studies in order to gain a better understanding of why *L. microphyllum* does so well in its introduced Florida habitat. We have considered the reproductive biology of the species, its whole plant growth and physiology under different environmental conditions, its community ecology, and its landscape spread. Currently, scientists from several institutions in the U.S. have developed collaborative research with colleagues from scientific institutions in Australia and are comparing *L. microphyllum* growth in its native Australian habitat versus its non-native Florida habitat. What we have found reads, in some case, like science fiction, especially with regard to its reproduction, which appears to be tailor-made for an invasive alien species.

Ferns are ancient species when it comes to reproduction, as they spread by spores instead of by seeds. Spores, which are similar in size to pollen grains, cost the plant very little energy to produce. At some *L. microphyllum*-dominated sites in Florida, over a billion airborne spores were estimated to be present (Volin et al. 2004). The hurricanes of 2005 undoubtedly spread copious amounts of spores throughout the southern peninsula, and we should expect a whole new generation of tiny tenacious ferns starting to climb into delicate tree island canopies in the coming years.

Lygodium, from the Greek *lygodes*, meaning flexible, in reference to the twining rachis.

Ferns reproduce in one of three ways: a single spore develops by itself into a plant; two spores from the same parent plant reproduce by one fertilizing the other; or two spores from two different parent plants reproduce. Ferns are conservative in that they typically adopt only one of these three reproductive strategies. Instead, Lott et al. (2003) found that both *L. microphyllum* and *L. japonicum* can produce plants by all three methods. The strength of this reproductive approach is that it only takes one spore to travel a long distance from its parent plant to establish in a new area, and once established the plant has a greater exchange of genetic information through reproducing via cross fertilization with other established plants. As if this were not advantageous enough, *L. microphyllum* has an additional component to its reproduction. It was found that the first spore to germinate produces a pheromone that impacts nearby spores as well as other nearby younger germinates. In the case of the nearby spore, the pheromone promotes its germination; in both cases, the pheromone determines their sex. Since the earlier germinate is almost always a female and the pheromone that is produced by this germinate causes the younger ones to become only male, cross-fertilization is assured (Lott et al. 2003).

Along with this flexible reproductive strategy, we also found that *L. microphyllum* maintains a high and continuous spore production throughout the year (Volin et al. 2004). In addition, it grows rapidly at both high and low light levels at a young stage. Young plants grown in only 20% full sunlight grew just as much as plants grown in 50% as well as 80% full sunlight (Lott and Volin, unpublished data). Thus, in intact understory environments with low light levels, new young germinates can grow quickly. Therefore, where most invasive species need disturbed habitats in which to establish, *L. microphyllum* appears to have no problem establishing in intact native environments, such as tree islands in the Everglades and the cypress forests of the Big Cypress Swamp. On *L. microphyllum*-dominated sites in the Big Cypress Swamp, we found the fern particularly suited to the naturally wet conditions of the swamp. Unfortunately, the wetter hydrological conditions that are being sought after through the Comprehensive Everglades Restoration Plan will actually make the environment even more conducive to the establishment of *L. microphyllum*.

Little is known about the growth and physiology of *L. microphyllum* within its native range, but the fern appears to be a comparatively benign constituent of its native range communities. The key question is what limits the growth and spread of *L. microphyllum* in its native range as compared to its non-native range. To answer this question, with funding from both the Florida Department of Environmental Protection and the South Florida Water Management District, my colleagues and I are currently conducting coupled controlled and field studies of this species in both its native environment in Queensland, Australia and in southern Florida.

It could be that in the new Florida environment the fern thrives because it no longer has the insects and diseases with which it coevolved in its native environment, something known as the *release from natural enemies hypothesis* (Elton 1958). In collaborative biological control efforts through the USDA and CSIRO (Commonwealth Scientific and Research Organization) in Australia, exploratory surveys for natural enemies of *L. microphyllum* have identified relatively few insect herbivores, from which Goolsby et al. (2003) suggest that enemy release may be less important in fern invasions. However, progress has been made with the release of the pyraloid moth, *Austromusotima camptozonale*, in February 2005, and the discovery of other potential biocontrol agents (see *Taking Down Climbing Fern—Biological Control of Lygodium microphyllum*, this issue). To date, there are no biological control insects approved for *L. japonicum*. In fact, much more needs to be understood about the ecology of this species.

Together, these two climbing ferns are of great concern for Florida's native environment. What follows in this special issue represents a big step forward in the understanding of these invasive species.

References available from the author at jvolin@fau.edu.

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FLEPPC will hold its first annual FLEPPC Photo Contest with awards to be presented at the 2006 Annual Symposium, April 24-26, in Gainesville, Florida.

You must be a current FLEPPC member to participate, but you need not be present at the symposium to win. More than one photograph may be submitted, but no more than three from any one photographer. Deadline for submission is April 24th at the symposium site in Gainesville.

Winners will be chosen at the symposium by members of the FLEPPC Photo Contest Committee and winning photographs will be published in **Wildland Weeds** magazine and on the FLEPPC website.

Photos may be digital or film, but a print must be submitted for the contest entry. Prints should be 5" x 7" or 8" x 10". The photo committee asks that photos not be digitally enhanced or altered, except for the humor and artistic categories in which digital alterations are optional.

To enter, please obtain an entry form from the FLEPPC web site (*www.fleppc.org*) and submit one with each photograph to be entered (no more than three from any one photographer). Participants may bring their entries to the symposium or mail them to: Karen Brown • FLEPPC Photo Contest • 7922 NW 71st Street • Gainesville, FL 32653

CATEGORIES INCLUDE

natural area landscape infestation • close-up of a Category 1 or 2 exotic pest plant
before/after control (two photos) • weed workers working • humor • artistic

An Explosion in Slow Motion:

Tracking the spread of *Lygodium microphyllum* in Florida

by Amy Ferriter, Boise State University and Tony Pernas, National Park Service

In the early 1990s, the South Florida Water Management District and the National Park Service began using Systematic Reconnaissance Flights (SRF) to monitor invasive plants over large areas of South Florida. Advancements in civilian Global Positioning System (GPS) technologies made SRFs a quick and inexpensive way to get a snapshot of the distribution of target plant species over large and remote areas.

In 1990, *Melaleuca quinquenervia* was considered "Public Enemy Number 1" in South Florida. The tree was spreading at an alarming rate and threatened to overtake vast areas of the struggling Everglades. The Department of Interior had dedicated but meager programs to control the tree in Everglades National Park, Big Cypress National Preserve and the Loxahatchee National Wildlife Refuge, and the South Florida Water Management District was in the process of launching its operational control program for the Water Conservation Areas.

With Florida EPPC's 1990 Melaleuca Management Plan hot off the press, several proposals were pitched to map melaleuca before large scale interagency treatment operations began. These early projects proposed the use of satellite imagery to detect melaleuca. Unfortunately, the price tag for these early surveys was prohibitively hefty. The $500K needed to map melaleuca in the Everglades outweighed the amount of money earmarked to control it. Resource managers opted to initiate operational programs without a map and instead, control crews "mapped" the tree's distribution *post mortem*–taking coordinates as they treated.

Largely to the credit of Florida EPPC, the serious melaleuca problem gained notoriety in the early 1990s and a business interest proposed the construction of a power plant that would burn melaleuca for energy. Seen as a win-win for the State of Florida, the District agreed to conduct an aerial survey to determine the amount of melaleuca fuel in the region. The only existing large scale assessment for the tree species in Florida had been conducted by the United States Forest Service (USFS) Southeast Forest Experiment Station in 1980.

The USFS consulted with the District in 1992 and proposed the use of aerial transects and GPS technology for the assessment. The USFS has used this assessment technique, termed the Systematic Reconnaissance Flight (SRF) method, to inventory timber in the United States since the 1920s. This method is also commonly used to monitor animal species such as wading birds, deer and marine mammals.

While flying a practice run of one of the 1993 melaleuca transects, the aerial observers noted a "weird vine" on a few tree islands in the northern tip of the Loxahatchee National Wildlife Refuge. That weird, isolated vine turned out to be Old World climbing fern (*Lygodium microphyllum*). At the time, it seemed interesting but almost insignificant. Project leaders debated adding this odd species to the melaleuca survey. Thankfully, wisdom or maybe dumb luck prevailed and the District survey began tracking locations of lygodium regionally.

To conduct a SRF survey, a small, high-winged aircraft (such as a Cessna 182) flies at a fixed height and speed across a study area while observers count targets (plants or animals) in a strip of land on either side of the plane. Occurrence points of the target species are collected on a GPS data recorder from either side of the aircraft. Using the USFS timber cruising method, these points are tallied and, based on the total number of points collected and the total acres of the study area, each occurrence is given an acreage factor. This acreage factor allows for the calculation of a gross infested acre estimate by species for the region surveyed.

The original survey boundaries extend from the northern tip of Lake Okeechobee, south through the Florida Keys, covering more than 8 million acres. Transects are spaced at 2.5 mile intervals, east/west across the state. The survey is always flown in the winter months in Florida to take advantage of leafless deciduous native tree species, such as cypress. This strategy works well in most cases, but it is suspected that the detection of frost-sensitive lygodium has been compromised in some surveys that were flown after a cold weather event.

1993

J. Beckner first reported lygodium as escaped in Florida in the late 1960s. Clifton Nauman and Dan Austin reported escaped populations near the "Cradle of Lygodium" in Martin County near Jonathan Dickinson State Park in the late 1970s, saying "the plants occur mostly in small clumps, while toward the center of the distribution near the Loxahatchee River and Loxahatchee Slough, lygodium may cover acres." By the early 1990s, Jonathan Dickinson State Park, the Dupuis Preserve, Corbett Wildlife Management Area and the northern third of the Loxahatchee National Wildlife Refuge were

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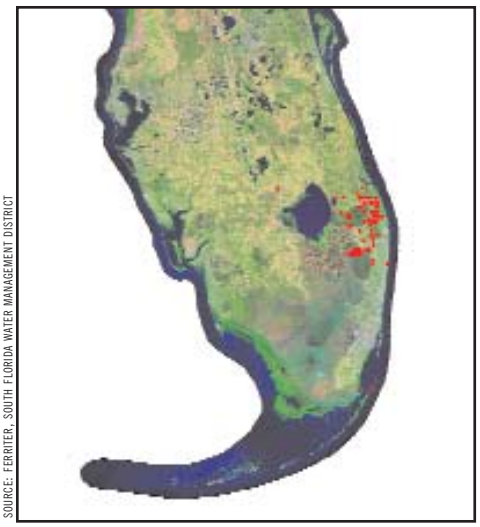
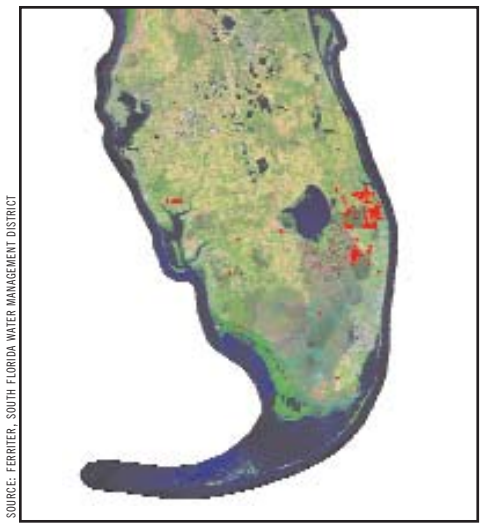
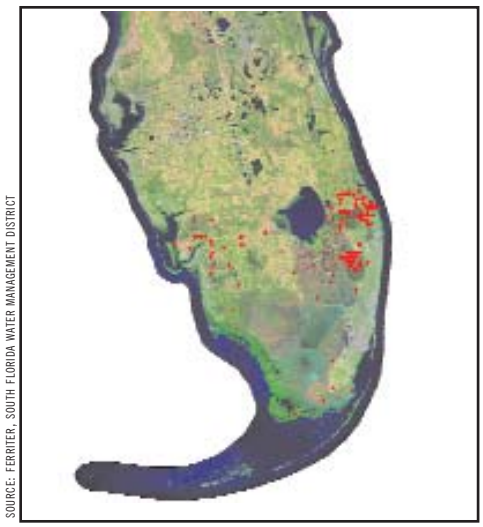


• **Lygodium Distribution 1993**



• **Lygodium Distribution 1995**



• **Lygodium Distribution 1997**

impacted by the fern, which occupied an estimated 28,152 gross infested acres when these surveys began.

1995

Lygodium remained primarily confined to Martin and Palm Beach Counties and these populations were becoming increasingly dense. Several isolated but important populations were spotted along Fisheating Creek, west of Lake Okeechobee in Glades and Hendry Counties, and along the west coast, where populations were infrequent at the time. The estimated gross infested acres in 1995 remained consistent with 1993, totaling approximately 29,970 acres.

1997

Lygodium maintained and strengthened its foothold along the Treasure Coast, becoming increasingly dense and spreading southward in the Loxahatchee National Wildlife Refuge in central Palm Beach County. Populations along Fisheating Creek in Glades and Hendry Counties increased and became more common. Isolated populations became more widespread along the west coast in Lee County in 1997, and the estimated gross infested acres totaled approximately 34,034 acres.

1999

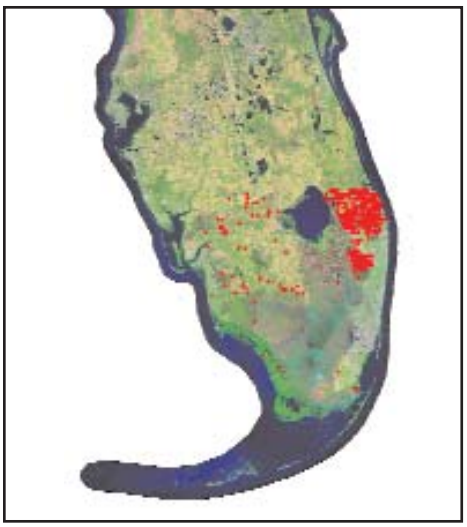
A dramatic densification of lygodium in Martin County was witnessed in 1999. Populations of the fern spread south and became denser in the Loxahatchee National Wildlife Refuge, occupying and covering a majority of the tree islands. Outlier populations also were more commonly seen in the interior of the region, such as Hendry County, and lygodium was becoming denser on the west coast in Lee and Collier Counties. The increase in occurrences and spread of the plant into previously uninfested areas of the region brought the total estimated gross infested acres to 120,780 acres.

2001

This was a transition year for the survey. Flight lines (originally spaced at 2.5 mile intervals to be consistent with the 1980 USFS survey) were shifted to 4 km intervals to be made compatible with National Park Service Universal Transverse Mercator-based surveys. The observers also varied in 2001. The single most important factor in conducting aerial surveys—for plants and animals—is a consistent, trained observer. Due to what is termed "observer bias" in this case, the new observers classified certain occurrences differently—more conservatively in this case—than previous observers. This underscores the importance of retaining consistent observers both throughout individual surveys and from year-to-year. Record low temperatures in inland areas of South Florida in January, 2001 may also have led to difficulties in detecting lygodium, which is quick to brown during cold weather events. While the shift in flight lines, a change in observers and a potential frost event in the area of interest created a situation where there were fewer observation points—the estimated gross infested acres only totalled 43,020 acres—the overall trend in this study ('93-'05) has remained consistent. This applied survey was designed to be flexible, and while the overall scope and purpose of the project—to track broad scale trends in populations that occur over millions of acres—will remain the same, periodic adjustments and unforeseen circumstances should be expected in this type of survey.

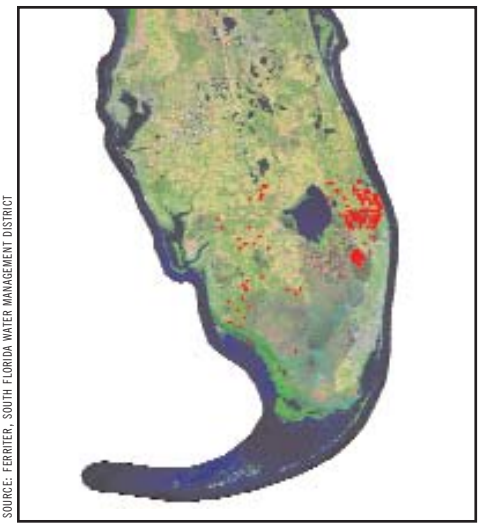
2003/2005

The survey study area was expanded to extend north to Central Florida, covering more than 14 million acres. National Park Service staff began serving as observers for the regional survey in 2003 to minimize observer bias. Due to the logistics of surveying such a large area, the south end of the survey was flown in 2003 and the north end was flown in 2005. The image here depicts both surveys combined to show the entire region for 2003/2005. Lygodium populations in the Loxahatchee National Wildlife Refuge extend into the southern portions of the refuge, and the species now impacts the entire refuge. The expanded survey shows an increase in density of lygodium throughout South Florida, with the gross estimated infested acres for the southern region totaling 120,780 acres. An alarming amount of lygodium is scattered throughout Central Florida, occurring in the entire region south of Pasco, Lake, Orange, and Brevard Counties. Resource



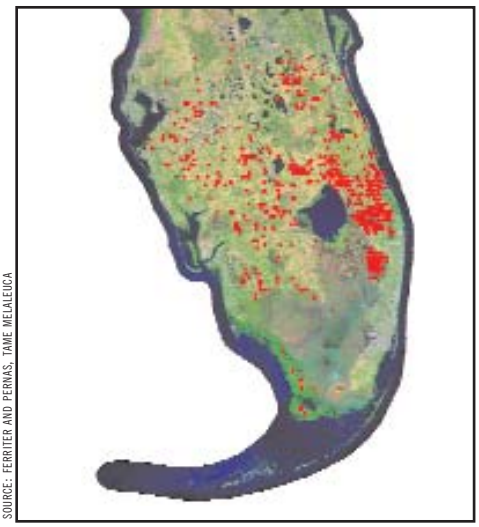
SOURCE: FERRITER, SOUTH FLORIDA WATER MANAGEMENT DISTRICT

• Lygodium Distribution 1999



SOURCE: FERRITER, SOUTH FLORIDA WATER MANAGEMENT DISTRICT

• Lygodium Distribution 2001



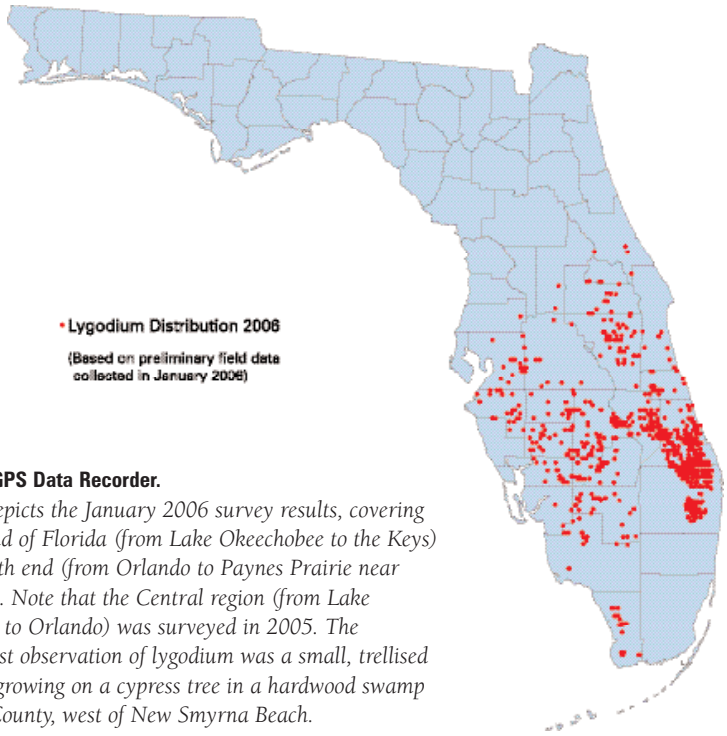
SOURCE: FERRITER AND PERNAS, TAME MELALEUCA

• Lygodium Distribution 2003/2005

managers were reporting lygodium throughout Central Florida with increased frequency, but the magnitude and scope of the infestation was not well understood until this survey was conducted. This is the area of the state where the ranges of *L. microphyllum* and *L. japonicum* meet. While it is not possible to differentiate the two species from the air, the majority of these sightings are most likely *L. microphyllum*, based on reports to the Florida EPPC database. However it is likely that some of them are in fact *L. japonicum*. Regardless of the species, lygodium is estimated to occupy 183,080 acres in the entire South/Central Florida region. If left unchecked, these populations are expected to become larger and denser through time. Given this trend, lygodium threatens to overtake many of Central Florida's forested wetlands, rivers and lake margins.

2005

A pilot project using Digital Aerial Sketch Mapping (DASM) technologies was conducted in the Everglades Protection Area to compliment the SRF surveys. This project involves the use of specialized airborne hardware and software to digitize plant populations "on the fly." DASM was originally developed for the USFS for monitoring forest health concerns such as southern pine beetle infestations. The South Florida pilot project plans to use this technology to delineate and track populations of invasive plants in the same way the Forest Service uses it to track invasive insect pests.



Hot off the GPS Data Recorder.
This map depicts the January 2006 survey results, covering the south end of Florida (from Lake Okeechobee to the Keys) and the north end (from Orlando to Paynes Prairie near Gainesville). Note that the Central region (from Lake Okeechobee to Orlando) was surveyed in 2005. The northernmost observation of lygodium was a small, trellised population growing on a cypress tree in a hardwood swamp in Volusia County, west of New Smyrna Beach.

WHAT NEXT?

The most recent SRF surveys (January 2006) show that lygodium has expanded as far north as Volusia County, west of New Smyrna Beach. SRF surveys extended north to Alachua County in an attempt to document the northern extent of lygodium (and melaleuca) in Florida. These long-term surveys are ongoing, and while it is logistically impossible to survey the entire state of Florida every two years, project leaders plan to continue this work, surveying portions of the state at regular intervals. To ensure consistency and eliminate the possibility of variability in future flightlines, a standard statewide transect map has been generated and will be used for all future surveys. In an effort to refine the SRF acreage estimates, which are derived from USFS timber cruising methods, project leaders are conducting a comparative study of SRF point survey results with more detailed DASM surveys.

Contact the authors at AmyFerriter@boisestate.edu or Tony_Pernas@nps.gov

Taking Down Climbing Fern–
Biological Control of *Lygodium microphyllum*

by Robert W. Pemberton, USDA-ARS Invasive Plant Research Laboratory

Old World climbing fern (*Lygodium microphyllum*) has been the subject of biological control research by the US Department of Agriculture–Agricultural Research Service (USDA-ARS) Invasive Plant Research Laboratory since 1997. The research has been possible because of the partnerships between the Invasive Plant Research Laboratory and two State of Florida agencies, the South Florida Water Management District and the Department of Environmental Protection, which provide essential funding. Old World climbing fern is thought to be an appropriate subject for biological control for a number of reasons: 1) It is a serious exotic weed with few natural enemies in Florida; 2) The plant has no recognized value in Florida; 3) It is not a weed in its native range; 4) Preliminary surveys found promising insect enemies; 5) The weed has few native or economic relatives in Florida and the surrounding region that could become accidental targets for biological control agents.

Although Old World climbing fern has a large native range (occurring in much of the Old World tropics), we have focused on Australia and Southeast Asia because these regions have the highest diversity of *Lygodium* species. Higher numbers of congeneric plants in the same area often have higher numbers of insects associated with them. In all, two mite and twenty insect species were found feeding on several *Lygodium* species. Of these, six to eight may have potential as biocontrol agents of Old World climbing fern. The majority of the *Lygodium* herbivores are Lepidoptera (moths), while Coleoptera (beetles) and Hemiptera (true bugs) were less represented. Given the amount of survey work, the number of herbivore species found was small and they generally occurred at low densities. The paucity of herbivores is not specific to Old World climbing fern, but has been noted for most ferns. Indeed, ferns were once thought to be almost free of insect herbivores. Nonetheless, eight years of surveys have revealed a number of potentially useful agents, although few diseases were encountered.

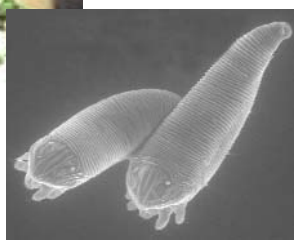
Pyralid moths and an eriophyid gall mite, all from the fern's Australian/Asian range, were prioritized for further study and have since undergone extensive evaluation. Host-specificity testing was conducted in the USDA-ARS Australian Biological Control Laboratory in Brisbane (a cooperative laboratory with Commonwealth Scientific and Research Organization (CSIRO) in Australia) and in the Florida Division of Plant Industry quarantine facility in Gainesville, where part of the Invasive Plant Research Laboratory is located.

The first agent, *Austromusotima camptozonale*, was officially released on February 14, 2005 at Jonathan Dickinson State Park in Martin County, Florida. This Australian species is one of a complex of pyraloid moths that has evolved with *Lygodium* ferns. The larvae eat the leaves of the fern and, at high densities, can completely defoliate it. The moth can produce a generation every month during the summer and every 2–3 months in the winter depending on temperature. Host-specificity testing showed it to be a very narrow specialist, able to use only a few *Lygodium* fern species. It is a tropical insect unable to survive in the temperate part of eastern North America where the only native *Lygodium* (*L. palmatum)* grows. It also was unable to use any of the four *Lygodium* species native to the Caribbean. In 2005, 12,000 moths were reared and released into a nursery site and research plots. Releases were made in field cages and in the open. Breeding occurred in the field but no definitive evidence of the moth's establishment outside of the cages has yet been obtained. We are beginning another release effort to try to colonize this moth in the wild. The Florida Department of Environmental Protection is providing funding for this mass rearing and release program.

The second agent, the eriophyid gall mite, *Floracarus perrepare,* is native to Australia and tropical Asia. Adult feeding on new leaves causes the leaf margin to roll and thicken, forming a leaf roll gall into which eggs are laid and a colony of mites develops. Galls can be physiological sinks, using up photosynthate normally used by the fern for new growth. Potted plant studies showed that mite infestation reduced climbing fern growth. Host-specificity testing showed the mite to be a narrow specialist with host races (subgroups that have narrower host ranges than the species as a whole) limited to two *Lygodium* species including Old World climbing fern. A release petition was submitted in February 2004, and in November 2004 the federal interagency scientific review body, the Technical Advisory Group for Biological Control of Weeds, recommended to USDA-APHIS (Animal and Plant Health Inspection Service), the permitting agency, that the mite be released. In December 2004, a draft Environmental Assessment was written on the mite's release and submitted to the USDA-APHIS. Although the mite is exceptionally safe, the USDA-APHIS has yet to issue a release permit but is expected to do so in 2006.

Austromusotima camptozonale adult

Damage from *F. perrepae* galling



The lygodium gall mite, *Floracarus perrepae,* adults

The third agent, and second pyralid moth, *Neomusotima conspurcatalis*, is native to tropical Asia east to northern Australia. The damage, biology and host specificity are all similar to those of *A. camptozonale*. In Australia it does well during the hot season, whereas *A. camptozonale* develops higher numbers during the cooler winter. The research was completed late in 2004 and in May 2005, a release petition was submitted to the Technical Advisory Group for Biological Control of Weeds. A decision is expected early in 2006.

What Next?

With completion of the research necessary to apply for the release in Florida of above natural enemies, attention is focusing on other potential agents. Several are now under investigation in Singapore, Australia, and Florida.

Of considerable interest are two species of pyralid moths that bore into the stems of *Lygodium*. One, *Siamusotima aranea*, attacks *L. flexuosum* in Thailand and the other, an apparently undescribed species from Singapore, attacks Old World climbing fern. The stem above the boring larvae is killed because the vascular tissue is cut. However, rearing these moths in quarantine has proved a challenge and attempts in both Australia and Florida have so far been unsuccessful. Larval development takes many months and the larvae seem to require larger stem diameters than can be easily obtained with potted plants. There are also questions about host races and taxonomy. These moths are the highest priority for research for the overseas part of the program. An entomologist from our Australian Biological Control Laboratory has been placed in Singapore to work on the *Siamusotima* species that attacks Old World climbing fern. This expensive work is possible due to a special grant from the US Department of the Interior through Everglades National Park.

Neomusotima conspurcatalis adult

A sawfly, *Neostrombocerus albicomus,* was brought into the Division of Plant Industry quarantine facility in Gainesville, Florida during the summer of 2005 for host specificity testing. We recognized the potential of this leaf feeding sawfly early in the project but could not rear it. Our Thai cooperator, Dr. Amporn Winotai, discovered that the insect would not mate in small cages. We now successfully rear the sawfly in large cages and preliminary host specificity testing indicates that *N. albicomus* probably has a narrow enough diet to be safely released in Florida. The sawfly has multiple generations per year and is a vigorous feeder on Old World climbing fern leaves.

Other insect natural enemies found include a thrips, *Octothrips lygodii*, which damages the leaves. The thrips is probably a specialist but opinions on the value of thrips as potential biological control agents vary. A brown leaf disease found in Sri Lanka needs to be identified and possibly evaluated.

Prospects

It is expected that *A. camptozonale* will establish in Florida. How much impact it has on Old World climbing fern will depend largely on the mortality that it experiences from ants and parasitic wasps that attack related pyralid moths. This biocontrol agent is not expected to be a 'silver bullet', however, and a suite of agents will be needed to subdue Old World climbing fern. We hope to add the mite, *F. perrepare,* and the second moth, *Neomusotima conspurcatalis,* in 2006. It is not possible to predict what impact they will have, but the combined effects of these agents acting in somewhat different ways may help reduce the abundance of the weed.

Lygodium sawfly *Neostrobocerus albicomus,* adult and eggs

N. albicomus leaf feeding larvae

As noted, other potential agents are in the pipeline. The stem-boring moths may hold the most promise if they can be successfully reared and evaluated.

Old World climbing fern is a very challenging problem for any kind of control effort, but its great environmental damage makes it a most worthy target for all our efforts.

Acknowledgements

John Goolsby, Tony Wright, Jeff Makinson, Ryan Zonneveld, USDA-ARS Australian Biological Control Laboratory and Commonwealth Science and Industry Research Organization in Brisbane and Singapore; Amporn Winotai, Thai Department of Agriculture in Bangkok; Roch Desmier de Chenon, Indonesian Oil Palm Research Station, Marihut, Sumatra; Christine Bennett and Mike Alexander, University of Florida in Gainesville; Luke Kasarjian and Carrie Boudreau, USDA-ARS and Student Conservation Corps in Ft. Lauderdale, Florida; Amy Ferriter, Dan Thayer and LeRoy Rodgers, South Florida Water Management District; Kathy Burks, Greg Jubinsky and Don Schmitz, Department of Environmental Protection, Tallahassee; and Jonathan Taylor, Everglades National Park.

Contact the author at bobpem@saa.ars.usda.gov

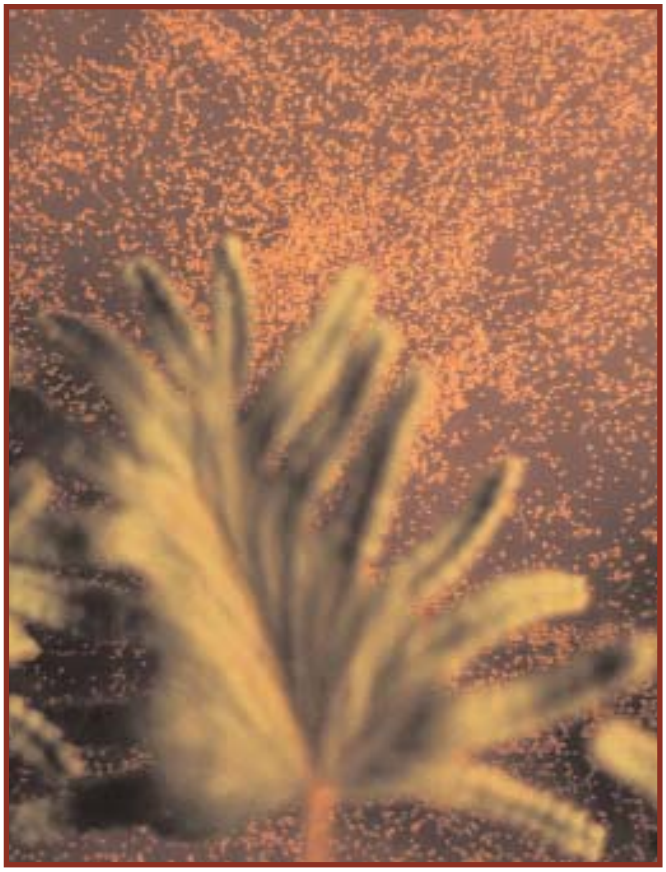
Victor Alan Ramey
06/21/48 – 11/24/05

Victor Alan Ramey, innovative and creative educator in the field of aquatic and invasive plants, passed away on Thanksgiving Day following heart surgery.

Vic worked for the University of Florida-IFAS Center for Aquatic and Invasive Plants for more than 25 years. During that time, he completed a large array of educational products for those in the aquatic plant management arena. Vic conceived of and built the Aquatic Plant Information Retrieval System (APIRS) database, which has been used by researchers and others around the world for 20 years. He started the AQUAPHYTE newsletter back in 1981 of which Volume 25 Number 2 has just been published and sent to almost 1,000 subscribers in more than 70 countries. He commissioned and produced a large set of aquatic plant line drawings; he traveled around Florida to obtain an extensive photographic collection; he created the popular *Aquatic Plant Identification Deck* and the companion *Grasses, Sedges, and Rushes Identification Deck*; he produced a series of aquatic plant educational videotapes, including the 7-part *Aquatic Plant Identification Series*, multiple aquatic plant applicator training videos, general education videos for students, homeowners and lake- and riverfront property owners, and the clever and popular *Careers in Florida's Freshwater Environments* video for middle and high school students. More recently, Vic and his team produced a set of four large-format aquatic and invasive plant photomurals, aquatic-themed mouse pads, and the two newest products: aquatic and invasive plant fold-out recognition guides to use as road maps to plant identification in the field. Along the way, there were peripheral items such as the hand-drawn *Freshwater Plants* poster, the *Aquatic Plant Coloring Book*, and more. Vic accumulated all of this information into the world's largest aquatic and invasive plant website at http://plants.ifas.ufl.edu. This website has been active for 10 years and has grown to hundreds of individual pages.

Vic's most recent project was to bring together all of his accomplishments into a far-reaching educational program to create study units, labs and hands-on learning activities for schoolchildren of all ages, and programs for Florida Park Service rangers, biologists and volunteers, in an effort to teach as many people as possible about aquatic, wetland and invasive plants in Florida, a subject Vic described as "dear to our hearts." The program is called Florida's Invasive Plant Educational Initiative, a joint effort by the Center for Aquatic and Invasive Plants and the Bureau of Invasive Plant Management of the Florida Department of Environmental Protection. The team members that Vic has left behind plan to continue working on these projects and to maintain and expand the existing programs at the Information Office of the Center. It is important to all of us to continue his legacy, the work that was dear to his heart, of providing the best educational resources on aquatic and invasive plants to the people of Florida and around the world.

by Karen Brown,
Vic's co-worker of 22 years



Fertile leaflets of Lygodium microphyllum *produce thousands of minute spores that can easily attach to the clothing and equipment of herbicide applicators.*

Potential Spread of *Lygodium microphyllum* Spores by Herbicide Applicators

by Jeffrey T. Hutchinson and Kenneth A. Langeland
University of Florida–IFAS, Agronomy Department
and Center for Aquatic and Invasive Plants

Old World climbing fern (*Lygodium microphyllum*) has spread across South Florida at a rapid rate relative to other invasive plants. This can be partly attributed to abundant wind borne spores that may be carried for miles, especially during major weather events such as tropical storms and hurricanes. A single fertile leaflet can produce thousands of spores, each one capable of starting a new fern population in an uninfested site (Lott et al. 2003).

Government agencies routinely hire contractors to treat Old World climbing fern infestations. Since contractors often work in multiple natural areas of the state, the potential exists for spores to spread to uninfested natural areas. The purpose of this project was to determine if herbicide applicators are spreading Old World climbing fern spores and, if so, to make recommendations on methods to limit the spread of spores by applicators.

METHODS

To quantify the amount of spores attached to applicators and equipment, we collected samples in the field using cotton squares in one re-treatment and three initial treatment sites infested with Old World climbing fern. Sampled sites included the Loxahatchee Slough in Palm Beach County (re-treatment site); initial treatment sites included Kissimmee River Restoration Site–Pool C in Highlands County, Allapattah Flats and Jonathan Dickinson State Park in Martin County. The re-treatment site had very low infestations of Old World climbing fern and had been treated within the past 12 months. Since infestations were low, samples were collected along the ground next to treated Old World climbing fern to determine if viable spores were still present one year after treatment. Initial treatment sites had heavy Old World climbing fern infestations with >75% vertical and horizontal coverage.

Cotton squares were used to collect samples from workers and equipment and were then placed in a covered petri dish with water. The samples were maintained under a temperature of 78ºF under cool florescent light for 16 hours and 8 hours of darkness. Samples were monitored at 20 and 40 days with a dissecting microscope for fern fragments and gametophytes (germinated spores). Old World climbing fern fragments found on the squares were observed to contain spores and represent micro-debris that can easily detach from clothing and equipment. Gametophytes are viable spores and, once fertilized, become sporophytes. Gametophytes are easily detected under a dissecting microscope.

Means, standard errors, range, and 95% confidence intervals were calculated for all samples. Initial and re-treatment sites were tested for differences between the number of gametophytes for all samples using a Mann-Whitney Test. Differences among samples were computed for both re-treatment and initial sites using a Kruskal-Wallis test and differences among sample types were tested with Multiple Comparison Test (Noether 1990).

RESULTS

Samples taken from workers and equipment at re-treatment and initial treatment sites contained micro-fragments of Old World climbing fern and gametophytes (Table 1). Spores were commonly observed attached to fern micro-fragments in many samples, but no quantitative data was collected. The mean number of gametophytes for all samples at the re-treatment site was 3.5 (SE = 0.8; Range 0 – 32), and 173.2 (SE = 42.3; Range 0 – 1472) for initial treatment sites. Significant differences were detected for the number of gametophytes between re-treatment and initial treatment sites ($Z = -8.338$, $P < 0.01$).

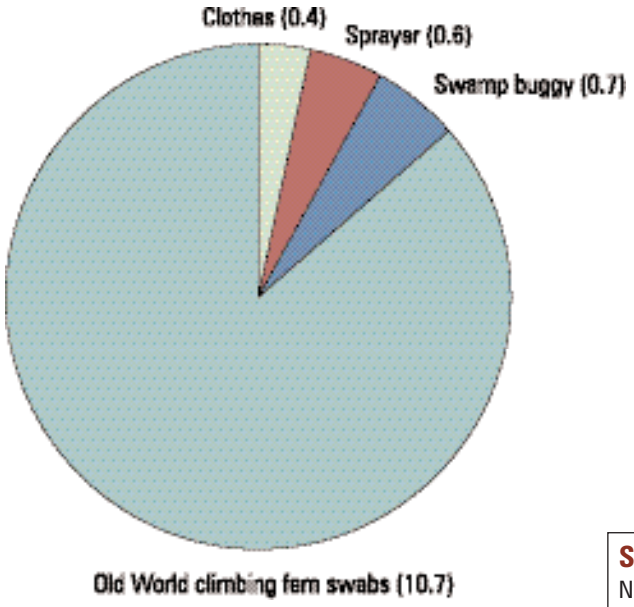
The average number of gametophytes per sample at re-treatment (low infesta-

Herbicide applicators taking samples for spores of *Lygodium microphyllum*.

PRACTICE GOOD SPORE HYGIENE

- Prior to leaving site, thoroughly spray down all equipment with a high-pressure sprayer using either water or compressed air.
  - Focus on all openings, cracks, crevices, and treads, including the underside of vehicles.
  - Cleaning of equipment should occur along the edge of the infestation to avoid spreading spores to areas outside the infested site.
- Clothing and accessories (shoes, gloves, hats, etc.) should be brushed off on-site to remove Old World climbing fern fragments and spores.
- Wash all clothing daily.
- Disposable suits should be removed prior to leaving the infested site and placed in a plastic bag.
- Limit track vehicles and swamp buggies in areas heavily infested with Old World climbing fern.
  - Treaded tires and tracks from vehicles easily trap soil that may contain spores.
  - Vehicles are difficult to clean due to the many crevices, openings, and covered parts.

Fig. 1 – **Low Infestation**



Spore contamination
Numbers in parentheses represent the average number of gametophytes detected per sample.

Fig. 2 – **High Infestation**

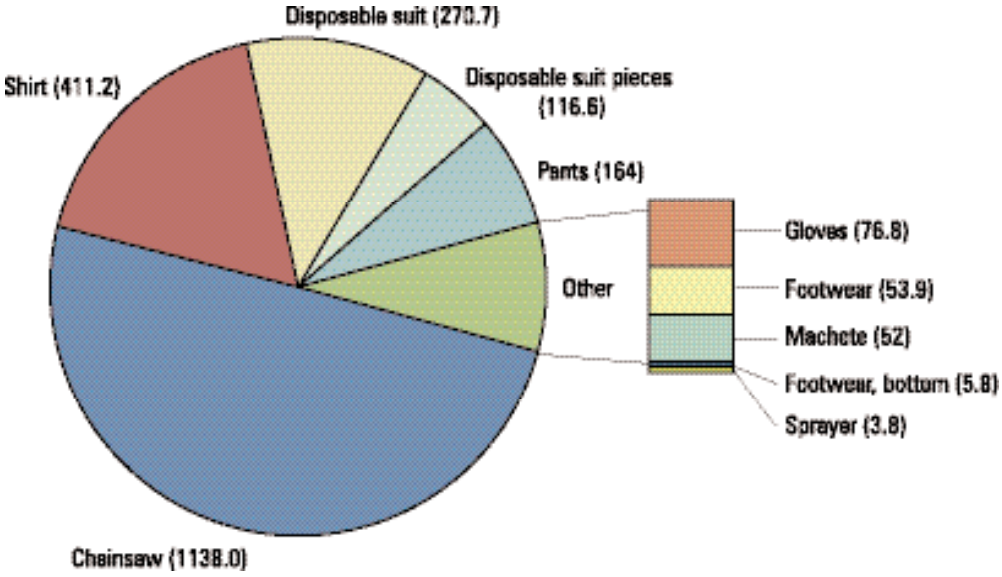


Table 1. Percentage of Old World climbing fern micro-fragments and gametophytes from samples taken from re-treatment (low infestation) and initial treatment (heavy infestation) sites.

	Old World climbing fern	
	Fragments	Gametophytes
Re-treatment site (n = 1)	22.2 %	56.8 %
Initial treatment site (n = 3)	61.6 %	96.1 %

tion) sites was < 1.0 for clothing, sprayers, and a swamp buggy, and no significant difference was detected among samples (Fig. 1). Samples taken from Old World climbing fern rachis mats treated 12 months prior at the re-treatment site averaged 10.7 gametophytes, and was significantly different than clothing, sprayers, and swamp buggy samples ($H = 42.2$, d.f. = 3, $P < 0.01$).

Within initial treatment (heavy infestation) sites, the average number of gametophytes for each sample varied between 3.8 (S.E. = 1.4) for sprayers and 1138.0 (S.E. 199.8) for chainsaws (Fig. 2). Clothing contained a higher, but not significant, number of gametophytes than equipment, with the exception of chainsaws. The highest number of gametophytes on clothing were detected on pants (mean = 164.0, S.E. = 87.0), disposable suits (mean = 270.7, S.E. = 103.7), and shirts (mean = 411.2, S.E. = 215.4). Significant differences were detected among samples from sprayers and the bottom of footwear compared to other samples at initial treatment sites ($K = 26.9$, d.f. = 9, $P = 0.001$).

DISCUSSION

Spores of Old World climbing fern were found to easily contaminate clothing and equipment. Even in re-treatment sites with light infestations and no fertile leaflets, gametophytes were detected in 56.8% of the samples. Samples taken with cotton swabs through Old World climbing fern treated one year prior averaged 10.7 gametophytes, indicating that viable spores are present at least one year after treatment.

In heavily infested sites, clothing contained a higher, but not significant, number of gametophytes than equipment, with the exception of sprayers and bottom of footwear. The large variation among samples may be explained by the treatment method wherein some workers cut the fern and other workers spray the cut portion of the fern. Workers cutting the fern are more likely to come in contact with fertile leaflets and falling spores than workers applying herbicide. Samples were not distinguished between workers cutting or spraying, but samples from two different applicator's shirts from the Kissimmee River site contained 95 and 1219 gametophytes, which may be attributable to one worker cutting and one spraying the plant. Due to this large variation in the number of gametophytes among samples taken from workers, all workers should take precautions to limit spreading spores to other areas.

Researchers and others working around Old World climbing fern also should clean their clothing and equipment prior to leaving the site. Samples taken from a researcher working in a heavily infested site revealed an average of 31 and 142 gametophytes for footwear and pants, respectively. While aggressive treatment of Old World climbing fern should not be hindered by decontamination of clothing and equipment, we do have some suggestions.

Please see "Practice Good Spore Hygiene" on page 14.

ACKNOWLEDGEMENTS

South Florida Water Management District; Aquatic Vegetation Control, Inc.; Applied Aquatic Management, Inc.; Florida Park Service.

LITERATURE CITED

Lott, M. S., J. C. Volin, R. W. Pemberton, and D. F. Austin. 2003. The reproductive biology of the invasive ferns *Lygodium microphyllum* and *L. japonicum* (Schizaeaceae): implications for invasive potential. American Journal of Botany 90: 1144-1152.

Noether, G. E. 1990. Introduction to Statistics – The Nonparametric Way. Springer-Verlag, New York.

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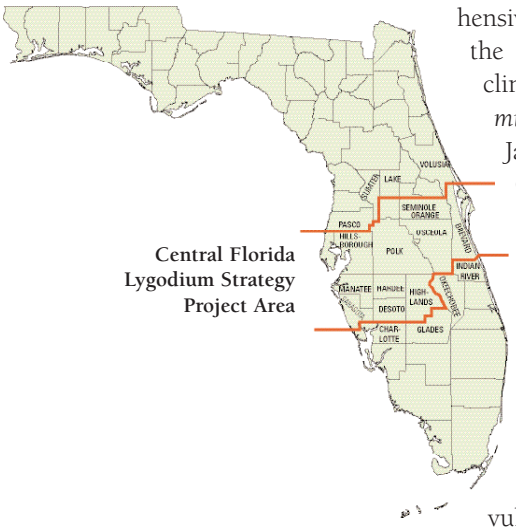
Central Florida Lygodium Strategy: A Regional Approach

by Kristina Serbesoff-King, The Nature Conservancy

The northward spread of Old World climbing fern and southward spread of Japanese climbing fern threaten to overwhelm central Florida's environment. A partnership, including The Nature Conservancy, other land management conservation groups, federal, state and local governmental agencies, and private landowners, has been developed to implement the Central Florida Lygodium Strategy (CFLS). The CFLS encompasses all or part of 12 counties in central Florida and was formed to provide a cooperative, comprehensive approach to stop the spread of Old World climbing fern (*Lygodium microphyllum*) and Japanese climbing fern (*L. japonicum*) in central Florida.



Central Florida Lygodium Strategy Project Area

We have estimated that about 850,000 acres of wetlands and forested habitats in central Florida, most of which are privately owned, are vulnerable to infestation. Through the CFLS, The Nature Conservancy is working with public and private landowners throughout the region to implement an early detection and rapid response program that will keep these invaders from taking over central Florida's natural areas. Infestations of both climbing ferns have been found in central Florida, but at lower densities than are found south or north of this region. The CFLS strives to create a "lygodium-free" zone through a coordinated approach involving both public and private landowners and managers that includes: **mapping and assessment** in central Florida and in northern expansion zones; on-the-ground **control** projects on private lands; and **public education** about identification and control of the ferns.

This strategy of coordination across political and land ownership boundaries will provide an example of how private/public partnerships, agency coordination and early control efforts can result in long-term, cost-effective control of invasive plant species.

Mapping/Assessment

Northern Expansion Zone Aerial and Ground Surveys

Starting in January 2006, aerial and ground surveys were conducted north of the CFLS zone to determine the northward spread of Old World climbing fern. Land managers expressed a need for these surveys with predictions that the active 2004 hurricane season, along with the plant's wind and water-dispersed reproductive strategy, may have expanded the northern range of Old World climbing fern. These surveys were conducted through funding and support from the Florida Department of Agriculture and Consumer Services–Division of Forestry (DOF), Florida Department of Environmental Protection–Bureau of Invasive Plant Management (BIPM), South Florida Water Management District (SFWMD), Southwest Florida Water Management District, St. John's River Water Management District, US Department of Agriculture (USDA)–Agricultural Research Service, National Park Service, The Nature Conservancy and Florida Natural Areas Inventory (FNAI).

The aerial surveys built on data collected in spring of 2005 by the SFWMD, which conducted systematic reconnaissance flights (SRF) from the north rim of Lake Okeechobee north to Orlando. Using the same methodology (See *An Explosion in Slow Motion*–this issue), the CFLS northern expansion zone began at the northern edge of the area surveyed by the SFWMD and continued north another 100 miles, encompassing approximately 7.7 million acres.

The northern expansion zone SRFs were conducted during the last two weeks of January 2006 by the National Park Service. The primary focus of this survey was to observe infestations of climbing ferns (*Lygodium* spp.), and 5 additional species: skunk vine (*Paederia foetida*), Chinese tallow tree (*Sapium sebiferum*), melaleuca (*Melaleuca quinquenervia*), Brazilian pepper (*Schinus terebinthifolius*), cogon grass (*Imperata cylindrica*), and tropical soda apple (*Solanum viarum*). The analysis of this effort will be completed shortly, including ground validation of the flights by sharing the survey results with public land managers in the northern expansion zone and asking them to verify data collected on their properties.

Ground surveys to detect infestations of lygodium and the other five prioritized species also began in January and will continue through mid-March 2006. These surveys, conducted by FNAI, are collecting data starting at the northern CFLS boundary and heading north roughly 56 miles. Lands were selected as candidates

for ground surveying according to the following criteria: within 2 km of a public conservation land; containing wetland habitats (due to higher priority of observing climbing ferns); and under conservation easement or other type of private conservation land. Within this area, approximately 491,000 acres of wetland habitats were identified within 2 km of public conservation lands. The ground survey covers approximately 5% of these habitats (~25,000 acres).

Lake Wales Ridge Aerial Survey

In March 2004, a helicopter survey was conducted along the Lake Wales Ridge covering a 400,000-acre area. This survey documented 111 infestations of climbing ferns on both public and private lands in Polk and Highlands Counties. Of the 111 locations mapped, 85 infestations were on private lands and almost 50% were less than one acre. Over 90% of the infestations detected on public lands have received initial treatment.

This survey was repeated in February 2006. The analysis is not yet complete, but it will provide additional information on the spread of the climbing ferns along the ridge and the success of control projects on conservation lands. SFWMD provided the helicopter services and members of the Lake Wales Ridge Ecosystem Working Group (LWREWG) provided the surveyors.

Florida Natural Areas Inventory (FNAI) Invasive Plants Geodatabase

The overall scope of this multi-year project is to provide a geo-referenced inventory and tracking tool for occurrences of invasive exotic plants on Florida's public conservation lands. Tasks include development of a statewide easy-to-apply system, data collection to populate the system, analysis of results as the system builds, and collaboration with natural resource managers statewide in adding and updating data.

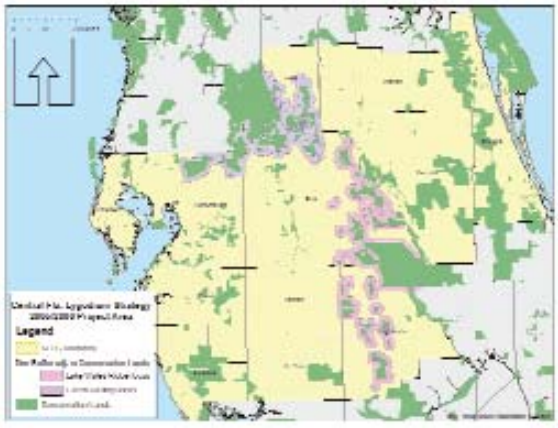
In addition, the project team has focused on collecting data for special management issues such as the spread of the highly invasive climbing ferns. They have completed initial data collection from public land managers in the CFLS zone and continue to collect new occurrence data of overlap areas of the two species. At present the northernmost known population of *L. microphyllum* is one found in early 2005 at Tomoka State Park in northeast Volusia County. The southernmost known population of *L. japonicum* was found in September 2005 at Picayune Strand State Forest in southwestern Collier County. The project is funded by the BIPM and co-sponsored by FLEPPC. For more on the GeoDatabase, visit the FNAI website, www.fnai.org.

Control

"Working Across the Fence Line"

The Nature Conservancy has begun a project to provide direct assistance to private landowners. Working with members of the Lake Wales Ridge Ecosystem Working Group and other regional land managers, two focus areas within the CFLS zone have been chosen for treatment in 2006: the Lake Wales Ridge and the southern region of the Green Swamp. We intend to expand on the efforts begun on conservation lands by "crossing the fence line" to work with neighboring private landowners. Professional contractors have been hired to conduct herbicide treatments of climbing ferns on private lands beginning in April 2006. Control work is on a voluntary basis and will be focused in wetland habitats on properties that are within 2 km of conservation lands in both focus areas. All treatment areas will be inspected 6 months post-treatment and misses and resprouts will be retreated as necessary. Ground control work areas will be assessed 1-year post treatment to guarantee a minimum of 95% control. Private landowners who participate in this project will be provided with herbicide control of both climbing fern species at 100% cost for this first year. Funds for this herbicide work have come primarily through the USDA Cooperative Forest Health Program grant administered by the DOF and through the US Fish and Wildlife Service (USFWS) Partners for Fish and Wildlife Program. Interested landowners can contact the Conservancy project team: Cheryl Millett 863-635-7506 or Kristina Serbesoff-King 561-262-9052.

As this strategy progresses, we will expand our work on private lands throughout the strategy zone. In 2006/2007, we will prioritize additional private lands for herbicide work based on the following factors: 1) infestations identified during the 2006 aerial and ground surveys; 2) remaining private properties in the Lake Wales Ridge and Green Swamp focus areas, and; 3) additional lands within the 12-county CFLS zone based on funding to expand east and west from the initial focus areas.



Public Education

Forging public/private partnerships is key to the success of the Central Florida Lygodium Strategy. As private landowners join our efforts in central Florida through the program described above, we will be building this partnership not only through direct support, but also by providing educational materials, local contacts and maintenance control information. In addition, these initial participants will be spreading the word to their neighbors, thereby creating the momentum necessary to carry these efforts across the landscape.

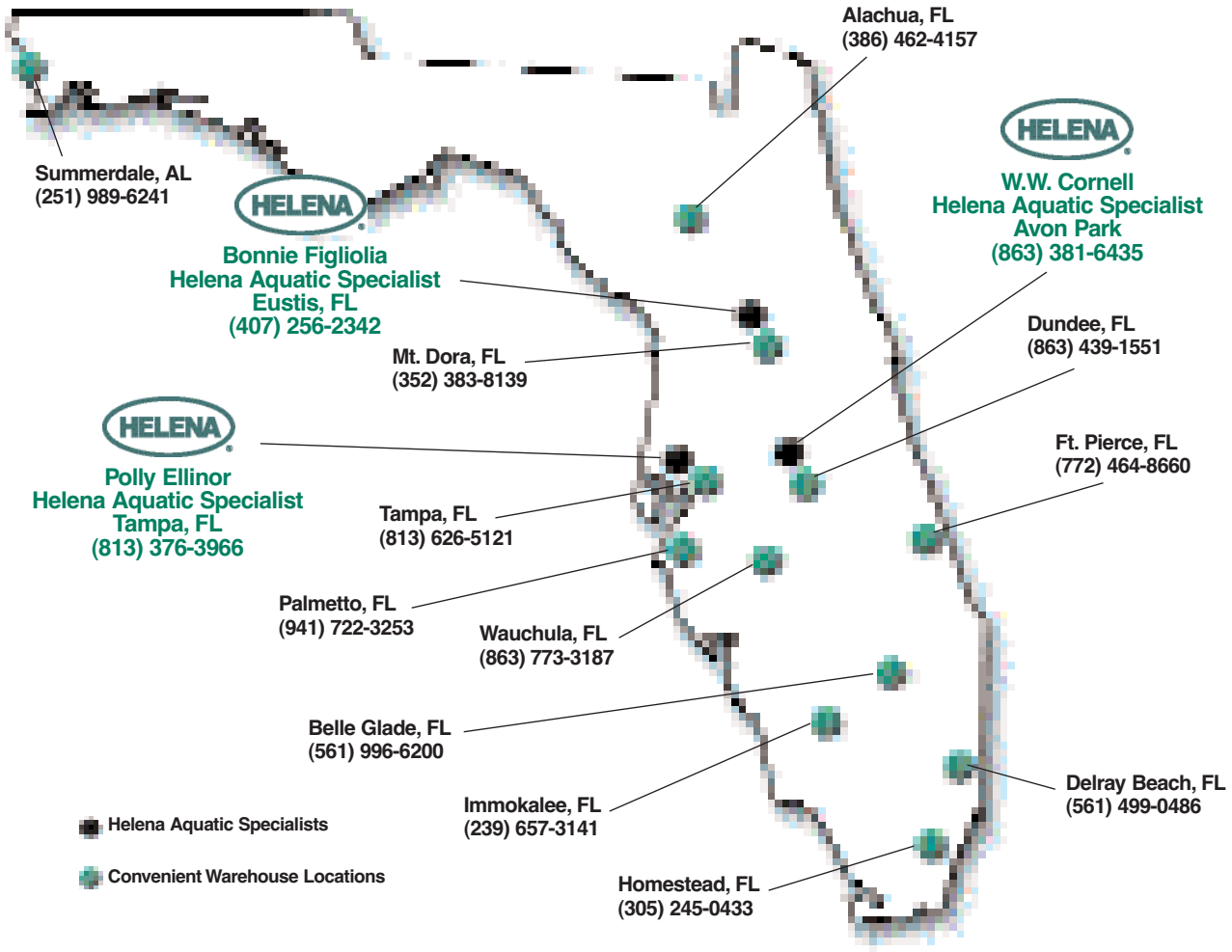
continued on page 21

In the spring of 2006, The Nature Conservancy, along with the Florida Exotic Pest Plant Council, the Florida Cattleman's Association, US Department of Agriculture Natural Resources Conservation Service (USDA NRCS), SFWMD and the University of Florida Institute of Food and Agriculture Sciences, developed and distributed a weed "identification deck" to landowners in central Florida that includes photos of invasive plants and instructions for removing them. Close to 10,000 weed decks have already been distributed. We also have begun working with other organizations to identify additional sources of funding for control work on private lands. Two prime examples of funding sources are the USDA-NRCS Farm Bill programs and the USFWS private lands programs.

Conclusion

The opportunities to build the Central Florida Lygodium Strategy into a regional success are endless. The public and private support that has already been generated through CFLS is truly exciting and this momentum will continue to drive forward our multi-year program. This type of coordinated, cross-jurisdictional, cross-boundary approach to address the threat of an invasive plant is crucial. Cooperative management of lygodium between both public and private land managers must include sharing of resources, treatment assistance, long-term sustained funding, and technical support (See *Resource Management Approach* in the attached CD-ROM 2006 Old World Climbing Fern Management Plan for Florida).

Contact the author at kserbesoffking@tnc.org



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The Double-Trouble Ferns: Status Surveys of Lygodium Treatment Sites

by Chris Lockhart,
Florida Natural Areas Inventory,
Florida State University

The author surveys Lygodium at Black Water River State Forest.

It is well known that the two exotic climbing ferns infesting Florida, *Lygodium microphyllum* ("Old World") and *Lygodium japonicum* ("Japanese"), are double trouble. They remain difficult targets, both to contain and to control. With several years experience in treating both species, could we glean good information for further improving management practices by taking a careful look at many "control project" sites in a systematic fashion?

Biologists at the Bureau of Invasive Plant Management (BIPM), Florida Department of Environmental Protection thought so. In 2004, they asked the Florida Natural Areas Inventory (FNAI) to develop a protocol and conduct status surveys of the hundred or more treatment sites in Florida public conservation lands where BIPM funding has been involved in treating either of the *Lygodium* species. Fieldwork for these site evaluations began in January 2005 and will continue well into 2006 to provide ground-truthing at all known sites.

When a particular managed area is visited, the survey specialist first reviews maps of the treatment sites with local staff and collects information on the staff's experience with managing *Lygodium*. The project sites then are surveyed and the observed *Lygodium* stands are geo-referenced. Live and dead plants are characterized by a simple density ranking: single plant/clump; scattered plants; scattered dense patches; dominant cover; or dense monoculture. The heights of pre- and post-treatment ferns are noted as well. Other data collected include the plant community type, non-target damage observed, presence of water and disturbances such as hog rooting or hurricane damage, and proximity to rare species if any are present.

Once the field survey is completed, a "project summary" is developed for all sites at that managed area. The summary condenses treatment information, including initial and most recent treatment dates, plant community description, observations, geo-referenced coordinates, a few photographs, and a map of points that represent the current *Lygodium* population(s). This summary is provided to BIPM and the local manager. The included GIS data and map are often useful to the local staff for planning further control projects.

By reviewing the details of initial and follow-up treatments at each site and evaluating the current status of treated populations, we hope the size of this "sampling" will yield for all resource managers a clearer pattern of which products and tactics have worked best under different conditions.

The initial geographic focus for the surveys in 2005 was the Central Florida Lygodium Strategy Zone (see *Central*

continued on page 24

Double trouble: Lygodium japonicum *on the left and* L. microphyllum *on the right. Photo taken on private land in Palm Beach County; ferns treated by county Invasive Vine Strike Force.*

Not sure which species you have? Check a couple of handy resources: "Identification and Biology of Non-Native Plants in Florida's Natural Areas" by Langeland and Burks (1998), available at the University of Florida IFAS Extension Bookstore (http://www.ifasbooks.ufl.edu) or online at www.fleppc.org, or view the Weed Alerts at the BIPM web site: http://www.dep.state.fl.us/lands/invaspec/

Florida Lygodium Strategy: A Regional Approach in this issue), but the surveys have now expanded into all regions of Florida. As of December 2005, 62 project sites have been surveyed at 36 managed areas in 14 counties of north, central, and south Florida.

While the accumulated treatment information has not yet been analyzed, a few preliminary observations are beginning to surface. Some of these may seem obvious now. For example, ground treatment has been more successful on high-climbing Old World climbing fern stands when the plants first received a "poodle cut"—fronds were cut at roughly 3 ft. in height and the ground-level material pushed down to create a gap between it and the frond portions still hanging in the non-target woody vegetation. A foliar herbicide application is then used on the ground-level mat. The hanging frond portions (and their spores!) can be left to die in place. The created gap makes life more difficult for any new or re-sprouting fronds intent on climbing again into the canopy—there's no easy, continuous "ladder" of dead rachis to scramble up. And of course, follow-up treatment of live fronds can be more efficient when all of them are still near the ground.

Clambering stands of Japanese climbing fern rarely have received a similar initial cutting of high reaching fronds, but such a tactic may be useful. This species also uses dead or live rachis (as well as woody vine stems) to aid its climb into the understory, as observed on several occasions during surveys.

Another observation that has turned up from multiple sources is a caution about the use of Escort (metsulfuron methyl). While it provides an efficacy similar to Roundup or Rodeo (glyphosate) with generally less non-target damage, there is an important exception. When cabbage palms *(Sabal palmetto)* are sprayed with Escort, they may be severely stressed or killed. Use of this chemical probably should be avoided if you are spraying over or near cabbage palms.

A couple of strategies that may help with treatment for either species are: 1) Plan for a follow-up treatment sometime between 6 to 12 months after the initial treatment; the goal is to interrupt the reproductive cycle; 2) Cut climbing vines whenever possible. Clipping climbers can have constructive consequences: it will reduce the height from which spores will spread, and foliar treatment of remaining ground patches should result in less non-target damage.

Managers have suggested other factors that affect the success of a treatment, such as the skill and diligence of the applicator and the proper use of surfactants. Use of a rain-fast product with the herbicide/surfactant formulation also has been suggested for those "iffy" weather days when the timing of rain may be difficult to predict.

Some managers have voiced frustration when, even after multiple treatments, the acres infested still appear to be roughly the same. Use of the density ranking in the site evaluations has shown, however, that often the density of the pest plant has been greatly reduced within that acreage. Hence, we can see that progress has been achieved, if not our dream of near-eradication.

Information on treatment results is very valuable data to share. At least one water management district is already looking into similar evaluations for their *Lygodium* treatment sites. We hope to have the general results from the 100+ BIPM sites by the end of this year. For more on this project—or if you have a "magic mixture" for fern treatment to share—please contact clockhart@fnai.org.

Contact the author at CLockhart@fnai.org

Japanese Climbing Fern: The Insidious "Other" Lygodium

by Andrea N. Van Loan, Florida Division of Forestry and University of Florida School of Forest Resources and Conservation

"The first time I saw a climbing fern I was shocked, as if I'd opened a window and a trout had flown in."

These words from Hipps (1989) may describe the reactions of many when first observing either of the invasive climbing ferns found in the southeastern United States. This has been particularly true for Old World climbing fern (*Lygodium microphyllum*), for which initial shock has turned to horror as the species has spread rapidly and dramatically across southern and now central Florida. Japanese climbing fern (*Lygodium japonicum*), however, has spread with perhaps equal rapidity but less drama, creeping insidiously through the understory of mesic sites in northern, central, and now southern Florida, and gaining much of its early recognition from its close relationship to Old World climbing fern. This close relationship has almost certainly enhanced awareness of Japanese climbing fern, but has potentially served to diminish perceptions of its invasiveness and impact as well. While not typically found forming the dense, canopy-covering infestations seen with Old World climbing fern, and limited annually by freezing temperatures throughout much of its range, many aspects of the life history of Japanese climbing fern indicate the potential for this species to be both equally tenacious and more broadly pervasive regionally, though perhaps slightly less damaging on individual sites.

DESCRIPTION

Japanese climbing fern (*Lygodium japonicum* (Thunb.) Sw.) (Lygodiaceae), is a perennial, creeping or twining vine with a wiry, stem-like, brown rachis capable of indeterminate growth to 30 m (90 ft.), and slender, dark brown rhizomes. Leaves (pinnae) may be fertile or sterile, stalked, twice-compound, roughly triangular in outline, and 10-20 cm (4-8 in) long and wide, and a moderate to "yellowy" green color, turning rusty-brown after frost damage, but evergreen in South Florida (Figure 1). Leaflets (pinnules) are deeply lobed, dissected, with fertile leaflets bearing two rows of sporangia on an enrolled leaflet margin (Langeland and Burks 1998). Throughout much of its range, initial leaflet formation is sterile, with increasing formation of fertile leaflets as the growing season progresses. Spores are trilete, rusty-brown in color and mature from July through January in much of its range, and year-round in South Florida (Lott 2003). During peak spore-release in the fall and early winter, a rust-colored haze can be seen in heavily infested stands.

TED BODNER, COURTESY OF WWW.INVASIVE.ORG

Figure 1: Typical leaflets of Japanese climbing fern (Lygodium japonicum).

DISTRIBUTION AND HABITAT

In its native range of temperate and tropical eastern Asia, Australia, and the East Indies, Japanese climbing fern occurs in forest edges, open forests, and secondary forests at both lower and higher elevations (Ferriter 2001). Introduced to the United States as an ornamental plant around 1900, naturalized populations of Japanese climbing fern are now established in nine southeastern states, extending westward from Florida to eastern Texas and northward to North Carolina. The fern is also documented in Hawaii and Puerto Rico. In this range, Japanese climbing fern occurs primarily in mesic and temporally hydric areas, including floodplain forests, bottomland hardwood forests, marshes, wetlands, secondary woods, moist pinelands (especially flatwoods), limestone outcroppings, and disturbed areas such as road shoulders and rights-of-way (Clewell 1982, Nauman 1993, Langeland and Burks 1998), and may occur on more hydric and xeric sites to a limited extent. Established populations range from scattered, creeping stems to dense, tangled mats of up to 100% cover over many acres. Dense patches effectively eliminate native groundcover and understory vegetation and smother seedlings of overstory tree species (Figure 3). While the ecological requirements of Japanese climbing fern are poorly defined, its broad distribution indicates a tolerance for a range of environmental conditions, across sites with a mesic moisture regime (Langeland and Burks 1998, Ferriter 2001).

One factor which has likely prevented formation of the "dense arboreal blankets" in tree canopies as seen with Old World climbing fern is frost/freeze damage in sub-temperate and temperate climates (Zeller and Leslie 2004). Winter dieback of Japanese climbing fern fronds occurs to varying extents through the majority of its range in Florida, but from 5-30% of the foliage has survived in some northern Florida populations over each of the past three winters. Like Old World climbing fern, the plants remain evergreen below the frost line in Florida (Ferriter 2001,

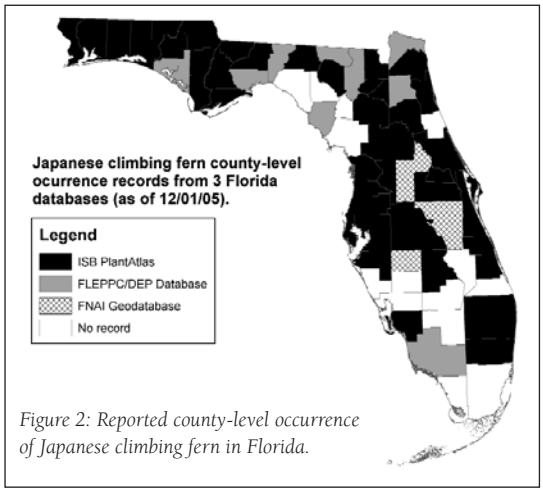


Figure 2: Reported county-level occurrence of Japanese climbing fern in Florida.

Valenta et al. 2001). In the spring, the fern will re-sprout from cold-tolerant subterranean rhizomes and often utilize freeze-damaged stems as ladders to grow back into the canopy. Plants are considered hardy in USDA plant hardiness Zones 7, 8, 9, and 10, and semi-hardy in Zone 6.

Japanese climbing fern has now been reported in 53 of Florida's 67 counties (Figure 2), with the heaviest infestations in northern and western Florida. This number reflects the herbarium-vouchered records from the ISB Atlas of Florida Vascular Plants (Wunderlin and Hansen 2003), as well as records in the FNAI Invasive Plant Geodatabase (FNAI 2005), and the FLEPPC/DEP land manager database (FLEPPC 2005). It is likely that infestations also exist in Taylor, Lafayette, Gilchrist, Levy and Flagler counties but have not yet been reported to any of these databases. Recognition of this plant has increased annually among public land managers since the mid 1990s, aiding in reporting, detection, and management, and the plant is now recognized as a threat to public conservation lands. Unfortunately, as is often true with invasive plants, private land owners and managers have been largely unaware of the plant's presence or that it's continued spread is of concern.

PRIVATE LANDS

A strategy that crosses property boundaries is required for successful management of most invasive species. In particular, the reproductive strategy (i.e. spore-dispersal, self-fertilization) of both the invasive climbing ferns facilitates rapid spread and establishment in remote areas (Lott 2003), and continual re-invasion if all populations in an area are not addressed jointly. The significance of private lands in management of Japanese climbing fern can be partially illustrated from a forestry perspective. According to Brown (1995), Florida has an estimated 14.7 million acres of timberland. 82% (12 million acres) is in the northern half of the State—the area most heavily impacted by Japanese climbing fern invasion, and 49% (7.2 million acres) is owned by private, non-industrial forest landowners.

Figure 3: Heavily infested pine plantation in Northwest Florida.

A very gross indication of Japanese climbing fern invasion on these lands might be derived from a 2002 survey conducted across 280 pine plantations in northern and western Florida in which seven non-native invasive plant species were recorded. Japanese climbing fern was recorded in 22% of slash pine plantations (flatwoods sites), and 3.8% of longleaf pine plantations (sandhill sites). If we only look at slash pine plantations (5.1 million acres in North Florida), and use the 22% occurrence figure for Japanese climbing fern in slash pine plantations, a value of 1.1 million acres of slash pine plantation with Japanese climbing fern occurrence *could* be calculated. However, occurrence in a plantation does not equate to occurrence over an acre, and this value serves only as a coarse indicator of what is a very large private land and plantation forest problem.

CURRENT CONTROL TECHNOLOGY

Figure 4: Typical Puccinia lygodii *damage on climbing fern foliage in Northwest Florida, 11/2004.*

Current control technologies recommend either glyphosate (e.g. Roundup or other) or metsulfuron methyl (e.g. Escort) applied foliarly (Valenta et al. 2001, Zeller and Leslie 2004) during the growing season, preferably prior to the maturation and release of the greatest spore load in the fall and early winter. These recommendations are further supported by preliminary results from herbicide trials evaluating 15 common forestry and vegetation management herbicides conducted on Japanese climbing fern in a heavily infested pine plantation in Northwest Florida. In general, glyphosate treatments have yielded both better long-term control (70-80% reduction in fern cover at one year after treatment), and slightly greater non-target damage than was seen with metsulfuron methyl. When finalized, results from the most recent evaluation may serve to expand and clarify the efficacy of several commonly used herbicides.

A species of foliar rust fungus (*Puccinia lygodii* (Har.) Arth. (Uredinales)) has been isolated from Japanese climbing fern in Louisiana, and several locations in North and Central Florida. The fungus, native to South America, causes severe damage to the leaflets, including necrosis, browning, and drying (Rayachhetry et al. 2001), and has been observed to be increasing in distribution and impact in North Florida climbing fern populations (Figure 4). The impact of this fungus on climbing fern in North Florida has been most noticeable in early winter (i.e., November and December), when varying levels of damage have been observable on approximately 95% of foliage in some forest stands in Calhoun County.

REGULATORY ISSUES

In 1999, Japanese climbing fern was designated as a noxious weed (Rule 5B-57.007, FAC) by the Florida Department of Agriculture and Consumer Services (FDACS), making it unlawful to introduce, cultivate, transport, or release any living stage of the fern without a permit. This designation has been an important part in the process of raising awareness among private forestland managers and members of the forest products industry in Florida. In particular, some members of the pinestraw industry have received scrutiny for sale of pinestraw bales intended for mulch that contained pieces of climbing fern frond. As a result, Rule 5B-57 has been utilized in multiple cases since 2001 where Japanese climbing fern was a contaminant in pinestraw. Notable cases include the rejection of contaminated pinestraw sold to Eglin Air Force base in 2001 and 2004, the prevention of the sale in Florida of multiple tractor-trailer loads of contaminated pine straw in 2004, and the removal of contaminated pine straw product found at a home-improvement store in 2004 (Clark, personal communication). However, the regulatory agency charged with implementing this Rule, the FDACS-Division of Plant Industry, does not have adequate resources to incorporate surveys of pine plantations into field inspectors' schedules, particularly in areas of the state where the pinestraw industry is most prominent. Therefore, enforcement of the Rule occurs primarily in response to violations reported by individuals outside the agency. FDACS and the University of Florida Institute of Food and Agricultural Sciences have provided focused training to members of the pinestraw industry to aid in compliance with the Rule. As with all such issues, some members of the industry have worked voluntarily to comply since 2001, while others continue to harvest pinestraw from infested stands. Japanese climbing fern has recently been recognized as "spreading at an alarming rate" in Georgia (Evans and Moorhead 2005), but it is not yet designated as a noxious weed by the Department of Agriculture in that state. Currently, Alabama is the only other state that designates Japanese climbing fern as a noxious weed.

CONCLUSION

"Although I'm sure the same thing was once said of kudzu and Japanese honeysuckle, I simply can't believe that this lovely vine will ever pose a threat to the world as we know it." (Hipps 1989)

These words from a horticulturist in north Alabama may have an unfortunately prophetic significance as Japanese climbing fern continues to spread with time. As with so many invasive plants, kudzu and Japanese honeysuckle have gone from being widely promoted and intentionally spread by humans to being recognized as problematic invasive plants. As the inadvertent spread of Japanese climbing fern through human activity continues, concurrent with natural spore dispersal, a similar widespread effect may result. Even if climate, biology, education, and management combine to restrict the range of Japanese climbing fern, experiences in Florida indicate that this plant is likely to continue to spread in the southeastern United States, impacting understory plant communities and their associated inhabitants.

References available from the author at vanloaa@doacs.state.fl.us

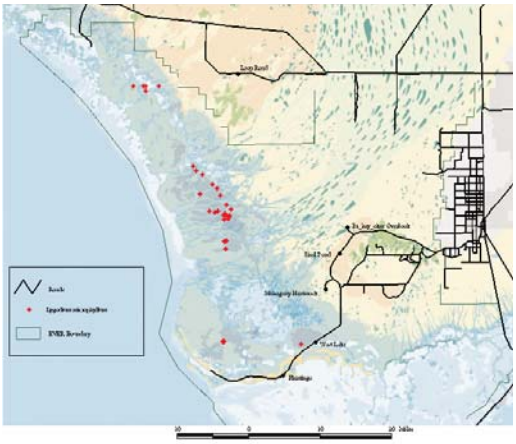
Remote Infestations of *Lygodium microphyllum*: A Case Study at Everglades National Park

by Jonathan Taylor, Everglades National Park

Lygodium (*Lygodium microphyllum*) or Old World climbing fern was first found in Everglades National Park in 1999. At that time, the gross infested area was estimated at 200 acres. Since 1999, the Park has aerially treated 3,650 acres of lygodium. However, despite these efforts, Old World climbing fern has expanded its range. Treatments with both prescribed fire and herbicide have suppressed the formation of dense stands and reduced above ground biomass. Nevertheless, in 2005, the gross infested area was estimated at 10,000 acres.

Every two years systematic reconnaissance flights (SRF) have been used to track the distribution of lygodium. Informal reconnaissance is conducted randomly by Everglades National Park employees, researchers, and volunteers. In addition, reconnaissance flights are flown prior to aerial treatments to prioritize sites and evaluation flights are flown post-treatment to evaluate treatment efficacy.

Old World climbing fern is found predominantly in remote western portions of the Everglades National Park from Cape Sable to Everglades City. The most affected areas are best described as coastal sparsely wooded prairies dominated by sawgrass (*Cladium jamaicense*), spartina (*Spartina bakeri*) and juncus (*Juncus roemerianus*). Old World climbing fern germinates readily on the tussocks created by these species. Lygodium grows upon the mangroves and hardwoods that delineate the affected prairies, but the infestations do not appear to start in these wooded areas. In 2003, very small discrete populations of the fern were found and treated at the base of melaleuca trees (*Melaleuca quinquenervia)* and within two tree islands in northeast Shark River Slough. In 2005, an individual plant was found and treated in Mahogany Hammock.



2001

Aerial herbicide application is currently the best treatment method for Old World climbing fern. Infested areas are remote and access to them is almost uniquely limited to helicopters. Landing ground crews to treat the infestations is problematic since most of the affected areas do not have suitable landing sites for helicopters. For those areas that do have relatively suitable landing sites, ground crews could only work under the driest of conditions. Even then, it is unclear how long the deep peat soils could reasonably support sustained foot traffic between infested areas and the landing site. The dense vegetation would be an additional hurdle the work crews would have to overcome.

From 1999 to 2002, aerial treatments of lygodium involved the use of Rodeo (glyphosate). While lygodium was controlled, all native plants also were killed and the treated areas were re-colonized

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Other – For subjects that don't conveniently fit into another category

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almost exclusively by lygodium. Native plants have not recovered in Rodeo treated areas. Therefore, in 2003 a request was made to the Florida Exotic Pest Plant Council to convene a meeting of the Lygodium Task Force to seek advice on alternative herbicides that would be more selective. The meeting concluded with a recommendation to use the herbicide Escort (metsulfuron methyl), known to be somewhat selective in sparing grasses and some broadleaf woody species.

Since 2003, Escort has been used to effectively treat Old World climbing fern. Grass species have not been noticeably affected. Woody species scattered in the prairies or around the fringes of the treatment areas (e.g., bay trees (*Persea* spp.), wax myrtle (*Myrica cerifera*) and buttonwoods (*Conocarpus erectus*)), appear unharmed. However, non-target affects were not completely avoided. Both native ferns and cabbage palms (*Sabal palmetto*) were killed by Escort treatments. Nonetheless, Escort has proven better than other herbicides.

Contact the author at Jonathan_E_Taylor@nps.gov

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Lygodium Research in Progress

PROJECT TITLE	LOCATION	PROJECT LEADER	RESEARCH OBJECTIVES	CONTACT INFORMATION
Biological Control of *Lygodium microphyllum*	Southern Florida	Robert W. Pemberton	Discover, permit, mass rear, and release biocontrol agents for *L. microphyllum.* Also evaluating impact of established biocontrols in different communities	Invasive Plant Research Laboratory USDA–Agricultural Research Service 3225 College Ave. Ft. Lauderdale, FL 33314 bobpem@saa.ars.usda.gov
Lygodium microphyllum: functional basis for geographical variations	Southern Florida and Queensland, Australia	John Volin	Evaluate the ecophysiology and soil characteristics of field-grown *L. microphyllum* in Florida and its native range. Evaluate physiological and hormonal processes regulating *L. microphyllum* growth.	Department of Biological Sciences Florida Atlantic University 2912 College Avenue Davie, FL 33314 jvolin@fau.edu
Detailed *Lygodium* Assessment in the Everglades Protection Area	Water Conservation Area 2B/3, Broward Co., FL	John Volin and Mary Ann Furedi	Survey *L. microphyllum* infestations in WCA-3A and WCA-2B.	
Evaluation of new and current herbicides to treat *Lygodium microphyllum*	Alachua Co., FL	Jeff Hutchinson and Ken Langeland	Herbicide trials to find more efficient control of *L. microphyllum*.	University of Florida–IFAS Center for Aquatic and Invasive Plants 7922 NW 71 St. Gainesville, FL 32653 (352) 392-9981 JTHutchinson@ifas.ufl.edu
Evaluation potential of *Lygodium microphyllum* resistance to the acetolactate synthase herbicide, metsulfuron methyl (Escort XP)	Alachua Co., FL	Jeff Hutchinson and Ken Langeland	Expose *L. microphyllum* spores to different rates of metsulfuron methyl and other herbicides to determine if herbicide resistance can occur.	
The effects of repeated aerial herbicide application on *Lygodium microphyllum* and native vegetation	Palm Beach Co., FL	Jeff Hutchinson and Ken Langeland	Three year study of target and non-target responses to aerial herbicide (glyphosate and metsulfuron methyl).	
Translocation of herbicides in *Lygodium microphyllum*.	Alachua Co., FL	Jeff Hutchinson and Ken Langeland	Isotope tracing study to determine movement of herbicides (glyphosate, metsulfuron methyl, and triclopyr) in *L. microphyllum*.	
Lygodium microphyllum: Herbicide Field Trials	Jonathan Dickinson State Park, Martin Co., FL	Philip Myers	Field evaluations of the herbicides Rodeo, Escort and Plateau on *L. microphyllum* control.	Division of Recreation and Parks, Florida Department of Environmental Protection 13798 SE Federal Hwy. Hobe Sound, FL 33455 (561) 546-0900
Control of Japanese climbing fern in North Florida forests	Calhoun County, FL	Andrea Van Loan and Greg MacDonald	Evaluation of 16 herbicide treatments for efficacy in reducing cover of *L. japonicum* in North Florida forests.	Florida Division of Forestry P.O. Box 147100 Gainesville, FL 32614 (352) 372-3505 ext. 429 vanloaa@doacs.state.fl.us
Evaluation of Site Characteristics Associated with Varying Levels of *L. japonicum* Invasion in North Florida forests	North Florida (Santa Rosa, Liberty and Calhoun Counties)	Andrea Van Loan and Jarek Nowak	Studying site characteristics and environmental conditions associated with *L. japonicum* in three forest types.	
Effect of Common Agricultural Quarantine Treatments on *L. japonicum* Spore Germination Levels	Alachua County, FL	Andrea Van Loan	Evaluation of fumigation, heat, and herbicide treatments on *L. japonicum* spore germination rates.	

Internodes

Mark your calendar

- Association of Southeastern Biologists (ASB) Annual Meeting, **March 29 – April 1, 2006,** Gatlinburg, TN. www.asb.appstate.edu/
- Florida Vegetation Management Association Annual Meeting, **April 19-21, 2006,** Daytona Beach, FL.
- Florida Exotic Pest Plant Council (FLEPPC) Annual Meeting, **April 24-26, 2006,** Gainesville, FL. www.fleppc.org
- UF-IFAS Aquatic Weed Control Short Course, **May 1-5, 2006,** Coral Springs, FL. http://conference.ifas.ufl.edu/aw/
- 14th International Conference on Aquatic Invasive Species, **May 14-19, 2006,** Key Biscayne (Miami), FL. www.icais.org/
- Florida Native Plant Society (FNPS) Annual Conference, **May 18-21, 2006,** Daytona Beach, FL. www.fnps.org
- Southeast Exotic Pest Plant Council (SE-EPPC) Annual Conference, **May 23-25, 2006,** Raleigh, NC. www.se-eppc.org
- Weeds Across Borders 2006, **May 25-28, 2006,** Hermosillo, Sonora, Mexico. www.desertmuseum.org/borderweeds/
- Florida Lake Management Society (FLMS) Annual Meeting, **June 5-8, 2006**, St. Augustine, FL. www.flms.net
- Aquatic Plant Management Society (APMS), Annual Meeting, **July 16-19, 2006,** Portland, OR. www.apms.org

Nodes of Interest

- Celebrity spokesperson? Well-known actor **Tommy Lee Jones** appeared on the **David Letterman** show recently and made an unexpected pitch for exotic pest plant control. Apparently, Jones has property in Florida that he has restored to a native habitat. He explained to Letterman how invasive exotic plants were a problem and even named Melaleuca and Old World climbing fern. When Letterman asked why the exotic plants were a problem, Jones described how native plants came back once the invasive exotics were removed. Way to go, Mr. Jones!
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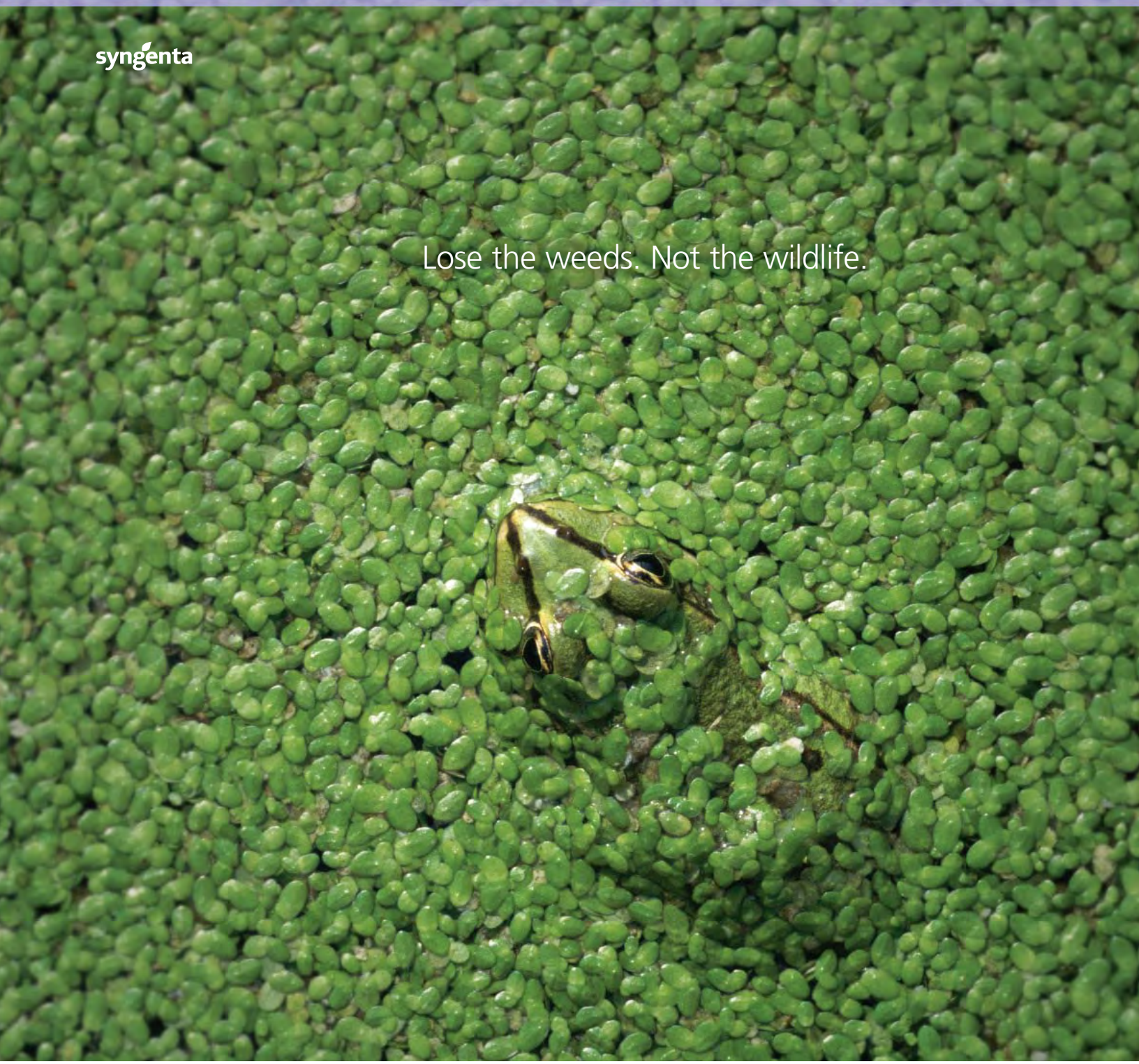
Publications & Web Sites

- *Conservation Management Notes* is an online forum for Florida land managers to report observations, discoveries, lessons, hints, tips, and mistakes not to be repeated. It is a free and open exchange of information to aid in management of natural lands. You can browse it, search it, submit articles to it or just visit it at http://nata.snre.ufl.edu/notes
- M.A. Nunez and D. Simberloff. 2005. Invasive species and the cultural keystone species concept. *Ecology and Society* **10**(1): r4. [online] URL: http://www.ecologyandsociety.org/vol10/iss1/resp4/ "We believe that the CKS [cultural keystone species] concept could hinder biological conservation if we consider how exotic species can influence human cultures."
- Species Invasions: Insights into Ecology, Evolution, and Biogeography by D.F. Sax, J.J. Stachowicz, and S.D. Gaines, eds. 2005. Sinauer Associates, Inc., Publishers (www.sinauer.com). "Several key advances emerge in each discipline, and collectively they provide a template for new research that transforms invasion biology into a powerful tool for basic research in ecology, evolution, and biogeography." (Editor's note: includes fauna as well as flora.) $49.95



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