Florida Forest Stewardship Tour:

George C. Owens Farm

Silvopasture: Combined Timber & Livestock

Washington County, FL

Date: **Wednesday, March 14, 2018**

Meet at the Washington County Extension Agricultural Center at 9:00 AM CT

Lunch will be served at the Ag Center after the tour.

Tour:

Congratulations to George and Pat Owens, **Florida Land Stewards of 2017**. One of the most renowned silvopasture operations in the Southeast, George C. Owens Farm combines trees with forage and livestock production. The trees are managed for high-value saw logs and, at the same time, provide shade, shelter and excellent forage habitat for livestock. This system reduces livestock stress and increases forage production. Properly managed silvopasture can be more productive, and often more profitable, than either timber or pasture management alone. The Owens demonstrate that environmental and economic sustainability walk hand in hand in good stewardship. Thank you for joining us for today's tour.

Funding for this event is provided by the USDA Forest Service via the Florida Department of Agriculture and Consumer Service's Florida Forest Service and the Florida Sustainable Forestry Initiative Implementation Committee.

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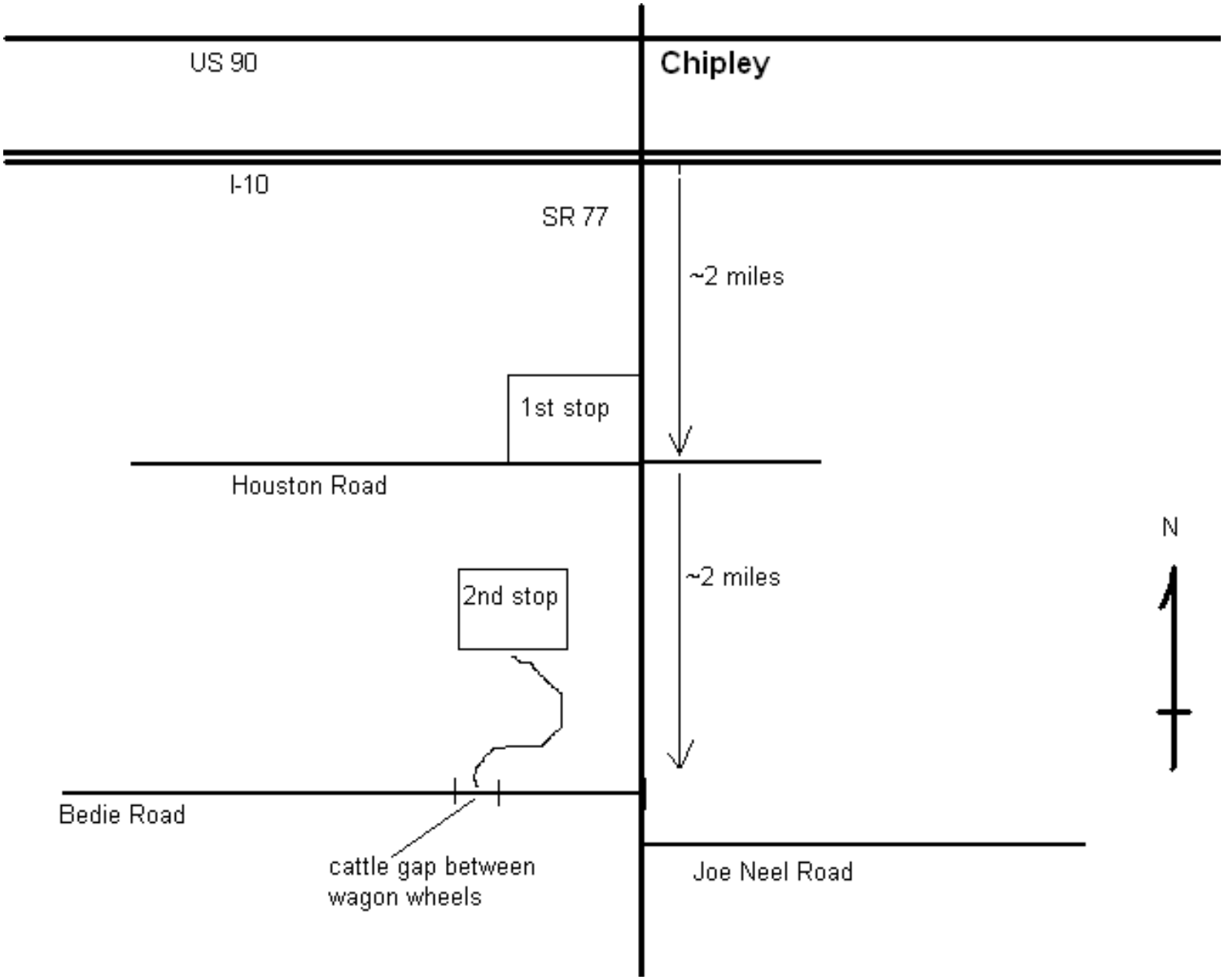
We appreciate the support of our
2018 Florida Forest Stewardship Program Sponsors
-listed on the back cover-

Agenda (all times local)

9:00 am	**Sign-in, meet & greet** at UF/IFAS Washington County Extension Ag. Auditorium
9:30	**Welcome, introduction**, *Mark Mauldin, UF/IFAS Washington County Extension and Chris Demers, UF/IFAS School of Forest Resources and Conservation*
9:45	Load vans, travel to George Owens Farm
10:00	**Tour George Owens Farm**, *George Owens*
12:00 pm	Travel back to Ag. Auditorium
12:15	Lunch
1:15	Conclusion, Complete evaluations
	Adjourn

Directions to George Owens Farm



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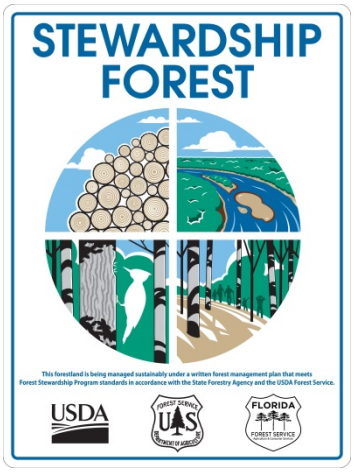
http://www.sfrc.ufl.edu/Extension/forest_stewardship

Florida's Forest Stewardship Program



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

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

Eligibility

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

Benefits to Landowners

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

How to Enroll

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

Tree Farm Program

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

Eligibility

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

Benefits to Landowners

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

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

Getting into the Program

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

https://www.treefarmsystem.org/florida

Florida Forest Service
Silviculture Best Management Practices

Silviculture Best Management Practices (BMPs)

Silviculture BMPs are the minimum standards necessary to protect our state's waterbodies and wetlands from degradation and sedimentation that can sometimes occur because of erosion from forestry operations. Silviculture BMPs should be applied on all bonafide ongoing forestry operations, especially those adjacent to waterbodies and wetlands, and may be enforced by federal, state and local authorities.

Silviculture BMP Courtesy Checks

Silviculture BMP courtesy checks are available for landowners, land managers, and loggers. These courtesy checks provide a "report card" on Silviculture BMP implementation for recent or ongoing forestry operations. This helps future management planning and evaluates the performance of contractors on your property.

Silviculture BMP Site Assessments

On-the-ground Silviculture BMP site assessments are available to determine which Silviculture BMPs apply to planned operations on a specific site. This helps with harvest plan development, road layout, mitigation of existing problem areas, etc.

Silviculture BMP Notice of Intent

The Silviculture BMP Notice of Intent (Rule 5I-6 F.A.C.) is a voluntary, one-time pledge that a landowner signs, indicating intent to adhere to Silviculture BMPs on their property. Once a landowner has signed the Notice of Intent, he or she will become eligible to receive a *presumption of compliance* based on reasonable evidence with state water quality standards during future ongoing forestry operations. This is very important if a landowner's property falls within an area covered by a Florida Department of Environmental Protection Basin Management Action Plan for impaired waters.

Additional Services

For information on the services listed above or any other services provided by the Florida Forest Service's hydrology section, please contact your local BMP Forester.

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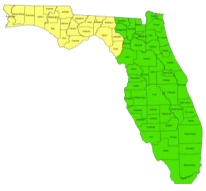

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Florida Department of Agriculture and Consumer Services
Adam H. Putnam, Commissioner

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

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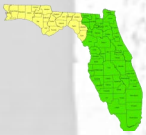

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Got Invasives?

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

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

Why was FloridaInvasives.org developed?

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

How does FloridaInvasives.org help you?

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

FloridaInvasives.org:

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

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

Go to FloridaInvasives.org to find out more.

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

FISP
Florida Invasive Species Partnership

Think Locally, Act Neighborly

invasive species know no boundaries!

Integrated Timber, Forage, and Livestock Production—Benefits of Silvopasture[1]

Jarek Nowak, Ann Blount, and Sarah Workman[2]

What is silvopasture, and what benefits does it offer to landowners throughout the Southeast? Silvopasture, an agroforestry practice, is an intentional combination of trees, forage plants and livestock. The term 'silvopasture' translates into 'forest-pasture', as the prefix 'silvo' was derived from a Latin word that means 'forest'. The system offers advantages described below, but requires intensive management. Silvopasture can be established either by planting trees in an improved pasture, or by thinning a tree stand and planting improved forage. Special tree arrangements in silvopastures allow for tree and forage growth, as well as for grazing livestock. This publication explains potential benefits and drawbacks of silvopastoral systems. It also describes steps for choosing appropriate tree, forage and livestock species. For details concerning silvopasture design and establishment, please see UF/IFAS Extension fact sheet: *Establishing Silvopasture in North Florida* (currently in preparation). Other relevant UF/IFAS Extension publications on the subject are: *Managing Pine Trees and Bahiagrass for Timber and Cattle Production* (Circular 1154) and *Managing Cattle on Timberlands: Forage Management* (SS-FOR-20). These and other UF/IFAS Extension EDIS publications are available at http://edis.ifas.ufl.edu/.

Why consider silvopasture?

Production of timber, forage, and livestock in the same place, at the same time is viewed as an attractive management alternative that has potential to improve cash flow for landowners (Figure 1).

Figure 1. Seventeen-year-old slash pine, bahiagrass, crimson clover, and cattle silvopasture. Trees were planted in double-row 4x8 ft spacing with 40 ft. pasture alleys between the double-rows. Bahiagrass dominates alleys during summer and crimson clover during winter months.
Credits: Todd Groh (2001)

1. This document is Cir1430, one of a series of the School of Forest Resources and Conservation Department, UF/IFAS Extension. Original publication date December 2002. Reviewed January 2017. Visit the EDIS website at http://edis.ifas.ufl.edu.

2. Jarek Nowak, assistant professor, School of Forest Resources and Conservation, UF/IFAS North Florida Research and Education Center; Ann Blount, assistant professor, Agronomy, UF/IFAS NFREC; and Sarah Workman, visiting assistant professor of Forestry, CSTAF; UF/IFAS Extension, Gainesville, FL 32611.

The goal in silvopastoral systems is to optimize, rather than maximize, production of all three components. A well-designed and properly managed silvopasture can be more economically attractive than plantation forestry under a wide range of conditions. This has been demonstrated in pine-based systems in north Florida, Louisiana, Mississippi, and Georgia, as well as in Douglas fir-based silvopastures of western Oregon. The key to improved cash flow of silvopastures is the annual income derived from forage and livestock, which supplements long-term, periodic income from timber sales. The multi-product nature of silvopastures provides safeguards against unfavorable markets, weather conditions, or agricultural policy decisions (Sharrow 1999). Silvopasture can be implemented on small acreages as well as on landholdings with hundreds of acres. It could be a stand-alone operation, or part of a mosaic of land-uses that include improved pastures and diverse timberlands. There is also potential for partnerships between forestland and livestock owners. The forest owners would gain annual income; the livestock owners would have access to an additional grazing resource.

Who should consider silvopasture?

Applying silvopasture and realizing its potential benefits requires combined expertise in timber, forage, and livestock management. Landowners may choose to work alone or combine their own strengths with those of other individuals. Silvopasture establishment could be favorably considered by the following:

- Non-industrial private forest landowners who want annual forest-derived income
- Pine plantation owners who want to diversify income sources after first commercial thinning
- Livestock producers who want to improve grazing conditions of their woodlots
- Livestock producers interested in diversifying their enterprises

Economics of Silvopasture

Studies from across the Southeast report productive livestock grazing under pine canopies while maintaining, or even improving high value timber production. In northwest Louisiana silvopasture generated a higher internal rate of return than managed timber or open pasture (Clason 1995). In southern Mississippi silvopastures attained higher land values than commercial pine plantations. Optional hunting fees added yet more value to those systems. However, in the same study, grazing for stocker steers on conventional pasture produced the highest land expectation values (Grado et al. 2001). In Georgia, there are examples of enhanced pine growth with controlled grazing (Lewis *et al.,* 1985). Research models show loblolly pine-forage-cattle practices in the Coastal Plain may have up to 70% greater net present value than a pure forestry operation (Dangerfield and Harwell, 1990). These examples suggest that converting timberland to silvopasture could be more economically attractive than adding timber to existing cattle operations. Recently publish data (Husak and Grado 2002) seem to support this conclusion, except for the lowest (5%) interest rate investigated (Table 1).

Equivalent Annual Income (EAI) is often used to compare forestry and agricultural investments. EAI represents a net present value (all revenues minus all costs discounted to the present) of an investment expressed as annual dollar amount. At the lowest interest rate (5%) pine plantation produced the highest EAI and silvopasture was a close second. However, at 7 and 9% interest rate cattle were the most profitable. On average, silvopasture was more profitable than pine plantation, but not as profitable as cattle operations. The reader is cautioned to consider these conclusions in the context of current market conditions and differences in management regimes. For example, one commodity not included in the analyses summarized above is pine straw, which is not produced in loblolly pine plantations.

Benefits of Silvopasture

When properly implemented, silvopasture can provide many economic and environmental benefits. Some of these are linked, e.g., reduced need for nitrogen fertilization in grass/legume silvopastures leaves more dollars in landowners' pockets, and lowers the risk of ground water contamination with leaching nitrates. Not all benefits will be possible in every silvopastoral system. Some may be more applicable than others to a particular landowner, depending on silvopasture design, level of management, external circumstances, and management objectives. Below is a list of the most common benefits provided by silvopastures:

- Diversified timberland income by added livestock, hay, grazing/hunting proceeds
- Reduced need for chemical or mechanical vegetation control underneath the trees
- Reduced fire hazard in the absence of brush and accumulated fuels
- Reduced need for nitrogen fertilization in grass/legume silvopastures

- Recycled nutrients from animal wastes benefit forage and tree growth
- Eliminated need for separate tree fertilization, if forage is fertilized
- Delayed forage maturity in the fall and earlier green-up in the spring
- Increased livestock protection from summer heat and winter chill
- Improved cover and forage for wildlife
- Increased opportunities for recreation, e.g., hunting, wildlife watching
- Aesthetically more pleasing than either solid pine plantations or open pastures

Drawbacks of Silvopasture Establishment

Full benefits of silvopasture may only be realized under intensive management of all three components: trees, forage, and livestock. When necessary management for any of these is not possible, silvopasture should not be considered. The system is most suitable for high value and quality timber production during long rotations. If saw timber is not the long-term management objective, other wood production systems should be explored. Similarly to traditional pastures, overgrazing or animal overstocking in silvopastures can damage trees, grazing resource, wildlife habitat or entire watershed. Other drawbacks to silvopasture establishment may include:

- Establishment cost associated with either planting trees in improved pastures, or preparing thinned pine plantations for forage planting
- Need for portable or other fencing before livestock is allowed to graze
- Cost of providing access to water from all grazing cells
- Temporary withdrawal of land from livestock production to avoid damage to young trees
- Temporary interruption of established cattle production cycles during pasture to silvopasture conversion
- Need of additional grazing resources to supplement small acreage silvopastures
- Compromising on tree and forage soil pH and fertilization requirements

Planning a Silvopastoral System

The key to successful silvopasture establishment and operation is selection of suitable site and well-matched trees, forage, and livestock. Intended site needs to be accessible to livestock and able to support tree and forage growth. Selected tree and forage species need to be able to share the existing site resources without much reduction of each others growth. Forage yield under trees must be sufficient to sustain the livestock. The state-of-the-art silvopastoral systems consist of three integrated and complementary plant components: trees, warm-season, and cool-season forages in addition to livestock. For example, slash pine-Pensacola bahiagrass-crimson clover-roping cattle silvopastures have been successfully implemented in north Florida.

Tree Species Selection

In the Southeast, all three commercially grown pines—loblolly, slash, and longleaf—are suitable for silvopastoral systems. Of these, slash pine is probably most widely used and suitable because of open crowns, good self-pruning ability, and ease of regeneration. Tree crown characteristics are important both for wood quality and forage production under tree canopies. Loblolly pine is less desirable than slash pine because of its branching and branch retention habits. It also seldom produces high value timber such as poles or veneer, for which silvopasture provides good growing conditions. In addition, loblolly pine needles are seldom used for pine straw mulch, which is another potential product of silvopastoral systems. Longleaf pine has all the desirable characteristics of slash pine, however, this species is more difficult to establish Pecan is another species that may be locally suitable. When this species is managed to produce nuts, there is ample space for grazing/haying between widely spaced trees. This short list does not explore all of the possible choices However, trees that meet the following criteria are most suitable:

- Compatible with intended site
- Capable of advancing landowner objectives
- Genetically improved to resist pests and diseases
- Have high value product potential
- Provide non-commodity benefits
- Open-crowned to allow good forage production
- Deep-rooted to avoid competition with forage for moisture

Forage Species Selection

Studies of warm-season forage species under pine canopies began in south Georgia as early as 1946 (Lewis 1984). Pensacola bahiagrass was the most shade tolerant of all the warm-season grasses studied. Later studies showed that Pensacola bahiagrass and coastal bermudagrass produced more forage under a tree canopy than carpetgrass or dallisgrass. Other varieties of bahiagrass (Argentine, Tifton-9) may be even better warm-season forages for silvopastoral systems than Pensacola bahiagrass. However, this requires further research.

Cool-season, nitrogen-fixing legumes play an important role in silvopastures Incorporation of these species into the overall system may reduce the need for nitrogen fertilization of warm-season forage and trees. Crimson, red, arrowleaf, and white clovers, or vetch are examples of cool-season nitrogen fixing species that could be used in silvopastures. Cool-season grasses like ryegrass, rye, wheat, or oats may also be over-seeded in silvopastures between wide-spaced rows of trees. Any cool-season species that provide forage during critical winter months reduces the need for hay and supplemental feeding (Demers and Clausen 2002). The checklist for forage choices include:

- Suitable for livestock grazing
- Compatible with site (soil, climate)
- Warm- and cool-season forages with little to none overlap in growing seasons
- Productive under partial shade and moisture stresses
- Responsive to intensive management
- Tolerant of heavy grazing

Livestock Selection

The selection of livestock suitable for a particular silvopastoral system will depend on landowner objectives and markets, as well as tree and forage species established. Beef cattle are the livestock of choice for many landowners. Certain breeds of cattle may fare better in a silvopastoral system than others. Contact your local UF/IFAS Extension livestock agent or a Natural Resource Conservation Service (NRCS) in your area for more information. Other than cattle, livestock possibilities include: goats, horses, sheep, and deer. Regardless of species selected, grazing should not be undertaken until trees have reached heights that put the main stem terminal buds beyond reach of livestock. Haying between young trees is recommended until the trees are old enough to better withstand pressure from livestock presence and grazing. Browsing animals such as goats, sheep or deer are more likely to eat, while large ruminants such as cattle are more likely to trample young trees. Bulls should be kept out of silvopastures during breeding periods because of higher risk of damage to trees. Generally, younger animals are more likely to damage trees than are older, more experienced ones. Cattle management in pine-bahiagrass systems is discussed in UF/IFAS Extension Circular 1154 (Tyree and Kunkle 1995). An electronic version of this and other extension publications relevant to timber, livestock and forage management can be found at: http://edis.ifas.ufl.edu/.

In Summary

Silvopastures are intentional, integrated, and intensively managed systems designed to optimize timber, forage, and livestock production from the same acreage, at the same time. Silvopastoral systems offer distinct economic and environmental benefits Among the most important is the possibility of annual revenue, and therefore improved cash flow compared to "timber only" operations. Other advantages from the timber management standpoint include: vegetation control under tree canopies by grazing, and increased tree growth as a by-product of forage fertilization and animal wastes recycling. Silvopastures provide benefits to livestock management as well. There is a longer grazing period compared to open pasture due to earlier green-up and delayed forage maturity under tree canopies. Trees offer shelter to livestock from heat and inclement weather. Other benefits offered by silvopastures include increased wildlife viewing and hunting opportunities, and increased land aesthetic appeal. The most serious drawbacks of silvopastures are the necessity to use fences on forestlands and extending water to all grazing cells. Planning for a silvopasture requires careful consideration of suitable tree, forage and livestock species for intended sites, local climate, and markets. Selected tree and forage species need to be able to share the existing site resources and produce acceptable growth. The state-of-the-art silvopastoral systems consist of three complementary plant components: trees, warm-season, and cool-season forage species. Beef cattle are usually livestock of choice, but many other animal species are compatible with silvopastoral systems, e.g., goats, horses, sheep, and deer.

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Acknowledgements

Authors are grateful to Mr. George Owens for multiple opportunities to take photographs and discuss the silvopastoral operations on his farm near Chipley, Florida. Reviews and comments by Drs. Martha Monroe, Alan Long, and Robert Kalmbacher helped greatly to improve on the original manuscript. Reviews and insightful suggestions by Mr. Shep Eubanks and Mr. Michael Goodchild are also gratefully acknowledged. Information for this publication is based in part on information contained in Agroforestry Notes: No. 8, November 1997; No. 9, November 1997; No. 18, April 2000; and No. 22, December 2000; published by USDA National Agroforestry Center, East Campus-UNL, Lincoln, Nebraska, website: http://www.unl.edu/nac. Other resources include Temperate Agroforestry, Vol. 10 No. 1, January 2002, published by Association for Temperate Agroforestry; and Silvopasture, a brochure published by University of Missouri Center for Agroforestry, both located at University of Missouri, Columbia, Missouri, website: www.aftaweb.org/index.php [October 2011]. This publication was in part supported by U.S. Department of Agriculture, Cooperative State Research Experiment and Extension Service, Initiative for Future Agriculture and Food Systems (USDA/CSREES/IFAFS) grant number 00-52103-9702. This is one of a series of extension publications on agroforestry by the Center for Subtropical Agroforestry (CSTAF) website: http://cstaf.ifas.ufl.edu at the UF/IFAS School of Forest Resources and Conservation, Gainesville, Florida.

Table 1. Equivalent Annual Income from loblolly pine-based silvopasture, cattle cow-calf operations, and loblolly pine plantation in 1999 dollars (based on Husak and Grado, 2002).

Interest Rate	Silvopasture	Cattle	Pine Plantation
%		**$/acre**	
5	67.06	55.31	69.26
7	51.15	55.01	45.00
9	38.27	53.70	26.62
Average	**52.16**	**54.67**	**46.96**

Establishment of Silvopasture in Existing Pastures[1]

Jarek Nowak, Alan Long, and Ann Blount[2]

Private forest landowners and cattle ranchers who combine timber, forage, and livestock into one production system increase the benefits they might receive from their land compared to management for just one of these commodities. This intentionally integrated and intensively managed system, known as silvopasture, can diversify revenue, enhance environmental benefits, and boost aesthetics of agricultural or forestry operations. Diversified cash flow is becoming especially important as landowners face unfavorable product prices when they rely on just a single commodity. Silvopasture is different from rangeland or woodlot grazing in that it employs improved forage. Rangeland grazing relies on native forages, whereas there may be no real forage except for opportunistic browse in woodlot grazing. Silvopasture has been practiced in the Southeast as "tree-pasture" or "pine-pasture" since the early 1950s.

Silvopasture establishment requires a number of different management steps depending on previous land use. Planting trees in an existing improved pasture is the easiest way to start the system. Another possible scenario is to thin existing timber stands and plant or seed forage species among the remaining trees. This publication discusses establishment of silvopastoral systems in existing improved pastures. Information presented here is applicable to north Florida and other Southeastern states where tree and forage growing conditions are similar.

Converting Pastures to Silvopastures

Silvopastures are usually established by planting trees in existing pastures. This eliminates costs of forage establishment, shrub and brush control, or removal of timber harvest residues. Well established and managed bahiagrass, bermudagrass, or other similar pastures are most suitable. Planting density varies from 100 to 450 trees per acre depending on tree species, product objectives, and anticipated level of management intensity. If fewer trees are planted, thinning of pulpwood size trees may not be necessary. However, when grown at wider spacings, most species will require pruning for quality timber production. Standard tree planting methods and equipment can be used, as described below.

Site Preparation

Site preparation before tree planting improves seedling survival and early growth by reducing competition from grass and other vegetation for water, nutrients, and light. Proper site preparation can be achieved by chemical,

1. This document is FOR107, one of a series of the School of Forest Resources and Conservation Department, UF/IFAS Extension. Original publication date June 2003. Reviewed October 2015. Visit the EDIS website at http://edis.ifas.ufl.edu.

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mechanical, or prescribed fire treatments applied alone or in combination. The method of choice depends on site conditions, vegetation to be controlled, treatment costs, and other considerations, such as herbicide acceptability or smoke from prescribed fires.

Chemical site preparation consists of herbicide applications before trees are planted. Herbicides are most often sprayed in bands along planting rows, or around planting spots. Pre-planting treatments allow for higher application rates, and, therefore, greater possibility of success in controlling competition. Chemical site preparation offers the longest lasting effects for competition control where it is needed most, within rows of planted trees. Reduction of competition is a key to rapid seedling establishment. Broadcast herbicide application is usually not necessary, unless current pasture is to be replaced with more suitable forage species. Under most circumstances, banded application, or even spot applications, should be sufficient to control vegetation competing with trees at a lower cost than broadcast applications. Some common herbicide treatments include Arsenal, or Velpar with Oust in the spring, or tank mixes of Accord with Arsenal in the fall. In bermudagrass pastures, Arsenal or Accord must be used. You should read the herbicide label prior to application for recommended rates, mixing instructions, and plant species controlled.

Scalping is a very effective **mechanical** site preparation technique on pastures. By exposing mineral soil, scalping prepares a furrow for tree planting machines and generally reduces weed competition during the next growing season. Sod and grass are stripped along intended tree rows by a tractor-pulled scalping plow. Some sites may also require subsoiling before planting. A metal shank is pulled behind the tractor at soil depths up to 24 inches. Subsoiling breaks existing "plow pans" or other "hard pans." Furrows allow for easier tree root penetration leading to better tree survival and establishment after planting. Scalping and subsoiling, or scalping and tree planting are sometimes combined into one operation with the right implements attached to a tractor. Scalping alone may not help with bermuda grass, which can quickly spread back across the opening.

Disked strips can also be used to break up sod and prepare planting rows. As with scalping, untreated areas are left between planted rows to protect soil and provide forage. Disking and scalping should always follow contours on slopes.

Prescribed fire recycles nutrients and temporarily reduces competition from herbaceous and other vegetation. It has an added benefit of increasing forage palatability. It should be applied shortly before tree planting. It is usually the cheapest site preparation option, but most pasture grasses resprout quickly after a fire.

Combination of methods, such as broadcast herbicide application followed by prescribed fire, or banded herbicides along scalped rows, may be necessary if shrubs, undesirable perennials, and vines need to be controlled. Prescribed fire (with or without prior herbicide application) may be followed by a mechanical site preparation treatment.

Tree Species Selection

Both coniferous and broadleaved species could be considered for establishment of silvopasture and other agroforestry practices. Among southern pine species, slash pine is the most suitable for silvopasture because of light crowns and good self-pruning abilities. This species grows best on moderate to poorly drained sandy soils. Loblolly pine has the greatest growth potential among the southern pines, and is a good match for well-drained upland and clay soils. However, loblolly pine tends to have more and thicker branches than slash pine, which makes it less suitable for silvopastures, unless the lower branches can be pruned as the trees mature. Longleaf pine can be planted both on upland and wetter flatwood sites. It has good crown characteristics and the greatest potential for high value timber products among the southern pine species; however, it is also the hardest species to establish in grass. Pecans are the most commonly grown broadleaved trees suitable for silvopasture. Detailed criteria for tree species selection are provided in Circular 1430 (Nowak et al., 2002). In addition, online decision support systems available at http://cstaf.ifas.ufl.edu can help in matching tree and shrub species suitable for silvopasture and other agroforestry practices in the Southeast, depending on local soil and climatic conditions.

Seedling Types

Genetically improved tree seedlings are preferred for establishment of silvopastures. It is especially important to use fusiform rust resistant seedlings if slash or loblolly pines are planted. Large caliper seedlings grown at low density in a nursery have much more desirable root characteristics than smaller diameter seedlings grown in crowded nursery beds. Well-developed, fibrous root systems speed up successful seedling establishment. Bare root seedlings are cheaper than containerized trees, but they need to be planted during winter. Containerized seedlings work well, especially for longleaf pine, and they can be planted either during the winter or after summer rains begin.

Tree Spacing at Planting

Silvopasture requires tree spacing that allows for sufficient timber and forage yields. A 4x8 ft tree spacing with 40 ft forage alleys between pairs of tree rows was found to best satisfy these requirements in Georgia and Florida experiments (Lewis et al., 1985). This double-row 4x8x40 ft tree spacing (Figure 1) yielded more wood and forage than single-row 8x12 ft control treatments in the same experiments (Table 1). Ever since the mid-1980s, this tree-planting pattern has continued to be popular for establishment of silvopastures in Florida (Figure 2).

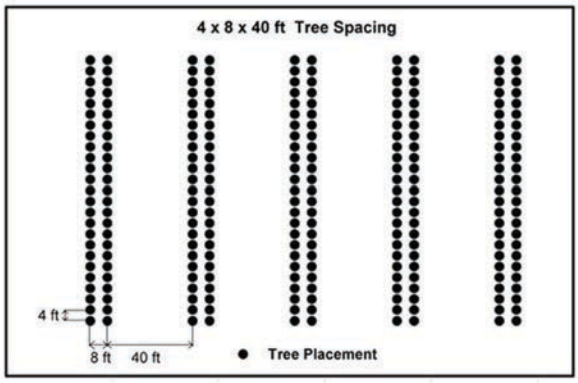

Figure 1. Double-row 4x8 ft tree spacing with 40 ft wide alleys between pairs of tree rows (also known as 4x8x40 ft spacing) was found to satisfy both timber and forage growth requirements (Lewis et al., 1985).

Figure 2. Loblolly pine planted in 4x8x40 ft spacing in bahiagrass—crimson clover pasture after one growing season in the field (George Owens farm near Chipley, FL, December 2001).

Other tree arrangements in silvopastures are also possible. Trees can be planted in single wide-spaced rows, sets of multiple rows with wide alleys between the sets, or in clusters. In any tree arrangement, open areas between trees allow for forage production. Planting trees in rows facilitates access for future forage and silvicultural operations (Sharrow, 1999). Therefore, planting trees in rows is preferred over random tree placement or planting tree clusters. Generally, wide spacing between single rows, or wide alleys between sets of multiple rows supports higher levels of forage production than closely spaced rows. However, too much open pasture space also means less wood production on a per acre basis. The trade-offs between timber and forage production are well illustrated by comparing yields of both commodities in 4x8x40 and 2x8x88 ft spacings. The 4x8x40 ft tree pattern produced twice as much wood as the 2x8x88 tree spacing, whereas the opposite was true for forage production (Table 1).

Tree Planting

Trees are best planted with a mechanical planter, but hand planting is also possible, especially on small or irregular tracts of land. Machine planting produces straight rows and uniform spacings, which is important in silvopastoral systems. General guidelines for planting trees in silvopastures are the same as for establishing tree plantations. Plant trees on the contour wherever pastures are on slopes. Staying in scalps and furrows while planting trees should not pose any difficulties. However, more effort may be needed to plant trees inside herbicided bands if the treated vegetation has not yet discolored. At planting, care needs to be exercised not to bend roots upwards, which causes "j-rooting," and may lead to low seedling survival. Soil should be firmly packed and cover each seedling root collar (the juncture between tap root and the shoot). When planting longleaf pine seedlings, pack the soil below the terminal bud. If planting bare root stock, keep seedlings and roots moist and in the shade from the time they are lifted from nursery beds until planted in the field.

Tree Survival and Establishment

Post-planting treatments are often necessary for best tree survival and establishment results. Grass and weeds often quickly reoccupy scalped or disked rows and they need to be controlled with herbicides during the first and/or second year after planting. Banded or spot herbicide applications along tree rows (up to 4 feet across) are most effective in controlling unwanted vegetation. The following herbicides can be used: (1) Oust, Arsenal, or Accord on bahiagrass; (2) Arsenal, Accord, or Fusilade on bermudagrass; (3) Arsenal, Oust, or Oustar, as single herbicide treatments, or tank mixes of Oust with Velpar, Arsenal, or Accord for other grasses and herbaceous vegetation. Please consult labels prior to herbicide applications for appropriate rates, mixing instructions and plant species that can be controlled with each herbicide. It is best to protect tree seedlings

from direct contact with the herbicides, although some are labeled for "over the top applications." Stressed seedlings are more prone to herbicide-caused damage than healthy and vigorous ones. Tank mixes may be more damaging than any of the herbicides applied alone. For example, applying Velpar or Arsenal with Oust may increase damage to new slash or longleaf pine seedlings.

Mowing between the rows of trees is advised several times a year during the first three growing seasons after tree planting. Mowing helps to further reduce the competition from grasses and increase light available to tree seedlings. If the grass yield is sufficient, mowing can be done as part of haying operations to provide revenue from forage during the years before cattle are allowed to graze on the site. Mowing, hay cutting, or any other operation that requires driving equipment between the rows of trees needs to avoid hitting the seedlings or scuffing off the bark.

Successful establishment of trees in the existing pastures concludes the first phase of pasture to silvopasture conversion. Livestock can be introduced to the system when trees reach sufficient heights to prevent damage to terminal buds from browsing or nubbing. Longleaf pine may remain stemless for several years, whereas loblolly pine and slash pine resume height growth in the spring after planting. Therefore, typically, grazing under planted loblolly and slash pines is possible sooner than under longleaf pine canopies. After livestock are integrated into the system, continued intensive management of all three components (forage, livestock, and trees) is needed to realize potential economic and environmental benefits offered by silvopasture.

Some of the possible livestock choices and criteria to help guide livestock selection are described in *Integrated Timber, Forage and Livestock Production—Benefits of Silvopasture*, Florida Cooperative Extension Service Circular 1430 (Nowak *et al.*, 2002). Cattle management in pine—bahiagrass systems is discussed in Circular 1154 (Tyree and Kunkle, 1995), and forage management on timberlands in publication SS-FOR-20 (Demers and Clausen, 2002). An electronic version of these and other UF/IFAS Extension publications relevant to tree, forage, and livestock management can be found at: http://edis.ifas.ufl.edu/.

In Summary

Silvopastures are intentional, integrated, and intensively managed systems designed to optimize timber, forage, and livestock production from the same acreage at the same time. One way of establishing a silvopasture is to plant trees in an improved pasture. Standard plantation forestry site preparation methods are used in silvopasture establishment. These include site preparation with herbicides, scalping plows, or prescribed fire. All three commonly planted southern pines are suitable; however, slash pine is easier to establish than longleaf pine, and both have all the desirable crown and wood characteristics. Loblolly pine, although also suitable, tends to have more and thicker branches than the other two species, which is less desirable for both wood and under-canopy forage production. Bare root or containerized seedlings can be planted, with the latter extending the planting season beyond the winter months. The most popular tree spacing for silvopasture establishment is a double-row configuration 4x8x40 ft. This tree planting pattern produced more wood and forage than the typical 8x12 ft plantation spacing in Florida and Georgia experiments. Twice as much wood was produced in the 4x8x40 ft than in 2x8x88 ft tree spacing. The reverse was true for forage production.

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Acknowledgements

Authors are grateful to Mr. George Owens for providing opportunities to photograph and discuss the silvopastoral operations on his farm near Chipley, Florida. This is one of the series of extension publications on agroforestry by the Center for Subtropical Agroforestry (CSTAF), website: http://cstaf.ifas.ufl.edu, at the UF/IFAS School of Forest Resources and Conservation, Gainesville, Florida.

Table 1. Average tree and forage responses of slash pine at age 13. Trees were planted in single (8x12, 4x24, 2x48 ft) and double-row (6x8x24, 4x8x40, 2x8x88 ft) configurations at 454 trees per acre (adapted from Tanner and Lewis, 1984).

	Tree Spacing (feet)					
	8x12	**4x24**	**2x48**	**6x8x24**	**4x8x40**	**2x8x88**
Tree Survival (%)	61	68	68	67	67	74
Tree Height (ft)	35	35	36	32	36	34
Tree Diameter (in)	5.7	5.2	5.1	5.0	5.5	4.3
Stand Basal Area (ft^2/ac)	50	49	52	40	59	33
Wood Volume (ft^3/ac)	903	866	973	658	1,086	580
Total Forage Yield (lb/ac)	1,138	542	1,069	1,347	1,264	2,573

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