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

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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.
Credit: UF/IFAS

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 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.
Credit: 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.
Credit: 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 southernmost 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.
Credit: UF/IFAS

Invasive Characterization and Regulatory Status

The IFAS Assessment and the Florida Invasive Species 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, and metsulfuron 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 increasingly used, but care must be taken to prevent potential nontarget damage to woody species. 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. The growth above the cut dies from cutting alone but the lower rooted growth must be treated. Treated populations should be monitored for regrowth and retreated as necessary. Treated sites should be revisited a minimum of every 6 months if possible. During site visits, all regrowth should be treated.

Extensive OWCF populations treated by helicopter receive a glyphosate or metsulfuron containing herbicides. 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 1-2 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.

As an alternative, triclopyr has been shown to provide comparable activity to glyphosate for ground-based treatments. Multiple formulations including an amine and an acid are labeled for aquatic use. Recent data has indicated some enhanced triclopyr selectivity on native ferns compared to glyphosate. This is ideal, but care must be taken to prevent excessive application, which may result in non-target damage to surrounding trees. General concentrations for backpack treatment range from 0.5% to 1.5%. Higher concentrations may become problematic for surrounding woody species due to triclopyr soil activity.

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.
Credit: USDA-ARS

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

Figure 7. Feeding damage from *Neomusotima conspurcatalis* larvae.
Credit: 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.

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

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

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.

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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.
Metsulfuron 60%	Spray to wet: .07–1.4 oz/100 gal Aerial: 1–2 oz/ac	The product Escort 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 acid 2.87 lb ae/gal	Spray to wet: 1.0% Aerial: NR[2]	Products registered for aquatic use. Broad spectrum on broadleaf plants and hardwoods.
Triclopyr amine 3lb ae/gal	Spray to wet: 0.5% Aerial: NR[2]	Products registered for aquatic use. Broad spectrum on broadleaf plants and hardwoods. Symptoms evident within days.

[1]Active ingredient expressed as the free acid.

[2]NR=Not recommended

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