Invasive Exotic Species and Control Workshop

Presented by the

Big Scrub Cooperative Invasive Species Management Area and
Florida Forest Stewardship Program

April 21, 2017; 9:00 am to 3:00 pm ET
UF/IFAS Marion County Extension Auditorium
2232 NE Jacksonville Rd; Ocala, FL 34470

Thanks for joining us today to learn about identifying and controlling some of the most troublesome invasive exotic plants like **cogongrass**, **Japanese climbing fern**, **Old World Climbing fern**, **Chinese tallowtree** and others. We'll also address exotic animals, such as **feral hogs**, that are causing big headaches for forestry and agricultural producers. **Earn pesticide applicator CEUs and forestry CFEs** and connect with partnership and assistance opportunities!

Agenda:

9:00 am	**Sign-in, meet & greet**
9:15	**Welcome & introduction**, Mark Shuffit, UF/IFAS Marion County Extension and Chris Demers, UF/IFAS School of Forest Resources and Conservation (SFRC)
9:30	**Herbicide safety and application techniques**, Mark Shuffit, UF/IFAS Marion County Extension
10:30	**Break**
10:45	**Invasive exotic plant species ID and control techniques**, John Kunzer, Florida Fish and Wildlife Conservation Commission
12:00 pm	**Lunch**
1:00	**Removing Feral Hogs**, J.C. Griffin, USDA Animal and Plant Health Inspection Service
1:50	**Partnerships and Cost-share assistance**, Megan Mann, UF/IFAS Lake County Extension and Jill Dobbs, USDA Natural Resources Conservation Service
2:20	**Reporting and Assistance Tools**, Rose Godfrey, SFRC
2:50	**Evaluation, CEUs, CFEs, adjourn**

FDACS CEUs approved: Please fill out your CEU attendance record this morning and the provider will sign the record after the workshop.
SAF CFEs approved: Foresters, please make sure you signed in on the CFE sign-in sheet.

Funding for this workshop is provided by the USDA Forest Service through the Florida Department of Agriculture and Consumer Services Florida Forest Service and the Florida Sustainable Forestry Initiative Implementation Committee.

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We appreciate the support of our

2017 Florida Forest Stewardship Program Sponsors

-listed on the back cover-

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Questions about this or other Forest Stewardship Program activities can be directed to Chris Demers at (352) 846-2375 or by email at cdemers@ufl.edu. For more information and events see the UF Forest Stewardship web site at:

http://www.sfrc.ufl.edu/forest_stewardship

Got Invasives?

Invasive exotic plant problem? Find a program to help by using FloridaInvasives.org.

The Florida Invasive Species Partnership has collected, evaluated and categorized assistance programs into a single resource, making it easier to find the financial and/or technical assistance available to Florida landowners to prevent or control invasive exotic species problems. FloridaInvasives.org has an online resource of management assistance programs to help in your fight against problematic plant species. This resource takes the guesswork out of finding the agencies or organizations offering assistance and will direct you to available programs. The Landowner's Incentives Database will also provide the requirements for each program, to help you decide if they are a good match for your needs.

Why was FloridaInvasives.org developed?

Invasive species have been identified as being costly ecologically and economically statewide in Florida. The Florida Invasive Species Partnership (FISP) is a collaboration of public and private entities in Florida, formed to link efforts at preventing and controlling invasive exotic plants across agency and property boundaries. FISP has developed an on-line tool of available financial and technical assistance sources to make it easier for landowners and land managers to find them.

How does FloridaInvasives.org help you?

FISP has created a searchable database, the Florida landowner incentives database, accessible at FloridaInvasives.org that allows you to find an assistance program for your needs. Search by your county, target species or other pertinent information into the online tool, and you will retrieve a current list of available programs. Floridainvasives.org will help provide focus to your search so that you can get the right person at the right program.

FloridaInvasives.org:

- Builds community awareness,
- Leverages limited resources through cooperation and
- May reduce individual land management costs.

This resource will be regularly updated with the most current program information to provide you the most up-to-date opportunities.

Go to FloridaInvasives.org to find out more.

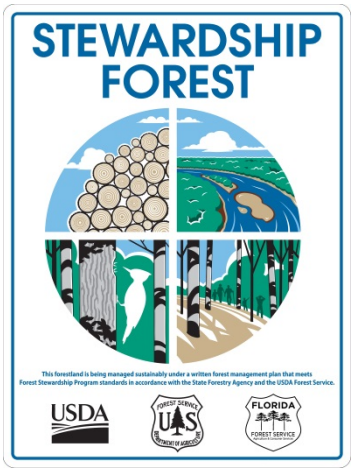
Species Shown from top to bottom:
Mexican Petunia, Boston Fern, Mimosa, Cogongrass, Camphor

FISP
Florida Invasive Species Partnership

Think Locally, Act Neighborly

invasive species know no boundaries!

Florida's Forest Stewardship Program



Forest Stewardship is active management of forest land to keep it in a productive and healthy condition for present and future generations, and to increase the economic, environmental and social benefits of these lands. Forest Stewards are landowners who manage their forest lands on a long-term basis by following a multiple resource management plan.

The Forest Stewardship Program addresses the improvement and maintenance of timber, wildlife, soil and water, recreation, aesthetics, as well as forage resources.

Eligibility

Private forest landowners with at least 20 acres of forest land and a desire to manage their ownerships according to Stewardship principles can participate in the Forest Stewardship Program. Also, adjacent landowners, with similar management objectives, may combine their holdings to meet this acreage limitation.

Benefits to Landowners

- A customized management plan that is based on the landowner's objectives. The plan will include forest stand characteristics, property maps, management recommendations, and a five-year time line for future planning. This plan also serves as documentation of active management on the property that may help reduce tax liability.
- An opportunity for public recognition as a certified "Forest Steward".
- Educational workshops, tours and the quarterly Florida Land Steward newsletter developed and distributed by the University of Florida, IFAS Cooperative Extension Service and other partners.

How to Enroll

Contact your local Florida Forest Service County Forester and tell them that you would like to have a Forest Stewardship Plan prepared for your property. More information and application online at: **http://FreshFromFlorida.com/ForestStewardship**

Tree Farm Program

The American Tree Farm System® is a program of the American Forest Foundation and was founded in 1941 to promote the sustainable management of forests through education and outreach to family forest landowners. Nearly 26 million acres of privately owned forestland and 80,000 family forest landowners in 46 states are enrolled in this program and committed to excellence in forest stewardship. About half of all Tree Farms are located in the South.

Eligibility

Private forest landowners with at least 10 acres of forest land and have a desire to manage their ownerships according to sustainable forestry guidelines can participate in Tree Farm.

Benefits to Landowners

Tree Farmers are good stewards of their forestland committed to protecting watersheds and wildlife habitat and conserving soil. They manage their forestland for various reasons, including timber production, wildlife, recreation, aesthetics, and education/outreach. Tree Farmers receive many benefits:

- Representation on local, state, and federal issues affecting forestland owners.
- Exposure to a network of forestry professionals and landowners committed to sustainable forestry.
- Invitations to workshops, tours and the quarterly Florida Land Steward newsletter produced by University of Florida IFAS and other partners.
- Certification that meets international standards of sustainable forest management.
- Participation in local, state, regional, and national Outstanding Tree Farmer of the Year awards and recognition.

Getting into the Program

Contact your local Florida Forest Service County Forester and tell them that you would like to join the Tree Farm program. More information here:

https://www.treefarmsystem.org/florida

Reporting and Assistance Tools

Invasive Exotic Species Control Workshop
Big Scrub CISMA/Forest Stewardship Program
April 21, 2017

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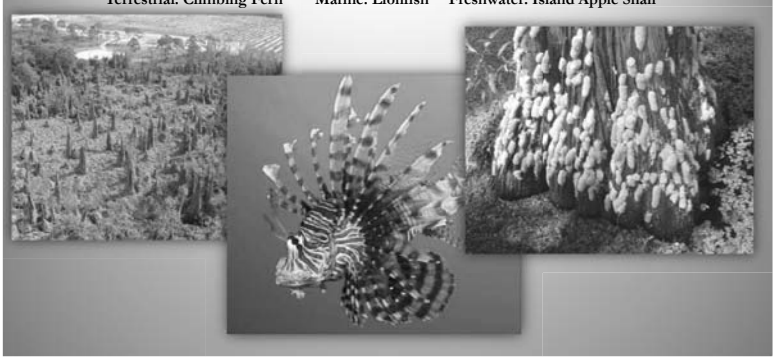
Invasive Non-Native Species

Terrestrial: Climbing Fern Marine: Lionfish Freshwater: Island Apple Snail



FISP Mission Statement

- ***Improve the efficiency and effectiveness of preventing and controlling invasive non-native species***
- ***Partnering to increase communication, coordination and use of shared resources.***
- ***Protect wildlife habitat, working agricultural and forest lands, natural communities and biodiversity in Florida.***

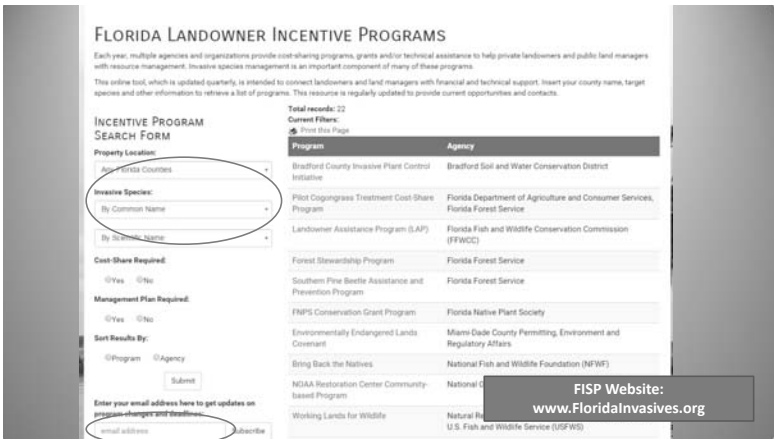
FLEPPC CISMA Session 2015

FISP Goals

- Build Partnerships
- Provide tools and resources
- Encourage innovative approaches

Everglades CISMA – Joint Work Day

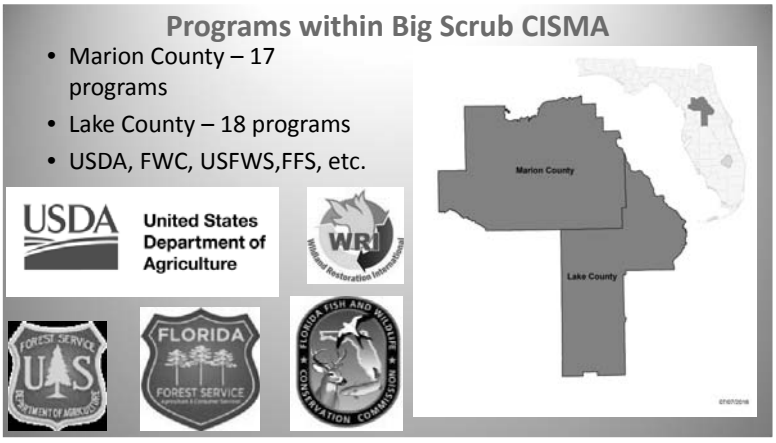
FISP Website: www.FloridaInvasives.org

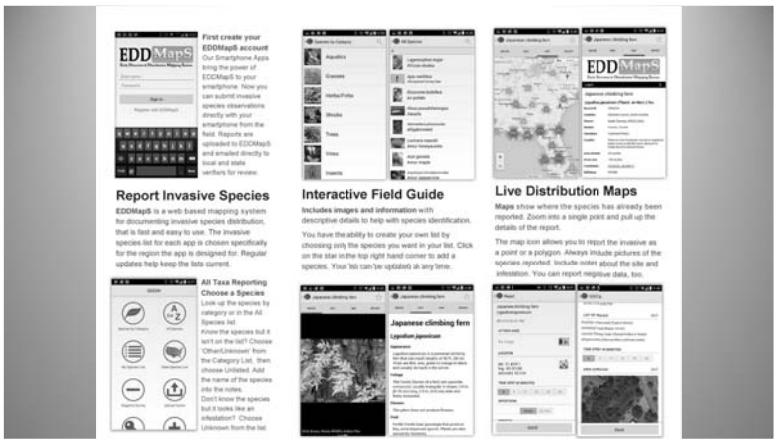


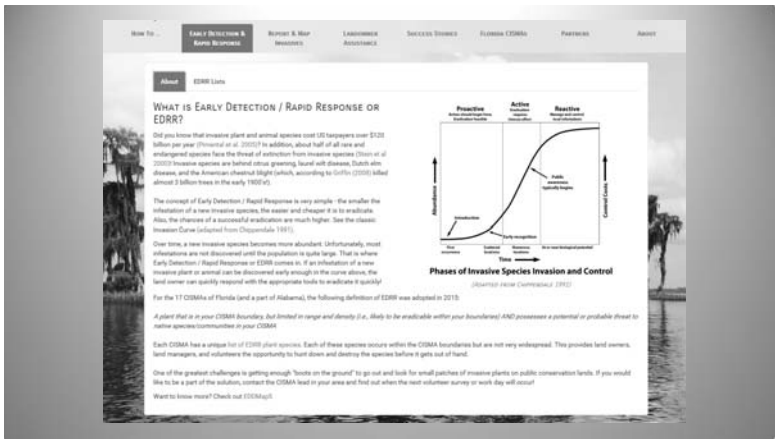
FISP Website: www.FloridaInvasives.org

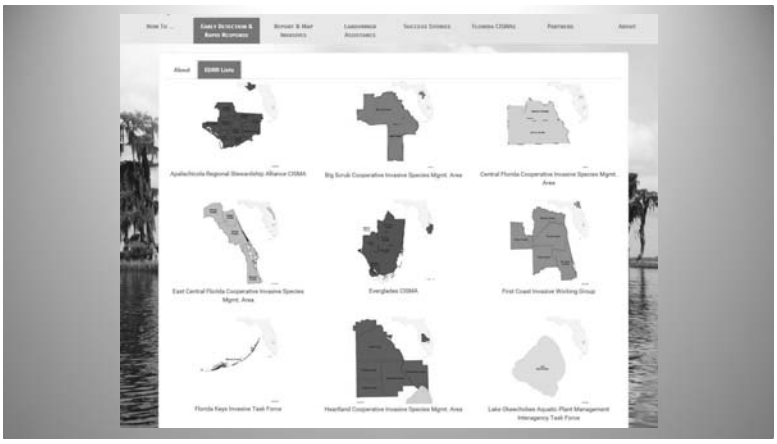
Programs within Big Scrub CISMA

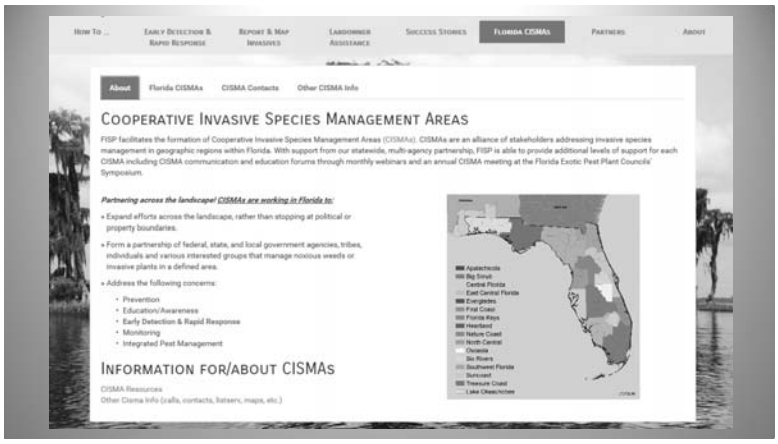
- Marion County – 17 programs
- Lake County – 18 programs
- USDA, FWC, USFWS,FFS, etc.

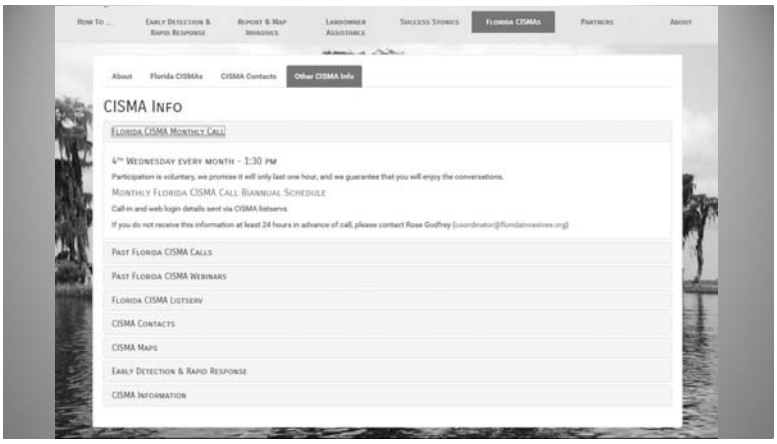


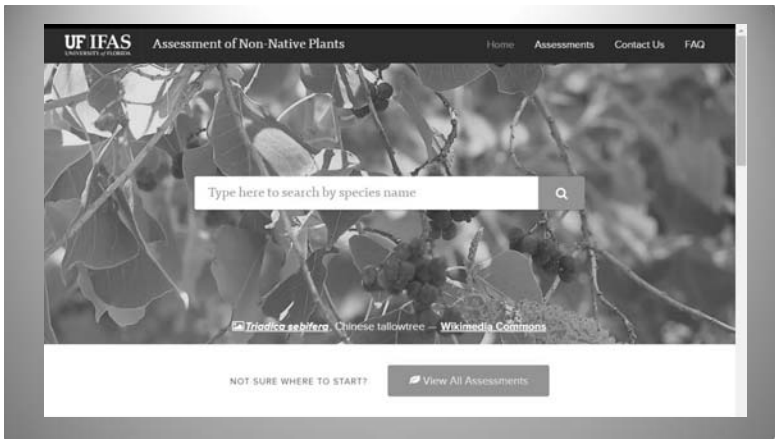




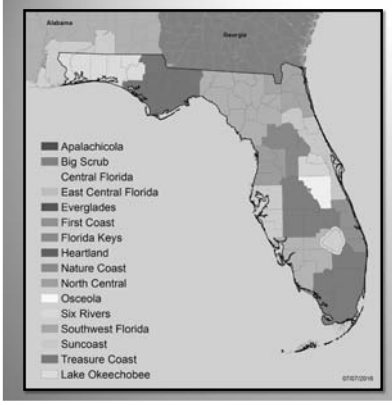








What Can You Do To Help?!



- **Get involved with your local CISMA.**
- **Use the www.floridainvasives.org resources.**
- **Report invasive species on EDDMapS.**

Questions?

Rose Godfrey, rosa23@ufl.edu

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Find out more and get connected

FISP/CISMA Newsletters and Event Tracking
www.floridainvasives.org/success.html

CISMA Listserv: Click on "Florida CISMA Listserv"
www.floridainvasives.org/cismas.html

CISMA Monthly Calls: If you would like to see any past calls, please check them out on the FISP website
www.floridainvasives.org/cismacalls.html

FISP Facebook:
https://www.facebook.com/floridainvasives.org

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SS-AGR-260

Herbicide Application Techniques for Woody Plant Control[1]

Jason Ferrell, Stephen Enloe, and Brent Sellers[2]

The encroachment of trees and other woody plants into pastures, fencerows, ditch banks, rights-of-way, and other areas is a common occurrence. These woody species can be particularly troublesome and require control since they will compromise fence integrity, vehicle safety, impede canal drainage, interfere with transmission of electricity. Additionally, some species (such as cherry trees) are highly poisonous to livestock. The aim of this publication is to detail the techniques for the removal of woody plants. For information on controlling similar species in natural areas or in forestry settings, consult UF/IFAS publications SP242, *Integrated Management of Nonnative Plants in Natural Areas of Florida* (http://edis.ifas.ufl.edu/wg209) and Circular 1477, *Primer on Chemical Vegetation Management in Florida Pine Plantations* (http://edis.ifas.ufl.edu/fr160).

Control of woody perennials can be difficult, but several control techniques are available. Mowing is a commonly used control procedure for small brush because the equipment is readily available and the results are immediate. However, this method generally provides only short-term success because it leaves live stumps and root-stocks that re-sprout. Mowing some species, like Chinese tallow, worsens the situation by replacing a single stemmed plant with a stump with multiple re-sprout stems. Another strategy that can reduce some troublesome species is fire. However, fire can be tricky to manage, and it is difficult to generate a fire with sufficient heat capacity to kill most hardwood species along fencerows, ditch banks, and other sites with low plant density.

Herbicides are often the most effective and inexpensive means of controlling woody plants. There are several application techniques that can be used to control trees and brush of various sizes. Not all brush species are equally susceptible to herbicides. Therefore, results may vary for any of these application methods, relative to brush size and species. Each application technique will be subsequently discussed.

Foliar Application

Foliar application directs an herbicide/water mixture directly onto the leaves of a plant (Figure 1). This technique can be highly effective on smaller species (6 to 8 feet in height). Auxin-type herbicides (such as triclopyr) are generally most effective early in the season, while enzyme-inhibiting herbicides (imazapyr and others) are most effective in the late summer or fall. Glyphosate is most effective in late summer or fall, prior to change in leaf color for deciduous species.

1. This document is SS-AGR-260, one of a series of the Agronomy Department, UF/IFAS Extension. Original publication date January 2006. Revised December 2015. Visit the EDIS website at http://edis.ifas.ufl.edu.

2. Jason Ferrell, professor; Stephen Enloe, associate professor, Agronomy Department; and Brent Sellers, associate professor, Agronomy Department, Range Cattle Research and Eduation Center; UF/IFAS Extension, Gainesville, FL 32611.

Figure 1. Foliar application with a backpack sprayer.
Credits: Stephen Enloe, UF/IFAS

Adequate control with foliar applications can be difficult to accomplish. This is because complete coverage of all foliage is essential for control, but over-application (which leads to spray runoff) will reduce effectiveness. Therefore, foliar applications commonly require multiple follow-up treatments before control is accomplished. It is important to control spray drift when making foliar applications. Certain desirable hardwood and crop species are highly sensitive to spray drift and can be inadvertently damaged. It is also advisable to include a tracer dye with the spray solution to ensure that some plants are not sprayed twice while others are missed entirely.

What about mowing before treatment? Mowing decreases foliage while maintaining a large root mass, making control even more difficult. If plants have been mowed, it is important to allow them to regrow to a height of 3 or 4 feet before herbicide application.

Basal Application

Basal application combines the herbicide with an oil penetrant and applies the mixture directly to the bark of a standing tree. For trees that are less than 6-inches in diameter and have smooth bark, this method is frequently successful. However, it is important that the lower 12 to 18 inches of the stem be treated on all sides with the herbicide/oil mixture (Figure 2). Adequate coverage is essential, since treating only one side of the stem will result in controlling only half of the tree. Basal applications can be made any time of the year, but control may be reduced when trees are flushing new growth in the spring. Winter is often the easiest time to do basal treatments as temperatures are cooler and many tress and surrounding herbaceous plants are dormant.

Basal applications will not provide rapid control. Herbicide injury is often not observed for several weeks after treatment, and complete control may require several months. Additionally, basal treatment is not effective on older trees greater than six inches in diameter or trees with very thick bark. For these situations, other application techniques should be employed.

Figure 2. Basal bark application with herbicide/oil mixture.
Credits: Stephen Enloe, UF/IFAS

Hack and Squirt

The hack-and-squirt technique is ideal for control of large trees that cannot be managed with basal applications. This method requires that you use a machete or hatchet to cut through the thick bark and into the sapwood. The hacks should be made at a downward angle of approximately 45 degrees. This will create a "cup" to hold the herbicide solution. If the hack does not hold herbicide solution, the treatment will not be effective. Most labels specify 0.5 to 1.0 ml of solution per hack. This is important to note, as small spray bottles commonly sold in garden supply stores may apply as much as 3.5 ml per stroke. This makes accurate application very difficult, but the most important aspect is not to overfill the hack. The recommended spacing of hacks around the circumference of the tree is specified on the herbicide label and may be described as slightly overlapping, continuous, or evenly spaced. (Figure 3) The addition of a basal oil is not recommended for this procedure.

This method of application is advantageous because it is highly selective and injury to surrounding species is not common. It can also be done at any time during the year,

but effective treatment of some species in the spring can be reduced because of heavy sap flow pushing the herbicide from the cut surfaces. Finally, the hack and squirt method should only be used where dead standing trees are acceptable from an aesthetic and safety standpoint. Therefore, it is not recommended along roadsides or in parks where hazard trees cannot be tolerated.

Figure 3. Hack-and-squirt application technique.
Credits: Stephen Enloe, UF/IFAS

Cut Stump

This technique is employed after cutting a tree to eliminate, or greatly reduce, resprouts from the stump or lateral roots. The herbicide should be applied to the cut surface as quickly as possible after the sawdust has been removed. If applied immediately, an herbicide/water solution is sufficient. If herbicide treatment is delayed and the cut surface has begun to dry, an herbicide/basal oil mixture must be used instead and applied to the top and around the collar of the stump.

For stumps greater than 3 inches in diameter, thoroughly wet the outer edge while avoiding herbicide runoff (Figure 4). This is because the only living tissue in larger trees is around the outer edge. Covering the entire cut surface will require more herbicide, most of which will provide little effect. For smaller stems it is appropriate to cover the entire cut surface (Figure 5). For this procedure, herbicides can be applied using a backpack sprayer, squirt bottle, or paint brush. Regardless of how the herbicide is applied, a tracer dye should be included to ensure treatment of all individual stumps.

Figure 4. Application of herbicide to larger cut stumps only requires treatment of the outer edge.
Credits: Stephen Enloe, UF/IFAS

Figure 5. Application of herbicide to smaller stumps requires complete coverage.
Credits: Stephen Enloe, UF/IFAS

Table 1. Recommended herbicides for each application procedure.

Herbicide	Application Rate	Comments
Foliar Application		
Imazapyr (Arsenal, others)	1–3%	Excellent control of sweetgum and maples. Use higher rates for oaks and cherry. A non-ionic surfactant is required.
Glyphosate (Several)	5–8%	Cover as much of the foliage as possible and spray until wet. If the brush has been cut, delay application for approximately 1 year. Retreatment is commonly required control.
triclopyr + 2,4-D (Crossbow)	1–1.5%	For control of various herbaceous and woody species. This product contains 2,4-D ester; precautions to manage drift must be employed. Repeat applications are often required.
Triclopyr ester (Remedy Ultra, others)	0.5–2%	Best when applied in late spring or early summer. If the brush has been cut, delay application for approximately 1 year. Thoroughly wet all leaves, but not to the point of runoff.
Triclopyr + fluroxypyr (Pasturegard HL)	2–4 qt/100 gal of spray	
Aminocyclopyrachlor Method 240 SL	8–16 oz/100 gal of spray	For best results, apply near the top of the tree and allow the spray to trickle down into the canopy. Full coverage of canopy is necessary, but do not allow runoff. Apply with 1% v/v methylated seed oil (MSO).
Aminopyralid Milestone	0.25–0.75% solution	For control of a wide variety of woody plants. For best results, mix with glypohosate (3-5%) and imazapyr (0.5%) or triclopyr at 1% plus a surfactant. Do not exceed 7 oz/A of Milestone.
Basal Bark		
Imazapyr (Stalker, others)	8–12 oz/gal	Best for trees less than 4 inches DBH (diameter at breast height). Be aware that imazapyr is highly active in the soil. If desirable plants are near to a treated individual, it is possible for the herbicide to wash off into the soil and injure or kill the desirable plant. Make sure to choose an imazapyr product that is soluble in basal oils.
Aminocyclopyrachlor Method 240 SL	10–20% solution	Best for trees less than 6 DBH. Spray until run-off at the ground line is noticeable. This herbicide significant soil activity, so be aware that desirable trees in the vicinity may be injured by these applications.
Triclopyr ester (Pathfinder)	100%	Pathfinder is a "ready to use" product that is formulated and dosed correctly for this type of application. Apply Pathfinder at 100% strength as directed.
Triclopyr ester (Remedy Ultra or others)	25% + 75% basal oil	Best for trees less than 6 inches DBH. Generally most effective 6 weeks prior to leaf expansion, until 2 months after. Most effective on trees with smooth bark. Thick bark trees may require retreatment. These herbicides have little or no soil activity.
Triclopyr + fluroxypyr (Pasturegard HL)	25% + 75% basal oil	
Hack-and-Squirt		
Imazapyr 4 lb/gal (Arsenal AC)	6 oz/gal	One hack per 3 inches DBH.
Triclopyr amine (Garlon 3A, others)	50–100%	One hack per 3 or 4 inches DBH. Apply 0.5 ml undiluted herbicides or 1 ml of 50% solution in water.
Hexazinone (Velpar)	100%	One hack per 4 inches DBH. Use undiluted herbicide.
Glyphosate (several)	50%	1 ml per 2 or 3 inches DBH, applied below the branches. For larger trees, best results are observed from applying glyphosate in a continuous frill around the stem.
Aminopyralid (Milestone)		Make a series of slightly overlapping hacks around the trunk. Apply 1 ml of the solution per hack.

Cut Stump		
Imazapyr (Arsenal AC or Stalker)	6 oz/gal (for Arsenal AC) or 8-16 oz/gal (for Stalker)	Apply to the top and side of a freshly cut stump. Garlon 3A is excellent for this use. If surface of stump has began to dry prior to herbicide treatment, apply Chopper or triclopyr ester product in basal oil or recut the stump and apply to the freshly cut surface. Garlon 3A will not effectively mix with basal oils.
Triclopyr amine (Garlon 3A)	50–100% in water	
Triclopyr ester (Remedy Ultra or others)	25% solution in water or basal oil	
Triclopyr + fluroxypyr (Pasturegard HL)	25% solution in water or basal oil	
Aminocyclopyrachlor Method 240 SL	5–10% solution in basal oil	Spray the stump surface and thoroughly wet the cambium layer all the way around.
Glyphosate (several)	50–100%	Apply to cut stumps immediately after cutting. Glyphosate is not effective on stumps that have started to dry after cutting. If immediate treatment is not possible, other herbicides should be selected since glyphosate will not mix with basal oils.
Aminopyralid (Milestone)	10%	Apply solution to cambium area around the entire circumference of the stump. Apply immediately after cutting.

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SS-AGR-52

Cogongrass (*Imperata cylindrica*) Biology, Ecology, and Management in Florida Grazing Lands[1]

B. A. Sellers, J. A. Ferrell, G. E. MacDonald, K. A. Langeland, and S. L. Flory[2]

Cogongrass is found on every continent and is considered a weedy pest in 73 countries. In the U.S., cogongrass is found primarily in the Southeast. It was accidentally introduced into Alabama in the early 1900s, and purposely introduced as a potential forage and soil stabilizer in Florida (and other states) in the 1930s and early 1940s. However, soon after investigations began it was realized that cogongrass could be a weedy pest. Since its introduction, cogongrass has spread to nearly every county in Florida. In some cases, it has completely taken over pastures so that it is the only species present. This is a common thread where cogongrass invades; it quickly displaces desirable species and requires intensive management.

There are many reasons why cogongrass is such a prolific invader. It is a warm-season, perennial grass species with an extensive rhizome root system. In fact, at least 60% of the total plant biomass is often found below the soil surface. In addition to the rhizome root system, cogongrass adapts to poor soil conditions, and its fires burn so hot that they eliminate nearly all native species. Cogongrass is drought tolerant and has prolific wind-dispersed seed production. Additionally, it can grow in both full sunlight and highly shaded areas, although it is less tolerant to shade.

Cogongrass spreads through its creeping rhizome system and seed production. The rhizomes can penetrate to a depth of 4 feet, but most of the root system is within the top 6 inches of the soil surface. The rhizomes are responsible for long-term survival and short-distance spread of cogongrass. Long-distance spread is accomplished through seed production. Seeds can travel by wind, animals, and equipment. Seed viability is significant in north Florida and other states of the Southeast; however, there are no confirmed cases of viable seed production in central and south Florida.

An established cogongrass stand invests heavily in its perennial root system. These infestations are capable of producing over 3 tons of root biomass per acre. This extensive network of rhizomes is capable of conserving water while the top growth dies back during prolonged drought. This is essentially a survival mechanism to keep the rhizome system alive. Another key to cogongrass invasion is that the root system may produce allelopathic chemicals that reduce the competitive ability of neighboring plants.

Identification

Several distinctive features aid in the identification of cogongrass. First, cogongrass infestations usually occur in circular patches. The grass blades tend to be yellow to green in color (Figure 1). Individual leaf blades are flat and

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2. B. A. Sellers, associate professor, Agronomy Department, Range Cattle Research and Education Center; J. A. Ferrell, professor; G. E. MacDonald, professor; K. A. Langeland, professor; and S. L. Flory, assistant professor, Agronomy Department; UF/IFAS Extension, Gainesville, FL 32611.

serrated, with an off-center prominent white midrib (Figure 2). The leaves reach 2–6 feet in height. The seed head (Figure 3) is fluffy, white, and plume-like. Flowering typically occurs in spring or after disturbance of the sward (mowing, etc.). Seed heads range from 2 to 8 inches in length and can contain up to 3,000 seeds. Each seed contains silky-white hairs that aid in wind dispersal. When dug, the rhizomes (Figure 4) are white, segmented (have nodes), and are highly branched. The ends of the rhizome are sharp pointed and can pierce the roots of other plants.

Figure 1. Cogongrass plants are yellow to green in color. Note that the edges of the leaf tend to have more yellow than green.
Credits: G. Keith Douce, University of Georgia, www.forestryimages.org.

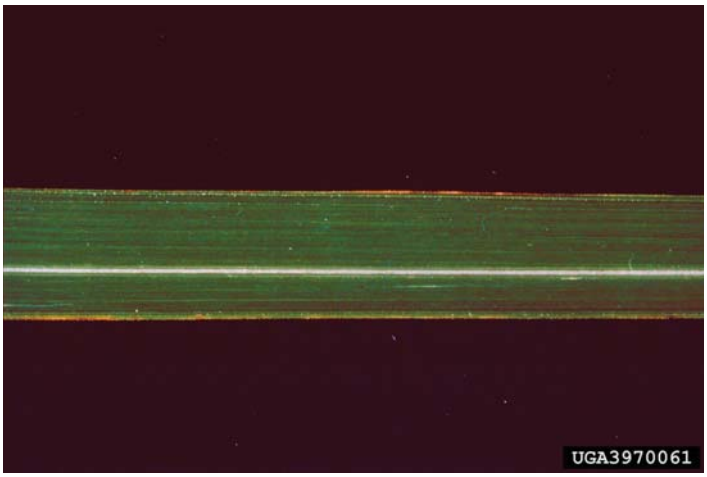

Figure 2. Cogongrass leaves have serrated edges and a prominent, white, off-center midrib.
Credits: L. M. Marsh, Florida Department of Agriculture and Consumer Services, www.forestryimages.org.

Figure 3. Cogongrass seed heads are fluffy and white. Each plant produces nearly 3,000 seeds.
Credits: John D. Byrd, Mississippi State University, www.forestryimages.org.

Figure 4. Cogongrass rhizomes are segmented (have nodes) where new shoots are able to grow.
Credits: Chris Evans, River to River CWMA, www.forestryimages.org.

Forage Value

Cogongrass has been used in Southeast Asia as forage because it is the dominant vegetation on over 300 million acres. In these areas it was found that only very young shoots should be grazed or cut for hay. At this stage, the leaves lack sharp points and razor-like leaf margins. For about four weeks following a prescribed burn, crude protein of regrowth is comparable to bahiagrass. Crude protein of mature stands rarely attains the minimal 7% level needed to sustain cattle, making supplementation essential for livestock production. Cogongrass yields are relatively

low, even under heavy fertilization, and usually do not exceed 5 tons per acre.

Management

For many years researchers all over the world have studied cogongrass control. During this time nearly all available herbicides have been tested, but few effective products have been found. For example, all of the commonly used pasture herbicides such as metsulfuron, 2,4-D, triclopyr, Velpar, and other combinations have little to no activity on cogongrass. Only glyphosate (Roundup, etc.) and imazapyr (Arsenal, Stalker, etc.) herbicides have been found to be effective, but long-term control is rarely achieved.

Imazapyr is an extremely effective herbicide that controls a variety of weeds, from herbaceous to woody species. One or two applications of imazapyr (0.75 lb/acre) will often effectively control cogongrass for 18–24 months. However, there are several disadvantages to using this herbicide. First, imazapyr will severely injure or kill forage grasses such as bermudagrass and bahiagrass. It also has a long soil half-life and will remain in the soil for several months after application. This often leads to "bare ground" for up to 6 months in the application area because of the non-selective nature of this herbicide. Imazapyr also has the potential to move down slopes during periods of rainfall, killing or injuring other species in the runoff area (oaks and other hardwood trees are especially sensitive). Second, imazapyr can only be used as a "spot-treatment" with no more than 10% of the pasture area treated per year.

Similarly, glyphosate is also a non-selective herbicide that effectively controls a variety of weeds. Unlike imazapyr, glyphosate possesses very little to no soil activity. Non-target effects caused by runoff during high rainfall events are not likely. Since glyphosate has no soil activity, it does not take very long for weeds or desirable grasses to reinfest the treated areas. Cogongrass will likely reinfest the area if only one application of glyphosate is applied during the same year. Research in Alabama has revealed that it takes approximately three years of two applications per year to reduce cogongrass rhizome biomass by 90%.

Small Infestations

Early detection of cogongrass in any setting is extremely important. A young infestation will be much easier to treat and eradicate than established infestations. In this case, we would define a small patch as 20–30 feet or less in diameter. Even for a small patch, monitoring is required after the initial application to ensure that any re-sprouting is quickly treated. See Table 1 for specific timelines and suggested herbicide rates.

Large Infestations

Large infestations are 30 feet or larger in diameter. These types of infestations can be considered as established and likely have a large, intact root system. This will require more herbicide treatments to completely eradicate cogongrass. See Table 2 for specific timelines and suggested herbicide rates.

Integrated Management

Herbicide inputs alone are rarely successful in eradicating perennial species like cogongrass. In these cases, we need to use all of the tools we have to remove an unwanted species to reestablish a desirable species. This type of strategy is best employed in an area where cogongrass has long been established and is the predominant species present. See Table 3 for specific timelines and suggested herbicide rates.

In general, burn the area infested with cogongrass in August to September. One to four months later, treat the burned area with a mixture of imazapyr and/or glyphosate. Take soil samples prior to spring tillage the next growing season to ensure that the soil pH is adequate for your desirable forage species. Till the treated area the following spring to a depth of at least 6 inches and prepare a seedbed.

Consult with your local county Extension agent to consider your options for forage cultivars and fertility recommendations. Getting a good start on the desirable forage will help limit cogongrass reinfestations in your pasture. Continue to monitor this area in six-month intervals until the fourth year. Spot treat with glyphosate when necessary to remove any new cogongrass growth.

Table 1. Herbicide suggestions for small infestations of cogongrass in grazing areas. This includes both improved and native rangeland. These concentrations are good for mixing in small (3–30 gallon) sprayers. Please read the entire label of the suggested products prior to treating existing cogongrass stands.

	Timing	Herbicide Rate	Application Notes
1st year	Fall (August–November)	1% Arsenal/Stalker + 0.25% non-ionic surfactant	Treat only 10% of the area to be grazed. No grazing restrictions, but do not cut for hay for 7 days. Read the herbicide label for mixing instructions.
		3% glyphosate	No grazing or haying restrictions. Read the herbicide label for mixing instructions.
		0.5% Arsenal/Stalker + 2% glyphosate + 0.25% non-ionic surfactant	Treat only 10% of the area to be grazed. No grazing restrictions, but do not cut for hay for 7 days. Read the herbicide label for mixing instructions.
2nd year	Spring (monitor regrowth)	2–3% glyphosate	See above.
	Fall (monitor regrowth)	2–3% glyphosate	See above.
3rd year–until eradicated	Spring–Fall (monitor regrowth)	Spot treat at the above rates for the 2nd year.	

Table 2. Herbicide suggestions for large cogongrass infestations in grazing areas, including both improved and native rangeland. These suggestions are intended for large (>1000 gallon) sprayers. Please read the entire label of the suggested products prior to treating existing cogongrass.

	Timing	Herbicide Rate	Application Notes
1st year	Fall (August–November)	48 oz/acre Arsenal/Stalker + 0.25% non-ionic surfactant	Treat only 10% of the area to be grazed. No grazing restrictions, but do not cut for hay for 7 days. Read the herbicide label for mixing instructions.
		3 to 4 qt/acre glyphosate	Do not graze for 8 weeks. Read the herbicide label for mixing instructions.
		24 oz/acre Arsenal/Stalker + 2 qt/acre glyphosate + 0.25% non-ionic surfactant	Treat only 10% of the area to be grazed. No grazing restrictions, but do not cut for hay for 7 days. Read the herbicide label for mixing instructions.
2nd year	Spring (monitor regrowth)	2–3% glyphosate	No grazing or haying restrictions.
	Fall (monitor regrowth)	2–3% glyphosate	No grazing or haying restrictions.
3rd year–until eradicated	Spring–Fall (monitor regrowth)	Spot treat at above rates for the 2nd year.	See above.

Table 3. Control of cogongrass using an integrated approach. Adjust your timelines based on your location in Florida. For example, burning should be performed earlier in north Florida than in south Florida because of the first onset of a potential killing frost. Please read all herbicide labels prior to treating cogongrass for restrictions and mixing instructions.

	Timing	Herbicide Rate	Application Notes
1st year	Summer—Fall (August–November)	1. Burn	Cogongrass fires burn extremely hot. Be sure to have firebreaks in place before attempting to burn cogongrass.
		2. Apply herbicide: 24 oz/acre Arsenal/Stalker + 2 qt/acre glyphosate + 0.25% non-ionic surfactant	Treat only 10% of the area to be grazed. No grazing restrictions, but do not cut for hay for 7 days. Read the herbicide label for mixing instructions.
		3. Take soil samples.	Have the soil pH tested at a reputable laboratory. Amend the soil as needed to grow desirable forage.
2nd year	Spring	1. Tillage	Prepare a seedbed for desirable forage species. Repeated tillage will help to desiccate any remaining cogongrass rhizomes.
		2. Plant desirable forage.	Please consult your local Extension agent for up-to-date recommendations on forage cultivars and fertility recommendations.
3rd year	Spring (monitor regrowth)	2–3% glyphosate	No grazing or haying restrictions.
	Fall (monitor regrowth)	2–3% glyphosate	No grazing or haying restrictions.
4th year–until eradicated	Spring–Fall (monitor regrowth)	Spot treat at the above rates for the 3rd year.	See above.

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FOR 218

Biology and Control of Japanese Climbing Fern *(Lygodium japonicum)*[1]

Patrick J. Minogue, Stella Jones, Kimberly K. Bohn, and Elsa D. Chevasco[2]

Japanese climbing fern (*Lygodium japonicum* (Thunb.) Sw.) is a non-native, invasive vine that from its introduction around 1900 has become established throughout the southeastern Coastal Plain from the Carolinas to Texas and Arkansas. It is native to eastern Asia from Japan and west to the Himalayas. The naturalized area has expanded from the Gulf States region to include TX, AR, LA, MS, AL, FL, GA, SC, NC, and PA (USDA Plant Database 2016). In Florida, climbing fern is widespread in north and west Florida and ranges into the south-central part of the Florida peninsula (Nelson 2000; Wunderlin et al. 2016). It occurs in sunny or shady locations, usually in damp areas such as the edges of swamps, marshes, lakes, creeks, hammocks, and upland woodlands (Langeland and Cradock Burks 1998).

Biology

Japanese climbing fern has climbing, twining fronds of indeterminate growth and can reach lengths of 90 feet. Above-ground growth occurs along wiry main stems, properly called "rachises" (the singular is "rachis"). Japanese climbing fern is closely related to Old World climbing fern (*Lygodium microphyllum*), another non-native invasive species in the United States. Both species are listed as Category I noxious weeds by the Florida Exotic Pest Plant Council, with the ability to "alter native plant communities, change community structures and ecosystem function" (FLEPPC 2016). Japanese climbing fern is also listed as a Class B noxious weed in Alabama (USDA Plants Database 2016). Japanese climbing fern has feathery, light green fronds in contrast to the leathery appearance of Old World climbing fern, which usually has un-lobed leaflets that are glabrous (waxy) below and articulately stalked. While Old World climbing fern is limited in its northern range due to a lack of frost tolerance. Japanese climbing fern occurs as both individual scattered plants and as tangled masses of dense canopy that can eliminate the underlying vegetation and cover larger trees. As a fern, it reproduces by spores that are extremely numerous, long-lived, and readily disseminated. Moreover, it can reproduce by self-fertilizing. Pinnae on lower rachises are sterile; but as the rachis develops, successive new pinnae become increasingly fertile. Spore abundance increases through the growing season as the rachis grows. In north Florida, peak spore release occurs in October (Van Loan 2006). Japanese climbing fern also spreads vegetatively by rhizomes located 1 to 3 cm below the soil surface.

Rhizomes spread and re-sprout after winter frosts, and the fern rapidly grows back from rhizomes after being burned (Evans et al. 2006). However, no studies have reported the spread rates of fern by these vegetative means.

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Figure 1. Japanese climbing fern, a common invasive plant in pine plantations of the Coastal Plain, has climbing, twining fronds that can grow to 90 feet long.
Credits: Ronald F. Billings, Bugwood

Figure 2. Japanese climbing fern is distinguished by its feathery, light green fronds, with triangular, compound leaf branches (pinnae) and lobed, stalked leaflets (pinnules) on wiry, twining, stems (rachises), often orange to brown in color.
Credits: Ted Bodner, Bugwood

Japanese climbing fern poses both economic and ecological threats to forests in Florida. It is especially problematic in pine plantations managed for pine straw production. For years, pine straw bales have been a suspected vector of viable Japanese climbing fern plant parts and spores (Zeller and Leslie 2004).

The fern is also problematic during prescribed burning because it provides a fuel ladder to canopy trees. Further, because of its ability to engulf and out-compete native vegetation, Japanese climbing fern can be of particular concern in natural and disturbed areas where restoration of remnant populations of native species is critical.

Figure 3. Prescribed fire alone has not been successful in controlling Japanese climbing fern, which is a ladder fuel that allows fire to climb into the forest canopy, potentially worsening the severity of wildfire and compromising the safety of prescribed burning programs.
Credits: Chuck Bargeron

Control Measures

Biological

Currently there are no published or on-going studies regarding biological control of Japanese climbing fern in the southeastern United States. Progress has been made, however, to identify selective biological control agents for Old World climbing fern (Pemberton 1998). In 2007, populations of the defoliating moth from Australia, *Austromusotima camptozonal* were released at nine locations of Old World climbing fern in Florida (Pemberton 2007). Breeding was detected at three locations, but there was no evidence of persistence or establishment of the insect. Researchers at the USDA Invasive Plant Research Laboratory (IPRL) in Ft. Lauderdale, Florida, are examining several other insect species as well, including lygodium gall mite (*Floracarus perrepae*), lygodium saw fly (*Neostrombocerus* sp.), flea beetles (*Manobia* sp.), and stem borers. The caterpillar stage of *Neomusotima fuscolinealis* is a natural pest of *Lygodium japonicum* in Japan but has yet to be tested for potential host range and environmental safety in Florida or the southeastern United States (Pemberton 2002).

Fire

Fire is not thought to be an effective means for control because the fern re-grows quickly following fires. A few researchers have examined the use of fire to control Old World climbing fern with little success (Munger 2005). Stocker et al. (1997) used a propane torch to burn off above-ground portions of Old World climbing fern and found that the ferns recovered speedily. Regarding efforts to

control Old World climbing fern, Roberts (1997) concluded that fire alone will not control this invasive weed. Control of other invasive species with significant above-ground and below-ground biomass such as cogongrass (*Imperata cylindrica*) has been enhanced by using prescribed fire in conjunction with herbicide application (Jose et al. 2002). However, citing a personal communication, Ferriter (2001) stated that prescribed burns, alone and in combination with the herbicide 2,4-D, were not effective in controlling Japanese climbing fern in pine plantations in north Florida. More research is needed to examine the combined use of herbicides and fire to control existing climbing fern plants and those that may arise from numerous spores.

Figure 4. The three patches of light green vegetation among the dark green junipers in this landscaping are infestations of Japanese climbing fern, which was introduced from commercial pine straw.
Credits: Pat Minogue, UF/IFAS

Herbicides

Herbicidal control of Japanese climbing fern has only been formally investigated by a few researchers (Valenta et al. 2001; Zeller and Leslie 2004; Van Loan 2006; Minogue et al. 2010). In a review of herbicide treatments for Old World climbing fern, Langeland (2016) noted that glyphosate and metsulfuron methyl, used alone or in combination, were most common. The effectiveness of glyphosate treatments was observed in early studies of Japanese climbing fern, however it was also noted that metsulfuron treatments were least damaging to surrounding native vegetation, particularly graminoids (Zeller and Leslie 2004; Minogue et al. 2010). Van Loan (2006) examined 15 herbicide treatments for selective control of Japanese climbing fern in three north Florida pine forests. She had best results using glyphosate, imazapyr, and metsulfuron methyl, herbicides that inhibit the formation of amino acids in plants. Minogue et al. (2010) and Bohn et al. (2011) examined these same herbicides for efficacy in controlling Japanese climbing fern and for their impact on associated vegetation using various herbicide rates and combinations at locations on conserved lands in north Florida. Early control of Japanese climbing fern improved linearly as the glyphosate product rate was increased from 1 percent to 4 percent of the spray solution, with nearly 100 percent cover reduction at 8 months after treatment using the 4 percent rate. However, at two years after treatment 5 to 16% cover was observed across the glyphosate rates, and they did not differ in effectiveness. Given that re-treatment was needed to control re-sprouting plants and new germinates, use of a 2% glyphosate solution was recommended to reduce costs and potentially avoid adverse effects to associated vegetation.

Combinations of glyphosate and metsulfuron methyl were generally more effective than combinations of glyphosate and imazapyr. Damage to associated vegetation, including overstory hardwood trees not sprayed with herbicide, was greatest with the persistent soil active herbicide imazapyr. Least injury to associated vegetation was with metsulfuron methyl. Native grasses quickly re-colonized treated plots at some locations. Miller (2007) recommends various herbicide treatments for control of Japanese climbing fern (see Table 1). When using metsulforon methyl (Escort®), be sure to add a surfactant (wetting agent) according to label directions to improve plant uptake. From operational experience, best results are obtained with application of these herbicides in late-season, from July to early October, prior to peak spore release.

The use of trade names in this publication is solely for the purpose of providing specific information. UF/IFAS does not guarantee or warranty the products named, and references to them in this publication do not signify our approval to the exclusion of other products of suitable composition. All chemicals should be used in accordance with directions on the manufacturer's label. Use pesticides safely. Read and follow directions on the manufacturer's label.

PLEASE READ AND FOLLOW ALL HERBICIDE LABEL DIRECTIONS.

Figure 5. Fertile leaflets (pinnules) are contracted in shape with two rows of sporangia along the leaf margin. The light brown spores are nearly microscopic.
Credits: Pat Minogue, UF/IFAS

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Table 1. Herbicide control measures adapted from Miller (2007). Foliage must be thoroughly covered with the spray, but avoid spray contact by desirable plants.

Escort® XP[1] (metsulfuron methyl)	1–2 oz product /acre	Mix 0.3 to 0.6 dry oz per 3 gallons water, or as a mixture with 0.3 oz Escort plus 2% Roundup in 3 gallons wa 3 ga ga 3RRoundup
Roundup®[2] (glyphosate)	2% product in water	Mix 2.6 fluid oz. per gallon water
Roundup®[2], Garlon® 3A[3], or Garlon® 4[4] (triclopyr)	4% product in water	Mix 5.2 fluid oz. per gallon water

[1]Escort® XP contains 60% metsulfuron methyl as the active ingredient.

[2]Roundup® contains 4 lb. active ingredient glyphosate per gallon.

[3]Garlon® 3A contains 3 lb. active ingredient per gallon as an amine salt of triclopyr.

[4]Garlon® 4 contains 4 lb. acid equivalent triclopyr ester per gallon as the active ingredient.

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SS-AGR-21

Natural Area Weeds: Old World Climbing Fern (*Lygodium microphyllum*)[1]

Kenneth A. Langeland, Stephen F. Enloe, and Jeffery Hutchinson[2]

There are many well-known invasive plants in Florida such as melaleuca, Brazilian peppertree, and cogongrass. Each of these has been present for over 80 years and has widespread negative impacts within the State. However, a species known as Old World climbing fern has greatly increased over the last thirty years in Florida and may become the greatest invasive plant threat to Florida's natural areas. Old world climbing fern, hereafter referred to as OWCF, is an aggressive, twining fern that forms dense smothering mats over trees, shrubs, and other vegetation (Figure 1). It spreads by wind-dispersed spores and is often found in very remote areas, making containment very difficult. This publication describes the biology and ecology of this invasive plant and provides management options for both public land managers and private landowners.

Figure 1. Old World climbing fern spreads along the ground, over shrubs, and climbs by twining around other structures, such as trees and vines.

How to Recognize Old World Climbing Fern

OWCF plants consist of fronds (up to 90 feet long) that spread along the ground, over shrubs, or climb by twining around other structures, such as trees and other vines (Figure 1). The rhizomes (underground stems) and rachis (main stem of the frond) are dark brown to black and wiry. Leafy branches, referred to as pinnae, develop off the rachis and are 2–5 inches long (Figure 2). Pinnae contain several

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pairs of either fertile or infertile leaflets known as pinnules. Fertile leaflets are fringed with tiny lobes of enrolled leaf tissue along the leaf margin that cover the reproductive tissues (Figure 3). Infertile leaflets lack these specialized reproductive structures. OWCF is closely related to Japanese climbing fern (*Lygodium japonicum*) but can be readily distinguished by pinnae and pinnule characteristics. Japanese climbing fern pinnae are often twice compound, and pinnules are deeply lobed and hairy on the lower surface. OWCF pinnae are once compound, and pinnules are oblong, generally unlobed, and hairless on the lower surface.

Figure 2. Leafy branches (pinnae) of Old World climbing fern are 2–5 inches long with several pairs of leaflets (pinnules). The leaflets are sterile in this case.
Credits: Richard Roberts

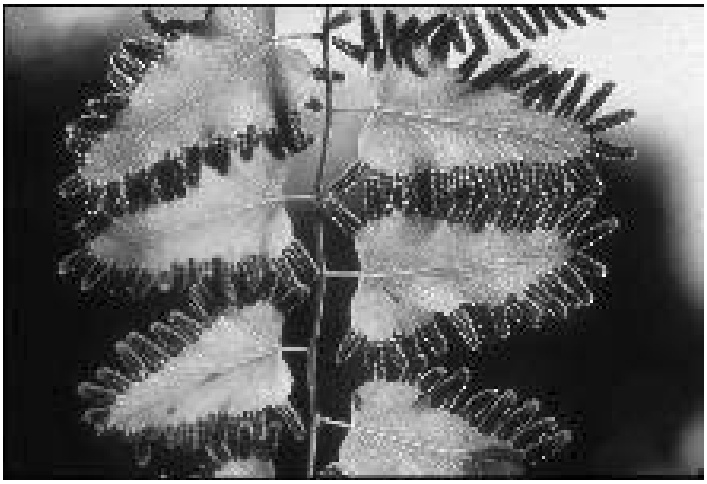

Figure 3. Fertile leaflets (pinnules) of Old World climbing fern are fringed with tiny lobes of enrolled leaf tissue along the leaf margin that cover the reproductive tissues.
Credits: Richard Roberts

Distribution and Spread

Native to Africa, Asia, and Australia, OWCF is a newcomer to Florida that has spread at an alarming rate since its introduction. The first record in Florida was collected from a plant in cultivation at a Delray Beach nursery in 1958 (University of Florida Herbarium record). Subsequently, a collection was made from the wild in Martin County in 1960 (Florida State University Herbarium record), and two additional collections were made from the wild in Martin County in 1965 (University of Florida Herbarium record). By 1978, it was well established and had already affected native vegetation by smothering shrubby and herbaceous plants in south Florida (Nauman and Austin 1978).

New OWCF populations are found in areas far from existing populations because the fern can reproduce by wind-dispersed spores. Spores are produced year-round in south Florida, and a single fertile leaflet can produce up to 28,600 spores, with each spore capable of starting a new population at a distant location (Lott et al. 2003; Volin et al. 2004). Area coverage of the fern increased from 27,000 acres in 1993 to 122,787 acres in 2005 . There are no more recent estimates of OWCF acreage than 2005. However, mapping efforts continue and new locations are frequently detected.

For many years, OWCF distribution was limited to south Florida and the most northern occurrence was Orange County (Pemberton 2003). However, occurrences now extend from the southern-most peninsula of Florida to Hernando County on the Gulf Coast and Duval County on the Atlantic Coast (EDDMapS 2016). OWCF occurrences verified by herbarium-vouchered specimens are reported by the University of South Florida Institute for Systematic Botany and can be accessed at http://www.florida.plantatlas.usf.edu (Wunderlin and Hansen 2008).

Impacts to Natural Areas

OWCF climbs into the tree canopy and competes with canopy trees and understory vegetation for light. It can completely engulf Everglade tree islands (Figure 4), pinelands, and cypress swamps, and spreads across open wetland marshes. It can kill mature trees along with their associated epiphytic orchids and bromeliads, and smother understory vegetation, preventing regeneration of the native plant community. As time progresses, a thick mat of old fern material accumulates on the ground, severely altering the habitat. When fire occurs, the fern carries fire into the tree canopy, causing greater damage and transporting fire through wet areas that otherwise present a boundary to the spread of fire. Rare plant species, such as the tropical curlygrass fern (*Actinostachys pennula*) and thin-leaved vanilla orchid (*Vanilla mexicana*), are threatened in their last remaining habitats, such as northern Everglade tree islands and coastal bay swamps. However, the highest potential for

significant damage to native plant populations is in areas such as Fakahatchee Strand State Preserve, Everglades National Park, and Big Pine Key National Wildlife Refuge, where numerous rare plants occur.

Figure 4. Old World climbing fern smothering a tree island in the northern section of the Arthur R. Marshall Loxahatchee National Wildlife Refuge in Palm Beach County.

Invasive Characterization and Regulatory Status

The IFAS Assessment and the Florida Exotic Pest Plant Council consider Old World climbing fern to be highly invasive within the State. Old World climbing fern is also regulated (possession, propagation, sale, and transportation) by the Florida Department of Agriculture and Consumer Services (FDACS) as a Florida Noxious Weed (5B-57.007 FAC) and by the United States Department of Agriculture (USDA) as a Federal Noxious Weed.

Management

Prescribed fire, flooding (water level management), biological controls, and herbicides have been investigated as tools for integrated management of OWCF (Hutchinson et al. 2006). Fire can reduce OWCF in certain habitats but can also result in colonization by other nonnative plant species (Hutchinson and Langeland 2010). Prescribed fire alone in most instances is not an acceptable management tool for OWCF (Hutchinson et al. 2006). OWCF grows in moist habitats, so water level interval and duration can affect certain life stages; however, flooding has not been found to be a predictable management method (Hutchinson et al. 2006). Since the late 1990s, when serious OWCF management efforts began, herbicides have been used to manage OWCF, and biological controls have been released and are currently being monitored.

Herbicides

Herbicide products that contain the active ingredients glyphosate, triclopyr, metsulfuron, and imazapic are active against OWCF. Recent research found that repeated treatment every six months for two consecutive years resulted in a >96% reduction in OWCF cover (Hutchinson and Langeland 2015). This study also found that OWCF recovery was initially from rhizomes at 6 months after initial treatment. However, almost all OWCF recovery at 12 months after initial treatment and beyond was from spore germination. The bottom line is that an aggressive multi-year treatment approach is necessary to effectively control OWCF.

The primary herbicides used by professional land managers are aquatic labeled glyphosate and metsulfuron products. Triclopyr is not commonly used, especially for broadcast application, because of the spectrum of non-target species that it affects. Imazapic is not routinely used due to a lack of products registered for application in aquatic systems. This lack of many effective control tools results in repeated use of the same herbicides for several years. This has raised concerns about resistant OWCF populations developing as a response to repeated use of glyphosate and metsulfuron (Hutchinson, MacDonald, and Langeland 2007). Use of glyphosate and metsulfuron, along with triclopyr, should be alternated when possible to minimize the potential for development of resistance.

Operationally, expansive OWCF populations are treated initially by helicopter. Small and scattered populations are spot treated, usually with a backpack sprayer or hand-held application equipment. If fronds extend up into trees where herbicide cannot be applied to all the foliage, the fronds are cut at about waist height, and herbicide is applied to the lower (rooted) portion. This is referred to operationally as a "poodle cut" due to the appearance after cutting. Treated populations should be monitored for regrowth and retreated as necessary. Treated sites should be revisited a minimum of every 6 months following treatment. During site visits, all regrowth should be treated.

Extensive OWCF populations treated by helicopter receive a glyphoste- or metsulfuron-containing product. Because these treatments are usually applied over water, a product labeled for aquatic application is used. A glyphosate-containing product that contains 4 lb glyphosate acid per gal is applied at a rate of 7.5 pt per acre during the season when nontarget woody species such as cypress are dormant.

A product that contains 60% active ingredient metsulfuron is applied at a rate of 1–2 oz product per acre when tolerant woody species are present. The metsulfuron-containing product Escort XP is labeled for application to sites where water is present.

Following initial aerial application, spot treatment with 3% solution of glyphosate-containing product (4 lb glyphosate acid per gal) alone or in combination with one oz of 60% metsulfuron-containing product is necessary on a one- to two-year cycle, depending on environmental conditions. While lower concentrations of glyphosate can be effective, control is more consistent using a 3% solution, an important and cost-effective consideration when treating OWCF in remote locations that are costly to access.

Herbicide applications to OWCF on Everglade tree islands have shown approximately 87% reduction in coverage (one year post treatment) after a single aerial application of either 3.75 or 7.5 pt Rodeo herbicide (4 lb glyphosate acid per gal)/ac. A greater reduction of approximately 99% was observed after aerial application of either 1.0 or 2.0 oz Escort XP (60% metsulfuron)/ac (Hutchinson and Langeland 2012). Approximately 89% control was maintained after two consecutive annual ground treatments (backpack sprayer) with a solution containing either 2% or 4% Rodeo to those islands initially treated with Rodeo. Approximately 99% reduction was maintained after two consecutive years of ground treatments with a solution equivalent to either 0.07 or 1.40 oz Escort XP/100 gal of water (0.05 or 1.0 g/L) to those islands initially treated with Escort XP.

Three years after the initial aerial applications and subsequent ground applications, dahoon holly (*Ilex cassine*) populations, though damaged, were not decreased by either Rodeo or Escort XP. Swamp bay (*Persea palustris*) and wax myrtle (*Myrica cerifera*) were susceptible to Rodeo but tolerant to Escort XP. Myrsine (*Rapanae punctata*) was susceptible to Escort XP and somewhat tolerant to Rodeo.

Biological Control*

From 2005 to 2007, a defoliating moth, *Austromusotima camptonozale* (Figure 5), was released in southeast Florida as a biocontrol for OWCF fern but failed to establish in any of the release range. Another species of defoliating moth, *Neomusotima conspurcatalis* (Figure 6), has established from releases made in 2008 and 2009. Populations are thriving in several areas and have spread to other points beyond the initial releases. The insect has caused considerable localized brownout of OWCF in certain areas. However, the overall impact still remains very limited.

Figure 5. The defoliating moth *Austromusotima camptonozale* was released in February 2005 to control OWCF but failed to establish in the release range.
Credits: USDA-ARS

Figure 6. *Neomusotima conspurcatalis* adult was released in 2008 and 2009. It is established and thriving in several areas.
Credits: R. Pemberton, USDA-ARS

Figure 7. Feeding damage from *Neomusotima conspurcatalis* larvae.
Credits: R. Pemberton, USDA-ARS

A leaf-galling mite *Floracarus perrepae* (Figure 8) was released in 2007, and has since established in many locations across south Florida. The full impact of the mite is yet

unclear. However, mite damage has been reported where fire has stimulated new Lygodium growth. Two additional insects are currently being tested for future releases: a defoliating moth within the same family as the two released moths and a sawfly whose larvae are heavy defoliators.

*Biological control information provided by Melissa C. Smith, PhD, research ecologist, USDA-ARS Invasive Plant Research Lab, Fort Lauderdale, FL

Figure 8. Leaf galling/rolling from Lygodium mite, *Floracarus perrepae*. Credits: M. C. Smith, USDA-ARS

What You Can Do

A recent survey of public land managers indicated that considerable progress has been made in many areas. However, there is great concern over the rapid spread OWCF on private lands. If left uncontrolled, the infestations will continuously produce new spores that may re-infest public lands following intensive control efforts. Citizens who want to help protect Florida's natural areas from OWCF should become familiar with how to identify it and teach others about the problem. If you find new populations of OWCF on public property, contact the property manager or appropriate agency such as a county environmental department, Water Management District, or the Florida Fish and Wildlife Conservation Commission.

If you find OWCF on your own property, pull it up by the roots or spray it with an herbicide. Monitor and retreat if regrowth occurs. Homeowners can purchase several glyphosate-containing herbicides in small quantities from retail garden supply stores. Do not dispose of Old World climbing fern in such a way that will cause further spread.

The Central Florida Lygodium Strategy (CFLS) is a program coordinated by The Nature Conservancy to stop the northward spread of OWCF. CFLS coordinates quick and effective treatment of newly reported OWCF occurrences along a line from northern Pinellas and Pasco Counties on the west coast northeast to northern Volusia and Flagler Counties on the east coast. Funding is available to treat private lands in the northernmost extent of the plant's range in central Florida to complement treatment efforts on public conservation lands. To find out more about CFLS, visit the program's website at http://www.nature.org/centralfloridainvasives.

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Table 1. Herbicide use for controlling Old World climbing fern.

Herbicide	Use rates	Comments
Glyphosate 4lb ae[1]/gal	Spray to wet: 2%–3% Aerial: 5–7.5 pt/ac	Use only glyphosate products registered for aquatic use. Symptoms evident within three weeks after application. Broad spectrum, some hardwoods tolerant depending on application timing.
Imazapic 2lb ae/gal	Spray to wet: 0.32% Aerial: No information	No products registered for aquatic use. Symptoms evident within three weeks after application. High degree of selectivity.
Metsulfuron 60%	Spray to wet: .07–1.4 oz/100 gal Aerial: 1–2 oz/ac	The product Escort is has a 24C SLN label for for aquatic application in Florida. Symptoms may not be evident for up to three months. High degree of selectivity.
Triclopyr amine 3lb ae/gal	Spray to wet: 0.5% Aerial: NA	Products registered for aquatic use. Broad spectrum on broadleaf plants and hardwoods. Symptoms evident within days.

[1]Active ingredient expressed as the free acid.

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SS-AGR-45

Natural Area Weeds: Chinese Tallow (*Sapium sebiferum* L.)[1]

K. A. Langeland and S. F. Enloe[2]

Introduction

Florida's natural areas—a great source of pride and enjoyment to its citizens—provide recreation, protect biodiversity and fresh water supplies, buffer the harmful effects of storms, and significantly contribute to the economic well-being of the state (Jue et al. 2001). Natural areas are protected in over ten million acres (nonsubmerged) of state, federal, local and private managed conservation lands in Florida (http://fnai.org). Unfortunately, many of these natural areas can be adversely affected when they are invaded by nonnative invasive plant species. An estimated 25,000 plant species have been brought into Florida for use as agricultural crops or landscape plants. While only a small number of these have become invasive, those that do can adversely affect native plant communities by competing for space and resources, disrupting hydrologic and fire regimes, or hybridizing with native species. They must be managed for the protection of native communities in natural areas. Chinese tallow (*Sapium sebiferum* L.) is one of these invasive plant species.

How to Recognize Chinese Tallow

Chinese tallow is a deciduous tree with a milky sap that commonly grows to 30 ft tall. Leaves are simple, alternate, 1–2.5 inches wide, with broadly rounded bases and tapering to a slender point (Figure 1). Leaf stalks are 1–2 inches long. Small yellow flowers that are borne on spikes to 8 inches long occur in spring (Figure 2). The fruit is a 0.5 inch wide, 3-lobed capsule that turns brown at maturity to reveal 3 dull white seeds (Figure 1). The seeds, which often remain attached to the tree through the winter, resemble popcorn, suggesting the other common name of popcorn tree.

Figure 1. Chinese tallow tree (*Sapium sebiferum* L.) can be identified by its simple, alternate leaves with broadly rounded bases that taper to a slender point and dull white seeds that remain attached after leaves have fallen.

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Figure 2. In spring, Chinese tallow tree displays spikes of small yellow flowers that are up to 8 inches in length.
Credits: Nancy J. Loewenstein, Auburn University

Distribution

Chinese tallow was introduced to the US before 1800. In a letter from Benjamin Franklin written in 1772 to Dr. Noble Wimberly Jones of the Georgia colony, Franklin wrote: "I send also a few seeds of the Chinese Tallow Tree, which will I believe grow & thrive with you. 'Tis a most useful plant" (Bell 1966). As early as 1803, Chinese tallow was spreading into coastal forests according to the noted French botanist Andre Michaux. Since Franklin's time, Chinese tallow has been introduced repeatedly to the United States as an ornamental and potential oil crop species. It is now naturalized from North Carolina, south through Central Florida, extending west into Texas and northwest Arkansas (McCormick 2005). Within Florida, Chinese tallow has increased greatly over the last twenty years. In 1993, it was naturalized in 57% of the counties (Jubinsky and Anderson 1996) and found as far south as Dade County (Wunderlin et al. 2003). Today, it is found in almost every county in the state.

Invasiveness

Chinese tallow has been recognized as a pest plant in the Carolinas since the 1970s (Langeland and Burks 1998). It is found throughout Florida where it invades mesic flatwoods, scrubby flatwoods, alluvial floodplain forest, strand swamp, and ruderal communities. Chinese tallow has been extensively used for ornamental planting and is a common plant on landscaped property. These trees present a constant source of seed for infestation of natural areas because the seeds are transported by birds such as pileated woodpeckers, cardinals, yellow-rumped warblers, American robins, and grackles, as well as by water (Jubinsky and Anderson 1996). While the length of time needed to deplete the seedbank is unknown, indications are that seeds remain viable for many years (Jubinsky and Anderson 1996). The Florida Exotic Pest Plant Council included Chinese tallow on its 1993 List of Florida's Most Invasive Species and it is currently a FLEPPC Category 1 species. **Chinese tallow was added to the Florida Department of Agriculture and Consumer Services Noxious Weed List (5b-57.007 FAC) in 1998. Plants on the Florida Noxious Weed List may not be introduced, possessed, moved, or released without a permit.**

Remove and Replace

Homeowners can help mitigate the problem of Chinese tallow trees in Florida's natural areas by removing them from their property. Mature trees should be felled with a chain saw by the property owner or a professional tree service. The final cut should be made as close to the ground as possible and as level as possible to facilitate application of an herbicide to prevent sprouting. Stumps that are not treated with an herbicide will sprout to form multiple-trunked trees (Figure 3). If it is not objectionable for dead trees to be left standing, certain herbicides can be applied directly to the bark at the base of the tree (basal bark application).

Figure 3. Stumps of felled Chinese tallow trees that are not treated with a herbicide will rapidly sprout to form multiple-trunked trees.

Herbicides that contain the active ingredient triclopyr amine (e.g., Brush-B-Gon, Garlon 3A) can be applied to cut stumps to prevent resprouting. The herbicide should be applied as soon as possible after felling the tree and concentrated on the thin layer of living tissue (cambium) that is just inside the bark. Herbicides with the active

ingredient triclopyr ester can be used for basal bark applications. Concentrated products (e.g., Garlon 4 Ultra) must be diluted, according to instructions on the herbicide label, with a penetrating oil, manufactured for this purpose. Herbicides with the active ingredients triclopyr ester can be used for basal bark applications. Herbicide products are available for basal bark application that are pre-diluted with penetrating oil (e.g., Pathfinder II). Only certain triclopyr amine products may be applied to trees that are growing in standing water. Suckers may grow from remaining roots, even if herbicide is applied to the parent tree. These suckers can be cut or treated with a foliar herbicide application. **It is illegal to use a herbicide in a manner inconsistent with the label's instructions; therefore, read the label carefully and follow the instructions.**

If trees are cut at a time when seeds are attached, make sure that the material is disposed of in such a way the seeds will not be dispersed to new areas where they can germinate and produce new trees. Seedlings should be pulled by hand before they reach seed-bearing maturity. A complete description of each of these control techniques can be found in the following publication: *Integrated Management of Nonnative Plants in Natural Areas of Florida*, K. A. Langeland, J. A. Ferrell, B. Sellers, G. E. MacDonald, and R. K. Stocker. 2011. http://edis.ifas.ufl.edu/wg209.

Space in a landscape left after removal of Chinese tallow can be used to plant a new native or noninvasive non-native tree for shade, or some other landscape purpose. Tree species recommended in Table 1 are similar in size to Chinese tallow. Blackgum, maples, dogwood, and crepe myrtles provide fall color similar to Chinese tallow. Fact sheets that provide additional information on landscape plants can be viewed at http://hort.ifas.ufl.edu/database/trees/trees_scientific.shtml. For information on the availability of native landscape plant species contact the Association of Florida Native Nurseries (877-352-2366 or http://www.afnn.org). The UF/IFAS Extension office in your county can help you identify plants appropriate to your property conditions, the ecosystems on and near your site, and your aesthetic preferences.

Table 1. Some suggested tree species for replacing Chinese tallow.

Native	Florida Hardiness Zones
American Hornbeam (*Carpinus caroliniana*)	North, Central
Blackgum (*Nyssa sylvatica* var. *sylvatica*)	North, Central
Cedar Elm (*Ulmus crassifolia*)	North, Central
Eastern Hophornbeam (*Ostrya virginiana*)	North, Central
Eastern Redbud (*Cercis canadensis*)	North, Central
Flatwoods Plum (*Prunus umbellata*)	North, Central
Florida Maple (*Acer saccharum* ssp. *floridanum*)	North, Central
Flowering Dogwood (*Cornus floridana*)	North, Central
Fringe Tree (*Chionanthus virginicus*)	North, Central
Geiger Tree (*Cordia sebestena*)	South
Paradise Tree (*Simarouba glauca*)	South
Red Bay (*Persea barbonia*)	Throughout
Red Maple (*Acer rubrum*)	Throughout
Red Stopper (*Eugenia confusa*)	South
River Birch (*Betula nigra*)	North, Central
Satin Leaf (*Chrysophyllum oliviforme*)	South
Silverbell (*Halesia diptera*)	North, Central
Swamp Bay (*Persea palustris*)	Throughout
Turkey Oak (*Quercus laevis*)	North, Central
White Ash (*Fraxinus americana*)	North
Winged Elm (*Ulmus alata*)	North, Central
Non-native	
Crepe Myrtle (*Lagerstroemia indica*)	Throughout
Queens Crepe Myrtle (*Lagerstroemia speciosa*)	South
Trumpet Tree (*Tabebuia argentea*)	South

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Wild Hogs in Florida: Ecology and Management[1]

William M. Giuliano[2]

History, Distribution, and Abundance

Florida's wild hogs (Figure 1) are often referred to as feral hogs or swine and are of three general types. These include free-ranging swine that come from domesticated stock, Eurasian wild boar, and hybrids of the two. Although technically the term "feral" refers to free-ranging animals descended from domesticated stock, all wild hogs are typically referred to as feral in Florida, whether they descend from wild boar or from domesticated stock. Likewise, all wild hogs in Florida are considered the same species, *Sus scrofa*. Wild hogs are in the family Suidae (true wild pigs), none of which are native to the Americas. The only native pig-like mammal found in the United States is the collared peccary or javelina (*Tayassu tajacu*; Figure 2), an animal not found in Florida. Javelina are not true pigs; they are in the family Tayassuidae, and are about half the size of typical wild hogs.

Figure 1. A wild hog foraging in a field. These animals are true pigs and not native to Florida or North America.
Credits: M. S. Smith

Figure 2. Although they look similar to wild hogs, peccaries are not true pigs. Not found in Florida, they are the only native, pig-like animal in North America.
Credits: T. Stehn, US Fish and Wildlife Service

It is believed that hogs were first brought to Florida, and possibly the United States, in 1539, when Hernando de Soto brought swine to provision a settlement he established at Charlotte Harbor in Lee County. However, it is possible that hogs had been brought to the same site in 1521 by Ponce de Leon during a brief visit. During the next four centuries, explorers and settlers brought pigs with them throughout

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Florida. Many of these animals were given to or stolen by Native Americans, who expanded pig numbers and distribution in the state. Europeans and Native Americans alike often raised their swine in semi-wild conditions (at least until the mid-1900s when open range ended and it became illegal) where hogs were allowed to roam freely and only rounded up when needed. Many of these animals and those escaping from captivity established feral populations throughout Florida. These feral populations have been further supplemented through deliberate releases of hogs in many areas by private individuals and the Florida Game and Freshwater Fish Commission to improve hunting opportunities (although the state no longer does this).

Eurasian wild boar were first released in the United States in New Hampshire in 1886. Boar were then released in New York (1900), North Carolina/Tennessee (1912), Texas (1919), Washington State (1981), and possibly other locations to provide a new, huntable big game species, and to increase the sporting and trophy value of feral hogs through hybridization. Although most were released in enclosed areas, many escaped and readily hybridized with local feral hogs. A few Eurasian wild boar and many hybrids naturally dispersed to areas around release sites, including neighboring states. Hybrids have been trapped and moved to many parts of Florida by private individuals. In addition, the Florida Game and Freshwater Fish Commission trapped and released feral hogs and hybrids in many areas to control hog-related problems in some areas and improve hunting opportunities in others. There are not believed to be any free-ranging, pure Eurasian wild boar in Florida, only feral hogs and hybrids.

Wild hogs are now found in every county in Florida and in at least 35 states and Canadian provinces, including most of the Southeast. Florida's wild hog population is second only to Texas's; the state is estimated to have more than 500,000 wild hogs in a relatively stable population (there are from 1 to 2 million wild hogs in the southeastern United States). Some of the highest hog population densities in Florida can be found north and west of Lake Okeechobee in areas with large forested tracts, dense understory vegetation, and limited public access. Hog numbers tend to be lower in areas with intensive agriculture and urbanization, and little water.

Description

All wild hogs are stocky, hoofed mammals with relatively short legs, long snouts ending in a disk, and long canine teeth that appear as tusks. Feral hogs resemble domestic hogs, but are usually leaner and have developed different behaviors that promote their survival in the wild. Eurasian wild boar stand slightly taller but are approximately the same weight as feral hogs, and typically have longer hair (especially bristles), a leaner appearance, larger heads, longer snouts, longer, straighter tails, and smaller, more upright ears. Coloration of feral hogs and Eurasian wild boar can vary. Feral hogs typically have solid-colored, black, white, and/or reddish-brown hair either in solid or mottled patterns across the body (Figure 3). The hair of Eurasian wild boar is typically brown at the base and light-tipped over most of the body, with some areas having brown or black, solid-colored hair. They also often have white-tipped hairs on the head forming a saddle-like patch of hair or streak of hair around the mouth. Hybrids have various combinations of feral hog and Eurasian wild boar characteristics. Appearance alone can be deceiving and is not considered a reliable means of determining whether a wild hog is of Eurasian wild boar descent, a feral hog, or a hybrid.

Figure 3. Wild hogs occur in a variety of colors.
Credits: J. Allen

Wild hog size and weight are variable, and depend on genetics and local conditions. Typically, male hogs (called boars) are larger than females (called sows). Average adult males may weigh 200+ pounds, stand 3 feet at the shoulder, have tails reaching 12 inches, and be almost 5 feet from the tip of the tail to the tip of the snout. However, males greater than twice this size have been recorded. Hogs have 4 continually growing, self-sharpening tusks (2 in the upper and 2 in the lower jaw; upper and lower tusks rub against each other, which keeps them sharp). Tusks in females are relatively small, while in males they become quite pronounced and have trophy value. Male hogs generally possess a thick hide on their shoulders (up to 3/4 of an inch thick) known as a hog shield that protects them during fights. All wild hogs have an excellent sense of smell and good hearing, but relatively poor vision. Wild

hogs use a variety of vocalizations, including an alarm grunt given by the first hog to sense an intruder that causes a flight response by the rest of the herd. Other vocalizations are similar to those of domesticated pigs. Wild hogs also communicate through scent posts that are often also used for body scratching and rubbing. Boars also "tusk" small trees, frequently pines, scraping off the outside bark with their tusks. This behavior may play a part in some type of dominance display. Such actions can seriously damage the rubbed objects, often trees (Figure 4). Hog sign includes tracks (Figure 5), trails, wallows, rooting, rubbing (Figure 4), and scat.

Figure 4. Wild hogs rub objects, often trees, for body scratching, and boars may "tusk" small trees as part of a dominance display.
Credits: US Department of Agriculture

Figure 5. Wild hog feet and tracks are similar to those of domesticated pigs. Typically, the rear toes make little or no mark on the ground.
Credits: C. L. Giuliano

Habitat Relationships

Hogs use a variety of habitat types in Florida, from flatwoods, upland pine, and bottomland hardwood forests to coastal areas, marshes, swamps, and more open agricultural lands. However, hogs prefer large forested areas with abundant food, particularly acorns, interspersed with marshes, hammocks, ponds, and drainages. Good hog habitats have plenty of cover in the form of dense brush and limited human disturbance. Dense cover is used as bedding areas and provides protection from predators and hunters (Figure 6).

Figure 6. Wild hogs prefer to live in large tracts of forest with abundant food, dense understories, access to water, and little human disturbance.
Credits: W. Boyer, US Department of Agriculture

The absence of water or wet soil conditions can limit the use of an area by hogs. Wet conditions are necessary for hog wallowing. Hogs have relatively poor physiological cooling mechanisms and keep from overheating by wallowing in mud and water (Figure 7): particularly important in Florida's warm climate. Wallowing also helps hogs rid themselves of ticks, fleas, lice and other external parasites. They will wallow in almost any wet area. In cooler weather, hogs may seek open areas that allow maximum warming from the sun. Seasonal changes in habitat use are typically related to food availability, with hogs preferring areas containing abundant hard mast (such as acorns and hickory nuts; Figure 8) and, if hard mast is unavailable, soft mast such as plums and other fruits.

Wild hogs are omnivorous, opportunistic feeders. The list of foods hogs eat is diverse and includes grass, forb, and woody plant stems, roots, tubers, leaves, seeds, and fruits, fungi, and a variety of animals including worms, insects, crustaceans, mollusks, fish, small birds, mammals, reptiles, and amphibians. They may occasionally consume carrion (dead animals). Wild hogs consume far more plant than animal material, and their opportunistic tendencies

often lead them to forage in agricultural lands and forest plantations where they can cause significant losses of crops, including corn, rice, sorghum, melons, peanuts, forage grasses, grains, various vegetables, and tree seedlings. Wild hogs will also readily exploit game feeders placed for deer, turkey, and other wildlife, and may destroy wildlife food plots by rooting (digging for foods below the surface of the ground).

Figure 7. Wild hogs wallow to stay cool and reduce parasite infestation.
Credits: US Department of Agriculture

Figure 8. Although they are opportunistic and omnivorous feeders, the favorite food of wild hogs is acorns.
Credits: P. Wray, US Department of Agriculture

General Biology

In Florida, wild hogs breed year round with peaks in the breeding cycle during fall and spring. Breeding activity includes courtship behavior, males fighting to achieve dominance and access to mates, and copulation. Most hogs are sexually mature at 6 months, but they typically do not breed until they are a year old, and then only if they are well-nourished. Sows produce a "nest," which is usually a shallow depression in the ground with or without vegetative nesting material, located in a shaded, upland site. Hog pregnancies last about 115 days. They can produce (farrow) 2 litters of 1–13 (usually 5–7) piglets per year, with the young usually born in a 1:1 male:female ratio. Piglets remain in the nest for 3 weeks, during which time they are frequently nursed by the sow. Piglets then begin to move with the sow away from the nest and progressively rely less on nursing for food. When sow nutrition is poor, reproduction may be reduced or delayed, and sows have been known to eat their young (Figure 9). Typically, boars are solitary animals except when breeding. However, several sows and their offspring often travel in groups called sounders.

Figure 9. A female wild hog in poor condition forages along a road. Poor nutrition will lead to lower reproductive success.
Credits: T. C. Crocker, US Department of Agriculture

Although they breed much earlier, it may take 3–5 years until hogs are fully grown. Under good conditions, wild hogs usually live 4–5 years, with some living 8+ years. Hog mortality is greatest during the first 6 months of life, with predation, accidents, and starvation as leading causes of death during this time. As adults, hogs typically have higher survival rates, with hunting, a wide variety of diseases and parasites, and starvation as leading causes of mortality. Humans are the main predators of wild hogs, but large carnivores such as alligators, black bears, and Florida panthers may be capable of preying on adult animals (Figure 10). Piglets are also preyed upon by smaller predators including foxes, coyotes, and bobcats. When conditions are favorable, hog reproduction exceeds mortality leading to growing and overabundant populations (Figure 11).

Wild hogs typically range over 450–750 acres, but may range wider in search of food. During the cooler months of the year, hogs may be active and feed during both day and night. However, if hunting pressure or temperatures are high, they will seek cover during the day, and feed and be most active at night. Seasonal changes in activity are also related to breeding, with sows being less active and traveling over significantly smaller areas when piglets are in

the nest, and males traveling over considerably larger areas in search of mates.

Figure 10. Humans are the primary predator of adult wild hogs. However, the Florida panther and other predators can easily prey upon younger animals.
Credits: G. Gentry, US Fish and Wildlife Service

Figure 11. Feral hogs typically breed at one year of age. Piglets stay in the nest for a few weeks, and then begin moving with the sow. When conditions are good, hog production often exceeds mortality leading to overabundant populations.
Credits: W. M. Giuliano, UF/IFAS

Problems

The opportunistic and omnivorous tendencies of wild hogs lead to many conflicts with people and wildlife. With hard mast, including acorns, as their preferred food, hogs directly compete with many popular game animals, including deer, turkeys, and squirrels (Figure 12). This competition is considered a significant limiting factor for populations of these native species in some areas. In addition, hogs may consume the nests and young of herpetiles (including turtles; Figure 13), ground-nesting birds, and mammals (including deer fawns). Wild hogs have also been known to consume young domestic livestock including poultry, lambs, and goats. When natural foods are scarce or inaccessible, hogs will readily forage on almost any agricultural crop and feed set out for livestock and wildlife, leading to significant losses. Wild hogs will also feed on tree seeds and seedlings, causing significant damage in forests, orchards, and plantations. In Florida and the Southeast, this may be a serious impediment to regenerating important long-leaf pine forests (Figure 14).

Figure 12. Wild hogs may compete with native wildlife such as white-tailed deer for food.
Credits: K. W. Gale, US Department of Agriculture

Figure 13. Hogs often prey upon the nests of ground nesting wildlife, including turtles, leading to significant nest losses.
Credits: National Oceanic and Atmospheric Administration/ Department of Commerce

Figure 14. By eating seeds and seedlings, wild hogs can inhibit forest regeneration.
Credits: W. Boyer, US Department of Agriculture

Hogs rub objects, often trees, to scratch themselves. In addition, males will often "tusk" small trees, scraping off the bark with their tusks, in what is thought to be some type of dominance display. Such actions can seriously damage the rubbed objects (Figure 4).

In addition to the effects of consuming, knocking down, rubbing, and trampling large amounts of native vegetation and crops, the rooting behavior of hogs also causes significant damage. Rooting (digging for foods below the surface of the ground) destabilizes the soil surface, which can lead to erosion and exotic plant establishment; uproot or weaken native vegetation; and damage lawns, dikes, roads, trails, and recreation areas (Figure 15). Hogs have also been known to damage fences and other structures. Finally, hogs' wallowing behavior destroys small ponds and stream banks and can lead to declines in water quality (Figure 7).

Figure 15. Rooting by wild hogs can lead to erosion and water quality problems, and the destruction of native vegetation around ponds and in the forest.
Credits: Top: W. M. Giuliano, UF/IFAS; Bottom: W. Frankenberger

Another area of concern is the potential for wild hogs to serve as reservoirs for many diseases and parasites that may affect native wildlife, livestock, and people. Hogs have been known to carry dozens of such pathogens, including cholera, pseudorabies, brucellosis, tuberculosis, salmonellosis, anthrax, ticks, fleas, lice, and various flukes and worms. Although these pathogens and parasites typically do not present a serious threat to people, they do threaten livestock. Millions of dollars are spent each year to keep livestock safe from diseases and parasites spread by wild hogs (Figure 16). Finally, hogs can be dangerous. Although wild hogs usually prefer to run and escape danger, if they are injured, cornered, or with young, they can become aggressive, move with great speed, and cause serious injury (mainly with their hooves and tusks; Figure 17).

Figure 16. Wild hogs may be a reservoir for diseases and parasites that can affect people, livestock, and wildlife.
Credits: W. M. Giuliano, UF/IFAS

Figure 17. Wild hogs can be aggressive, and long, sharp tusks make them dangerous.
Credits: Top: J. Dunlap and M. Ludlow; Bottom: W. Frankenberger

Management, Hunting, and Other Control Measures

On private land in Florida, wild hogs are considered domestic livestock and the property of the landowner where they are found. With landowner permission, there is no closed season, bag or size limit when hunting in

these areas. Hunters often pay $100–$2,000 to harvest a trophy wild hog, providing an economic incentive for hog introductions and management. On public lands, hogs have various classifications, and depending on the property may require licenses and permits to be legally taken during specific seasons.

In the past, state and private hog management included removal of hogs from public lands and other areas with sensitive ecological communities, and the introduction of animals to other areas to maintain or establish huntable populations (Figure 18). While private individuals may still introduce animals in enclosed areas for hunting, most management now focuses on controlling hog populations. Because hogs are such prolific breeders, mortality may not be able to balance hog production, and therefore further stocking of hogs in Florida should be avoided. It would simply increase the multitude of problems associated with wild hog populations. If stocking is desired on private, fenced property, only castrated males should be considered.

Figure 18. Trapping of wild hogs has been used to reduce populations and associated damage in some areas and supplement hog populations for harvest in others.
Credits: J. Allen

In good habitat, it is unlikely that any amount of hunting or other population control will eradicate wild hog populations, but it may be possible to limit further population expansion by using a combination of methods on a sustained basis. Wild hog control methods include hunting, various trapping methods, shooting, and exclusion. Toxicants and repellents have been suggested as viable means of controlling or deterring hog populations. However, none are registered for use in the United States. Before undertaking any hog control measure, review local laws. The Florida Fish and Wildlife Conservation Commission (http://myfwc.com/) and USDA-APHIS Wildlife Services (http://www.aphis.usda.gov/wildlife_damage/) are excellent sources of such information.

Hunting is an important control method for wild hogs because it provides recreational opportunities, is inexpensive, and can be useful at reducing numbers of adult animals. However, hogs are intelligent animals and can be challenging quarry. Many hunters consider large boars with prominent tusks to be a desirable trophy, and the lean meat is excellent fare. Typically, hogs are hunted from a stand over bait such as corn or other grains (although this may not be allowed on public lands), but they can also be stalked (keep the wind in your favor). Hunting may also involve trained dogs to locate hogs and hold them at bay. However, dogs should be properly trained to avoid injury from hogs. Harvested animals should be field dressed as one would a deer, and gloves should be worn to reduce the possibility of disease transmission. Hog remains should be kept away from domestic animals to avoid disease transmission and buried or incinerated (landfills may not accept them).

Trapping is usually a better method of controlling hog numbers than hunting, especially when the animals are active at night. While there are several types of traps (including cage, leg-hold, and snare) that can be used to capture hogs, cage traps are most effective because they can capture more than one hog at a time. Regardless of type, traps should be well constructed: hogs are powerful animals and easily excited when approached.

Cage- or corral-style live traps are the most commonly used types (Figure 19). Such traps should be located in shaded areas with large, active hog populations. This type of trap includes single- and multi-capture designs with various door/gate styles, including swinging or sliding doors and lift gates. These traps can be made from a variety of materials, however, steel fence posts with 4-inch by 4-inch, welded 12 gauge (or heavier) wire fencing works well. Larger traps (often as large as ten feet square) will allow more hogs to be captured at once. Doorframes can be made of wood or steel, with doors made of plywood (more than ¾-inch), steel, or wire mesh. Doors should be at least two feet by two feet. They should only open inward or upward (for sliding doors), and they should close with the use of heavy springs. Swinging doors are better than sliding doors because once an animal is caught, other animals can enter by pushing through the door, and hogs often learn to pry open sliding doors with their snouts. Doors should close down on a bar or cross member to prevent hogs from lifting them open. A trip wire placed in the rear of the trap is often used to trigger the door. Bait should be placed at the rear of the trap, with the trip wire between it and the door. Wire fence, attached to the walls, should be put on top (particularly if the trap has short walls) to prevent hogs from going over

the top. Smaller, portable traps have also been used successfully (Figure 20). However, their size typically limits the number of captures on a single occasion to one or a very few animals. Trap construction plans can be found at sites listed in the Additional Information section at the end of this document.

Figure 19. Baited hog traps can be an effective control method and come in various shapes and sizes. They should be sturdy enough to contain large hogs and have tall walls or a wire roof to prevent hogs from climbing or jumping out.
Credits: Top: W. M. Giuliano, UF/IFAS; Bottom: S. Barlow

Figure 20. Small, portable traps can be effective by allowing you to change trapping locations. However, they are limited in the number of animals that can be caught on one occasion.
Credits: M. S. Smith

Traps should be prebaited for several days before actual trapping begins. Prebaiting involves baiting traps but locking the door open for several days so that hogs have time to find the bait and grow accustomed to entering the trap. Prebaiting enables the capture of multiple animals at one time. Automatic feeders may be placed over the trap to dispense bait without introducing human scent, a major deterrent to hogs entering the trap. Common baits include grains such as corn, oats, and barley (often soaked in water), vegetables, livestock feed, and carrion. It may take several days for hogs to start coming to bait as they range over large areas. Once hogs begin visiting traps, bait must be replenished daily so that hogs will continue to visit the trap and not move on to areas with more food. At times and places with abundant natural foods such as acorns, this type of trapping may not be effective because preferred, natural foods will reduce the attractiveness of bait to hogs. To keep livestock from eating bait and springing traps, barbed wire fencing can be used around traps (be sure hogs can get under it). In addition to bait, live decoy hogs can be placed inside traps to attract others. These hogs may be placed in a smaller pen within the trap. Such animals should be fed and watered as needed. Traps should be checked daily and from a distance (to avoid exciting the animals, which can lead to injuries and damage to traps; Figure 21).

Figure 21. Traps should be checked from a distance to avoid alarming the animals, which can cause injury to the hogs and damage traps.
Credits: S. Barlow

Leg snares and steel leg hold traps (No. 3 or larger) have been used to capture hogs, but they are not recommended. They are less effective than other methods, and they are illegal in Florida and many other areas without a special permit. These are typically placed on active travel routes such as where hogs regularly pass under a fence, securely fastened to a heavy drag (for example, an eight-foot-long log), tree, or fence post. The trap should be sturdy enough to handle a large hog. Such traps are not generally as effective as other methods because they can only capture one animal at a time. Further, such traps often capture and injure non-target animals, such as livestock, dogs, foxes, etc.

Before using such methods, individuals should check with the Florida Fish and Wildlife Conservation Commission for applicable regulations and permits. Captured hogs should be kept away from domestic animals to avoid disease transmission and euthanized as soon as possible. Bury or incinerate hog remains immediately.

Shooting at night may be an effective control measure on private lands when hunting and other human activity stimulate hogs to become nocturnal, and trapping is ineffective or incomplete. Spotlights with red filters and night vision optics are valuable aids when using this method. Before using such methods, individuals should check with the Florida Fish and Wildlife Conservation Commission for applicable regulations and permits.

Excluding hogs using fencing can be an effective but expensive control option for relatively small areas such as a garden (Figure 22). However, hogs are intelligent and resourceful animals and often find ways through many types of fence. Chain link fences or heavy-gauge hog wire buried at least 12 inches under the ground with heavy supports and posts, and various types of mesh or multi-stranded electric fence provide the best results.

Figure 22. Fencing can be an effective method of protecting small areas from wild hog damage.
Credits: W. M. Giuliano, UF/IFAS

Additional Information on Wild Hogs

http://www.wildflorida.org/critters/hog.asp

https://agrilife.org/texnatwildlife/feral-hogs/

http://icwdm.org/

http://ector-co.tamu.edu/publications/l1925.pdf

http://www.noble.org/Ag/Wildlife/FeralHogs/

http://feralhogs.tamu.edu/

FERAL SWINE: Impacts on Game Species

What Are Feral Swine?

Feral swine (also called wild pigs, boar, feral hogs, and many others) are a destructive invasive species. They vary in color from black to brown and even patchwork colors, and range in size from 75 to 250 pounds. Feral swine belong to the family *Suidae* and were introduced into the United States in the 1500s by early explorers and settlers as a source of food. Over centuries, domestic pigs, Eurasian boar, and their hybrids have escaped, been released, and been reintroduced, setting the scene for the rapidly expanding populations we have today.

Why Are They Considered an Invasive Species?

Invasive species are defined as plants or animals that are non-native to an ecosystem and often have broad negative impacts on the environment where they are introduced. With feral swine populations over 6 million and distributed across more than 35 States, the damage they cause is significant to the environment, economy, and human health. Feral swine damage to habitats, predation on wildlife, and disease transmission can be linked to the decline of nearly 300 native plants and animals in the United States, including native game species.

What Is Their Impact?

Feral swine directly impact native game species by preying on the nests, eggs, and young of ground-nesting birds and the young of larger animals such as deer. They compete with native wildlife for important food sources, displace other animals through aggression and competition, and can spread diseases and parasites. The most far-reaching impact feral swine have on game species and other wildlife is habitat change and destruction through their rooting, wallowing, trampling, and feeding behaviors. Feral swine are ecosystem engineers, which means they can change their environment by altering water quality and runoff in wetland environments, shifting plant composition and distribution in grasslands, and decreasing tree diversity in a forest. Feral swine are a risk to native game species such as deer, quail, grouse, turkey, and many others, as well as to the economic stability of businesses that depend on these game species to succeed.

What Can I Do?

Feral swine cause problems by damaging native ecosystems, preying on or competing with native wildlife, and spreading diseases.

- **Do not relocate feral swine** to new areas or transport them to other States.
- **Share the knowledge**; discourage transportation and spread of feral swine.
- If you live in a State with no or low levels of feral swine, **report any sightings, sign, or damage** to wildlife or agriculture officials in your State.

GAME SPECIES
at Risk From Feral Swine Impacts and Damages

Upland Birds

Upland game species such as quail, woodcock, and grouse are at risk from predation by feral swine because they nest on the ground. In addition to direct predation, feral swine destroy important upland game bird habitat by rooting up and eating native plants, allowing the growth and spread of invasive weeds.

Deer

The feral swine diet consists largely of vegetation; therefore, they compete with herbivores for food sources. Most notably, feral swine compete with deer (white-tailed, mule, or black-tailed) for seasonal resources such as acorns or beech nuts. They easily disperse deer from prime feeding areas, will prey on fawns, and transmit diseases to which deer are vulnerable.

Turkey

Wild turkeys are ground nesters, leaving their eggs and young exposed to feral swine predation. Additionally, feral swine compete with wild turkeys for important seasonal resources such as acorns. Since feral swine can eat larger amounts of food and digest it more quickly than turkeys, they easily outcompete these birds for vital seasonal food sources.

Furbearers

Foxes, weasels, raccoons, and other furbearers prey on eggs, small mammals, carrion, and invertebrates, which are also desirable food sources for feral swine. A group of feral swine, called a sounder, can easily displace smaller, often independent, furbearers from a food source. Feral swine also carry many diseases and parasites, such as giardia, which may be passed on to furbearers.

Small Game

Feral swine outcompete small mammals for important seasonal resources such as acorns. They have also been known to raid the buried food caches of squirrels, leaving them with no stores for winter. Feral swine even actively hunt small mammals such as ground squirrels. Furthermore, feral swine rooting and feeding behaviors alter forest growth and diversity, damaging crucial habitat for small game animals.

Big Game

Feral swine feeding behaviors and preferences are similar to black bears, meaning they may compete for food resources such as vegetation, berries, acorns, and more. Some large predators, such as mountain lions, may benefit from feral swine as prey, but this can put them at risk of contracting the diseases and parasites feral swine carry.

Want To Learn More?

Call Wildlife Services, a program within the U.S. Department of Agriculture's (USDA) Animal and Plant Health Inspection Service, at **1-866-4-USDA-WS** or visit **www.aphis.usda.gov/wildlife-damage/stopferalswine** to learn more about the problems caused by this invasive animal, as well as to seek advice and assistance in dealing with feral swine.

Manage the Damage
Stop Feral Swine

Photo credits: Images courtesy of USDA-APHIS Wildlife Services and U.S. Fish and Wildlife Service.

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Some Resources for Identifying and Controlling Invasive Exotic Plants

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University of Florida/IFAS Center for Aquatic and Invasive Plants, http://plants.ifas.ufl.edu/

Florida Department of Agriculture and Consumer Services, Florida Forest Service, Invasive Non-native Plants, http://www.freshfromflorida.com/Divisions-Offices/Florida-Forest-Service/Our-Forests/Forest-Health/Invasive-Non-Native-Plants

Florida Exotic Pest Plant Council Invasive Plant Lists, http://www.fleppc.org/list/list.htm

Florida Fish and Wildlife Conservation Commission, Invasive Plant Management Section, http://myfwc.com/wildlifehabitats/invasive-plants/

Florida Natural Areas Inventory, Invasive Species, http://www.fnai.org/invasivespecies.cfm

United States Department of Agriculture, National Agricultural Library, National Invasive Species Information Center, Florida, http://www.invasivespeciesinfo.gov/unitedstates/fl.shtml

Miller,James H. 2003. **Nonnative Invasive Plants of Southern Forests: A Field Guide for Identification and Control.** U.S. Department of Agriculture, Forest Service, Southern Research Station, Asheville, N.C., Gen. Tech. Rep. SRS-62. 93pp. http://www.srs.fs.usda.gov/pubs/gtr/gtr_srs062/ To request a printed copy, call 828-257-4830, or email pubrequest@fs.fed.us nd ask for GTR-SRS-62.

Miller, James H., Erwin B. Chambliss and Nancy J. Loewenstein. 2010. **A Field Guide for the Identification of Invasive Plants in Southern Forests**, United States Department of Agriculture, Forest Service, Southern Research Station General Technical Report SRS–119. 126 pp. http://www.srs.fs.usda.gov/pubs/35292 Hardcopies available without charge from the Southern Research Station, 200 W.T. Weaver Blvd., Asheville, NC 28804.

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UNIVERSITY of FLORIDA

Introduced and Invasive Species in Florida — Online Resources

Prepared by: Dr. Steve A. Johnson, Associate Professor, Dept. of Wildlife Ecology, University of Florida

Invasive Species Websites of General Interest

Florida Invasive Species Partnership—FISP: This website is an invaluable resource for land managers in Florida. An excellent resource provided by FISP is its "Florida Landowners Incentives Program", which lists more than 25 potential sources of funds available to managers of private and public lands for control of invasive species. Other features of this site include an up-to-date calendar of events and news on invasive species, details for Florida's Cooperative Invasive Species Management Areas (CISMAs), and information on reporting and mapping observations of invasive plants and animals. This is a MUST VISIT site for anyone responsible for managing Florida's natural areas!

http://www.floridainvasives.org/index.html

The National Invasive Species Council—NISC: NISC is consortium of US federal agencies working together to address a myriad of invasive species nationally. NISC provides high-level interdepartmental coordination of federal invasive species actions and works with other federal and non-federal groups to address invasive species issues at the national level. Be sure to check out the 2008-2012 National Invasive Species Management Plan, which can be downloaded from NISC.

http://www.invasivespecies.gov/index.html

INVASIVES.ORG Center for Invasive Species and Ecosystem Health: The University of Georgia, in partnership with the USDA, hosts this great website and it's worth a visit. There you will find links to species profiles and a diversity of reports and publications, a library of digital images, and much more. This site provides information on invasive plants, invertebrates, vertebrates, and diseases. Click the "Maps" button at the top of the home page to go to the EDDMapS where you can report observations of introduced animals and plants. You will want to bookmark this web page for sure.

http://www.invasive.org/

USDA National Invasive Species Information Center: This site is a "gateway to invasive species information; covering Federal, State, local, and international sources." Although the information provided here for invasive vertebrates is relatively sparse, it is a great source of information for invasive insects, plants, and aquatic species. It also includes links to recent news and events on invasive species from a national perspective.

http://www.invasivespeciesinfo.gov/index.shtml

eXtension: "eXtension is an interactive learning environment delivering the best, most researched knowledge from the smartest land-grant university minds across America." This site provides resources for a variety of species of North American wildlife, including invasive vertebrates such as feral hogs and armadillos. There is also a great deal of additional information potentially valuable to natural resource managers.

http://www.extension.org/

Florida Fish and Wildlife Conservation Commission—Nonnative Species: This site provides a general background on invasive species and the problems they cause, numerous links to invasive species resources, and rules and regulations governing non-native animals in Florida. This FWC site is especially valuable because it is the clearinghouse for information on the status of introduced animals in Florida. Here you will also find brief profiles for virtually all of the state's introduced animals.

http://www.myfwc.com/nonnatives

Species Profiles and Management Resources

eXtension

- Feral Hogs: http://www.extension.org/feral_hogs
- Armadillos: http://www.extension.org/pages/8781/armadillo-damage-management#.Uo6eGulyga8

Internet Center for Wildlife Damage Management

- Armadillos: http://icwdm.org/handbook/mammals/armadillos.asp
- European Starlings: http://icwdm.org/handbook/birds/EuropeanStarlings.asp

Florida Fish & Wildlife Conservation Commission

- Armadillos: http://myfwc.com/wildlifehabitats/profiles/mammals/land/armadillo/
- Coyotes: http://myfwc.com/wildlifehabitats/profiles/mammals/land/coyote/faqs/
- Outdoor Cats: http://myfwc.com/wildlifehabitats/nonnatives/mammals/feral-cats/
- Feral Hogs: http://myfwc.com/media/2102702/6staffreport-wildhog_presentation.pdf
- Feral Hogs: http://myfwc.com/wildlifehabitats/profiles/mammals/land/wild-hog/
- Mallard/Mottled Ducks: http://myfwc.com/wildlifehabitats/profiles/birds/waterfowl/mottled-ducks/
- Mallard Ducks: http://myfwc.com/license/wildlife/nuisance-wildlife/mallard-control/

University of Florida Institute of Food and Agricultural Sciences

- Armadillos: http://edis.ifas.ufl.edu/uw362
- Coyotes: https://edis.ifas.ufl.edu/uw397
- Feral Hogs: http://edis.ifas.ufl.edu/uw322
- Iguanas: http://edis.ifas.ufl.edu/in528
- Purple Swamphen: http://edis.ifas.ufl.edu/uw317
- European Starling: http://edis.ifas.ufl.edu/uw300
- Cuban Treefrog: http://ufwildlife.ifas.ufl.edu/cuban_treefrog_inFL.shtml & http://edis.ifas.ufl.edu/uw259
- Cane (Bufo) Toad: http://edis.ifas.ufl.edu/uw345
- Burmese Python: http://edis.ifas.ufl.edu/uw333 & http://edis.ifas.ufl.edu/uw286

Florida Museum of Natural History

- Iguanas: http://www.flmnh.ufl.edu/herpetology/kk/pdf/2007_Krysko_et_%20al-Iguana_iguana.pdf

American Bird Conservancy

- Outdoor Cats: http://www.abcbirds.org/abcprograms/policy/cats/index.html

US Department of Agriculture

- Feral Hogs: http://www.aphis.usda.gov/wildlife_damage/feral_swine/
- Feral Hogs (Immunocontraception) : http://digitalcommons.unl.edu/cgi/viewcontent.cgi?article=1102&context=icwdm_usdanwrc
- European Starlings: http://www.aphis.usda.gov/wildlife_damage/blackbirds_and_starlings/index.shtml

Cornell Lab of Ornithology

- European Starlings: http://nestwatch.org/learn/nest-box-resource-center/managing-house-sparrows-and-european-starlings/

Education and Training Resources

University of Florida Institute of Food and Agricultural Sciences

- UF Wildlife**:** This is a website with information about invasive vertebrates, their natural history, and management. Online guides to Florida's Snakes and Florida's Frogs & Toad can be found here too, as well as resources for educators. Be sure to check out the page for the *Invader Updater* (click the "Invasive Vertebrates" link), a quarterly newsletter focused primarily on providing information on invasive vertebrate animals in Florida and the southeastern US. http://ufwildlife.ifas.ufl.edu/
- Reptile Early Detection and Documentation (REDDy): This is a free, online training module focused on identification and reporting of observations on large constrictors and carnivorous lizards in Florida. Numerous supplemental resources are provided. http://ufwildlife.ifas.ufl.edu/reddy.shtml
- Buyers Guide to Pet Reptiles: This brochure offers advice on the purchase of pet reptiles. It is available as a tri-fold brochure at the second link below. http://edis.ifas.ufl.edu/uw357 http://ufwildlife.ifas.ufl.edu/pdfs/PARC%20pet%20buyers%20guide.pdf
- Options for Unwanted Pets: This brochure offers advice on suitable options for unwanted exotic pets. A similar version is available as a tri-fold brochure at the second and third links below. http://edis.ifas.ufl.edu/uw353 http://edis.ifas.ufl.edu/pdffiles/UW/UW35300.pdf http://ufwildlife.ifas.ufl.edu/pdfs/PARC%20Pet%20Brochure.pdf

The Nature Conservancy

- Python Patrol: The Nature Conservancy conducts workshops that provide participants with hands-on training for safe and effective methods to capture large constrictors. http://www.nature.org/ourinitiatives/regions/northamerica/unitedstates/florida/howwework/stopping-a-burmese-python-invasion.xml

Florida Fish and Wildlife Conservation Commission

- FWC Pet Amnesty Program: The FWC conducts several "Pet Amnesty" events each year throughout the state. Anyone is allowed to surrender unwanted, exotic pets (no dogs, cats, etc.) with no questions asked. After a veterinarian examines each animal, those deemed healthy are sent home with pre-approved, adoptive parents. FWC can also help place needy animals with adopters upon request.
  http://myfwc.com/wildlifehabitats/nonnatives/amnesty-day-events/

National Park Service

- "Don't Let It Loose": This educational campaign provides numerous resources for educators on the issue of invasive species. The curriculum consists of numerous classroom activities targeted at middle school-aged students. "Interactive games and classroom activities instill students with the importance of responsible pet selection and ownership."
  http://www.nps.gov/ever/forteachers/dlil.htm

Aquatic Nuisance Species Task Force

- Habitattitude: This program is a partnership among several federal agencies—the USFWS is the lead—and the pet industry to educate the public about not releasing nonindigenous fish and aquatic plants.
  http://www.habitattitude.net/

Center for Invasive Species and Ecosystem Health

- Early Detection & Distribution Mapping System—EDDMapS: Developed by the University of Georgia with support from several federal agencies, EDDMapS is the portal for reporting and mapping observations of nonindigenous animals and plants in Florida. Here you can report observations and check current distribution maps for introduced plants and animals. You can also download smartphone apps for reporting your observations.
  http://www.eddmaps.org/

I hope you find these resources useful. If you have any suggestion, such as websites to add, please don't hesitate to email Steve Johnson at tadpole.ufl.edu.

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