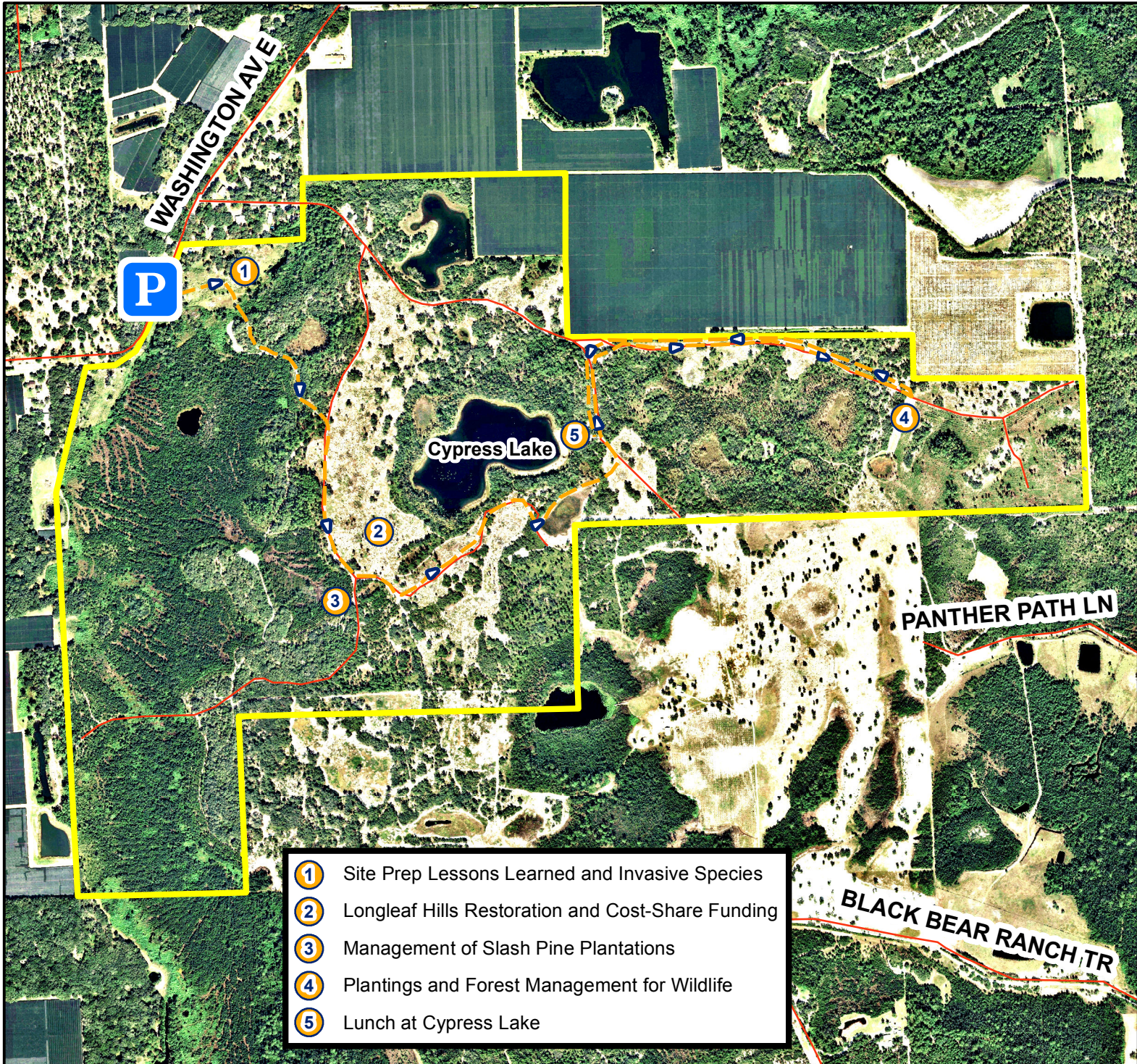




# Yulee Tree Farm

## Forest Stewardship Tour

S:25,36 T:14S R:28E  
S:30,31 T:14S R:29E  
29.249°N 81.418°W  
505.23 +/- Acres



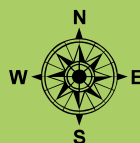
- ① Site Prep Lessons Learned and Invasive Species
- ② Longleaf Hills Restoration and Cost-Share Funding
- ③ Management of Slash Pine Plantations
- ④ Plantings and Forest Management for Wildlife
- ⑤ Lunch at Cypress Lake

## Legend

-  Property Boundary
-  Local Roads

Prepared by: Kraig Jones, Florida Forest Service  
Date: 2/16/2015  
Sources: ArcGIS Online / Bing Maps  
NAD83 HARN FL GDL Albers

## FOREST STEWARDSHIP PROGRAM



0 660 1,320  
Feet  
66 ft = 1 chain; 80 chains = 1 mile;  
10 sq. chains = 1 acre

### DISCLAIMER

This map is the product of the Florida Forest Service. No warranties are provided for the data therein, its use, or its interpretation.





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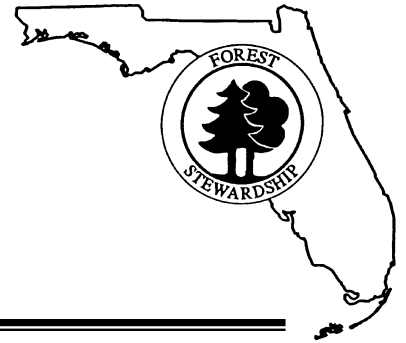
# Property Tour

## *Yulee Tree Farm*

### Property of Bill Anderson

### Volusia County, FL

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**Date / Location:** Friday, March 20, 2015  
Yulee Tree Farm, Volusia County  
Sign in, meet and greet at 9:00 AM  
Adjourn after lunch

**Tour:** Owned and managed by Bill Anderson, Yulee Tree Farm is about 500 acres of rolling topography, featuring sandhills, flatwoods, wetlands and ponds. When Bill purchased the property, fire had been excluded and much of the sandhill sites were occupied by upland oaks and sand pine. Wanting to restore the land to the longleaf pine forest that once occupied it, Bill cleared out the oaks and sand pine and planted over 100 acres of longleaf pine. He has also planted some slash pine on the more moderately drained sites and has done a tremendous amount of work managing a cogongrass infestation, cleaning up the property and improving recreational opportunities for his family, the local Boy Scout troop and other groups. Today we'll learn about longleaf pine regeneration and management, wildlife habitat management, ponds, how to combat cogongrass and get assistance.



Funding for Florida's Forest Stewardship Program is provided by the USDA Forest Service through the Florida Department of Agriculture and Consumer Service's Florida Forest Service and the Florida Sustainable Forestry Initiative Implementation Committee.



## **Tour agenda:**

**9:00 am        Sign in, meet and greet**

**9:30            Introduction, begin tour**

### **Stop 1**

Longleaf pine regeneration: site preparation and planting  
Bill Anderson, Kraig Jones, Steve Lloyd

Cogongrass invasion and management  
Bill Anderson, Kraig Jones, Chris Demers

### **Stop 2**

Sandhill restoration  
Bill Anderson, Kraig Jones, Mark Asleson

Cost-share assistance  
George Johnson, Mark Asleson, Steve Lloyd

### **Stop 3**

Slash pine management  
Bill Anderson, Kraig Jones, Steve Lloyd

### **Stop 4**

Forage plantings for wildlife  
Bill Anderson, Mark Asleson

### **Stop 5**

Cypress Lake  
Best Management Practices for water quality and wildlife habitat  
Steve Lloyd

**12:30 pm        Lunch at Cypress Lake - THANKS SPONSORS! (see back cover)**

**Please fill out your Tour Evaluation and give to Chris Demers before you go!**

**Safe Travels!**



## Tour Resource Contacts

<b>Bill Anderson</b> Landowner Yulee Tree Farm <a href="mailto:andersonwta@yahoo.com">andersonwta@yahoo.com</a>	<b>Chris Demers</b> Forest Stewardship Coordinator UF/IFAS School of Forest Resources and Conservation PO Box 110410 Gainesville, FL 32611-0410 (352) 846-2375 <a href="mailto:cdemers@ufl.edu">cdemers@ufl.edu</a>	<b>George Johnson</b> District Conservationist USDA Natural Resource Conservation Service DeLand Service Center 101 Heavensgate Road DeLand, FL 32720 (352) 538-3909 <a href="mailto:George.Johnson@fl.usda.gov">George.Johnson@fl.usda.gov</a>
<b>Mark Asleson</b> Regional Coordinator Landowner Assistance Program Florida Fish and Wildlife Conservation Commission 1239 SW 10th St Ocala, FL 34474 (352) 732-1225 <a href="mailto:Mark.Asleson@myfwc.com">Mark.Asleson@myfwc.com</a>	<b>Sharon Fox Gamble</b> Extension Agent IV UF/IFAS Volusia County Extension 3100 E New York Ave DeLand, FL 32724-6410 (386) 822-5778 <a href="mailto:sgamble@ufl.edu">sgamble@ufl.edu</a>	<b>Steve Lloyd</b> CFA Regional Coordinator Florida Forest Service (386) 226-0445 <a href="mailto:Stephen.Lloyd@freshfromflorida.com">Stephen.Lloyd@freshfromflorida.com</a>
	<b>Robin Holland</b> Silviculture BMP Forester Florida Forest Service 8282 SE Hwy 314 Ocala, FL 34470 (352) 732-1273 <a href="mailto:Robin.Holland@FreshFromFlorida.com">Robin.Holland@FreshFromFlorida.com</a>	

Questions about this or other Forest Stewardship Program activities can be directed to  
Chris Demers at (352) 846-2375 or [cdemers@ufl.edu](mailto:cdemers@ufl.edu).

For more information and events see the UF Forest Stewardship Program Web site at:  
[http://www.sfrc.ufl.edu/forest\\_stewardship](http://www.sfrc.ufl.edu/forest_stewardship)



# Florida's Forest Stewardship Program

Forest Stewardship is active management of forests and related resources to keep these lands 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 forestlands 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 have 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 future public recognition as a certified "Forest Steward".
- Educational workshops, tours and a quarterly Stewardship newsletter developed and distributed by the University of Florida, IFAS Cooperative Extension Service.

## Getting into the Program

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 here:

**<http://www.freshfromflorida.com/Divisions-Offices/Florida-Forest-Service/For-Landowners/Programs/Forest-Stewardship-Program>**





## 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.
- Access to seminars, field days, and workshops to help manage their Tree Farm even better.
- 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:

[http://www.floridaforest.org/tree\\_farm.php](http://www.floridaforest.org/tree_farm.php)





# Forestry Wildlife Best Management Practices for State Imperiled Species



- Forestry Wildlife Best Management Practices for State Imperiled Species (WBMPs) were adopted into Florida Administrative Code (Rule 5I-8) on October 21, 2014.
- WBMPs were developed through a partnership between the Florida Department of Agriculture and Consumer Services' Florida Forest Service and the Florida Fish and Wildlife Conservation Commission (FWC).
- WBMPs are **voluntary** practices designed as a practical approach for avoiding and minimizing the loss of **State Imperiled Species** due to silviculture operations.
- WBMP practices address the 16 State Imperiled Species which are considered to be potentially vulnerable to silviculture operations including ten aquatic species, two burrowing animals, and four nesting birds.
- WBMPs are designed to supplement the existing water quality-based Silviculture BMPs which already provide many valuable benefits to the conservation and management of fish and wildlife in Florida.
- Landowners and other forestry resource professionals can enroll in the voluntary program by completing a WBMP Notice of Intent. Those who do not wish to enroll will continue to be subject to all current laws and regulations regarding State Imperiled Species.
- Once enrolled, applicants who **properly implement** WBMPs will no longer be required to obtain a permit authorizing the incidental take of State Imperiled Species during bonafide ongoing forestry operations. In addition, they will not be subject to any fines or penalties associated with an incidental take of the State Imperiled Species covered by the WBMP Manual.
- WBMPs are not designed to facilitate wildlife habitat restoration or species recovery and expansion. Also, they do not address any Federally Listed Species. For information on Federally Listed Species, refer to FWC's online "Florida Wildlife Conservation Guide."
- To obtain more information or a copy of the WBMP Manual and Notice of Intent, contact your local Florida Forest Service BMP forester (see below) or a FWC Landowner Assistance Program biologist (850) 488-3831.

## Florida Forest Service BMP Foresters

Roy Lima  
Panhandle Area  
(850) 681-5942



Robin Holland  
Peninsula Area  
(352) 732-1273

Roy.Lima@FreshFromFlorida.com

Robin.Holland@FreshFromFlorida.com





# Got Invasives?

Invasive exotic plant problem? Use the Florida Invasives.org website to find financial and or technical assistance to manage or prevent an infestation.

FloridaInvasives.org is 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. It 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?

Public and private land managers have identified the high ecological and economic cost of invasive species as a statewide problem in Florida. The Florida Invasive Species Partnership (FISP) is a collaboration of federal, state and local agencies along with nongovernment organizations in Florida, formed to link efforts at preventing and controlling infestations of 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?

Each year, multiple agencies and organizations provide cost-share programs, grants and/or technical assistance to help landowners and land managers with various agriculture or natural resource management practices. Invasive exotic species management is an important practice covered within many of these programs.

FISP has created a searchable database, accessible at FloridaInvasives.org, that allows you to determine which agency or organization(s) might have an assistance program for your needs. Simply provide your county, target species and other pertinent information into the online tool, and you will retrieve a current list of available programs along with the most up-to-date contact information. 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. Log on at <http://FloridaInvasives.org> to find assistance with your invasive species problem.

## Conclusion

The Florida Invasive Species Partnership has created FloridaInvasives.org to help connect Florida's landowners and land managers with available technical and/or financial assistance programs to prevent or control invasive exotic species problems. These programs have been collected, evaluated and categorized in a single resource, making it easier to find the financial and/or technical assistance available to Florida landowners.

Go to [FloridaInvasives.org](http://FloridaInvasives.org) to find out more.

Florida  
Invasive Species  
Partnership

Think Locally, Act Neighborly  
Invasive exotic species know no boundaries!



# Cogongrass (*Imperata cylindrica*) Biology, Ecology, and Management in Florida Grazing Lands<sup>1</sup>

B. A. Sellers, J. A. Ferrell, G. E. MacDonald, K. A. Langeland, and S. L. Flory<sup>2</sup>

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

1. This document is SS-AGR-52, one of a series of the Agronomy Department, Florida Cooperative Extension Service, Institute of Food and Agricultural Sciences, University of Florida. Revised August 2012. Please visit the EDIS website at <http://edis.ifas.ufl.edu>.
2. B. A. Sellers, associate professor, Agronomy Department, Range Cattle Research and Education Center, Ona, FL; J. A. Ferrell, associate professor, Agronomy Department; G.E. MacDonald, professor, Agronomy Department; K. A. Langeland, professor, Agronomy Department; and S. L. Flory, assistant professor, Agronomy Department; Florida Cooperative Extension Service, Institute of Food and Agricultural Sciences, University of Florida, Gainesville, FL 32611.

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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](http://www.forestryimages.org).

green in color (Figure 1). Individual leaf blades are flat and 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.

## 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.

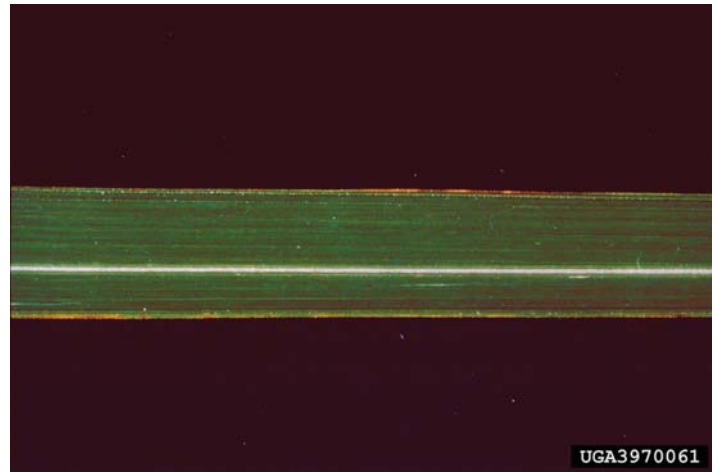


Figure 2. Cogongrass leaves have serrated edges and a prominent, white, off-center midrib.  
Credits: L. M. Marsh, Florida Department of Agriculture and Consumer Services, [www.forestryimages.org](http://www.forestryimages.org).



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](http://www.forestryimages.org).

## 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



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](http://www.forestryimages.org).

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
1 <sup>st</sup> 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.
2 <sup>nd</sup> year	Spring (monitor regrowth)	2–3% glyphosate	See above.
	Fall (monitor regrowth)	2–3% glyphosate	See above.
3 <sup>rd</sup> year – until eradicated	Spring – Fall (monitor regrowth)	Spot treat at the above rates for the 2 <sup>nd</sup> 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
1 <sup>st</sup> 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.
2 <sup>nd</sup> year	Spring (monitor regrowth)	2–3% glyphosate	No grazing or haying restrictions.
	Fall (monitor regrowth)	2–3% glyphosate	No grazing or haying restrictions.
3 <sup>rd</sup> year – until eradicated	Spring – Fall (monitor regrowth)	Spot treat at above rates for the 2 <sup>nd</sup> 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
1 <sup>st</sup> 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.
2 <sup>nd</sup> 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.
3 <sup>rd</sup> year	Spring (monitor regrowth)	2–3% glyphosate	No grazing or haying restrictions.
	Fall (monitor regrowth)	2–3% glyphosate	No grazing or haying restrictions.
4 <sup>th</sup> year – until eradicated	Spring-Fall (monitor regrowth)	Spot treat at the above rates for the 3 <sup>rd</sup> year.	See above.



# Longleaf Pine Regeneration<sup>1</sup>

Chris Demers, Alan Long and Patrick Minogue<sup>2</sup>

Longleaf pine (*Pinus palustris*) has many favorable characteristics for landowners who have long-term, multiple-use resource management objectives. Of all the southern pine species, longleaf pine is the most insect-, disease-, and fire-resistant and has the greatest longevity. When burned regularly, longleaf pine forests develop a stable grass savannah ecosystem, providing ideal habitat for many plants and animals.

Longleaf pine is a pioneer species on a variety of sites but is intolerant of competition and flooding during its grass stage, when it appears like a clump of grass. Historically, fire and moisture have been the principal factors controlling longleaf distribution within its natural range. In the lower Coastal Plain longleaf grows on sandy, well-drained to excessively well-drained soils where loblolly or slash pine perform more poorly. Fire removes competing vegetation, exposing the bare soil necessary for successful seedling establishment. In the historic fire-dominated longleaf pine grass savannah ecosystem, relatively stable plant communities are characterized by an overstory of uneven-aged, widely spaced longleaf pines and fire-tolerant oaks such as bluejack oak (*Quercus incana*) and turkey oak (*Quercus laevis*) and a predominate ground cover of bunch

grasses such as wiregrass (*Aristida stricta*) and bluestems (*Andropogon* spp) which facilitate ignition and spread of periodic fires (Landers 1991). It is interesting to note that, despite this tree's performance on high, dry ground, its Latin name means "swamp pine." It does grow sparsely in wet areas as well.

## Artificial Regeneration

Options for artificial regeneration include planting of bareroot or containerized seedlings or direct seeding. Control of pine stocking (density) is best when seedlings are planted and container-grown seedlings generally provide the best survival rate. However, direct seeding may be a viable option for some situations, such as regenerating relatively small areas.

## Site Preparation

Longleaf pine is very intolerant of shade and is difficult to regenerate successfully without vegetation control. Vegetative competition around seedlings must be kept at a minimum until an adequate number of seedlings emerging from the grass stage are at least as tall as the competition. The type and degree of site preparation and the choice of

1. This document is SS-FOR-13, one of a series of the School of Forest Resources and Conservation, UF/IFAS Extension Service, Institute of Food and Agricultural Sciences, University of Florida. First published January 2000. Revised November 2010. Reviewed August 2013. Please visit the EDIS website at <http://edis.ifas.ufl.edu>.

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site preparation methods before planting longleaf seedlings will depend on the regeneration technique used, site conditions and your management goals.

At the very least, prepare the area for direct seeding by first performing a prescribed burn. Disking also enhances seeding by exposing mineral soil and reducing competing vegetation for a short period of time. More challenging site conditions require more extensive site preparation techniques to increase the likelihood of success.

The most common situations encountered include recently harvested forest sites and conversion of old fields and pasture land. On recently harvested forest sites, most residual hardwoods should be removed with heavy machinery such as a root rake or controlled using various herbicides (Table 1). Following herbicide treatment, broadcast site preparation burning is often done to improve hand or machine planting access. V-blade planters are used to improve machine planting access by pushing debris away from the planted row. On old fields and pastures ripping will help break hardpans (compacted soil layers) and scalping a narrow (1–2 ft) strip, about 2 to 3 inches deep, along the planted row will break up the sod and improve the effectiveness of the planting machine in setting the seedlings with good soil contact. Scalping and ripping are usually done following the contour on sloping land to avoid erosion problems. It is best to rip the soil during dry periods in the summer to obtain good soil fracture and well in advance of the planting season, so that eventually rain will settle the soil prior to planting in the late fall or winter. When planting into established grass sod, the most effective practice is to deaden the sod with glyphosate herbicide (Table 1) either by broadcast application or by treating a 5–6 ft wide band centered on the planted row *prior to planting*. Herbicide control of grasses is very important for successful longleaf establishment, and glyphosate is most effective when applied during periods of active growth. Disking established sod prior to planting is not recommended because it makes herbaceous vegetation control after planting very difficult.

The best results are obtained when vegetation is managed both before and after planting. During the first and sometimes the second growing season following planting, selective herbicides are used to control grasses and broadleaf weeds (herbaceous weed control). This practice significantly improves seedling survival, and accelerates seedling growth rates by reducing the period that seedlings remain in the grass stage by one or more years. In longleaf plantations in the sandy soils of the Coastal Plain, hexazinone and sulfometuron methyl are the most commonly used herbicides for herbaceous weed control in longleaf

pine plantations (Table 1). These herbicides may be applied directly over planted seedlings safely when care is taken to ensure the proper herbicide rate is applied and labeled method is followed. Pine tolerance to these herbicides is best when seedlings have initiated new root growth following transplanting. Many growers excavate a few trees to check for new roots, which are white in color, prior to herbicide application. Herbaceous weed control treatments are most effective when weeds just start to develop in the Spring, which is typically in late March through mid-April.

Once seedlings are established, a prescribed burning program is a natural and cost-effective means to manage hardwood vegetation and also shift the ground cover to grass savannah species which provide desirable habitat for many desired wildlife species (Platt *et al.* 1998, Noss 1989).

## Planting

Since longleaf pine seedlings do not become truly dormant, they require greater care in handling and planting than other southern pines. The success of longleaf pine planting depends on: (1) good soil moisture at and following planting (2) a well-prepared, competition-free site; (3) fresh, healthy, top quality planting stock; (4) extreme care in handling the stock from lifting to planting; (5) quality planting; and (6) managing competing vegetation through stand establishment. High quality seedlings can be grown as either bareroot or container stock, but container stock is somewhat more forgiving of less than optimum conditions.

The appropriate planting density will depend on your objectives. Low planting densities, 300 to 500 seedlings per acre or less, may be appropriate for longleaf ecosystem restoration and/or to provide wildlife habitat (such as that for bobwhite quail), whereas 750 seedlings per acre or more may be desirable to optimize timber production and pine straw raking.

Supplies of longleaf pine seedlings may not be sufficient to meet demands, so order your seedlings by early summer at the latest. For a list of longleaf nurseries, call your DOF County Forester ([http://www.fl-dof.com/field\\_operations/county\\_foresters/index.html](http://www.fl-dof.com/field_operations/county_foresters/index.html)) or the Longleaf Alliance, at 334-427-1029, and request a copy of the *Longleaf Nursery List*. This is also available on their website: <http://www.longleafalliance.org/>.

Choose a tree planting contractor that has experience with planting longleaf pine. Planting failures frequently result from improper seedling handling and planting. Hiring an experienced and reputable contractor may help to ensure



seedling survival and minimize the possibility of having to replant.

## BAREROOT SEEDLINGS

Longleaf pine seedlings at the nursery are stem-less and resemble a carrot with a clump of pine needles on top. Ideally, bareroot seedlings should have: (1) a root collar diameter (RCD) of 0.4 to 0.6 inch; (2) a stout, 6- to 8-inch or longer tap root; (3) at least 6 well-developed, 6- to 8-inch lateral roots with evidence of ectomycorrhizal development; (4) a winter bud with scales; (5) abundant, large, fascicled needles that are free of brown-spot disease; (6) been grown at a reputable nursery; (7) been undercut in the nursery bed well before lifting; and (8) a seed source from the same region as the planting site. Seedlings with a RCD of 0.3 inch or less generally have low survival rates.

Longleaf seedlings come out of the grass stage and initiate stem height growth when the seedlings have a RCD of about one inch. After planting, longleaf seedlings allocate their growth to develop a tap root prior to initiating stem height growth. As noted above, seedlings may initiate height growth at a younger age if competing vegetation is controlled. Once the seedlings emerge from the grass stage, height growth is comparable with loblolly or slash pine of the same age.

## CONTAINERIZED SEEDLINGS

There is increasing interest in using containerized longleaf pine seedlings (plugs) because they generally have greater survival than bareroot seedlings. Also, containerized seedlings can be planted throughout the year, whenever soil moisture is adequate *before and after planting*. Containerized seedlings have even been successfully planted during the hot summer months, when afternoon rains are common. They can be used to replant partial regeneration failures in the year they occur as well. Studies have shown that both fall-planted and late winter-planted containerized longleaf seedlings *often* have better survival and growth than winter-planted bareroot seedlings. Seedlings grown in large containers (large plugs) can enhance survival on adverse sites, but to ensure success sufficient site preparation and vegetation control measures must be taken.

The main drawback of containerized seedlings is cost. On average, the price per thousand is about twice as much for container-grown seedlings as the cost for bareroot seedlings. The larger the plug volume, the greater the cost to produce the plugs. Also, containerized seedlings are more bulky to handle during shipping and planting. However,

cost-share programs and increased survival make them a feasible option.

## NURSERY TO FIELD

Proper care and handling of seedlings from the nursery to the field includes several steps: (1) pick up seedlings from the nursery the day they are lifted; (2) protect roots from desiccation; (3) protect seedlings from wind and refrigerate them if possible during transportation to the planting site (place plugs loosely in large coolers or waxed boxes); (4) store seedlings in a cool, well-ventilated area for no more than three days before planting (or up to 3 weeks in refrigeration, 5 weeks with humidity control); and (5) do not expose seedlings to sunlight or heat. To optimize success, plant seedlings within three days of pickup from the nursery. Large planting jobs may require multiple trips to the nursery.

Longleaf seedlings are normally planted between November and the beginning of March when cool temperatures are prevalent and soils are normally moist. Planting during the early part of this time frame is best to give seedlings time to grow new roots before the dry weather of April and May. Containerized seedlings can be planted earlier whenever available soil moisture is adequate and rainfall occurs as noted above, but risks are diminished during the winter planting season. Avoid planting during periods of low soil moisture, dry weather, high temperature, low relative humidity, high winds or when soil is frozen.

Take enough seedlings to the field for one day of planting and keep them moist, but not submerged. When hand-planting bareroot seedlings, keep a little water or wet Tera-Sorb in the bottom of the planting bag. Make sure tree planters carry seedlings in the bag to prevent the roots from drying out.

For bareroot seedlings, machine planting is preferable to hand planting because the larger slit created by the machine provides for better root alignment. If hand-planting, bareroot seedlings should be planted with a shovel or large dibble. Containerized seedlings can be planted with a cylinder-type dibble or any of the flat-bladed implements used to plant bareroot stock.

For bareroot stock, position seedlings with taproots straight down and root collars at or slightly below the ground line (no more than 1 inch below), which allows the bud to be exposed once the soil has fully settled. Attention to detail during planting is critical -- a seedling planted too shallow will die quickly, and a seedling planted too deep will die slowly.



For containerized seedlings, position the plug so that the terminal bud is well above the soil surface. Tell planters to “leave the upper part of the plug exposed.” This insures the seedling is not planted too deep.

Don't plant directly in a subsoiled/ripped furrow because the seedlings may sink. Instead, offset 2–4 inches to the side of the ripped furrow.

On scalped sites, anticipate soil movement back into the scalped furrow and plant more shallowly, leaving approximately 1 ½ to 2 inches of the plug above the soil surface. Very shallow planting also works well on wetter sites.

## A WORD ABOUT COST-SHARE CONTRACTS

If you have a cost-share contract under the USDA's Conservation Reserve Program or Wildlife Habitat Incentives Program, the planting crew must know about it. If not, they may plant more than the maximum number of seedlings allowed in the terms of the contract, causing problems with your funding.

## POST-PLANTING CARE

Once seedlings are planted, the principal factors affecting seedling development are vegetative competition and brown-spot needle blight. Prescribed fire is the most common cultural treatment used to control both. If average brown-spot infection exceeds 20% of the cumulative foliage on sampled seedlings, a burn will be needed to control the disease unless it will result in excessive mortality. Seedlings in the early stages of height growth (coming out of the grass stage) are most susceptible to fire kill, especially when heavily infected by brown-spot.

## Direct Seeding

Due to increases in seed costs, this once cost-effective regeneration option is now potentially cost prohibitive, and it involves substantial risk. Failure can occur as a result of inadequate control of competing vegetation, low seeding rates, using seed not treated with bird or rodent repellent, seeding at the wrong time, or adverse weather conditions. Often, direct seeding results in stands with patchy stocking, with some areas not adequately stocked and some areas with too many trees. Low, poorly drained sites that are likely to be covered with standing water a week or more after seeding should be avoided. Likewise, deep upland sands that dry out rapidly after a rain are also unsuitable for direct seeding. Generally, sites that can be successfully planted can also be successfully seeded. As with planting, site preparation methods must control vegetative competition and expose at least 50% of the mineral soil. Seeds must

be in contact with the mineral soil for germination to take place. Seeds lodged in non-soil material will probably not become established.

In general, local seed sources are best. Seed or seedlings from North and South Carolina tend to grow poorly when planted on the Florida peninsula and vice versa. Most genetic improvement work with longleaf pine is concentrated on breeding for brown-spot disease resistance and accelerated initial height growth.

Purchase seeds from a reputable seed dealer. Longleaf seeds should be refrigerated at subfreezing temperatures until sowing. Sowing can take place in fall, when moisture is adequate and maximum daytime temperatures drop below 85 degrees. Seed can be sown at low cost by broadcast seeding at 3 pounds per acre, or spot seeding (dropping 3 to 5 seeds per spot). Row seeding, at 1 to 2 feet spacing between seeds, can be used when better control over spacing and density is desired. Large areas are best seeded by aircraft which use carefully calibrated equipment. After establishment (two to three years), clumps of seedlings can be thinned down to one tree.

## Natural Regeneration For Even-Aged Stands

Landowners who already have stands of longleaf pine can take advantage of a practical, inexpensive natural regeneration method known as the *shelterwood* system, a natural seeding method well-suited to the biological requirements of this species. The shelterwood method maximizes per-acre seed production and yields sufficient needle litter to fuel fires hot enough to inhibit hardwood regeneration and to prepare a seed bed. Regular prescribed burns should be scheduled throughout the rotation to maintain a low understory. Most of the mature stand is removed at the end of the rotation, but a portion is left standing as a seed source until regeneration is well established. Success with this method depends on: (1) a good seed year with adequate seed supply, (2) a receptive seedbed, (3) minimal vegetative competition and (4) ample soil moisture.

The shelterwood system requires 3 cuts that serve 3 basic purposes: (1) to prepare the stand for production of abundant seed, (2) to modify the environment in a way that promotes germination and survival, and (3) to build up the amount and size of advance regeneration to ensure a well-distributed stand following overstory removal.



## Preparatory Cut

The preparatory cut is 10 or more years before the planned harvest date of the stand and at least 5 years before the seed cut. This cut is essentially a thinning which reduces the basal area (BA) of the stand to a maximum of 60–70 square feet per acre of dominant and codominant pines. This cut promotes crown development and cone production. Most of the hardwoods not controlled by fire should also be cut at this time.

## Seed Cut

The seed cut is made 5 years prior to the planned harvest date and leaves no more than 30 square feet BA per acre of dominant trees at least 15 inches diameter at breast height (dbh), with well-developed crowns. Trees with evidence of past cone production are favored. Cone production peaks in the range of 30 to 40 square feet BA per acre, but the lower end of this range is preferred because logging-related seedling losses increase when more trees are removed in the final cut.

Monitor the cone crop by taking spring binocular counts of both flowers (next year's cone crop) and 1 year-old conelets (this year's cone crop) on selected sample trees in the regeneration area. These counts will give an estimate of the potential for the cone crop to regenerate the stand so that the seedbed can be prepared before the cones open. Generally, few seeds are produced by trees under 30 years old or under 10 inches dbh.

In order to achieve adequate natural regeneration, the available seed supply must feed various forms of wildlife with enough left over to establish a satisfactory stand. A minimum of 750 to 1,000 or more cones per acre is needed for successful regeneration. Longleaf cone crops are highly variable. Good seed crops occur every 5 to 10 years. Seedfall begins in late October and continues through November, but most seeds fall within a period of 2 to 3 weeks. About 70% of viable seeds fall within 65 feet of the parent tree. Under favorable weather conditions, seeds will germinate one or two weeks after dispersion. A prescribed burn 1 year before seedfall will remove accumulated litter and expose sufficient mineral soil for seedling establishment. A late-spring burn is most effective in controlling woody stems.

## Removal Cut

Once an acceptable stand of seedlings is established, the parent overstory can be removed. This cut can be delayed if necessary for management needs or market conditions. Seedlings can survive 8 or more years under the parent overstory with little or no effect on survival given exclusion of burning. However, logging damage becomes more serious once seedling height growth begins.

Naturally regenerated stands require the same attention as planted stands with respect to brown-spot disease and competing vegetation. Young stands should not be burned until at least 2 years after the removal cut to allow time for logging slash to decay and the seedlings to respond to release.

## Natural Regeneration for Uneven-Aged Stands

Uneven-aged stands are created using the selection system. In the selection system, trees representing a range in size are harvested at fixed intervals (called the cutting cycle, which ranges from 10 to 25 years). Regeneration (either natural or artificial) occurs in the harvested openings. This management approach allows periodic harvests, while maintaining a continuous forest cover. Smaller, lower quality trees are also removed to improve the overall quality of the stand. This method is covered in detail in this publication on opportunities for uneven-age management: <http://edis.ifas.ufl.edu/fr132>

## Conclusion

Longleaf pine has many desirable characteristics for landowners who have multiple-use forest management objectives. On appropriate sites, and with careful attention to detail during the regeneration phase, it is possible to enjoy the versatility of this species without compromising growth rates.

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Table 1. Common herbicide treatments for longleaf pine establishment on sandy, Coastal Plain sites. Read and follow all label directions.

<u>Common Name</u>	<u>Herbicide Rate</u>	<u>Trade Name</u>	<u>Amount Product</u>	<u>Comments</u>
A. Site preparation of recently harvested forest sites primarily to control hardwood and shrub vegetation				
Hexazinone	1.9 to 3 lb ai/A	Velpar L	2.5 to 4 lb/A	Hand "spotgun application" on grid pattern or to individual rootstocks, same sites as above
Imazapyr + Glyphosate	0.625 lb ae/A + 3lb ai/A	Chopper Gen2 Accord XRT II	40 oz + 2.2 qts	Tank mix, broadcast aerial or ground sprayer, clay soils, where maple, ti ti present
B. Site preparation in established pasture or grass sod				
Glyphosate	2 lb ai/A	Accord XRT II	1.5 qts	Foliar application, broadcast or apply to a band on tree rows prior to planting
C. Herbaceous weed control (grasses and broadleaf weeds) over-the-top of planted seedlings				
Hexazinone + Sulfometuron	6 oz ai/A 1.5 oz ai/A	Velpar L Oust XP	24 oz plus 2 oz	Tank mix, very broad spectrum
Hexazinone Sufometuron	7.6 oz ai/A 1.4 oz ai/A	Oustar	12 oz	Pre-package mix, very broad spectrum Use 10 oz product on sandy soil.



# Establishing and Maintaining Wildlife Food Sources<sup>1</sup>

Chris Demers, Alan Long, Chris Latt, and Emma Willcox<sup>2</sup>

As human populations in the southeastern United States have grown, so have recreational demands for game and nongame wildlife. Fortunately, southern forests have the potential to be productive wildlife areas, well-suited to meet the growing recreational demands. To take advantage of potential economic opportunities or simply for personal enjoyment, many landowners now include wildlife in their forest management objectives.

Landowners who adopt wildlife management strategies must recognize that each wildlife species requires a specific set of habitat conditions. In other words, animals will frequent your property depending on the condition, type, and variety of food and cover that are present. Although proper wildlife management requires both habitat and population considerations, this publication focuses on methods of increasing the abundance and variety of wildlife food sources on and next to forestlands. Both “consumptive” uses (hunting) and “nonconsumptive” activities (bird watching, wildlife viewing, photography) will benefit from your careful attention to these methods.

## Food Sources

Food requirements vary widely among wildlife species and it is beyond the scope of this publication to include all of them. Mast—the seeds and fruits of trees and shrubs—is probably one of the most important naturally occurring seasonal wildlife food sources on your property. Mast is often separated into two categories: hard mast and soft mast. Hard mast includes hard-shelled seeds such as acorns,

hickory nuts, chestnuts, beechnuts, walnuts, pecans, and pine nuts. These seeds, commonly produced in fall and winter, are long-lived and typically high in fat, carbohydrates, and protein. As a result, they provide an energy-rich food source important to many wildlife species during colder months when other forms of nutrition are scarce. Soft mast is comprised of soft, fleshy, perishable fruits such as blackberries, cherries, pawpaws, and persimmons. These fruits are often high in sugar, vitamins, and carbohydrates and also provide an important food and energy source for wildlife. Unlike the seeds that comprise hard mast, soft mast fruits are not normally present during the winter. However, their occurrence during spring, summer, and fall is essential to many migrating and reproducing wildlife species.

Acorns are an especially important source of hard mast in many forests because of their substantial contribution to the total wildlife food base. In autumn, the diets of white-tailed deer and wild turkey can be comprised of up to 70% acorns. Acorn production varies by locality, season, year, oak species, and between individual oaks of the same species. Oaks can be divided into two types, “white oaks” and “red oaks,” based on the length of time it takes them to produce mature acorns. The acorns of white oaks mature in one growing season, while those of red oaks take two growing seasons to mature, resulting in different species having different seasonal and yearly acorn yields. Even within a particular oak species, acorn production can fluctuate greatly from year to year. In good mast years, acorns are abundant and available to wildlife well into the winter season, but in bad

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years supplies are consumed much earlier. Much of this fluctuation is the result of a natural cycle in oaks called “masting.” Most years, oaks produce low or moderate acorn crops. However, every 2 to 5 years they produce an abundant crop. Acorn yield during an abundant crop year may be 80% higher than in a low-production year.

Like oaks, most other hard and soft mast producers have varying seasonal and yearly yields. It is important to have a variety of hard and soft mast-producing species on your property so that wildlife food is available in each season and to compensate for years when certain individuals or species have low production. In addition to variety, the distribution of these trees across your property will also influence wildlife usage. For more information see the following extension publications on mast and increasing mast production:

- Making the Most of Your Mast (<http://edis.ifas.ufl.edu/fr036>)
- Managing Oaks to Provide Food for Wildlife (<http://edis.ifas.ufl.edu/uw293>)
- The Value of Oaks to Wildlife (<http://edis.ifas.ufl.edu/uw292>)

Although animals will tend to favor mast whenever it is available, herbage and browse (leaves, twigs and buds) provide a second major food source. As with mast, it is better to provide a variety of forage types than to rely on a single species or a few species. You can keep these foods palatable and nutritious through forest management practices such as prescribed burning, timber thinning, and harvest.

## Openings and Plantings for Wildlife

A variety of wildlife species benefit from open spaces and supplemental plantings. Good examples of these habitat components include managed forest openings, edge plantings, food plots, and fruit and nut plantations.

### Forest Openings

Many wildlife species require and/or benefit from open spaces. These areas provide a variety of foods and cover types that may not occur on forested sites—grasses, herbaceous plants, various insects, berries, small mammals, nesting habitat, and sites for territorial displays and watching for predators. Properly planned openings not only provide important wildlife habitat, but also can add to the attractiveness of your property, serve as firebreaks, and increase internal access. Openings may be located along

roads, right-of-ways, and fence lines, on old log decks, and in strips between different aged plantations. You can plan to scatter several irregular small openings throughout your forest or leave entire old fallow fields unplanted. Two rules of thumb for leaving openings when planting pines on your property are:

- When planting areas of five to ten acres, leave openings approximately 77 feet wide between the newly planted area and existing forest.
- For areas of greater than ten acres, leave numerous small openings scattered throughout the new plantation.

Various low-cost operations encourage the establishment and maintenance of herb and grass cover in these open areas. Disk or rotovate to break up compact soils, such as on log decks or old fire lines. Where grass cover is missing, seed clover or grass. Mow regularly to prevent the intrusion of shrubs and trees. Use rotational mowing (mow different areas at different times of the year) to encourage a wider variety of plants and available mast. Disk established ground covers periodically to enhance species and mast diversity. To avoid the disturbance of ground nesting species such as turkey and quail, and to promote the growth of important wildlife foods such as partridge pea, ragweed, and beggarweed, mow and disk during the winter months (December–February).

Landowners planning to create and maintain forest openings for wildlife may be eligible to receive cost-share funding for these operations under the Wildlife Habitat Incentive Program (WHIP). Wildlife plantings also fulfill requirements for enrollment in the Conservation Reserve Program (CRP). Contact your local U.S. Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) office for more information about these programs. See <http://offices.sc.egov.usda.gov/locator/app> to find your USDA Service Center.

### Edge Plantings

Other food sources include edge plantings, food plots, and fruit/nut plantations. An edge is a place where two or more different habitat types come together. Wildlife abundance and diversity is typically greatest along edges because they contain food and cover resources common to multiple habitat types. Borders between field and forest or forest stands of different ages or species create edge and are valuable to wildlife because they typically contain a diversity of species from each of the adjacent plant communities. Edge can be further enhanced by planting shrubs, vines, and other herbaceous plants or by managing existing vegetation



to benefit wildlife adjacent to fields, plantations, roads, water bodies, or other openings. Besides wildlife foods, these plants can provide shade, nesting areas, and hiding cover for many wildlife species and, in some cases, may improve the aesthetics of the property. Additional wildlife food and benefits can be provided by leaving several crop rows surrounding harvested agricultural fields.

Edge plantings should be at least 20 feet wide and usually contain taller plants than adjacent open areas. Sometimes the only action needed to establish a stand of shrubs, vines, and other wildlife food plants in an edge is to cut existing trees and let succession run its course. If this method fails to produce the plant community you want, it may be necessary to plant. A clever and inexpensive way to seed these areas is to plow the strip, then stretch a wire or cord between poles along its center. Birds resting on the wire will drop seeds to revegetate the strip. Be advised, however, that this may introduce unwanted or invasive weeds.

If you want more control over your edge plantings, transplanting from elsewhere on the property is a relatively inexpensive solution. A more costly alternative is to order nursery stock. Wax-myrtle, native hollies, hawthorn, crabapple, dogwood, wild plum, bicolor lespedeza, sumac, persimmon, cherries, blackberries, honeysuckle, greenbriar, and blueberries are some of the species suitable for edge plantings. You can allow these to grow into solid thickets, which will provide both food and cover. If you remove trees to provide sufficient light to the strips, cut the trees with the least wildlife value. Trees such as cherries, oaks, and other fruit- and nut-producers have high food value, and should be retained scattered throughout the edge strip.

## Food Plots

Food plots are an effective, albeit relatively expensive, method of providing food sources for game birds, deer, rabbits, raccoons, and other species. In this method, fields are planted with grains, corn, millet, legumes, sunflowers, and other plants with high nutritional value for wildlife. The size of food plots varies according to landowner preferences and the requirements of the target wildlife species, but usually they are a minimum of 1/2 to 1 acre in size, with a maximum of 5 acres.

When creating food plots, one of the most important considerations for many wildlife species is distance to escape cover (brushy, shrubby, and wooded areas). Animals may not use the center of larger plots if they feel they are exposed and too far from shelter where they can hide from predators and human disturbance. Rectangular plots have

the advantage of keeping distance to cover relatively short, while size can be increased as needed with added length. Rectangular plots also have far more edge than square or circular plots of similar size. Because wildlife diversity and abundance is typically greater at edges, the more edge you have the more individual animals you are likely to see. In most cases, food plots should be distributed across the property to make them available to as many animals as possible and lessen foraging pressure on any one plot. Well-distributed food plots will also fall within more animals' home ranges and therefore will benefit more individuals. Generally, 1- to 5-acre food plots should comprise approximately 1–5% of your land area.

Generally, it is best to provide food for wildlife year round by planting both cool- and warm-season food plots. Try to plant your cool- and warm-season food plots in different fields or in different sections of a field. That way you will not have to remove available food in preparation to plant the next season's food plot. Each season, make sure you plant a mixture of different plants in each food plot. Mixed plantings reduce the risk of losing entire food plots to poor weather, insect pests, or disease. They also provide a diverse food source and, as different plant species grow at different rates and times even within a season, ensure that new plant species are available to replace those that have matured and died. Diverse food plots also attract a wider variety of insects, which are important to certain wildlife such as turkey and quail, particularly when they are rearing young.

As with any crop, the successful establishment of food plots starts with proper soil sampling and depends on good seedbed preparation followed by proper liming and fertilization. Seed selection is important and should be based on your soil type and the wildlife species or groups of species you are targeting.

The Florida Fish and Wildlife Conservation Commission, the Natural Resources Conservation Service (NRCS), or the Cooperative Extension Service can provide advice on which crops to plant for your target wildlife species, the suitability of your soil for these crops, and their cultural requirements. For more information on wildlife food plots see the following Extension publications:

- 2010 Wildlife Forages for North Florida—Part I: Cool Season Food Plots (<http://edis.ifas.ufl.edu/ag140>)
- A Walk on the Wild Side: 2010 Cool-Season Forage Recommendations for Wildlife Food Plots in North Florida (<http://edis.ifas.ufl.edu/ag139>)



- Soil Fertility Management for Wildlife Food Plots (<http://edis.ifas.ufl.edu/ss468>)
- Establishment of Food Plots for White-tailed Deer in Central and South Florida (<http://edis.ifas.ufl.edu/uw262>)
- Supplemental Feeding and Food Plots for Bobwhite Quail (<http://edis.ifas.ufl.edu/uw264>)

## Fruit and Nut Plantations

Small fruit and nut plantations are another way to attract wildlife. Fast-maturing species like sawtooth oak, red mulberry, honeylocust, persimmon, black cherry, and Chinese chestnut should produce fruit by age 10. Large-caliper trees (diameter = 2–4 inches) should be stagger planted approximately 50 feet apart in rows 12 feet apart. Bareroot stock can be planted using a spacing pattern of 8 feet by 12 feet. Once these mast producers bear fruit, watch them for about three years and note which trees produce well and which produce poorly. As thinning becomes necessary, remove the poor-producing trees to provide additional light and space for the best-producing trees and understory plants.

In the case of dioecious species such as red mulberry and persimmon (which produce male and female flowers on different trees), only the female trees bear fruit. To provide growing space for fruit-producing trees, you should remove most of the male trees, leaving only a few to pollinate the female flowers.

Use caution when considering species. Some exotic species, such as sawtooth oak and Chinese chestnut mentioned above, have been championed due to their production of abundant mast at a young age. However, a multitude of native fruit and nut producing trees is available in Florida. Planting a variety of native species of fruit and nut trees is considered a superior alternative to planting exotic species.

In areas where deer or rabbits may excessively browse or girdle newly established seedlings, it may be necessary to use some type of protection device, such as a tree shelter. These devices provide physical protection for seedlings until they become established and can withstand some damage.

## Enhancing Wildlife Food Production in Existing Forests

Regular forest management practices can also increase diversity, availability, and quality of wildlife food. The primary objective of these practices will be to replace older shrub and hardwood cover with younger sprouts and herbaceous vegetation.

## Prescribed Fire

Fire causes many shrubs, grasses, and herbaceous plants to re-sprout from roots and produce more succulent foliage and flower more prolifically than they would in the absence of fire. Fire also recycles nutrients, raises the soil pH and increases germination of seeds that have accumulated in the soil surface. Fire frequency and season will favor different species. For example, a one- to two-year burning schedule keeps the understory open and creates habitat favorable for quail. A three- to five-year burning schedule allows browse and cover plants to develop, thereby favoring deer. Some plant species only bloom when they are burned during a certain season. Other plant species will re-sprout if burned in one season but are killed if burned at a different time of year. All of this affects the availability of wildlife food and cover resources. For more information on prescribed fire and wildlife see the following extension publications.

- Effects of Prescribed Fire on Florida's Wildlife and Wildlife Habitat (<http://edis.ifas.ufl.edu/uw132>)
- Benefits of Prescribed Burning (<http://edis.ifas.ufl.edu/fr061>)
- Understanding Fire: Florida's Land Management Tool (<http://edis.ifas.ufl.edu/uw124>)

## Thinning

Thin dense pine plantations to allow more sunlight to reach the forest floor, which promotes growth of herbaceous plants, grasses, shrubs, and vines. Residual pine densities of 50 to 70 ft<sup>2</sup> /ac are a little lower than optimum for timber production, but will favor understory plant development and are a good compromise if wildlife is to be included in forest management objectives. Follow-up treatments of prescribed burning or fertilization will increase ground cover development and the nutritional value of forage and mast. For more information on thinning and other forest management practices that benefit wildlife, see the following Extension publications:

- Ten Tips for Increasing Wildlife Biodiversity in Your Pine Plantations (<http://edis.ifas.ufl.edu/uw319>).
- Ten Tips for Increasing the Use of Your Pine Plantations by Game Species (<http://edis.ifas.ufl.edu/uw318>).
- Management of Pine Forests for Selected Wildlife in Florida (<http://edis.ifas.ufl.edu/uw098>)
- Management Practices to Support Increased Biodiversity in Managed Loblolly Pine Plantations (<http://edis.ifas.ufl.edu/fr236>)



## Promote Diversity

Forests with a variety of stand ages and/or species mixtures generally support more animals than do forests with little habitat diversity. Pines and hardwoods, although not always economically compatible, are a very good combination for creating habitat diversity. Protect hardwood hammocks or clumps, hardwood stands along streams, and productive, mast-producing individual trees. Also, wildlife populations benefit when stands of different ages are available because each age represents a different stage of plant succession that favors different plant and animal species. Balancing the age structure of a forest accomplishes two objectives: (1) sustained yield of forest products, and (2) diverse wildlife habitat.

In addition to the availability of wildlife food plants, consider the availability of *protective cover*. Many things can be considered cover—tall grass, brush piles, thickets, snags, stands of mature timber—depending on the wildlife species you wish to promote. In the ideal situation, plants that provide wildlife food will provide cover as well. Many animals often hesitate to stray far from cover; therefore, to obtain the greatest benefit from your wildlife food sources, try to maintain patches of protective cover nearby.

## Conclusion

Mast and forage production for wildlife can be increased on your forest property through the judicious use of open areas, edge strips, food plots, prescribed burning, thinning, and stand diversity, singly or in various combinations. The two most important criteria for the success of your efforts will be the diversity and seasonal availability of food sources.

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# A Walk on the Wild Side: 2013 Cool-Season Forage Recommendations for Wildlife Food Plots in North Florida<sup>1</sup>

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There is great interest in wildlife forages nationally. Florida poses different challenges for successful food plot plantings. Light, sandy soils, hot and humid summers, and distinct seasonal droughts make selecting forages for wildlife unique and challenging. We recommend using **adapted varieties** developed for Florida's particular growing conditions. We also suggest using **forage blends** to increase the longevity and stability of the plot, as well as using supply variety to suit multiple wildlife components. It is important to **soil test** and apply fertilizer and/or lime based on the soil test report. Information on soil testing is available on EDIS at [http://edis.ifas.ufl.edu/topic\\_soil\\_testing](http://edis.ifas.ufl.edu/topic_soil_testing).

## Cool-Season Legumes

Winter legumes are more productive and dependable on either the heavier clay soils of northwest Florida or sandy soils underlain by a clay layer than on deep upland sands or sandy flatwoods. White clover and ryegrass overseeded can be grown successfully on certain flatwoods areas in

northeast Florida. Inoculation of legumes is very important because it eliminates the need to supply nitrogen. Certain plants manufacture nitrogen if the proper inoculant (*Rhizobium* bacteria) is used. Many clovers and alfalfas come **pre-inoculated**. If the legumes you intend to use are **not** pre-inoculated, there are commercially available inoculants **specific** to each legume variety.

## Alfalfa

This high-quality legume is usually grown as a winter annual in Florida. Several new varieties have been selected under grazing by cattle and are low-dormancy types. Low dormancy means that the alfalfa will sprout and grow in Florida's mild winter climate. Many food plot blends sold commercially include mid- or high-dormancy type alfalfas that do not grow well in the southern United States. Alfalfa requires a soil pH of 6.5–7.0, high soil fertility, and good management, making it difficult to manage in wildlife food

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plot situations. Recommended varieties are Bulldog 805 and Amerigraze 702.

## Arrowleaf Clover

This is an annual clover similar to crimson clover in soil adaptation, management, and fertility requirements. It is mainly grown on heavier soils in northwest Florida. It is more productive in late spring than crimson clover. The recommended varieties are Yuchi and Apache.

## Berseem and Other Miscellaneous Clovers

There are many other small seeded clovers, including Rose, Berseem, Hop, Bur, Subterranean and Ball clover, all of which work fairly well for wildlife food plots. Limited local seed availability or high seed costs may be limiting factors. Generally these clovers produce less forage than crimson, white, arrowleaf, and red clover, and have a short duration growing season. Ball and hop clovers reseed well. Recommended varieties include Bigbee Berseem, Grazer Select, Don Ball Clover, and Overton Rose Clovers.

## Red Clover

This clover behaves as a winter annual under most North Florida conditions, and some reseeding may occur. Non-dormant (or low dormancy) varieties are recommended. Red clover does not tolerate flooding. Recommended varieties are Southern Belle, Bulldog Red, Barduro, and Redland. Southern Belle and Barduro were developed in Florida.

## Crimson Clover

This is a well-adapted legume for North Florida. It is an excellent forage producer and can reseed itself each year, if weather conditions permit. It is an annual clover adapted to fertile, well-drained soil. Of the clovers, it appears to be the least sensitive to soil pH. It has a relatively short grazing season, so it may be grown in combination with ryegrass, clovers, or a small grain crop to extend the period of forage availability. Recommended varieties are Dixie and AU-Robin.

## Vetch

Vetch grows best on well-drained, fertile, loamy soils. It has a spreading, viney growth habit and is an annual plant. The plant does reseed itself fairly well. Seed and foliage are consumed by many wildlife species. Recommended varieties are Hairy, Americus, AU-Early Cover, Cahaba White, and Nova II. Commercial seed production of most vetch varieties will be limited in 2013.

## White Clover

White clover in Florida is usually a winter annual, but may act as a short-term perennial under optimum fertility and moisture conditions. It is adapted to moist soils throughout Florida and is a good reseeder. Nematodes and other pests can limit production. Recommended varieties are Ocoee and Osceola (both developed in Florida), Louisiana S-1, Barblanca, and Regal Ladino. Durana and Patriot are also well adapted, and have a prostrate growth habit and longevity.

## Winter Peas

This annual legume is best suited to well-drained soils with high clay content. They typically are not very cold hardy. Austrian, Whistler, and Maple are recommended varieties. Several new varieties are commercially available and may be well suited for wildlife food plots in this region, but these have not been broadly evaluated.

## Cool-Season Grasses

Cool-season grasses generally include ryegrass and the small grains—wheat, oats, rye, and triticale (a man-made cross of wheat and rye). These grasses provide excellent winter forage and a spring seed crop readily used by wildlife.

## Oats

Oats may be planted and grazed by wildlife earlier than rye. When seeded in mid-fall they should produce very palatable forage by late fall. Oats are not as cold hardy as rye or wheat and may be susceptible to freeze injury. It is important to choose recommended oat varieties. Many “feed” oats are sold and planted as seed oats, but often they do not have a guarantee on the percent germination. Feed oats also may not have any resistance to the heavy disease pressure in Florida, particularly to rust and virus. Recommended varieties include Big Boss Wildlife Forage Oat, Horizon 270, Plot Spike LA 9339, Ram LA 99016, Horizon 201, SS76-40, and Buck Forage. Big Boss Wildlife Forage Oat, Buck Forage, and Ram Oat are relatively new varieties that have improved crown rust resistance, winter hardiness, and good grain and forage production for wildlife interests in Florida.

## Rye

Rye is widely used for winter grazing for cattle, but may be grazed by deer as well. Rye is more cold tolerant than oats and generally produces more forage than either oats or wheat. Rye should not be planted as early as oats because of



several disease problems occurring in the early fall. It is best to wait until cool weather to begin planting. Recommended varieties are FL 401 (for early grazing or use in blends), AGS 104, Wrens 96, Wrens Abruzzi, Bates RS4, and Oklon. Wintergrazer 70 and Early Graze have performed well in past trials, but have not been included in our variety trials in recent years.

## Wheat

Wheat is excellent for wildlife. Deer graze the forage, and birds use the seed. Recommended varieties are SS8641, USG 3592, Pioneer 26R6, and AGS 2038. Hessian fly resistance is important in wheat, particularly with early planting as wildlife forage. Coker 9553, Roberts, and GA-Gore are Hessian fly susceptible and are no longer recommended.

## Ryegrass

Ryegrass is a valuable and hardy forage crop for use on flatwoods soils or the heavier sandy loam soils in northwest Florida. Seeding ryegrass with small grains and clover lengthens the seasonal forage availability. **In wildlife food plots, ryegrass may become a weedy problem and dominate the food plot.** Ryegrass also has a tendency to reseed and may germinate the following year.

**Early recommended varieties:** Attain, Big Boss, Earlyploid, Bulldog/Grazer, Ed, Flying A, Oregro DH-3, Rio, TAM-TBO, and Verdure

**Late recommended varieties:** Attain, Big Boss, Earlyploid, Jackson, Jumbo, Marshall, Rio, TAMTBO, Prine, and Verdure

**Season-long recommended varieties:** Attain, Big Boss, Earlyploid, Jackson, Diamond T, Jumbo, Ocala, Nelson, Marshall, Prine, Rio, TAMTBO, and Verdure. (Varieties Marshall and Jackson are susceptible to rust and gray leafspot.)

These varieties were selected based on their recent three-year, multi-location performance.

Other ryegrass varieties, such as Florlina, Surrey II, Big Daddy, Passeral Plus, Brigadier, Fantastic, Graze-N-Gro, King, and Beefbuilder III, have also performed well in regional trials. Other new varieties may be suitable but have not been adequately tested in Florida.

## Triticale

This is a very high-quality, robust small grain that resulted from a cross of wheat and rye. It is very well adapted to North Florida, has good disease and insect resistance, and grows well even when late planted in December and January. Seed availability may be limited because seed production is scarce. Recommended varieties include Trical 342 and Monarch.

## Brassica and Forage Chicory Crops

Brassicas are annual crops that are highly productive and digestible and can provide forage in as short as 40 days after seeding, depending on the species. Forage brassica crops such as turnip, swede, rape, and kale can be both fall- and spring-seeded. **Little is known about adaptability of forage brassicas to Florida or if wildlife accepts them as a food source.**

### Kale

Kale (*Brassica oleracea* L. acephala group) is very winter hardy. Varieties include Premier, Vates, and Siberian.

### Rape

Rape (*Brassica napus* L.) would also be considered to be very winter hardy. Varieties include Rangi, Rangiora, Barnapoli, Dwarf Essex, Emerald, and Winfred.

## Turnip or Turnip Hybrids

Turnips (*Brassica rapa* L.) grow very fast, reaching near maximum production levels in 80–90 days. Varieties include Purple Top, White Globe and Barkant. Some varieties such as All Top and Seven Top only produce tops.

### Swede

Like turnip, swedes (*Brassica napus* L.) produce a large edible root. Yields are higher than those of turnip, but they grow slower and require 150–180 days to reach maximum production.

## Daikon Radish

Daikon radish (*Raphanus sativus*) is a highly palatable brassica and is well adapted to light, sandy soils. It is often referred to as tillage radish. Early planting may cause early bloom. Consider staggered planting dates to encourage longer season availability. Recommended varieties are Trophy and Daikon radish.



## Forage Chicory

Forage chicory (*Cichorium intybus* L.) is a perennial plant (forb) suited to well or moderately drained soils with medium to high fertility levels and a pH of 5.5 or greater. Varieties available at this time are Puna and Forage Feast.

## Recommended Cool-Season

### Forage Blends

#### Best Buy for your Buck

- 50 lb (2 bu) oats
- 50 lb (1 bu) wheat or triticale
- 6 lb red clover
- 15 lb crimson clover

#### Double Treat (for well-drained sites)

- 10 lb red clover
- 15 lb crimson clover

#### Triple Treat (for wet or poorly drained sites)

- 4 lb white clover
- 12 lb red clover
- 4 lb arrowleaf clover

#### Tetra Treat (for medium-drained to wet sites)

- 15 lb crimson clover
- 6 lb red clover
- 4 lb arrowleaf clover
- 2 lb white clover



# Soil Fertility Management for Wildlife Food Plots<sup>1</sup>

C.L. Mackowiak<sup>2</sup>

## Introduction

A good seed bed is the foundation for a successful wildlife food plot. Soil fertility is an important component of seed bed preparation. At a minimum, growers should be familiar with their soil characteristics. Deep sands typically do not hold many nutrients. The heavier, red soils such as those found in the Florida Panhandle, will likely hold more nutrients when fertilized. Your local County Extension or NRCS (Natural Resources Conservation Service) office should have a soil survey book or you can go online and use the NRCS Web Soil Survey at <http://websoilsurvey.nrcs.usda.gov/>. The soil maps and descriptions of your property will describe soil type, inherent fertility and pH, and will guide you in choosing a plot location, thereby avoiding marginal soils.

## Soil Sampling

Your next step is to sample the soil for pH and plant-available nutrients. You want to be certain that the small package of soil you send to the lab represents the soil you intend to manage for your food plots. This is best accomplished by gathering a composite soil sample.

A composite soil sample is comprised of several representative subsamples taken throughout the food plot that are combined into a single sample, using a 5-gallon bucket or a clean, non-metallic container. Metal containers may contaminate your soil sample with iron, zinc or other metals that may affect the lab results for those metals. Ten to 20 subsamples taken from the upper 6-8 inches of topsoil



Figure 1. Examples of soil sampling options. From left, soil probe, spade, sharpshooter and soil auger.

are used to create a composite sample. If you are unsure, take additional subsamples.

A shovel, soil probe or soil auger can be used to remove soil. To further prevent contamination, be sure the equipment is rust-free, particularly if micronutrient analysis will be conducted (Figure 1). Soil probes are fairly inexpensive and provide much more uniform core removal than shovels. Prices range from about \$50 to over \$200.

The most systematic method for gathering samples is subsampling at either grid centers or intersections (Figure 2). This approach is used in precision agriculture, but is less necessary for wildlife food plots. Instead, a random or

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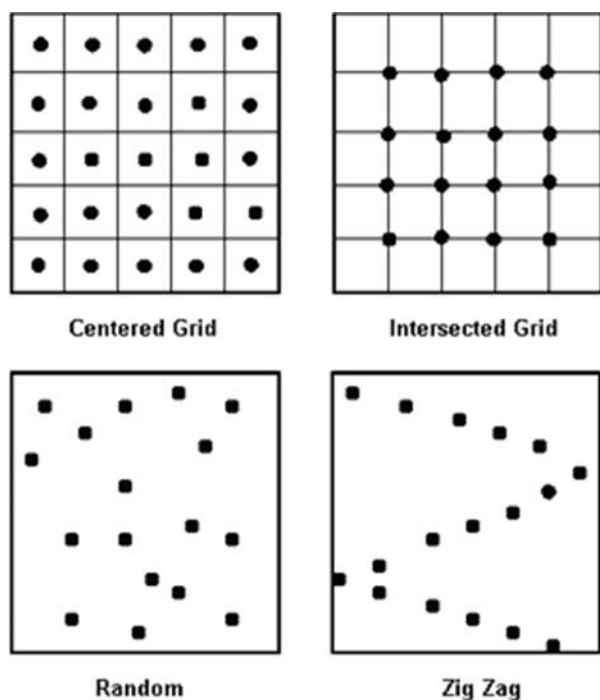


Figure 2. Each example represents a 10-acre field. Each point represents a subsample.

zig-zag sampling pattern is acceptable. The zig-zag method has the preferable advantage over random sampling of removing some unintentional bias in selecting subsampling points (Figure 2).

If soil pH and fertility are in good standing, sampling every three years is adequate. Annual sampling may be required if fertility is sub-optimal or the food plot is located on deep sands.

Approximately two cups of a soil composite are required by an analytic laboratory. Allow your soil sample to air-dry (e.g., spread sample on a cookie sheet) before packaging it for delivery. Soils are analyzed for plant-available nutrients, not total nutrients. Moist soil samples kept in air-tight bags may undergo chemical changes, which may produce an inaccurate representation of nutrient availability in the original sample. You may send your samples to a trusted commercial lab or contact your local Extension agent for instructions on sending them to the University of Florida (UF) Extension Soils Testing Lab (ESTL), which is located on UF's campus in Gainesville.

## Soil Analyses

Laboratory analytic parameters may include soil pH, buffer pH, available  $\text{NO}_3\text{-N}$ ,  $\text{P}_2\text{O}_5$  (phosphate),  $\text{K}_2\text{O}$  (potash), Ca, Mg, Fe, Mn, Zn, Cu, B, cation exchange capacity (CEC), and percent base saturation. At a minimum, the soil should be tested for pH, buffer pH (used for calculating lime

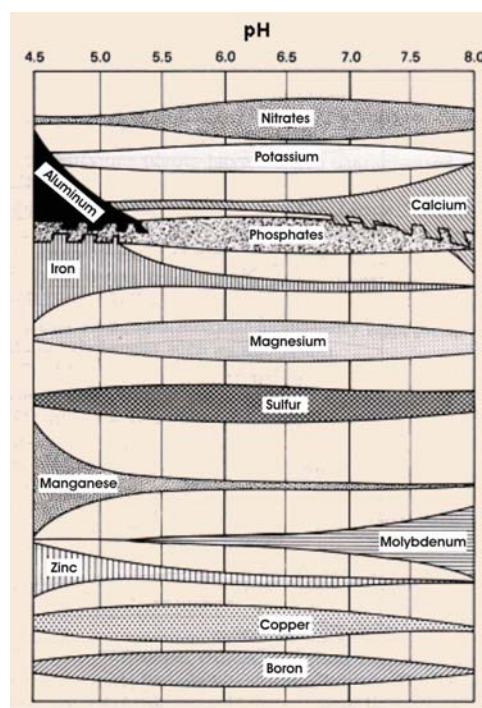


Figure 3. Relationship between soil pH and relative plant nutrient availability (a widening bar equates to greater availability). Where nutrients are shown interlocking, they combine at that pH to form insoluble compounds that reduce phosphate solubility.

Credits: Taken from R.W. Miller and D.T. Gardiner. *Soils in Our Environment*. Prentice Hall, 2001.

requirement),  $\text{P}_2\text{O}_5$ , and  $\text{K}_2\text{O}$ . Nitrate-N soil values change rapidly over time; therefore, soil testing for  $\text{NO}_3\text{-N}$  may not be warranted, nor is it recommended by UF/IFAS.

Percent base saturation, buffer pH, Ca and Mg values provide information relative to soil acidity and liming status. Cation exchange capacity provides an estimate of nutrient storage and release from soil particles whereby the higher the CEC value, the more fertile the soil may be. Because clays tend to hold more nutrients, the CEC provides an approximation of soil texture and vice versa. Sandy soils typically have a CEC below 12, and loamy soils typically have a CEC above 20. Soils high in  $\text{CaCO}_3$  (calcium carbonate) may have a higher CEC than their soil texture would infer. This is typically true of soils overlying marl or karst topography (i.e., limestone).

Micro or minor elements (Fe, Mn, Zn, Cu, B, Mo) are required in much lower doses than N, P, and K, and they are not measured as often. However, some Florida soils are deficient in one or more minor elements and, therefore, trace elements should be analyzed every few years, more often in very sandy soils. It is important to act cautiously when applying trace nutrients because excessive applications can harm plant growth over many years.



## Soil pH/Liming

If your soil pH is above 6.0, then liming is probably not required. Without a proper soil pH, some fertilizer nutrients become less available (Figure 3), resulting in lower yields. In comparison, an acid soil (pH < 5.0) increases the risk of plant aluminum (Al) and manganese (Mn) toxicity.

It is best to incorporate the lime several months before planting your food plot. This provides time for the lime to neutralize soil acidity. Applying lime to the surface without incorporating it into the soil may limit liming effects to the upper inch or two of soil.

Not all liming materials are the same! Pure calcite is used as the standard to rank all other liming materials. Calcium carbonate equivalent (CCE) is a term used to describe relative effectiveness. If you have a material with a CCE of 70, then it will take 1.3 tons of your product to produce the same liming effect as 1.0 ton of pure calcite. Additionally, some fertilizers have either a liming or acidifying

effect (negative CCE) (Table 1). Lime particle (mesh) size determines liming effectiveness or the effective neutralizing value. Rule of thumb: large lime particles (less than 20 mesh) will have minimal neutralizing value so choose smaller particle (higher mesh) sizes.

Often food plot fertility is accomplished at fall planting. Since agricultural lime requires some time to affect soil pH, pelletized lime may be used to get more rapid liming. Pelletized lime is often pulverized lime pressed into a pellet, which provides effective liming in a relatively short time. The ESTL will provide liming recommendations with your soil analysis report.

## Fertilizer Recommendations

Fertilizer recommendations may be provided in either parts per million (ppm) or lbs per acre. If the analytic results are in ppm, they can be converted to lbs per acre by multiplying the values by 2. A good guide to follow for fertilization requirements of specific forages common to food plots is SL129/SS163: *UF/IFAS Standardized Fertilization Recommendations for Agronomic Crops* (<http://edis.ifas.ufl.edu/ss163>).

In addition to the UF/IFAS forage recommendations, some legumes (many clovers, alfalfa) tend to have a higher pH requirement (6.5), but there are several species, such as crimson clover and perennial peanut, that perform well in moderately acidic soils (pH 5.5 or greater). Since forage blends are frequently used, a rule of thumb is to lime to keep soil pH around 6.0. Besides being high-quality, legumes rarely need N fertilizer since they often have root associations with microorganisms that fix N, which benefits the microorganisms, the host plant, and sometimes neighboring plants, particularly as the legume is grazed, browsed, or dies.

There is plenty of anecdotal information suggesting that intermixing legumes with other forage species may reduce the need for fertilizer N. Legumes, in particular, tend to have higher S, Ca, Mg, and B requirements and, therefore, may benefit from additional fertilization with one or more of these nutrients.

To make the most use of fertilizers, follow the best management practice (BMP) of splitting the recommended fertilizer rate into two or more applications. This improves the likelihood that the plants will capture more of the fertilizer to meet their nutrient requirements. Additionally, splitting applications will lessen the economic loss from

Table 1. Typical CCE of some liming materials.

Liming Materials	Typical CCE (%)
Calcite (pure)	100
Calclitic limestone	75 - 100
Dolomitic limestone	75 - 108
Aragonite	95 - 100
Hydrated lime (Ca(OH) <sub>2</sub> )	120 - 136
Marl	50 - 90
Burned lime (CaO)	178
Flue dust	60 - 80
Wood ash	30 - 70
Basic slag	50 - 70
<b>Other Materials</b>	
Calcium nitrate	20
Potassium nitrate	23
Rock phosphate	10
Gypsum (land plaster)	0
Urea	-83*
Ammonium sulfate	-110*
Diammonium phosphate	-70*
Humus	9
Milorganite	10
Sludges	20 - 80
*Negative values represent acidifying.	



leached fertilizer and reduce the potential for surface and groundwater nutrient contamination.

## Organic Fertilizers

Organic fertilizers, such as manures, litters and composts, can sometimes be used for wildlife food plots. The organic matter often improves a soil's water holding capacity and nutrient retention. The amount of available nutrients found in composts is low. Therefore, application rates may approach 20 ton/acre to meet plant nutrient requirements. In comparison, manures and litters are more nutrient-dense, so application rates are typically 5 tons/acre or less. One to 2 tons per acre is a frequent application rate.

Biosolids (AA-rated municipal sludge) are also good sources of plant nutrients. However, wildlife (deer in particular) may have an aversion to the material until it degrades and becomes incorporated into the soil. Thus, biosolids may work to protect against browsing pressure for a time, allowing for better forage establishment. To delay early encroachment by deer, application rates of around 300 lb dry biosolids/ac are all that is required. It might be advantageous to test biosolids on a small area for one or more seasons to evaluate their effectiveness as a temporary deer repellent prior to using them on larger acreage.

To learn more about specific wildlife food plot forages, see the following:

- SSAGR28/AG139: *A Walk on the Wild Side: 2010 Cool-Season Forage Recommendations for Wildlife Food Plots in North Florida* (updated yearly) - <http://edis.ifas.ufl.edu/ag139>
- SSAGR84/AA266: *2011 Cool-Season Forage Variety Recommendations for Florida* (updated yearly) - <http://edis.ifas.ufl.edu/aa266>



# Managing Florida Ponds for Fishing <sup>1</sup>

Charles E. Cichra<sup>2</sup>

Florida has thousands of natural and man-made ponds which range in surface area from less than 1/10 acre to greater than ten acres. Man-made ponds include dug-out and impounded waters, limerock pits, and sand or gravel pits, commonly called borrow pits. Fishing pressure on public waters is increasing due to Florida's rapidly growing population and the growing interest in fishing as a source of recreation and food. Competition for public fishery resources, coupled with the high cost of transportation to go fishing, has resulted in an increased interest in fishing private waters that are closer to home. These private ponds must, therefore, be more intensively managed to maintain good quality fishing for the pond owner's personal recreation or as a source of income.

Ponds that consistently produce good catches of fish require the proper stocking of the correct species and number of fish, a balanced harvest of mature fish, good water quality, and proper aquatic vegetation management. Many unmanaged ponds can produce more pounds of fish if good management practices are followed. The annual harvest of fish can provide hours of recreation, an excellent source of food, and even a supplemental income. The purpose of this publication is to provide an introduction to the management of Florida ponds for fishing.

## STOCKING THE POND

### What to Stock

Largemouth bass, bluegill (commonly called sunfish or bream), and channel catfish are the most commonly

stocked species in Florida ponds. When properly managed, these species can provide excellent fishing.

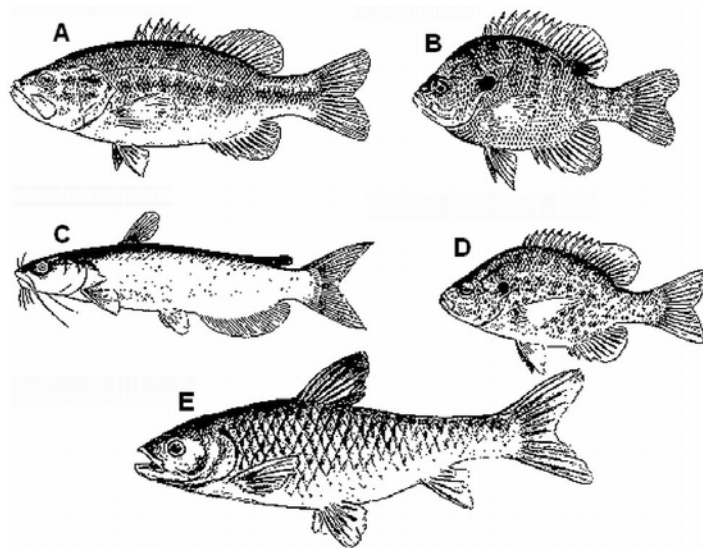


Figure 1. A. Largemouth Bass, B. Bluegill, C. Channel Catfish, D. Redear Sunfish (shellcracker), E. White Amur (grass carp)

The largemouth bass ( Figure 1A ) is a predatory species and requires large numbers of small fish as prey to maintain good growth. Many pond owners are reluctant to stock bluegill ( Figure 1B ) into their ponds because of their tendency to overpopulate and stunt, however, when stocked in conjunction with bass and properly fished, this species provides food for the bass and a fine sport fish for the angler. Without bluegill or other suitable prey species, a quality bass fishery will not develop.

1. This document is CIR802, one of a series of the Fisheries and Aquatic Sciences Department, Florida Cooperative Extension Service, Institute of Food and Agricultural Sciences, University of Florida. Original publication date July, 1998. Reviewed June 2012. Visit the EDIS website at <http://edis.ifas.ufl.edu>. Please visit the FAIRS website at <http://hammock.ifas.ufl.edu>.

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The channel catfish ( Figure 1C ) is both a popular food and sport fish in Florida. This species should be stocked alone in ponds smaller than one-half acre or in ponds that are muddy throughout the year. In larger ponds, catfish do well when stocked alone or with bass and bluegill. If stocked alone, catfish may overpopulate if spawning sites are available, so the addition of milk cans and sewer tiles to provide spawning sites is discouraged. In the presence of bass, the survival of small catfish is lowered because of predation. Supplemental stocking with catfish in the 8-to-10 inch size range is required to maintain their population in ponds with bass.

The redear sunfish ( Figure 1D ), commonly called the shellcracker, can also be stocked as a prey species for bass and as a sport fish for the angler. This species should not be stocked alone or comprise more than 30% of the initial stocking of sunfish (bluegill and redear sunfish) because it will not produce enough offspring to sustain the bass population. When stocked with bluegill, these two species will often produce hybrids which grow faster and to a larger size than either of the parents.

The white amur, commonly called the grass carp ( Figure 1E ), can be stocked into a pond to control aquatic vegetation. A permit must first be obtained from the Florida Game and Fresh Water Fish Commission before this species can be introduced into a pond in Florida. Only triploid grass carp, which are sterile, are legal for use in Florida ponds.

## What Not to Stock

Many other species have been stocked into ponds, but none have been as successful as the largemouth bass, bluegill, and channel catfish combination. While other species do well in streams, lakes or reservoirs, they often cause problems in ponds or are not well suited for the pond environment.

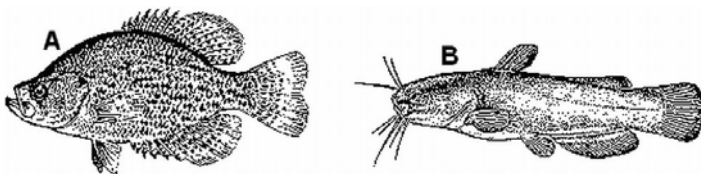


Figure 2. A. Black Crappie (speckled perch), B. Yellow Bullhead

Black crappie ( Figure 2A ) and white crappie, also known as specks, speckled perch or white perch, are among the worst fish to stock into ponds. They compete with bass for food, eat small bass, and have a tendency to overpopulate and become stunted in a pond. They spawn prior to bass in the spring. The young crappie quickly grow too large to serve as prey for young bass.

Common carp and bullheads ( Figure 2B ) should be avoided because they will stir up the pond bottom while feeding, causing muddy water. Bullheads will also often overpopulate in a pond.

## What Sizes to Stock

New or reclaimed ponds are normally stocked with small (1- to 4-inch) fish, called fingerlings. These small fish will produce harvestable populations in one to two years. Care must be taken to make sure that wild fish are not present in the pond, or the newly stocked small fish may be eaten.

To shorten the time before a pond becomes fishable, larger fish can be stocked. These will be more expensive to stock, but the amount of time required before fish can be harvested from the pond can be reduced.

## How Many to Stock

It is critical that the correct number of each species of fish is stocked. Improper stocking rates may prevent a pond from producing a quality fishery. In Florida, 100 bass and 500 bluegill fingerlings are normally stocked per acre. Catfish can be stocked at 100 per acre, along with the bass and bluegill or by themselves in catfish-only ponds. If the catfish are to be fed, then higher stocking rates of catfish can be used. If larger fish are stocked, fewer fish are required. Stocking rates of fifty 8- to 12-inch bass, two hundred 4- to 5-inch bluegill, and fifty to one hundred 8- to 12-inch catfish should be used.

## When and How to Stock

To prevent wild fish from becoming established and competing with stocked fish, a pond should be stocked as soon after it is filled or reclaimed as possible. Bluegill and catfish are normally stocked in the fall, and bass are stocked the following spring. Stocking bluegill in the fall will allow them to spawn, providing the small bass with a forage base. Catfish are stocked in the fall to allow them to grow large enough so that the bass will not be able to eat them. Bass are stocked in the spring because they are highly cannibalistic, and if left in the hatchery ponds in large numbers throughout the summer, they would eat each other, thereby reducing the number of fingerlings that would be available for stocking. Contact your regional Florida Game and Fresh Water Fish Commission office or your County Extension Service office for a list of local fish suppliers.

Stocking a pond in mid-summer should be avoided. High water temperatures and low dissolved oxygen may weaken fish being transported. Sudden temperature changes can cause fish to go into shock and die. When stocking fish,



transport water and pond water temperatures should be equalized by slowly adding pond water into the transport container. The fish can then be added to the pond when the water temperature in the container is about the same as that of the pond.

## **FISH MANAGEMENT**

### **Fishing the Pond**

When it comes to managing a pond for fishing, a distinction must be made between fishing and harvesting. Fishing is simply the act of trying to catch or catching fish, while harvesting is removing the fish from a pond. Generally, no limit needs to be placed upon the fishing of a pond, but fish harvest must be closely controlled. Occasionally, a fish that is returned to the pond may die from hook injuries or mishandling. These fish must be considered as part of the harvest. If properly handled, few fish will die while being caught and released.

Overharvesting of bass probably ruins fishing in more Florida ponds than any other cause. Anglers can easily overharvest the bass population during the first season of fishing. This allows the bream (bluegill and redear sunfish) to overpopulate the pond. The likelihood of bass overharvest can be reduced if the pond owner restricts the harvest of bass by anglers. However, making a pond off limits to everyone is not encouraged because underharvesting can also lead to problems.

The most sensible way to prevent bass overharvest is to establish a 15-inch length limit for a period of two to three years following stocking. If during this time, all bass that are less than 15 inches in length are released, the pond should begin producing harvestable-sized fish of all species. During this time, the fish that were originally stocked will have to support most of the fishing, so care must be taken not to overharvest these fish.

Two to three years after stocking, a decision should be made as to what size fish are desired. Bass will have reproduced two or three times during this period, yielding an abundance of small young bass. If left unharvested, these young bass will grow slowly due to competition with each other, resulting in a bass population comprised primarily of fish less than 12 inches in length. These small bass will feed heavily upon the sunfish, controlling their number. Fewer sunfish will be available for harvest, but they will be of larger size (7 to 8 inches). The catch will thus consist of small bass and large sunfish.

If the pond owner is interested in harvesting bass larger than 15 inches in length and sunfish of a variety of sizes, then 12- to 15-inch bass should be released after the initial two to three years following stocking. Bass of this size grow rapidly, produce many young, and prey heavily upon intermediate-sized sunfish. About twenty-five 8- to 12-inch bass should be harvested per acre per year, along with any bass larger than 15 inches. Total bass harvest should not exceed 20 to 25 pounds per acre per year. A good rule of thumb is to also harvest 4 to 6 pounds of sunfish for every pound of bass harvested.

Catfish can be harvested at any rate desirable to the pond owner. A good record of catfish harvest should be kept, so that the catfish population can be maintained at a predetermined level by supplemental stocking of 8- to 12-inch fingerlings as needed. These catfish fingerlings must be stocked to prevent them from being eaten by bass.

### **Stock Assessment and Correction**

If the fish have not been properly harvested, an adjustment of the fish populations may be required. If primarily 3- to 5-inch bluegill and few or no bass are caught, then overharvest, high natural mortality, or poor survival of young bass has occurred. This problem can be corrected by stocking fifty 8- to 12-inch bass per acre. Bass less than 15 inches in length should be released when caught until small bass become abundant. One of the harvest strategies mentioned above can then be followed.

If only small bass and no sunfish are caught, harvest of bass has not been adequate or no sunfish are present. In this situation, 200 4- to 5-inch bluegill should be stocked per acre. Approximately twenty 8- to 12-inch bass should be harvested per acre per year over the next two years. After this time, a decision should be made as to which of the management strategies described above will be followed.

### **Removal of Unwanted Fish**

Ponds which contain large numbers of rough fish such as gar, bowfin (mudfish), bullheads, carp, suckers or shad are best managed by the complete removal of all fish from such ponds, and then restocking with desirable species. This process is called pond renovation.

The least expensive method of removing unwanted fish from a pond is to drain it, and to allow its bottom to dry. Unwanted fish will often leave the pond through the standpipe. Those remaining will die as the pond water evaporates. This will effectively remove any fish from the pond, and will allow bottom sediments to oxidize. Many



impounded ponds in the Florida panhandle can be drained. If a pond cannot be drained, as is the case with many dug-out ponds in Florida, any water remaining in the pond can be treated with chemicals to kill the fish. Rotenone is the chemical most frequently used. When used at recommended rates, rotenone is not harmful to livestock or other warm-blooded animals, even if they drink the pond water immediately after treatment. During the autumn, when water temperatures are above 70 F, is the best time to renovate a pond to ensure a complete kill prior to restocking.

Rotenone comes in both an emulsifiable powder and liquid form. The powdered form can often be obtained from your local feed and seed store. The liquid form is occasionally available from local sources, but is usually mail-ordered. Contact your County Extension office or the regional office of the Florida Game and Fresh Water Fish Commission. The first step in reclaiming a pond is to determine the quantity of rotenone required. The surface area of the pond (in acres) should be multiplied by the average depth of the pond (in feet) to give the pond volume in acrefeet. At the recommended rate of 2 parts per million, 5 pounds of 5% powder or 0.65 gallons of liquid rotenone is needed for each acre-foot of water. For example: if you have a 1-acre pond with an average depth of 5 feet and you treat with 0.65 gallons of rotenone per acre-foot, you will need 3.25 gallons of rotenone (1 acre X 5 feet X 0.65 gallons per acre-foot = 3.25 gallons).

The next step is preparing the rotenone for application. If the powdered form is used, water is first added to the powder to form a paste. Additional water is then added until the paste is evenly mixed with the water (about 10 gallons of water to 5 pounds of rotenone). Likewise, the liquid form is diluted with water (about 1 gallon of rotenone with 10 gallons of water).

Finally, the rotenone is applied to the pond. Uniform distribution of the rotenone-water mixture is necessary to assure the complete removal of all fish. Most areas can be treated by pouring the chemical into the prop wash of an outboard as you slowly motor around and across the pond. Rotenone can be applied to shallow marshy areas and the shoreline with a garden sprayer. Deep areas should be treated by either pumping the chemical below the surface or by gravity feeding the rotenone through a perforated hose that is weighted at one end while moving across the deep areas. The reintroduction of unwanted fish species can occur from small pockets of water located upstream from the treated pond. To prevent this from happening, these areas should also be treated.

Ponds should be stocked soon after reclamation, but not until the rotenone is detoxified, generally about 7 to 14 days after application. In cold water, rotenone may remain toxic for longer periods of time. Toxicity can be tested by placing several live fish into a cage placed in the pond, and then observing the fish for several days to make sure that none of them die.

Scaled fish can be selectively removed from catfish ponds without harming the catfish by using Antimycin-a according to label directions. This chemical is most effective at warm temperatures and in neutral or slightly acid ponds.

## Feeding Your Fish

Fish can be fed artificial diets on an occasional basis to attract them to selected areas so that they can be more readily caught by anglers, or fed more intensively to promote rapid growth and higher standing crops (pounds per acre). Species such as the channel catfish and bluegill respond well to artificial feeds. Commercially produced pelleted catfish feed is an excellent choice (for further information, see Florida Cooperative Extension Service Fact sheet FA-1, "Catfish Feeds and Feeding"). Floating pellets are preferred over sinking feeds because species such as the bluegill will better utilize the floating form, and the pond owner will be able to determine if all the feed is being eaten. In addition, the pond owner will be able to determine if the fish go off feed, which could be an indication that the fish are sick or water quality is poor.

If a pond is heavily fished, an intensive feeding program can be established. Begin by feeding at a rate of two pounds per surface acre per day. Feed at several locations around the pond. Feeding should be daily, at the same time, and at the same locations. Feeding rates can be increased as the fish learn to take the pellets, but do not exceed ten pounds of feed per surface acre per day, and do not feed the fish more than they can eat in 10 to 15 minutes. Also, do not feed them when the water temperature is below 60 ° F, or, above 95 ° F. Fish do not actively feed at these times. Excessive feeding can lead to the increased chance of fish kills due to low oxygen and can become costly.

Feeding small quantities of food or on an occasional basis will likely have limited benefits to increased fish growth and standing crops. Feeding fish can, however, be an enjoyable experience, and should help in attracting fish to established feeding locations so that they can be more readily caught. Feeding may indirectly increase the natural productivity of a pond by introducing small quantities of nutrients into the pond each time the fish are fed.



## FISH DISEASES, PARASITES, AND KILLS

Fish are prone to diseases and parasites just like any other animal. Their diseases are caused by bacteria, fungi, or viruses (see Florida Cooperative Extension Service Circular 716, "Introduction to Fish Parasites and Diseases and Their Treatment"). Fish are most susceptible to disease outbreaks in the spring as water temperatures are increasing and their resistance is at its lowest coming out of the winter, and in the summer when water temperatures are high and water quality is often poor (see Florida Cooperative Extension Service Circular 715, "Management of Water Quality for Fish"). Generally, mortality is low in natural populations, such as in sportfish ponds, but can be a major problem when they are crowded as in aquaculture ponds. The cost of treating diseases is usually prohibitive in most private recreational ponds. The best rule of thumb is to let such disease outbreaks run their natural course.

Most fish have parasites, such as crustaceans, flukes, leeches, protozoans, roundworms, and tape-worms. Generally, these have little effect on the health of a fish. Little can be done to rid a pond of all parasites. Maintaining good water quality and preventing overcrowding of fish is the best way to keep a healthy fish population. If fish flesh is properly cooked, any parasites in the flesh pose no health hazard to humans who consume them.

Fish kills in sportfish ponds are often due to low oxygen concentrations. Several conditions can lead to oxygen depletion. Excessive aquatic vegetation can or occasion die back, consuming large quantities of oxygen as it decays. The best prevention for this is to maintain aquatic vegetation at a minimum. Floating plants such as duckweed can quickly cover the surface of a pond, preventing photosynthesis and the free exchange of oxygen from the atmosphere into the water. Microscopic plants, called phytoplankton, produce much of the oxygen in ponds. On calm overcast days, the animals and plants in a pond can consume the oxygen faster than the plants can produce it, resulting in oxygen shortages during the night or early morning hours. Heavy mortality can often be prevented by pumping fresh aerated water into the pond or by aeration of the water in the pond.

Runoff from livestock feedlots should not be allowed to enter a pond in excessive quantities. Nutrients in the runoff will promote the growth of rooted aquatic plants and dense algal blooms. In addition, the decaying organic matter will consume large quantities of oxygen. Fish kills may also occur in ponds where high densities of fish are crowded into small shallow areas due to low water levels. Accidental

introduction of pesticides into ponds should be prevented. Many agricultural herbicides and insecticides are toxic to fish.

## HABITAT MANAGEMENT

### Muddy Water

Muddy water is not only undesirable aesthetically, but also from a fisheries management point of view. Muddy or turbid water reduces the ability of a pond to produce fish food (microscopic plants and animals) and the ability of sight-feeders such as largemouth bass, crappie, and sunshine bass (striped bass crossed with white bass hybrids) to effectively capture their prey. This can result in reduced growth rates for these predatory species and overpopulation of prey species such as bluegill and redear sunfish.

Water in newly constructed ponds is often muddy. This should clear up as the pond banks become vegetated. Several factors may cause ponds to remain muddy after their construction. These include erosion of soils within the watershed or of the pond banks by wave action, the presence of fine clays in suspension, activity by crayfish or certain fish, and livestock wading along the shoreline.

The cause of the muddy water should first be determined and then controlled. This will allow the pond to clear over time. Planting windbreaks and deepening shallow shoreline areas of the pond will reduce turbidity due to erosion. Livestock can be fenced from a pond and given an alternate source of drinking water. Crayfish are not normally a problem in ponds that have established bass populations because predation of bass on crayfish will often result in reduced crayfish abundance. Nuisance fish such as carp or bullheads can be removed by rotenone as discussed previously in the section on removal of unwanted fish. Shallow ponds with large numbers of catfish will often be muddy. This type of pond is best left alone. Any attempt to clear this type of pond will usually fail as the catfish will continuously stir up the pond bottom.

If the water does not clear, the turbidity could be due to suspended clay particles. This type of water can be quickly cleared by broadcasting either 75 to 100 pounds of ground agricultural gypsum or 5 to 15 pounds of aluminum sulfate (commercial alum crystals) per acre-foot of water.

Hay can also be applied at about two bales per surface acre. The bales should be broken apart and scattered about the surface of the pond. As the hay decays, the clay particles will settle out. The decaying hay will also promote the growth of microscopic plants and animals which are food



for small fish. If the pond does not clear, additional hay can be added at a rate of two bales per surface acre every two weeks, not to exceed a total of 10 bales per acre per year. Care must be taken to avoid depleting oxygen in the pond which could lead to a fish kill.

## Aquatic Vegetation

Aquatic plants serve many roles in ponds. They produce oxygen which is used by fish and they remove waste nutrients. They provide cover for small fish, spawning habitat for adult fish, and substrate for small aquatic animals which are food for fish ( Figure 3 ). Aquatic plants reduce wind erosion to shorelines by dampening wave action. At times, however, plants may become too abundant, interfering with the recreational use of a pond, including such activities as fishing, boating, and swimming. Excessive plants can also disrupt the ability of predators such as the largemouth bass to capture prey species such as the bluegill. Under such conditions, growth of both of these species will be reduced. In addition, decaying plants consume large quantities of oxygen, which may result in fish kills.

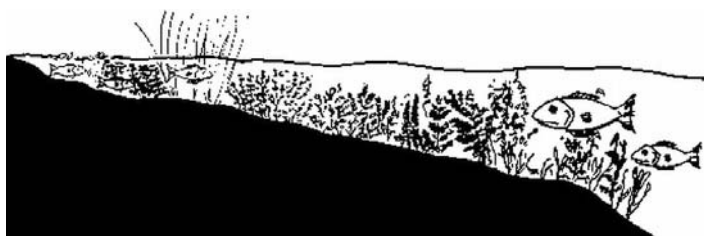


Figure 3.

When ponds are constructed with minimal amounts of shallow water and are relatively fertile, aquatic vegetation is normally not a serious problem. If aquatic vegetation becomes overabundant, three methods of control are available. These include mechanical, chemical, and biological techniques (see Florida Cooperative Extension Service Circular 707, “Weed Control in Aquaculture and Farm Ponds”).

Mechanical control may be as simple as cutting plants such as willows or cattails from the dam of a pond or raking submerged plants from a favorite fishing area. Large mechanical harvesters are also available, but are cost-prohibitive and impractical for small ponds. Such devices are generally used to maintain boat trails in larger lakes. Mechanical control is time consuming and its effects are shortlived if total control is not achieved.

Chemical control can be an effective means of controlling nuisance aquatic vegetation in a pond. Before using any

chemical control, the aquatic plant to be treated must be correctly identified so that the most effective and economical herbicide can be chosen. Assistance in aquatic plant identification can be obtained from the Florida Cooperative Extension Service, the Florida Department of Natural Resources, and the Florida Game and Fresh Water Fish Commission. Specific areas within a pond can be kept free of aquatic vegetation or the entire pond can be cleared. If the pond owner wishes to remove all the vegetation from a pond, only a portion of the vegetation should be treated to minimize the chance of having a fish kill as the dying vegetation decays. After the treated vegetation decays, additional vegetation can then be treated. Always read and observe the herbicide label precautions. After herbicide application, the water and fish may be unfit for food or agricultural purposes until a specified period of time has elapsed. This information will be provided on the herbicide label. Although chemical control is effective, it can be expensive. The herbicides may have to be applied several times during the year.

Biological control of aquatic vegetation can be achieved using herbivorous fish such as the white amur, commonly called the “grass carp”. The grass carp is almost totally vegetarian after it reaches a length of about four inches. It prefers to eat pondweeds that contain little fiber, but will consume emergent reeds, rushes, and sedges. In the absence of aquatic vegetation, grass carp feed on terrestrial plants overhanging or falling into the water. A free permit is required to possess grass carp in Florida. The permit must be obtained from the Florida Game and Fresh Water Fish Commission. Only sterile triploid fish can be stocked into Florida waters. Recommended stocking rates range from 5 to 25 fish per acre of water. These rates vary depending on the type and quantity of vegetation present. Only eight-inch or larger grass carp should be stocked into ponds with existing bass populations to minimize predation by bass. Grass carp may live more than ten years, making their use a cost-effective means of controlling nuisance aquatic vegetation. For further information, see Florida Experiment Stations Bulletin 867, “Grass Carp, a Fish for Biological Management of Hydrilla and Other Aquatic Weeds in Florida”.

## Liming

Many Florida ponds are constructed on acid soils. This can cause water to become acid, reducing the efficient use of nutrients, thus decreasing the overall productivity of a pond. Fish are often stressed in low pH (acid) water, causing them to grow slowly. A pH of 7.0 is considered to



be neutral, while a pH of 6.0 to 8.0 is considered desirable for maximum fish production.

An acid water (low pH) situation can easily be overcome by liming. Ponds can be limed just as agricultural fields are limed to increase soil pH. One ton of limestone will raise the pH of a one-acre pond by approximately one pH unit. Only finely ground agricultural limestone should be used. Lime can be applied from a boat over the surface of a pond, or in shallow areas around the perimeter of the pond. Response of the pond water to liming may take four to eight weeks. Frequency of liming varies from pond to pond depending upon the local soil acidity and movement of water into and out of the pond. Your county agricultural extension agent can assist you in determining if and how much lime should be added to your pond.

## Fertilization

Fertilization, the artificial addition of nutrients to a pond, is not a recommended or necessary management practice for most of central and south Florida. Most soils in these areas are naturally rich in phosphate and any ponds built in these soils are naturally rich in nutrients and highly productive. Ponds in the Florida Panhandle may benefit from fertilization.

Fertilization can be an effective means of controlling submergent aquatic vegetation. If begun early enough in the year, the addition of nutrients to a pond will promote the growth of microscopic plants ( Figure 4 ). Their dense populations will shade the rooted plants, preventing them from growing. Increased risks of having a fish kill exist for any pond with high nutrient loads. In addition, if fertilization is stopped, rooted plants may grow back in even greater abundance than existed before fertilization.

A fertilization program can also greatly increase the productivity of a pond. Fertilized ponds often maintain two to three times the standing crop (pounds per acre) of fish than unfertilized ponds. Such a program is not warranted unless a pond receives heavy fishing pressure. Contact your County Extension office or your regional Florida Game and Fresh Water Fish Commission office for further information on pond fertilization specific to your locale.

## INCOME FROM YOUR POND

The number of anglers in Florida is rapidly increasing due to the growing interest in fishing and Florida's rapidly growing population. Fishing pressure on our public waters is increasing, with many anglers looking for alternative places to fish. With increasing transportation costs, many anglers

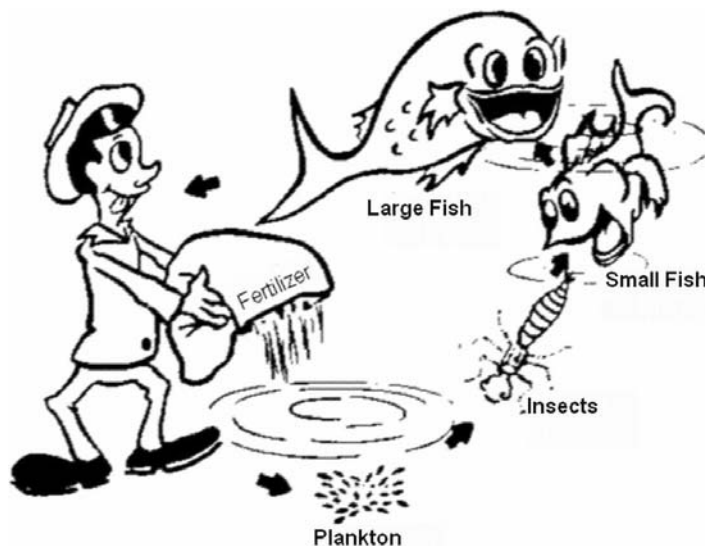


Figure 4.

are looking for fishing opportunities closer to home. Fee fishing, paying for the right to fish and/or paying for any fish that are caught, is becoming popular among anglers.

There are three basic types of fee fisheries: longterm leasing, day leasing, and pay by the pound operations (see Florida Cooperative Extension Service Circular 809, "Fee Fishing in Florida"). Fishing rights to a private pond or lake can be leased on a long-term basis to an individual or group of individuals such as is done with hunting or grazing leases. Management of the pond is often the responsibility of the lessee. Day leasing involves collecting a daily user fee from the fisherman. Pond management is the responsibility of the operator, who may stock the pond with catchable-size fish, such as channel catfish, on an occasional basis. Normally, however, only those fish that are produced within the pond through natural reproduction are made available to the angler. Generally, largemouth bass-bluegill ponds are used in day leasing operations. "Put and take" or "pay by the pound" fisheries involve stocking a pond with fish and then charging the fisherman for each fish that is caught. Consequently fish populations in this type of operation must be artificially maintained at high levels by regular stocking of catchable-size fish, usually channel catfish.

Fee fishing operations in Florida are rapidly increasing in number, but vary substantially in their success. Little is known as to why this variation occurs and what attracts anglers to these facilities.

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## UF/IFAS Forest Management and Stewardship Extension Publications on EDIS:

[http://edis.ifas.ufl.edu/TOPIC\\_Forest\\_Management\\_and\\_Stewardship](http://edis.ifas.ufl.edu/TOPIC_Forest_Management_and_Stewardship)

- [Assessing the Economic Feasibility of Short-Rotation Woody Crops in Florida](#)
- [Assessment and Management of Hurricane Damaged Timberland](#)
- [Beyond the Trees: A Systems Approach to Understanding Forest Health in the Southeastern United States](#)
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