Groundcover Restoration

IN FORESTS OF THE SOUTHEASTERN UNITED STATES

Jennifer L. Trusty & Holly K. Ober

CFEOR
Conserved Forest Ecosystems
Outreach and Research

Acknowledgments

The funding for this project was provided by a cooperative of resource managers and scientific researchers in Florida, Conserved Forest Ecosystems: Outreach and Research (CFEOR).

CFEOR is a cooperative comprised of public, private, non-government organizations, and landowners that own or manage Florida forest lands as well as University of Florida faculty members. ***CFEOR is dedicated to facilitating integrative research and outreach*** that provides social, ecological, and economic benefits to Florida forests on a sustainable basis. Specifically, funding was provided by

- Florida Fish and Wildlife Conservation Commission
- Florida Department of Environmental Protection
- Northwest Florida Water Management District
- Southwest Florida Water Management District
- Suwannee River Water Management District

We are grateful to G. Tanner for making the project possible and for providing valuable advice on improving the document. We are also indebted to the many restorationists from across the Southeast who shared information with J. Trusty. Finally, we thank H. Kesler for assistance with the maps and L. DeGroote, L. Demetropoulos, C. Mackowiak, C. Matson and D. Printiss for assistance with obtaining photographs.

Cover photo: Former slash pine plantation with restored native groundcover. *Credits: L. DeGroote.*

Suggested citation: Trusty, J. L., and H. K. Ober. 2009. Groundcover restoration in forests of the Southeastern United States. CFEOR Research Report 2009-01. University of Florida, Gainesville, FL. 115 pp.

Table of Contents

Introduction

Ecological restoration is the process of assisting the recovery of an ecosystem that has been degraded, damaged or destroyed as a direct or indirect result of human activities (SER 2004). Any activity that intentionally initiates or accelerates the return of an ecosystem to its historic developmental pathway can be considered ecological restoration.

Traditionally, emphasis in forested areas has been placed on tree species, while understory or groundcover communities received limited consideration. However, in recent years restoration practitioners have become increasingly interested in restoring the structure and function of the understory or groundcover vegetative community. Regardless of the physical size of your project site, restoration can be an enormous and, depending on the level of degradation, daunting task. The goal of this manual is to provide information that will make the planning of a groundcover restoration project less overwhelming. The resources we provide will include tips on how to go about planning a restoration project, suggestions regarding factors to consider when determining what restoration actions to use, descriptions of successful methodologies for restoring sites from various initial habitat conditions, and cost estimates of time, materials, and equipment to implement groundcover restoration projects. We have also included a comprehensive list of references from the literature for individuals interested in additional information. Finally, we have compiled an elaborate list of restoration projects in forested ecosystems throughout the Southeastern United States, complete with information on the location and characteristics of sites being restored as well as contact information for personnel associated with each project. Our hope is that this will facilitate networking opportunities among resource managers with similar interests.

The impetus for this manual arose from the recognition that the information needed to guide the planning of groundcover vegetation restoration projects was often scattered in a diverse array of books, scientific journals, agency reports, and online sources. It is the objective of this manual to serve as a starting point for groundcover restoration in the Southeast by summarizing the existing information into a single, available and understandable source. The manual serves as both a guide to tested groundcover restoration techniques (Part 1) and as a catalog of information on existing restoration sites and the people and plants associated with each (Part 2).

In order to distill the information from the ever-expanding field of understory restoration theory and techniques to a manageable size, this manual provides an extensive reference bibliography rather than repeating information already described in detail from every available source. Our goal has been to outline the general steps required to restore native groundcover and to provide resources that should help accomplish this task, rather than to provide protocols for every imaginable scenario. Individuals interested in a more thorough step-by-step guide of prescriptions for restoration activities and associated timelines are encouraged to examine detailed publications such as Gordon (1994), Brockway et al. (2005), USDA Natural Resources Conservation Service (2008), and Matson et al. (in prep).

Restoration: Why?

Ecological restoration projects are initiated for many reasons, such as to reverse biodiversity loss, augment wildlife habitat, restore ecosystem services, reduce the risk of catastrophic wildfire, enhance aesthetic value, heighten personal enjoyment, or increase financial gain through wetland mitigation credit sales. This list is not exhaustive: there is a large volume of literature available to cement the rationale of the benefits to be gained from restoration (Leopold 1949; Bradshaw and Chadwick 1980; Daly and Cobb 1994; Cairns 1995; Balmford et al. 2002; Lackey 2004; Aronson and van Andel 2006; Clewell and Aronson 2006). This manual assumes that you have already addressed the question “Why should I restore?” and are ready for the next big question; “How do I restore?”

PART I

Designing and Executing a Groundcover Restoration Project

Chapter 1

Planning a Restoration Project

Groundcover restoration is assisting the recovery of the structure and function of herbaceous and low-growing woody species to plant communities.

One common goal of restoration projects is the establishment of the assemblage of species characteristic of similar, non-degraded ecosystems. Groundcover restoration is typically one component of projects that attempt to alter the species composition or vegetation coverage at a site. The successful restoration of understory plants is directly dependent upon knowledge of a multitude of disciplines, including botany, plant ecology, plant physiology, horticulture, and natural resource management. Do not be discouraged. Many groundcover restorationists have been forging the path ahead. They have identified the following basic "steps to success" in a groundcover restoration project:

1. **Identify the factors that have caused or are causing environmental degradation at the site.**
2. **Define your goals and objectives in very specific terms.**
3. **Consider the feasibility of your goals and objectives.**
4. **Identify the reference community for your site.**
5. **Determine which restoration activities are necessary to reach the restoration goals you set for your site.**
6. **Develop a detailed project schedule and be prepared to change it.**
7. **Monitor.**

Collectively, these considerations form the backbone of a solid restoration plan, or blueprint, which will guide the entire project from start to finish. Each of these steps is discussed briefly below, and then addressed in more detail elsewhere.

1. **Identify the factors that have caused or are causing environmental degradation at the site.**
   Prior to spending time and money initiating a restoration project, the restorationist must identify what factors have caused the site's degradation and determine whether it is feasible to mitigate these factors. For example, if the cause of degradation was the removal of natural stressors such as wildfire or flooding, consideration should be given to whether or not it is possible to reintroduce prescribed fire or to remove dams or other infrastructure so that periodic flood events can occur. Due to legal, operational or societal constraints, not all sites are suitable for restoration. If the factors that caused the degradation cannot be changed, the efforts put into ecological restoration are not likely to succeed.

2. **Define your goals and objectives in very specific terms.**
   Each restoration project has a unique purpose and a necessary first step in every restoration project is identification of your definition of restoration success. Only after this is established can you begin to plan the path you need to take to get there. Goals should be broad ecological statements of what you hope to achieve. Some examples of goals are:

   - Convert an agricultural/silvicultural area to a community with native species and natural structure
   - Establish groundcover to reduce erosion

   Objectives are much more specific statements regarding the end results you want to achieve. Each statement should be quantifiable and should have a timeframe associated with it so that you can determine whether or not it has been achieved. Some examples of objectives are:

   - Increase the coverage of groundcover species to 50% within the next 2 years
   - Increase the species richness of groundcover in a habitat that has been degraded through fire exclusion to within 10% of that found in an intact ecosystem nearby by the end of 3 years
   - Reduce the cover of non-native species to <5% over the course of the next 5 years

3. **Consider the feasibility of your goals and objectives.**
   A groundcover restoration project requires a commitment of both time and money. A simple and obvious rule is that the larger the area to restore, the more it will cost. However, on a per-acre basis, projects that cover larger acreages cost less per acre of restored land than do projects on smaller acreages. In addition, the budget required for individual restoration projects varies widely according to the activities required. For

example, projects that involve herbicide applications, and/or seeding and planting will cost more than those that simply involve tree harvest, thinning and/or burning.

Many restorationists suggest that a minimum of 5 years of funding be set aside for any project to have a buffer against set-backs and delays. Others suggest that funding be secured for a much longer timeframe. Some types of management, such as prescribed fire and removal of invasive exotic species, will need to be implemented on the restoration site as long as the site exists, requiring an investment of time and funds in perpetuity. Restoration is a long-term commitment that should not be initiated if future availability of financial resources is highly uncertain.

Prior to the initiation of any restoration activities, careful consideration should be given to the identification of the following items:

- Funding sources
- Labor availability
- Equipment
- Biotic resources

If the availability of any of these resources is limited or uncertain, your proposed restoration project may not be feasible.

4. **Identify the reference community for your site.**
The goal of a restoration project would ideally be to restore the previously intact ecosystem that has been lost from that site. Unfortunately, this information is often unavailable for sites that have been impacted for long periods of time, and in other cases the information that is available is not sufficient to fully characterize the restoration goals. Egan and Howell (2001) have created a useful key to identify reference information that can be used to determine the potential composition, structure and function for a restoration site in situations where that information is missing. In short, when historical data is missing and there is no intact habitat on the restoration site, off-site locations, known as "reference sites", that match the conditions and geography of the restoration site are used to gain baseline data. A complete description of this methodology is given in the section of this manual entitled "Selecting Reference Sites" (see Chapter 2).

5. **Determine which restoration activities are necessary to reach the restoration goals you set for your site.**
Restorationists should conduct site assessments at reference sites and at the sites to be restored, and then compare the ecological attributes between the sites in order to prioritize which attributes need to be and can be addressed. During this process, consideration should be given to previous research in the community being restored. The activities required for groundcover restoration can be determined using information available in this manual, from the literature, and by contacting the people who are active in your specific habitat or geographic area. Specific restoration activities that are discussed in this manual are:

- Mechanical site preparation
- Chemical site preparation
- Cutting/thinning canopy or midstory trees
- Prescribed fire
- Outplanting
- Direct seeding

Each of these techniques can be used alone or in combination with others.

6. **Develop a detailed project schedule and be prepared to change it.**
Chaos is real. Be aware that the climate, the contractors, and the equipment are not under your complete control. By the time you complete a restoration project, there will likely be many activities that you needed to do that you didn't plan for initially. The ability to change course in response to unplanned results is part of adaptive management. Adaptive management is an approach to resource management which emphasizes monitoring the effects of management actions with the intention of changing management tactics if it becomes apparent that actions are not meeting the original objectives. In the realm of restoration, this means that the effects of restoration activities are monitored, and different actions are implemented if it becomes apparent that site conditions are not changing along the trajectory desired. This approach increases efficiency and also increases chances of success in the long-term.

"Treating management and policy decisions that result in management as large experiments that test predictions and assumptions in management plans, and then using the results to revise and improve the plans." (TNC 1998). Basically, adaptive management is recommended as a way to proactively deal with uncertainty: if you view your restoration projects as experiments, you can learn from your results so that your next restoration efforts are more successful and more efficient than previous attempts. Restorationists use adaptive management to acknowledge the need for additional restoration activities in response to unexpected or unplanned results of previous management decisions. Some examples of unexpected conditions that may be encountered during the course of a restoration project are:

- Lack or overabundance of seed bank species
- Drought/flood and loss of seedlings/planting
- Invasive species introduced by equipment or seed
- Incomplete or patchy prescribed fires

Developing a descriptive list of desired future conditions at the beginning of a project and then maintaining an attitude of flexibility in exactly how those conditions will be created is essential to restoration success.

7. **Monitor.**
The best way to monitor the success of your groundcover restoration project is through periodic vegetation sampling. Using cover and diversity estimates to compare your site to the reference sites through time will help document the direction and magnitude of restoration progress. Monitoring is absolutely essential to the identification of which ecosystem components are responding to restoration activities in the manner desired, and which are not. The use of photostations (same place, same direction) is a quick way to visualize the structural changes in vegetation resulting from restoration, but photographs will not provide information on species composition or plant demographics that may be needed to assess success in reaching restoration objectives. Monitoring is fundamental to the adaptive management approach discussed in step 6: without monitoring, it is not possible to learn from previous mistakes. By putting forth effort to develop a plan for how you will monitor the effectiveness of your restoration efforts before you begin, you will have a much better likelihood of success in the end.

Groundcover vegetation monitoring at The Nature Conservancy's Disney Wilderness Preserve in Kissimmee, FL.
Credits: L. Demetropoulos.

The steps identified here are very broad. For a checklist with much finer detail, the Society for Ecological Restoration (SER) Guidelines for Developing and Managing Ecological Restoration Projects is an excellent resource (Clewell et al. 2005). The SER International Primer on Ecological Restoration (SER 2004) gives definitions of terms and concepts involved in ecological restoration and the Florida Department of Environmental Protection (DEP) provides excellent information in their manual for restoration on public lands. The Florida DEP also provides a worksheet to assist in the determination of whether your site has characteristics that would make it suitable for restoration or whether time and effort would be better spent on another site (TNC 1998).

Chapter 2

Implementing a Restoration Project

If you have followed the steps above and have (1) identified the cause(s) of degradation, (2) defined a goal for your restoration site, and (3) addressed the feasibility of this goal, you are now ready to determine the reference condition for your site.

Selecting Reference Sites

Reference sites serve as models for the site that is going to be restored. Reference sites represent the future target condition on which the restoration is designed and also serve as a basis to compare the progress of restoration activities (SER 2004). Because restoration is a goal-driven process, it is essential that desired results are explicitly defined. Carefully selected reference sites help define restoration goals.

To function as a reference, the site should closely match the abiotic characteristics of the restoration site and should have intact (minimally degraded) biotic characteristics including species diversity and vegetation structure, as well as functional ecological processes. Finally, if possible, more than one reference site should be selected so that these sites collectively include spatial and temporal variation to approximate the ecological variability that is found in nature (White and Walker 1997).

The importance of the choice of reference sites cannot be overstated. Egan and Howell (2001) recommend the use of both historical and contemporary data when gathering reference information and choosing reference sites. The best possible reference sites are areas within or nearby the restoration site that have not been degraded. If the entire restoration site is heavily degraded and isolated from intact communities, restorationists need to gather historical data (aerial photos, habitat descriptions) to learn what type of communities may have existed on the site, and then locate nearby areas containing those communities that match the restoration site in abiotic conditions. Determining the best areas to serve as reference sites for your restoration project requires a thorough assessment of both reference and restoration sites. The reference site should match the historical conditions at the site to be restored as closely as possible in:

- Climate
- Topography
- Soil characteristics such as texture, pH, and quantity of organic components
- Light availability at the ground level
- Hydrology

If good matches are found in these abiotic characteristics, the reference sites need to be inventoried and assessed to provide baseline data concerning:

- Plant species composition and structure
- Cover and depth of the litter layer
- Availability of materials that could serve as fine fuels for fire
- Quantity and patchiness of open ground
- Patchiness of habitats
- Dominant species in different successional stages in relation to environmental disturbance/stress
- Occurrence and timing of disturbances such as fire, wind, and flooding, or stressors such as saltwater inundation, herbivory, and pathogens

The choice and assessment of reference sites is related to the ecological theory of succession. Succession is often defined as “the hypothetically orderly sequence of vegetation change leading to a stable climax community” (Dodson et al. 1998). The entire sequence of successional stages is called a sere and the sequence of seral communities through time is a chronosequence. This theory has come under scrutiny for its assumptions that environmental conditions at a site remain stable for a period long enough to create a single climax community. One of the main criticisms of this theory is the realization that environmental conditions commonly change more rapidly than it takes for a “climax community” to develop when species generation times are considered (Clewell and Aronson 2007). What this means to groundcover restoration is that sites with similar abiotic characteristics may have differing biotic composition and structure if the frequency or intensity of disturbances to the “environmental conditions” at those sites differs. By identifying a chronosequence of successional sites in their target ecosystem, restorationists can more accurately identify their restoration objectives, which will help in planning the activities required to achieve these objectives. Early successional reference sites would offer guidance for a highly degraded restoration site while sites in later successional stages could provide models for sites where native species exist but fire exclusion or invasive species have changed the natural succession trajectory.

Preparing the Restoration Site

The preparation of a restoration site includes all the activities involved in physically manipulating the restoration site in order to maximize the success of the vegetation restoration activities that follow. Therefore you must determine which restoration activities are needed (e.g., alteration of hydrology, reduction of the midstory, thinning of the overstory) prior to deciding which kinds of techniques (e.g., earthmoving, mulching, fire) to use on your restoration site. The use of site preparation techniques is extremely important when abiotic factors of the sites have been altered. If the degradation of the restoration site has caused changes to the soil, hydrology, or light environment, these factors must be addressed before you can expect the biotic communities to respond. In order to illustrate the range of techniques and their use, scenarios of some common restoration site "problems" are given.

Soil

Soil disturbances can include former agricultural use, silvicultural bedding techniques, and mining. Soil disturbance causes major changes to ecosystems and these changes cascade through the biotic community on the site. The upside is that recognizing historic soil disturbances is usually very easy. The downside is that recovery of topography and soil characteristics will take time and usually requires some heavy equipment operation.

Agriculture and mining operations

Both agriculture and mining operations turn the soil and disturb its natural layering (known as the soil horizons). These changes to the soil often affect the nutrient availability and water infiltration, percolation, and holding capacity of the site. Agriculture and mining operations usually completely remove native vegetation at the site, so restorationists of these sites are beginning their work with a blank slate. The restoration of former agricultural lands is sometimes called "old field" restoration and a number of resources address activities on these sites (Prach and Pysek 2001; Cramer et al. 2007; Cramer et al. 2008). Agricultural soil disturbances do not usually prevent the growth of native species and generally the site preparation techniques required for restoration of these sites are dependent on the number of species and the level of infestation by exotic species (Cramer et al. 2007).

In contrast, mining operations cause deep soil disturbance and reclamation usually involves recreation of the overall moisture regime and topography of the site using heavy equipment. In Florida, phosphate mining alone impacts between 5000-6000 acres each year, and companies are mandated by law to initiate some level of reclamation depending on the upland or wetland status of the site (Roth, in prep.). In phosphate mine reclamation, in addition to restoring topography and hydrology, topsoil from a donor site (one that will be mined) is sometimes added to increase nutrient content, augment mycorrhizal communities, and provide seeds and rootstocks of native plant species. The addition of topsoil and its corresponding plant propagules can substantially increase botanical diversity to reclamation sites (Roth, in prep.). Typically, the abundance of nonnative species on phosphate-mine lands compels restorationists of these sites to include both reestablishment of native species and removal of invasive species as top priorities in their restoration plans (Tamang et al. 2008).

Silvicultural bedding

In pine communities of the Southeastern coastal plain, slash (*P. elliottii*) or loblolly (*P. taeda*) pine plantations are often planted in raised "beds" to influence the hydrology of the site in ways that aid the growth of off-site pine species (Means 1997). It has been shown that bedding changes the nutrient distribution and moisture relations of a site for greater than 30 years (Shultz 1976). Typically, in bedded plantations, the beds are reduced or removed by heavy equipment during a selective harvest of the canopy trees prior to restoration of the groundcover. Restorationists at The Nature Conservancy's Apalachicola Bluffs and Ravines Preserve (ABRP) in Florida are working on the restoration of sandhill communities on over 3,000 acres where bedded slash pine plantations are being converted to longleaf pine forests with appropriate groundcover species (Seamon 1998; Cox et al. 2004).

Hydrology

Hydrologic disturbances are found when the natural movement and retention of water within a site has been altered or impeded. Changes to hydrology can be caused by impediments such as dams and canals, by changes to the topography of the site through soil disturbances like those described above, soil compaction, or simply when the removal of vegetation causes an increase in run-off or erosion. The importance of hydrology in wetland communities is well understood and numerous publications and resources exist to aid in the hydrologic restoration of these community types (Kusler and Kentula 1990; Wheeler et al. 1995; Middleton 1999). It is important to understand both the spatial and temporal aspects of hydrology in your reference and restoration sites since hydrologic changes also effect non-wetland sites on broad landscape and time scales.

Dams and canals

One of the largest groundcover restoration sites in the world has been initiated in response to the need for hydrologic restoration of the Everglades. In order to restore the slow sheetwater flow from Lake Okeechobee through the sawgrass (*Cladium jamaicense*) marshes and cypress (*Taxodium* spp.) habitats of south Florida, it is expected that over 8 billion dollars will be needed for the removal of canals installed historically to channel water and dry wetlands for human use (Skoloff 2008). On a smaller scale, the restoration of mesic longleaf flatwoods and savanna communities in Florida's Tate's Hell State Forest has involved the removal of canals and the flattening and removal of slash pine beds during tree harvest and thinning activities (Florida Division of Forestry 2007).

Topographic changes

The natural flow of water is changed when topographic features are added to or removed from a site. One of the most common topographic changes to a site results from the installation of roads or trails that can impound water in low-lying areas, divert water flow, and increase erosion when done at higher elevations. When restoring areas impacted by military training on Eglin Air Force Base in Florida, careful attention was paid to limiting the hydrologic impact of roads and trails. The use of large road underpass pipes to prevent impoundment, the use of novel road building materials, and contouring roads with natural topography to reduce erosion allowed for native groundcover vegetation to respond with minimal additional restoration activity inputs (W. Pizzoleto, Eglin Air Force Base Natural Resources, pers. comm.)

Light

Although light is an abiotic component of the ecosystem, the availability of light is directly related to the biotic community present. The occurrence and density of forest canopy cover will impact the groundcover response in your restoration project through competition for light, space, nutrients, and moisture (Thomas et al. 1999; Provencher et al. 2001). Identifying differences in the light environment between the restoration site and the reference system and understanding the light requirements of desired understory plant species for growth, flowering, and seedling establishment is crucial to restoration success.

In order to influence the light environment, restorationists use a number of techniques to remove or add canopy and midstory vegetation and to reduce the presence and density of invasive plant species. The most common techniques are tree planting, mechanical removal of biomass through cutting, thinning, roller-chopping, mowing, or mulching, chemical treatment with herbicides, and pyric treatment with prescribed fire.

Planting

When restoring a forested environment, the species composition and canopy coverage of the tree species influences the understory vegetation community. In high light, open canopy systems such as longleaf pine flatwoods habitats, restorationists have found that it is not necessary to plant trees before restoring groundcover species (Walker and Silletti 2006: Roth, in prep.). In fact, the reverse may be true; canopy thinning may be required for establishment of some groundcover species, such as wiregrass (*Aristida beyrichiana/A. stricta*), beneath pine plantations (Mulligan et al. 2002). In contrast, in many closed canopy ecosystems, the native understory community cannot survive high light environments and canopy cover must be left intact or established prior to groundcover restoration. For example, in order to restore riparian forest community structure to phosphate-mined lands in central Florida, Clewell (1999) planted over 22,000 trees of 17 species in an 8.5 ha mining mitigation site along with 31 native groundcover species. Eleven years post-restoration, an additional 42 groundcover species characteristic of mature undisturbed reference sites had colonized the restoration site as the planted trees matured.

Mechanical removal

In the Southeast, many natural communities have been degraded by the exclusion of natural fire disturbances (Landers et al. 1995; Frost 1998; Walker and Silletti 2006), by reduction or prevention of natural flood events (Sharitz and Mitsch 1993; Tockner and Stanford 2002), and/or by the heavy stocking of pine species in plantation silviculture (Brockway et al. 2005). Effects of these changes can include an increase in the amount of canopy cover of fire/flood intolerant species and the replacement of herbaceous groundcover species with woody midstory or shrub species. Mechanical removal of overgrown vegetation can include mowing, chopping, mulching and/or logging. At the Joseph W. Jones Ecological Research Center in Georgia, a large experiment has been designed to restore longleaf pine sandhill habitats from loblolly pine plantations using canopy thinning techniques (Kirkman and Mitchell 2002). Mulligan et al. (2002) found that canopy thinning was necessary for the survival and reproduction of re-introduced wiregrass plants. At the Eglin Air Force Base sandhill site in northwest Florida, Provencher et al. (2001) found that oak encroachment could be reduced by chain saw felling, girdling, or chipping, but that fire was necessary for maximum understory species response. In a recent comparison of mechanical removal techniques in scrub habitat, Menges et al. (in press) found that mechanical treatments worked best when applied within a few months prior to prescribed burning.

Chemical control

Herbicides are used in understory restoration to reduce competition of native groundcover species with woody shrubs and/or invasive species. Herbicides are often the only effective method for reducing those invasive species that resprout after mechanical or prescribed fire treatments (for more information, see the section on control methods for invasive species below). In contrast, the use of herbicides to reduce groundcover competition with midstory hardwoods can accelerate the restoration process although prescribed fire may also be effective and less expensive in this role (Brockway et al. 2005). Brockway et al. (1998) found little or no short-term reduction in native understory grass or forb species on sandhill sites in Florida when using herbicides to control the hardwood midstory. Similarly, Freeman and Jose (2009) found that herbicide treatments did not alter species richness, diversity, or community composition of groundcover at a Florida site where slash pine was removed and replaced with longleaf pine. However, these authors caution that a combination of herbicide application and prescribed burning is needed to maintain control over resprouting hardwoods.

Prescribed fire

The Southern Coastal Plain and the Southeastern Plains contain numerous pyrogenic habitat types. The natural fire return frequency varies among these forest communities (see Chapter 7). Due to fire suppression over the last 50-70 years, many forest habitats in the Southeast have been degraded by the encroachment of woody shrubs and hardwood tree species (Glitzenstein et al. 1995; Landers et al. 1995). Prescribed fire is one of the most effective and low cost tools available to restorationists and land managers in the Southeast for removing woody biomass encroachment and for promoting the reproduction and germination of native plant species (Platt et al. 1988; Harrington and Edwards 1999; Robbins and Myers 1992). Research on the role of fire in Southeastern communities is an active area and the information learned can fill a library such as the Tall Timbers Fire Database (www. http://firedb.ttrs.org:83/rmwp?&func=advSearch). Prior to initiating a restoration project, it is important to determine the answers to 4 questions regarding fire:

1. Is/was fire a part of the community in need of restoration? If so,
2. At what frequency?
3. At what time of year?
4. Can prescribed fire be returned to the restoration site?

Question 1. Is/was fire a part of the community being restored?

If your restoration site was or is a grassland or pine dominated community, it is highly likely that fire plays an important role (Garren 1943; Wright and Bailey 1982). Flood plain and riparian forests are the least likely habitats to require fire but under certain drought conditions, even these areas may have burned in the Southeast. Fire is so prevalent in Southeastern communities that it shouldn't come as a big surprise to learn that small lightning strike fires were found to play an important role in mangrove forest community composition in south Florida (Whelan 2005). Chapter 7 includes information on fire return intervals for the major forest community types of the Southeast. For any habitat type not listed in this section, further research will be necessary.

Question 2. At what frequency did fire historically occur in this community?

For most Southeastern habitats, this is a critically important question. Different communities burned at different frequencies (Christensen 1981). The impact of burning can be difficult to detect visually in communities such as pine flatwoods, where frequent fire (1-5 year fire intervals) rarely kills any of the plant species present. In other communities, such as some sand pine habitats, infrequent but catastrophic fire events (20-60 year fire return interval) kill the majority of adult trees but are necessary to open serotinous pine cones which release the seed source for the replacement stand (Christensen 1981; Menges et al. 1993). Although we have given the best frequency estimates for each community type in the section below, continued research is necessary to determine how different fire return intervals influence groundcover species dynamics in most pyrogenic communities. It may be helpful to contact others working in your habitat to discuss how fire frequency has affected their groundcover restoration success.

Question 3. What is the best season to burn?

In nature, it is believed that most fires were ignited by lightning in the early growing season (with the onset of spring and summer storms) in the Southeast (Platt et al. 1988; Stambaugh et al. 2005; Huffman et al. in press) but today, prescribed fires can be ignited throughout the year. This versatility in timing can help achieve different management objectives (Outcalt 2006), because burns at different times of the year can have very different effects on vegetation (C. Hess, USFS, pers. comm.). In general, dormant or wet season burns can remove biomass, duff, and litter accumulation, but because they do not burn as hot as growing or dry season burns, they are less effective at top-killing shrub species or promoting herbaceous biodiversity (Drewa et al. 2002; Slocum et al. 2003). In addition, dormant or wet season fires do not penetrate thick vegetation zones such as titi (*Cyrilla racemosa* and C*liftonia monophylla*) stands and therefore do not maintain ecotonal habitat for many rare savanna plant species (Hess and Laniray 2008). Finally, the season of burn is also important when prescribed fire is being used to influence the flowering or seedling establishment of native groundcover species (Platt et al. 1988; Brewer and Platt 1994). Burning induces flowering of a number of native plant species, and the open ground conditions created along with the exposure of mineral soil improves seed germination and establishment (Gilliam et al. 1986; Brewer and Platt 1994; Kesler et al. 2008). Wiregrass is a species in which flowering and seed production is highest after growing season burns (Outcalt 1994).

Question 4. Can fire be restored to this restoration site?

Determining the answer to this question requires both biological and regulatory knowledge. The biological information needed includes determining what kind of fuels are available on your site, the quantity of the fuel load present, evaluating whether introduced fire could be controlled safely, and assessing how likely it is that prescribed fire could kill desirable native species (Outcalt and Wade 2004; Varner et al. 2005). These questions are most easily answered by a knowledgeable prescribed fire burn boss who has visited your restoration site. The regulatory knowledge needed includes understanding how to comply with state prescribed fire laws and how to educate the surrounding human community for the presence of fire and smoke in and around their roads and homes. Some residential areas have burn bans in effect and area-wide burn bans can be implemented during drought or windy weather. It is necessary to inform nearby residents of prescribed burn plans, to notify local fire stations and police when you are planning to burn, and to have someone available on site that can reassure concerned citizens and answer common questions. The prescribed burn statutes for each state can be found on the web at the Forest Encyclopedia Network (www.forestencyclopedia.net).

Managing Invasive Species

Non-native invasive species are now recognized as second only to habitat loss as primary causes of native species declines and habitat degradation in the United States (Reis et al. 2004). Often the presence of invasive species is one of the conditions responsible for initiating the habitat restoration process (D'Antonio and Meyerson 2002). Wherever the inspiration for restoration lies, the presence and identity of invasive plant species on the restoration site will determine the methodology and restoration activities necessary for their removal and for the successful establishment of native groundcover species. Invasive species can negatively impact restoration goals by (1) recolonization of a site after initial treatment or removal due to seed bank and/or resprouting, (2) modification of chemical or physical attributes of the restoration site and, (3) introduction or novel colonization of the site after a restoration soil disturbance (Vitousek 1997; D'Antonio and Meyerson 2002). Even if invasive species are not present prior to restoration, their introduction can occur as a result of restoration activities. Therefore, all restorationists should be prepared to rapidly identify, treat, and control the common invasive species that occur in their area. Because invasive species removal and management can be a very costly component of groundcover restoration, it is essential to prioritize the species and locations that are most important to control. Information on the biology of each invasive species and their typical response to control procedures is necessary for restorationists to determine which control technique will best suit their site. Extensive information on the identification of invasive plant species of the Southeastern United States and control methodologies are available on the internet (www.invasives.org; www.se-eppc.org), and in published formats (Langeland and Burks 1998; Radosevich et al. 1997; Miller 2003).

Biology of invasive species

Life history (annual or perennial; phenology)

The life history of an invasive species is an important consideration when determining the timing of control efforts. If an invasive is an annual plant, treatment or removal prior to seed set helps deplete the potential seed bank of the species, potentially reducing the time and costs of eradication. For example, when infestations of the annual Japanese stilt grass (*Microstegium vimeneum)* are controlled with herbicide application prior to seed set, the infestation can be eliminated in 5 years or less depending on the existing seed bank (Swearingen 2000). If allowed to set seed even once during that time period, the timeline for eradication doubles due to this species' 5-year seed bank.

Habitat requirements

Invasive plant species, just as native species, are often restricted to distinct climatic, soil, and light environments. Knowledge of these requirements can enable simple cost-effective control. For example, in wetland environments, many non-native species have invaded following a change in the site hydrology, and the invasive species population will decline without additional actions when the natural hydrologic regime is restored to the site (Toth 2009). Soil chemistry can also be manipulated to create conditions inhospitable to invasive species. This tactic was used to control invasive bahia grass (*Paspalum notatum*) in flatwoods in Blackwater State Park in north Florida. Sulfur was applied in areas where wiregrass was recently restored to raise the soil pH so that bahia grass could not persist (S. Miller, St. John's River Water Management District, pers. comm.) Finally, control of some early successional invasive species that have high light requirements for germination or growth can be achieved through the application of heavy mulch on the restoration site (Teasdale and Mohler 2000).

Propagation (sexual vs. asexual)

Plants may reproduce asexually through the propagation of vegetative parts or sexually through pollination and seed production. Although it is less common, an invasive species such as golden bamboo (*Phyllostachys aurea*) that does not reproduce sexually (or at least very infrequently) will not have a seed bank to combat. Once this asexual species is eliminated from the site, it will not re-colonize. Unfortunately, most invasive species in the Southeast reproduce sexually and have a seed bank.

Seed bank

The existence and persistence of the seed bank of an invasive species will impact the timeline required to achieve control. In south Florida, Liu and Pemberton (2008) found that the seed bank of the invasive skunk vine (*Paederia foetida),* was greater in forested habitats than in grassland or forest edge. Due to this, they recommended that monitoring and control for this species last a minimum of 2 years in non-forest habitats and 4 years in forested habitats. The better understanding restorationists have of the particular invasive species on their site, the better they can tailor their control strategy to combat these specific species, and the greater the likelihood of successful eradication.

Control methods for invasive species

The best defense against invasive species is a three step process: constant surveillance, early detection, and effective treatment (Miller 2003). Once you have identified the non-native invasive species present at your restoration site, you need to determine which methods of control are most successful for those specific species. An excellent review of control methods is available online through the US Fish and Wildlife Service (www.fws.gov/invasives/StaffTrainingModule/index.html). The control methods fall into four main categories:

- Physical control
- Chemical control
- Biological control
- Pyric control

Physical control

There are many physical methods available to restorationists. These include hand pulling, cutting, tilling, disking, physical barriers, mulching, etc. The decision to use physical methods will depend on the size of the infestation, effectiveness of the method on the invasive species present, and the availability of personnel and/or equipment. Often physical methods in combination with other types of control will increase effectiveness of control (Marks et al. 1993; Tu et al. 2001; Hatcher and Melander 2003). However, it is important to be aware that some physical control methods can increase the spread of certain invasive species rather than reduce it.

Chemical control

The use of herbicides in controlling invasive species is prevalent in Southeastern habitats and many control prescriptions are available (www.floridainvasives.org/mgmtplans.html). Many invasive plants in our area are sexually reproductive perennial species with extensive roots/runners and a soil seed bank. The use of herbicides on these species will allow for control without baring the soil and exposing the seeds of invasive species in the soil seed bank (Miller 2003). In addition, selective herbicide applications such as directed foliar spays, stem injection, cut-and-treat stump application, basal sprays on woody stems, and soil spots allow the restorationists to target non-native plants while minimizing impact on native species. A review of the herbicides used in forestry and their activity is found in McNabb (1996). All restorationists who use chemical control methods should be aware of state and federal laws on their use and have on hand personnel or contractors who have their pesticide applicators license. Miller (2003) recommends the following steps for successful herbicide control of invasive species:

1. Use the most effective herbicide for the species that need to be controlled.
2. Follow the application methods prescribed on the label.
3. Choose an optimum time period to apply treatments; for foliar-applied herbicides this is late summer to early fall, at least one month prior to frost.
4. Adhere to all label prohibitions, precautions, and Best Management Practices during herbicide transport, storage, mixing, and application.
5. Remember that some herbicides require up to a month before herbicidal activity is detectable. After application, be patient; allow herbicides to work before resorting to other treatment options.

Biological control

Biological control is the use of a natural predator or herbivore to control population growth and reduce dominance of an invasive species within a plant community. It is necessary that a restorationist gains a complete understanding of the potential impacts of the species being considered for release before introducing another non-native species into the restoration site. The use and testing of biocontrol methods in the US is growing and more agents are expected to become available (Wheeden et al. 2008). In the Southeast, biocontrol agents have been effective at controlling alligator weed (*Alternanthera philoxeroides*) and melaleuca (*Maleleuca quinquinervia)* on state and federal lands although the biocontrol agents are not currently commercially available (Rayamajhi et al. 2002; Wheeden et al. 2008).

Pyric control

The ability of prescribed fire to control an invasive plant species depends on that species' response to fire (Rice 2005). While some species such as Kentucky bluegrass (*Poa pratensis*) can be eliminated by prescribed burning, others, such as cogongrass (*Imperata cylindrica*), actually respond favorably to fire. The presence of certain invasive plants may create conditions that alter the characteristics of fire regimes such as spread patterns, intensity, frequency, and seasonality (Brooks et al. 2004). Increases in fire frequencies can impact the remaining plant community by suppressing species that are poorly adapted and promoting species that are well adapted to fire patterns under the new regime (TNC 2008). Because cogongrass can increase the intensity of prescribed burns, burning in areas with this species can result in the death of native pyrogenic species (Abrams and Hulbert 1987; Lippencott 2000). If research is not available on the response to fire for the invasive species present on your restoration site, it is recommended that other invasive control measures be taken prior to the initiation of prescribed fire.

An infestation of cogongrass *(Imperata cylindrica).*
Credits: H. Ober.

Increasing Biodiversity and Coverage of Native Groundcover Species

After all the restoration planning, site preparation, and invasive species control activities have been undertaken it is time for the real test of a groundcover restoration project: to increase the biodiversity and cover of native plant species appropriate to your restoration habitat. Once the native groundcover species are established, the restoration site will start to gain important ecosystem functions such as carbon sequestration, reduced erosion and nutrient run-off, cleaner water, reestablishment of natural fire regimen, as well as food and cover for wildlife. Therefore, a true ecological restoration project requires restoring the presence and structure of the vegetation community (SER 2004; Clewell and Aronson 2007). There are two methodologies employed in groundcover restoration: (1) preparing the site to maximize natural recruitment of native species from the seed bank or through natural seed dispersal, and (2) sowing seeds and/or introducing outplantings of native species. Many projects benefit from incorporating both strategies.

Natural recruitment

In many sites that weren't previously used for agriculture or mining, there may be reduced or remnant plant populations of species characteristic of the site (Walker and Silletti 2006). In these cases, restoration of much of the groundcover community can be achieved without the addition of seeds or plants; restoration of historical disturbances such as fire (Hedman et al. 2000) or flooding (Toth 2009) will suffice. However, it is often the case that although a suite of species can be restored through natural recruitment, one or more plant species has been eliminated completely and is no longer present in the seed bank (Cox et al. 2004; Kirkman et al. 2004; Coffey and Kirkman 2006; Ruth et al. 2008). Prior land management activities such as fire frequency and season of burning strongly influence the species composition of the seed bank (Andreu et al. 2008). In pine-dominated communities of the Southeastern coastal plain, a widespread keystone plant species, wiregrass, has often been eliminated completely through intensive soil disturbance and does not naturally recruit back into degraded sites (Clewell 1989; Outcalt and Lewis 1990). Because of the essential role of wiregrass in carrying prescribed fire in these fire-dependent communities, it is necessary for restorationists to seed or plant this species to ensure success to their project (Seamon et al. 1989; Outcalt et al. 1999).

Seeding/planting

The common need to establish or augment groundcover species into restoration sites has inspired research into determining which methods are best at establishing native plant populations. The advantages and disadvantages of direct seeding and outplanting should be compared carefully when deciding which of these two techniques is most appropriate for a particular project (Glitzenstein et al. 2001; Walker and Silletti 2006). Before seeds or plants are introduced into a site, the following critical issues should be considered: species choice, seed or plant source, and genetic diversity.

Species choice

If a particular plant species is missing from the restoration site when compared to the reference site(s), a detailed understanding of the biological requirements of that species is required. For example, if the species needs heavy shade, has an obligate mycorrhizal associate or a specific pollinator, these requirements must be present on or introduced to the restoration site for that particular species to survive, grow, and/or reproduce. Gordon (1994) created a helpful dichotomous key that considers the implications and information needed prior to the introduction of a species to a restoration site. Information on the growth habit and flowering season of many of the rare groundcover species that occur in forests of the Southeast are listed in Hardin and White (1989), and more complete species lists are presented according to forest community type in Chapter 8.

Source

Many plant species found in the Southeast have widespread distributions covering different habitats or even ecoregions (www.usda.plants.gov). Although seeds for some widespread species may be available for purchase, there is a chance that those seeds will not be adapted to the climate or soils of your restoration site if the source of that species' seed is not local (Norcini et al. 1998; Pfaff et al. 2002). Worse yet, translocations could result in the introduction of maladapted genotypes, negatively impacting restoration success through "genetic pollution" (McKay et al. 2005). It is therefore recommended that local ecotypes be used if available (Houseal and Smith 2000; Booth and Jones 2001; Norcini and Aldrich 2004). Pfaff et al. (2002) suggest that the ecotype should be planted no more than 50-300 miles from its original location, although abiotic factors such as soil, climate, and hydrology may be more important determinants of plant adaptation than the physical distance between sites.

Due to the importance of local adaptations, many restorationists are now collecting or contracting seed collections from nearby intact communities, called donor sites, to use for restoration (Huenneke 1991; Walker and Silletti 2006). Nancy Bissett, a groundcover restorationist in Florida, using a flail-vac or green silage cutter to collect seeds in the fall from donor sites, has found that simply spreading the mixture of seeds and chaff on the prepared restoration site can restore numerous native groundcover species with a single planting (Bissett 1996). Numerous publications offer detailed advice from lessons learned regarding issues and equipment involved in seed harvesting, drying, conditioning, cleaning, and storage protocols (Glitzenstein et al. 2001; Pfaff et al. 2002).

Genetic diversity

All of the current local adaptations and a species' future ability to adapt are related to the genetic diversity found in the source population(s) (Frankel 1970; Barrett and Kohn 1991). Populations with low genetic diversity are negatively affected by genetic drift and inbreeding, and therefore most conservation efforts are focused on maximizing genetic variation (Center for Plant Conservation 1991; Frankham et al. 2002). For this reason, it is recommended that hybrid or clonally propagated plants are not used in restoration activities. When selecting seeds for your restoration site, it is best to collect from sites that have similar environmental conditions, to collect seeds from as many plants as possible, and if you can, to augment seed collection over multiple sites and over multiple years (Huenneke 1991). To prevent adverse effects at the donor site(s) you should take less than 50% of perennial and 10% of annual seed production, collect only what you can use, and avoid trampling donor plants (Apfelbaum et al. 1997). To avoid degradation of the donor site, seed collections should not be made every year (Ecological Restoration Workshop 1996). A protocol for maximizing genetic diversity in seed collection is available from the Seeds of Success program (http://www.nps.gov/plants/sos/protocol/index.htm).

Seed biology

Many seeds have dormancy mechanisms that prevent their germination under unfavorable conditions. Some seeds need cold or moist cold conditions (cold stratification) and should be sown before winter or placed in refrigerated storage for 1-2 months prior to planting to mimic a winter environment. Other seeds have hard seedcoats, such as those of legume species, and require soaking or scarification. Finally, many woodland spring ephemeral species (e.g., *Trillium*, bloodroot) must be sown fresh (moist) and often remain in the soil for multiple years prior to emergence (Baskin and Baskin 1998). Without a thorough understanding of the seed biology of the species you plan to restore, successful restoration is unlikely.

Seeding Rate

The seeding rate for wildflowers and grasses will vary depending on the species, the density desired, and the seeding method employed.

Seed drill sowing: Pfaff et al. (2002) recommends 15-30 pure live seed (pls) per square foot on favorable sites and 22-60 pls per square foot for unfavorable sites. Bissett (2007) recommends 50 or more seeds per square foot for native seed mixes.

Broadcast sowing: Pfaff et al. (2002) recommends 30-60 pls per square foot on favorable sites and 44-120 pls per square foot on unfavorable sites. Norcini and Aldrich (2004) recommend 10 lb of bulk seed per acre for wildflower seed and 20 lb per acre for legume species if seeding recommendations are not found in the literature. Bissett (The Natives, pers. comm.) states that 4 acres of seed harvested from a donor site is needed per acre of restoration site when using seed collected through bulk silage then broadcast to an accumulation of 12 inches depth. When adding seed of species that are not present on the donor site or those that ripened prior to harvest, Bissett (2006) recommends using a rate of 2 lb/acre bulk seed per species. For wiregrass specifically, seeding rates have ranged from 2 lb/acre to over 80 lb/acre, depending on the viability of the seed (Walker and Silletti 2006).

Hand sowing: Between 4 and 10 lbs/acre is recommended for *Paspalum setaceum*, *Panicum anceps*, *Eustachys petraea*, *Eragostis refracta*, and *P. distichum* (Jenkins et al. 2004).

Planting density

Using nursery grown plants rather than sowing seed directly decreases the time to restoration and increases plant survivorship, but also increases the cost of groundcover restoration (Walker and Silletti 2006). For rare plants and woody species, it is more common to use plants than seeds due to low seed germination and seedling establishment rates. When determining planting density for each individual species, factors that should be considered are the density or cover of the species desired (determined by making comparisons between the reference and restoration site), estimated survival and growth of outplantings, and the desired timeline for attaining restoration success. For wiregrass, it was found that 0.046 – 0.093 plant/ft2 was sufficient for successful establishment and reproduction in a sandhill restoration in Georgia (Outcalt et al. 1999; Mulligan et al. 2002).

Timing

Norcini and Aldrich (2004) recommend that native wildflower seed be sown in late summer to mid-fall. Bissett (2006) recommends sowing the same time as seed collection when sowing bulk silage from donor sites, between mid-November and mid-December. Pfaff et al. (2002) state that many native seeds can be seeded year round if the soil moisture conditions are favorable, but winter sowing is often more successful than summer due to cooler soil temperatures and lower weed competition in Florida. In particular, seeding or outplanting should not occur in March and April in Florida due to stress associated with dry, windy conditions (Kindell et al. 1996; Pfaff et al. 2002). David Printiss from TNC's Apalachicola Bluffs and Ravines Preserve in North Florida recommends collecting native seed between early November and early December and planting this seed mixture anytime between December and March (pers. comm.). Finally, timing is also important in determining when to re-introduce fire to the newly seeded restoration site. At the Apalachicola Bluffs and Ravines Preserve wiregrass plugs were found to have good survival if burned greater than 1 year post planting; burning prior to 6 months resulted in 100% mortality (D. Printiss, pers. comm.). At the Joseph Jones Ecological Research Center in GA, survivorship of wiregrass seedlings was much greater after first-year dormant season burns (43%) compared to first-year growing season (17%) or second-year growing season burns (27%; Mulligan and Kirkman 2002a).

Investigation of production enhancing strategies for wiregrass seed at the North Florida Research and Education Center in Marianna, FL. *Credits: C. Mackowiak.*

Monitoring

Ecological monitoring methodologies are used to assess the status and detect change in populations, communities, and ecological systems over time. Monitoring is essential for groundcover restoration in order to determine whether management actions are having their intended impact and to ascertain the need for future management actions. Developing an effective monitoring protocol requires thoughtful examination of your restoration priorities and associated measures of success. There are a number of resources available with descriptions of specific monitoring protocols and their uses (Pavlik 1996; Masters 1997; Elzinga et al. 1998; Holl and Cairns 2002).

For many groundcover restoration projects, success includes establishing a minimum number of native plant species, reducing the cover of non-native species, and increasing the cover or density for a selected group of native groundcover species. To determine whether success in these criteria is obtained, restoration objectives must be defined in quantifiable terms (see Chapter 1). In order to develop a groundcover monitoring plan, the following questions need to be addressed:

- What will be measured?
- How will these indicators be measured?
- What is the timeframe for taking repeated measurements?
- What type of data analysis will be used?

A first step in deciding what to measure is identifying a small number of factors that could serve as indicators of restoration success. Data gained from the reference community for the identity, cover, and spatial distribution of native species appropriate to the restoration site can be used as a benchmark for the restoration site. The goals of the restoration and the botanical knowledge of the field crew will help determine whether measurements will be taken for each species, for a few previously identified key species, or simply by cover categories (grass, forb, shrub, and/or tree cover). Although it may be tempting to measure many factors as a precautionary measure so that an important variable is not left out, narrowing the list to a few key elements will greatly increase monitoring efficiency. When choosing what to measure, it is important to try to select factors known to be sensitive to management activities, to only include relevant factors, and to ensure that the factors chosen are not redundant (measuring the same thing). These suggestions help minimize the time, effort, and cost of monitoring activities.

Once the factors to measure are chosen, the restorationist must decide how the selected indicators will be monitored. The two main types of ecological data collection are qualitative (descriptive) and quantitative (numerical). The benefits of qualitative measurements are that they are usually less time intensive and therefore less expensive. The downsides of qualitative measurements are that they are dependent on the person taking the measurements (more subjective) and therefore can be less repeatable. Qualitative measurements include:

- presence/absence
- area encompassed by a community
- rough estimates of numbers (on a log scale)
- permanent photo-points

In contrast, quantitative measurements are repeatable amongst different researchers and can be analyzed statistically to determine whether the measured changes are "real" or simply due to chance. This requires that all quantitative monitoring approaches be done with a minimum number of replicates (e.g., 30 1-m2 cover quadrats per community-type). These approaches are more labor intensive and often require specialized botanical and statistical expertise. Quantitative measurements used in restoration monitoring are:

- abundance/density estimates
- percent cover
- number or percent of plants flowering or fruiting
- biomass
- demographic data collection which tracks the survival, growth, and reproduction of individual plants

Although monitoring survival and/or growth of introduced plants may seem adequate for assessing the success of a restoration project, the true measure of restoration success is sustained production of the introduced species (Gordon 1994). For this reason, monitoring over a short term is not nearly as telling as monitoring over a longer term.

Once your monitoring protocol is in place, the next decision involves development of a timeframe for monitoring. For many vegetation monitoring protocols, the time of the year will influence which species are present and the percent cover that they achieve. For this reason, most monitoring is done during the growing season. In contrast, many rare or invasive species are most easily identified when in flower or fruit, and monitoring for these species should be done at the time most conducive to their identification. In addition to seasonal affects, monitoring should be repeated at intervals that are useful to the restoration goals. For example, if seeds have just been introduced to the site, monitoring should occur regularly at short intervals if the goal is to determine germination percentages. In contrast, when monitoring the survival of outplantings, the first month will show the most change and then bi-annual or yearly monitoring should suffice unless an unexpected climatic event (e.g., drought or hurricane) has occurred or a restoration activity (e.g., prescribed fire or herbicide) has been introduced into the site. In conclusion, the timeline for monitoring must take into account the biology of the species of interest and must gather the data needed to make informed decisions regarding the need to change management strategies.

Finally, the goal of monitoring is to be able to understand how a restoration activity affects plant community presence, composition, and/or structure. When choosing monitoring protocols, it is important to understand what types of data analysis will be necessary to make the data collected understandable and useful. For species presence/absence data this can be as simple as a list of native species found or a graph of the number of native species through time. For quantitative data on density or cover, graphs of changes over time can be employed. If different restoration activities have been conducted within the site, the responses among plots can be compared statistically using a t-test or ANOVA. Finally, when rare species are monitored or when having predictive power of the future health or status of populations is of interest, an analysis of demographic data using matrix models should be employed (Caswell 2006; Maschinski and Duquesnel 2006).

The Society of Ecological Restoration International (SER) developed a Primer that recommends 9 ecosystem attributes worthy of consideration when assessing if restoration efforts have been successful (SER 2004). These attributes can be lumped into 3 categories: vegetative diversity, vegetative structure, and ecological processes. Time invested in careful consideration of exactly which of these characteristics is most appropriate for defining success in a particular project before work is initiated will be time well spent.

Chapter 3

Tailoring Restoration Strategies to Initial Site Conditions

The steps outlined in Chapter 1 provide the framework for planning a successful groundcover restoration project that is specific to the site chosen. The full complement of planning, site assessment, reference community selection, implementation of restoration activities, and monitoring must be site-specific in order to identify and address the sources of degradation and ecological impairment that are unique to that site. For this reason, there is no simple, prepared restoration plan that will work on every site. However, there are a number of common starting points from which a new restorationist can begin their groundcover restoration planning and benefit from the research and hard work done by those before them. Due to the important ecological services provided by wetlands and their recognized significance by state and federal governments, there are a number of wetland restoration resources available (Kusler and Kentula 1989, 1990; Wheeler et al. 1995; Middleton 1999). In contrast, research on restoration of the many diverse upland habitats is still in its infancy. In order to provide information to address this scarcity we have compiled publications from many sources and classified them into three groups according to the starting condition of the sites to be restored. The three main starting points we have identified for upland groundcover restoration are:

- Scenario A: sites with native overstory species and native groundcover (e.g., sites degraded as a result of fire exclusion);
- Scenario B: sites with off-site overstory species lacking native groundcover (e.g., former pine plantation sites); and
- Scenario C: sites lacking overstory and native groundcover (e.g., old field sites).

SCENARIO A: Areas with Site-Appropriate Overstory Species and Degraded Groundcover

The restoration of a site that has both native overstory and understory components is considered one of the top priorities for restoration due to the high probability of restoration success. These sites have generally been degraded for a shorter period of time or less extensively than sites at the other potential starting points. The most common degradation of upland communities in the Southeast is caused by the alteration of the historic fire regime. Reduction or lack of fire in many communities changes the cover and composition of groundcover vegetation communities. Without fire, woody shrub species increase in density and cover, competing with or shading out herbaceous species (Robbins and Myers 1992). Also, if fire does not remove accumulated litter and duff, many herbaceous species will have reduced regeneration rates (Hiers et al. 2007). Therefore the first 2 questions to ask when restoring a site with site-appropriate trees and intact groundcover is:

Question 1. Is fire a part of my reference community?

Question 2. If your site is fire-dependent, is sufficient fuel present to re-introduce prescribed fire to the restoration site?

Answer (YES to questions 1 and 2):
For restoration of fire-dependent communities, the re-introduction of prescribed fire is usually necessary. In urban locations or where prescribed fire is restricted, restorationists can use a combination of mechanical and herbicide treatments to try to mimic the effects of fire although the long-term success of these treatments is unknown (Litt et al. 2001; Freeman and Jose 2008). Where prescribed fire can be used, the restorationist should realize that burning can only effectively top kill small diameter woody vegetation; if the woody vegetation is greater than 2 inches (5 cm) dbh or the canopy trees are too dense to allow sufficient light on the forest floor, the restorationist may need to use mechanical or chemical treatments (especially cut-and-treat or basal spray; Reburtus et al. 1989; Joint Fire Science Program 2008).

Prior to the reintroduction of fire into a site, the fuel status of the site must be assessed to ensure that there are enough fine fuels present for effective burning but not so much that fires cannot be controlled if ignited. In sites that have been fire-excluded for long periods of time, the high fuel load and overgrown shrubby vegetation present on the site may act as “fire ladders” that send fire into the canopy. In addition, heavy duff accumulation may smolder when ignited rather than quickly passing through a site. The increased heat and duration of smoldering duff fires have been implicated in increased native pine mortality (Varner et al. 2005). If fuel ladders exist, they can be thinned mechanically (e.g., brush hog or gyro-trac) or herbicides can be applied to top kill shrubs and cause leaf drop. If there is a concern that deep litter and duff layers could cause unnecessary tree or rare species mortality during normal prescribed burning, two activities can be employed. First, the thick duff around individual plants can be raked away from the roots. Second, the first few prescribed burns can be implemented during environmental conditions that will ensure a "cool" fire (dormant season or when duff is wet) to remove the duff layer incrementally. These fires may not be useful in top-killing encroaching shrub species or promoting reproduction in most herbaceous species, but once the duff layer is reduced, hotter prescribed fires with more complete coverage can be introduced to achieve this objective (Outcalt 2006). Finally, recent research has shown that prescribed fire is both an effective and inexpensive tool for restoration but that it can take a minimum of three prescribed fires before groundcover responses reach restoration goals in fire-suppressed longleaf sites (K. Outcalt, USFS, pers. comm.).

Answer (YES to question 1, NO to question 2):

If the community to be restored is fire dependent but adequate fine fuels are not present at the site, the restorationist must use mechanical or chemical treatments (especially cut-and-treat or basal spray) to remove woody vegetation in the midstory and canopy to increase light at the forest floor. Some restorationists are able to introduce fire once this treated vegetation has aged (dried) but for the continued application of prescribed fire, it is essential that populations of native groundcover species that can carry fire (e.g., wiregrass) increase in cover on the site. If the coverage of these species does not increase following the initial thinning and/or burning treatments, it will be necessary to seed or plant these species on the site.

Answer (NO to questions 1 and 2):

If fire is not a driver (or is extremely infrequent) in the reference community for your site, the second most likely cause for degradation is human interference in an ecological process such as hydrology, regeneration (forest product removal impacts), or dispersal through the separation of the site from intact communities by barriers, roads, or trails.

The first two impacts can be addressed immediately. If the site is to be restored, any impediments to the natural hydrology must be removed first. In addition, forest product harvesting (plant or seed removal) must be prevented until data indicate that harvest levels will not affect the long-term viability of populations on that site.

If the restoration site is an island of remnant vegetation in a sea of highly degraded habitats, the restorationist must consider that the degradation of that habitat may be due to the loss of specialized pollinators or seed dispersers or an imbalance in herbivores and/or predator populations. Extremely small or isolated restoration sites may not have the resources necessary to maintain populations of essential fauna or maintain balance in their populations. One of the unforeseen results of habitat fragmentation and urbanization has been the loss of specialized pollinators. When studying seed set and predation in urban environments, it has been found that seed predation is higher and seed set is lower in fragmented habitats (Aizen and Feinsinger 2003). In addition, in remnant patches in an urban matrix, pesticide drift may be responsible for the loss of pollinators and reduction of insect diversity (Buchmann and Nabhan 1996; Heuberger and Putz 2003). Conducting an inventory of organisms responsible for pollination, seed dispersal, herbivory, and predation at a restoration site may be a useful means of identifying necessary modifications of fauna.

Once the role of fire has been assessed at the restoration site, the next major question is:

Question 3. Are non-native invasive species present?

Answer (YES):

If invasive species are present on the restoration site and you plan to restore fire to the site, it is very important that you determine the response of the invasive species to fire prior to ignition. Many invasive species can be reduced or eliminated mechanically or with the application of selective herbicides prior to burning. However, some invasive species respond to fire with copious regeneration, increasing in cover after prescribed burning (e.g., Zedler and Scheid 1988).

Cogongrass is an invasive species that is particularly difficult to control. The species is highly flammable and can change the intensity and pattern of fire, leading to the reduction of native species that normally respond favorably to fire (Lippencott 2000). Treating cogongrass with herbicides prior to fire is not recommended, as this can lead to even more intense fires. Implementing a cool fire or mowing the cogongrass stand before herbicide treatment during the fall is likely to reduce the amount of herbicide needed and improve control of the species (G. Tanner, University of Florida, pers. comm.).

Whether or not prescribed burning is a part of your restoration activities, you should investigate available recommendations regarding the control methodologies known to be most effective for the invasive species present on the site (Murphy et al. 2007). It is important to keep in mind that many control efforts must be repeated multiple times before control is gained over invasive populations.

Answer (NO):

If your site is fortunate enough not to have invasive species present, you are ready to monitor how the vegetation responds to the restoration activities you have completed to address the source(s) of degradation at the site.

EXAMPLE 1: Fire-suppressed longleaf pine stands on Eglin Air Force Base (native overstory, native understory).

Goal: Restore longleaf pine sandhill communities that have been encroached by hardwoods (oaks) in the midstory.

Fuels Present: Yes

Invasives Present: No

Restoration Activities: Eglin has employed mechanical, chemical, and prescribed burning treatments to reduce the midstory oak coverage in their sandhill sites. All methods were effective but only prescribed fire increased groundcover species diversity and density through the removal of heavy oak litter that had accumulated. Since fire was the most cost effective of the treatments, prescribed burning is the management action of choice on Eglin. Prescribed fires are ignited every 3-6 years to meet restoration needs. Finally, when immediate hardwood reduction is needed near red-cockaded woodpecker (RCW) nesting trees, large hardwoods are removed by felling or girdling.

Monitoring: Eglin has installed 200 permanent 1 ha monitoring plots to track vegetation responses in different habitats that are measured on a rotating basis (4-5 years).

SCENARIO B: Areas with Off-Site Overstory Species Lacking Native Groundcover

Many groundcover restoration sites in the Southeastern United States are pine plantation sites that have an intact canopy but lack native groundcover. Many of these sites have heavy canopy coverage of off-site pine species with a variable groundcover component that depends on the site preparation methods used in establishing the plantation, the occurrence of prescribed fire, and the degree of canopy closure. When planning the restoration of a pine plantation site, just as in a site with intact groundcover, the first two questions are whether fire should and can be re-introduced to the site and whether invasive species are present (see previous section for details). In addition, two more considerations must be taken into account: When and how should native on-site tree species be introduced? and, What activities need to be performed to introduce or promote the establishment of native groundcover species?

Question 4. When and how should native on-site tree species be introduced?

On-site tree species are typically introduced to plantation sites with off-site species via one of two methods: planting after clearcutting the off-site tree species or planting in “gaps” created by selective harvest. Clearcutting is used when:

- plantation trees are young and do not provide needed shade or fuel source.
- the off-site tree species is sand pine in a fire-dependent ecosystem.
- proceeds from the sale of merchantable timber are required to fund other restoration activities.

When off-site trees are young or when sand pine is dominant at the site, the re-introduction of prescribed fire becomes problematic. In a young plantation, the undergrowth is composed of weedy species such as dogfennel (*Eupatorium capillacifolium*), winged sumac (*Rhus copellina*), blackberry species (*Rubus* spp.) and woody shrubs (oak (*Quercus* spp.) species and gallberry (*Ilex glabra*)) that are native but do not carry fire well. In addition, without their removal, the young off-site trees would compete for resources with any native tree plantings. In contrast, sand pine (*Pinus clausa*) is an aberrant species with a very different fire pattern than other native Southeastern pine species. When burned, fire is carried into the canopy of sand pines by their dense lateral branches and the fires tend to be catastrophic or stand-replacing. If left on the restoration site, this pattern of fire does not promote the establishment of native flatwoods or sandhill vegetation and can be very difficult to control. Finally, on some sites, the funding necessary to implement restoration activities is gained through the sale of the off-site timber. If clearcutting is the method chosen to remove off-site pine species in fire-dependent habitats, it is necessary that the restorationist take measures to ensure that fine fuels are present at the restoration site. This is accomplished most often by the introduction or promotion of native warm-season grass species on the restoration site.

An advantage of using selective harvest to replace off-site pines with native species is that needle cast from the remaining trees will provide a fuel source for prescribed fire while also maintaining some shade on the site. This type of selective logging conversion process is being tested by the Joseph Jones Ecological Research Center in central Georgia in the restoration of loblolly pine plantations to longleaf sandhill habitat (Kirkman et al. 2007) and in the Apalachicola National Forest in the restoration of slash pine plantations to longleaf flatwoods habitat (C. Hess, USFS, pers. comm.). Kirkman et al. (2007) recommend that a variable canopy retention approach be used as an alternative to clearcutting because it allows for the maintenance of pine cover necessary for needle cast (aka fine fuel production). Underplanted longleaf pine seedlings will be released in stages as the off-site pines are harvested and the restoration will result in an uneven aged longleaf stand (Kirkman et al. 2007). Harvesting of timber has been implicated in both soil disturbance and the introduction of non-native invasive species so precautions must be taken to minimize these potential problems when harvesting at the restoration site. A review of environmentally sound forest harvesting techniques is found in Long (2001).

EXAMPLE 2. Joseph W. Jones Ecological Research Center restoration of longleaf pine sandhill from loblolly pine plantations by selective harvest (off–site canopy species present, groundcover lacking).

Goal: Restore longleaf pine sandhill communities on degraded loblolly pine plantations

Fuels Present: Yes

Invasives Present: No

Restoration Activities:
Overstory thinning. Overstory pines were thinned using single-tree selection and canopy gaps were created ranging in size from 5 - 9m2 per ha. *Midstory thinning.* Two methods of midstory hardwood control were found to be effective, herbicide (Velpar tablets applied at 3 kg/ha in May) and prescribed fire alone. *Prescribed fire.* All sites are burned on a 3-5 year rotation. *Planting.* Longleaf pine trees were planted in newly created gaps at variable densities ranging from 450 – 1000 trees per ha. *Seeding.* The site was seeded with wiregrass by hand-dispersal in February with 650 g of pure seed per ha.

Monitoring: The sites are monitored for species richness, understory hardwood density, and herbaceous ground cover biomass both prior to the study installation and on 5 year intervals post-restoration.

Question 5. How should native groundcover species be introduced?

A major goal of any groundcover restoration project is to maintain the diversity and cover of native groundcover species at the restoration site. Whether you need to create a groundcover community from scratch or simply augment key species to meet restoration goals, many restoration projects include the planned introduction of native groundcover species to the site. This can be a challenging but rewarding experience for any restorationist. As a reminder, prior to the introduction of any native species at the restoration site, the causes of environmental degradation must be identified and mediated (soil and hydrological alterations, introduction of prescribed fire, removal of canopy and midstory biomass) and invasive species should be controlled.

There are many considerations to take into account when determining which species to introduce and what the best source for those species may be, as detailed in Chapter 2 of this manual in the section on increasing biodiversity and coverage of native groundcover species. The practical way to address these considerations is to start by comparing the cover of the species present at the reference site to those at the restoration site. The restorationist needs to identify which species have high cover percentages in the reference site and which species play important ecological roles such as providing habitat structure, fine fuels for fire, and food and cover for wildlife. With this list of species in hand, the restorationist needs to determine how these species should be introduced. Depending on the prior history of human activities at the restoration site (silviculture or agriculture) and its proximity to natural habitat, there may be a number of native species present in the seed bank of the restoration site. This has been shown for a number of former pine plantation sites (Hattenbach et al. 1998; Cohen et al. 2004; but see Kirkman et al. 2004; Ruth et al. 2008). For example, at The Nature Conservancy's Apalachicola Bluffs and Ravines Preserve, the soil seed bank of former sand pine plantations provides similar species composition and diversity as sites that are actively seeded with native seed bulk mixtures (Cox et al. 2004). If time permits, and the project has a skilled botanist on hand, a soil seed bank study can be performed at the restoration site to assess the species composition of propagules already present.

One keystone species commonly missing from the soil seed bank of degraded Southeastern sites is wiregrass. For many restoration sites, wiregrass is the focal species for groundcover restoration due to the essential role this species plays in carrying fire. If wiregrass is introduced simultaneously with other native groundcover species, wiregrass survival may be lower than if introduced alone (Aschenbach et al. 2009). For this reason, at sites where wiregrass establishment is top priority, the use of a two-step process of reestablishing wiregrass first and other native species at a later date may lead to the greatest long-term success.

Wiregrass, or any other species identified, can be introduced to the site by either seed or small plants (plugs) depending on the timeline for restoration, the size of the site, and the budget for the restoration. Once the list of species needed at the restoration site is compiled, the next consideration is the source(s) for those species.

Propagation of wiregrass tubelings at The Nature Conservancy's Apalachicola Bluffs and Ravines Preserve in Bristol, FL. *Credits: NWFL TNC.*

The best source for seeds and plants is from a donor site on or adjacent to the restoration site. If a nearby donor site can be found, it is likely to be adapted to the local climate and soil types of the restoration site. As long as the donor site has large populations (500+) of plants of the species from which you are planning to harvest seed, the genetic diversity of the seeds should be sufficient for the future adaptability of the species at the restoration site. If no donor sites are available and commercial seed/plant sources are sought, it is recommended that seeds of the same ecotype be used from populations that are both nearby and matched in hydrological characteristics (e.g., wet vs. dry habitats; Gordon and Rice 1998). The viability of seeds obtained can be determined by inspecting the seed for mature embryos, testing with tetrazolium blue staining or by a germination test (Baskin and Baskin 1998). Finally, these considerations are not restricted to groundcover species; when planting trees or shrubs local adaptation and genetic diversity are also important. Historically, trees used in plantations were not genetically diverse and were often not adapted to the site where they were planted (Lambeth and McCullough 1997; McCutchan et al. 1997).

Once the seeds are in hand, the restorationist can chose to plant them directly on the site by either broadcast or seed drill sowing. If seeds were harvested from a donor site by the collection of bulk silage (using a flail-vac or silage cutter) it has been recommended that seeds are planted within a month after their harvest from the donor site to maximize germination and prevent spoilage/molding. If seeds are collected throughout the year, it is best to store them in a cool (50-70°F) dry location, in paper or mesh bags (not plastic) until sowing in the fall. The seeds of many native species have a dormancy mechanism that can delay germination for at least one year. For that reason, if you tested the seed viability prior to planting, patience is suggested to allow for seed dormancy.

If the restorationist has the resources, native plant seeds can be propagated in a nursery setting. This method requires a greater input of resources such as time, water, soil and nursery pots but has a number of benefits:

- Greater number of plants established using less seed
- Increased plant species diversity through propagation of rare species
- Better outplanting success
- Larger time window for outplanting
- Opportunity for community involvement

The nursery environment with its inputs of water and reduced competition can greatly increase the number of plants available for the restoration in comparison to direct seeding. At the ABRP it was estimated that for every 70-80 wiregrass seeds broadcast on a site, one seedling was observed (Roth, in prep.). The large number of wiregrass seeds that can be machine harvested at ABRP make up for this loss but nursery propagation becomes especially important when working with plant species that do not flower and fruit in synchrony, are not common on the donor site, are not in seed at the time of bulk harvesting, or are unavailable commercially. The ability to collect and propagate these species in a nursery environment will eventually lead to higher overall species diversity at the restoration site. Nursery propagation is the method of choice for rare plant species whose seed availability and numbers are limited because the extra effort will maximize the germination and survivorship of seedlings. In addition, a number of studies have correlated outplanting success with plant size and found that adult plants have greater outplanting survival (Kindell et al. 1996; Mulligan and Kirkman 2002a; Wendelberger et al. 2008). Finally, nursery propagation gives volunteers a chance to work with and learn about native plants in a comfortable environment and creates a connection between the restoration work and the community. At the ABRP, despite the higher cost of nursery propagated wiregrass plugs, the benefit of community involvement and outreach provides the impetus for the continuation of the nursery propagation program (D. Printiss, TNC, pers. comm.).

Most nursery-propagated plants, whether grown at the restoration site or purchased from native nurseries, are hand-planted on the site using volunteers that have been trained in the proper methods of planting the particular species being restored. The use of nursery-raised plants at the restoration site widens the window for outplanting to any season that has sufficient rainfall. Although plants can be planted year round, a meta-analysis of groundcover restoration site data found that plant survivorship was significantly lower when plants were outplanted in the spring compared to the other seasons (Trusty and Ober, in review). For this reason, for temperate restoration sites, we recommend fall or winter planting. Once the seed or plants are in the ground at the restoration site, the ability to water during drought conditions will likely increase seedling germination and survival (Cox et al. 2004). As to fertilizer, studies in wiregrass and native wildflower species have shown that most native species do not require fertilizer addition and some actually respond negatively (Outcalt et al. 1999; Mulligan and Kirkman 2002b; Jenkins et al. 2004). Therefore the use of fertilizer is not recommended.

The germination rate and survivorship of all seeded or planted species should be monitored. However, the survival of introduced native species is not the final endpoint in a groundcover restoration project. The ability of those species to flower, produce seed, and regenerate on the restoration site is one sign of the ecological functioning of that site. Monitoring efforts should include identifying regeneration of native species on the site through determination of seed production or monitoring for new germinants. A watchful eye should also be kept for non-native invasive species. If any invasive species are found, they must be controlled mechanically or chemically before they spread throughout the restoration site.

EXAMPLE 3. Apalachicola Bluffs and Ravines Preserve (ABRP) restoration of longleaf pine sandhill from slash pine plantations (off-site canopy species present, groundcover lacking)

Goal: Restore longleaf pine sandhill communities on degraded slash pine plantations

Fuels Present: No

Invasives Present: No

Restoration Activities: *Overstory thinning.* Overstory slash pines were thinned to 30 trees/acre but this proved not to provide enough needle cast to carry fire. *Midstory thinning.* Hardwoods are manually removed and stump-treated with Garlon in selected areas. *Mechanical site treatment.* Windrows are bulldozed at restoration sites to knockdown logging debris and spread soil. *Seeding.* Bulk seed was collected on-site and then seeded using broadcast sowing and rolling or a grasslander drill seeder. *Planting.* Longleaf pine trees were planted in newly created gaps at 200 trees per acre. *Prescribed fire.* All sites are burned on a 2-3 year rotation.

Monitoring: The sites were monitored for species richness and cover prior to the study installation and will continue to be assessed annually for the first 2-3 years post-restoration.

Groundcover restoration at The Nature Conservancy's Apalachicola Bluffs and Ravines Preserve. *Credits: L. DeGroote.*

SCENARIO C: Areas Lacking Overstory and Native Groundcover (Bareground Restoration)

When a restoration site lacks both native canopy and understory plant species it can be considered a bareground restoration. These sites include pastures, former agriculture fields, and mine reclamation sites. Restoration of bareground sites is becoming more common as urbanization surrounds former agricultural lands and as larger and more continuous habitat areas are needed to serve as corridors for animal species movement. Bareground restoration sites are highly modified by humans and at times it can be difficult to determine what the former habitat on the site might have been. In other cases, the soil and hydrologic disturbances cannot be mitigated and the restorationist must determine what natural habitat type(s) can be supported under the current ecological conditions at the site.

Unfortunately, a bareground restoration site is not usually bare but most often covered in non-native and invasive plant species. Therefore, initial restoration activities usually involve controlling the invasive species present at the site. A number of chemical and chemical + mechanical combination treatments have been tested in Florida pasture restorations. At The Nature Conservancy's Disney Wilderness Preserve (DWP), all pasture sites receive multiple herbicide applications over the growing season and are burned prior to seeding or planting. Managers have discontinued the practice of disking the sites prior to planting due to observations that disking spreads existing non-native vegetative propagules across the site and creates disturbed, open ground conditions for new non-natives to become established. Restorationists at DWP have found that a number of herbicides are effective at treating sod grass species but are less useful in the control of cogongrass infestations. They suggest that a 1% solution of Arsenal with a surfactant be sprayed both on the cogongrass plants and in a 1 m radius around each plant to control underground rhizomes (TNC 2008). After seeding/planting a former pasture site, the restorationist must systematically patrol and treat non-native invasive plants in the seeded/planted areas for 2-4 years to ensure that complete control has been gained over invasive species. The Florida Fish and Wildlife Conservation Commission has a number of groundcover restoration sites in former pasture or agricultural land. On these sites, invasive and sod grass species are treated chemically for one to two growing seasons. Prior to planting native groundcover seeds, each site is then disked and rolled or cultipacked (Nagid 2006).

Once the sites have been prepared, the introduction of groundcover seeds or plants follows the same methodology as described above. Since bareground sites generally do not have any tree cover, larger equipment can be used on the restoration sites, saving time and contractor costs. Some bareground restorationists prefer to use a grasslander drill seeder rather than a hayblower broadcast seeder as it reduces the need (and costs associated) with rolling the seeds into the ground. When restoring open canopied longleaf pine habitat, most restorationists plant trees 2 or more years after the area is seeded in native groundcover species to ensure that the prescribed fire fuels are present prior to introducing the longleaf pine seedlings. In forested sites that are not fire dependent, it is likely that tree canopy cover may be required prior to the introduction of shade-loving native groundcover species. Finally, bareground restoration sites that have had heavy infestations of non-native invasive species require continuous monitoring and treatment of any invasive populations in addition to regular monitoring of native species survival and growth.

In south Florida, bareground sites may consist of forests of invasive species such as melaleuca and Brazilian pepper (*Schinus terebinthifolius*). A pine rockland restoration undertaken by the Miami-Dade Natural Areas Management, the Florida Department of Transportation, and Fairchild Tropical Garden required the chipping of a monoculture of Brazilian pepper, leaving only a sparse canopy of south Florida slash pine and a mulch layer 10-30 cm deep (Wendelberger et al. 2008). In this study, 68 native species recruited from the seed bank although 5 non-native species were also present (Wendelberger et al. 2008). In contrast, mine restoration sites are usually completely devoid of vegetation and the high degree of soil disturbance precludes the germination of seed bank species. In some mine reclamation sites, topsoil from sites that will be mined is placed on the disturbed mine sandtailings and overburden to provide propagules for revegetation (Roth, in prep.). In other sites, sandtailings and overburden are directly seeded with bulk green silage (Pfaff and Gonter 2000; Roncoby 2004).

EXAMPLE 4. Disney Wilderness Preserve restoration of improved pasture to longleaf pine sandhill habitat (canopy lacking, groundcover lacking).

Goal: Restore longleaf pine sandhill communities on sodgrass pasture lands

Fuels Present: No

Invasives Present: Yes

Restoration Activities: *Invasive control.* Herbicide application by tractor or helicopter mounted broadcast sprayers a minimum of twice during the growing season. *Prescribed fire.* All sites are burned pre-seeding to remove biomass. Prescribed fire is re-initiated 3 years post-seeding but prior to tree and shrub planting. *Seeding.* The sites are seeded with wiregrass and bulk collected seeds collected on site with a flail-vac harvester using a grasslander. Hand collected seeds of small smooth-seeded species such as panic grasses (*Panicum* spp.) and yellow-eyed grasses (*Xyris* spp.) are seeded by hand with home-made shaker bottles. *Mowing.* Sites are mowed the first year to reduce cover and seeding of early-successional species such as dogfennel. *Planting.* Longleaf pine trees are planted at 5 trees per acre and upland shrubs at 20 plants per acre after groundcover species are established.

Monitoring: The sites are continuously monitored for invasive species establishment. Herbaceous ground cover is monitored by species using percent coverage in random quadrats. In addition, photopoint data are collected.

Groundcover restoration at The Nature Conservancy's Disney Wilderness Preserve in Kissimmee, FL. *Credits: TNC/Chris Matson.*

Chapter 4

Important Considerations for Groundcover Establishment

Restoration is a long, complex process that should involve planning, site assessment, reference community selection, consideration of alternative restoration strategies, implementation of restoration activities, and monitoring. These efforts must be site-specific so that they identify and address the sources of degradation and ecological impairments that are unique to each site. For this reason, there is no simple, prepared restoration plan that will work on every site.

The sheer magnitude of decisions which must be made regarding which activities to employ and when to initiate each can be overwhelming. Practitioners need to decide which site conditions need to be altered and then select the most appropriate site preparation techniques to make these changes; determine if invasive species control is needed and if so which techniques would most effectively address the species present; decide whether to rely on natural recruitment or to actively pursue direct seeding or outplanting; if necessary, decide where and how to obtain plant material and what equipment is needed to acquire and to distribute the plant material; and decide whether prescribed burning would be appropriate, and if so, how often. Furthermore, the time of year that each of these activities takes place and the ordering of activities is of crucial importance in determining the ultimate degree of restoration success. Although a lot of information on these topics exists in the published literature, most studies address only 1 or 2 issues at 1 or 2 locations, and do not look at the entire restoration process holistically.

We decided that distilling existing information from numerous studies that addressed a variety of issues at multiple sites across the Southeast could be a useful endeavor. By integrating restoration planting and seeding research from numerous projects into a single analysis, we examined the relative importance of the myriad factors that influence restoration success across studies. Using classification and regression trees (CART), we identified which site preparation and planting techniques were most critical to understory restoration success (Trusty and Ober, in review). The following simple suggestions derived from these analyses should increase the survivorship of outplantings and increase the establishment rate of native seeds during restoration efforts.

Outplanting

The factors we considered in our analyses included planting season, whether outplantings were established in intact or severely degraded habitat, use of 5 different site prep activities, presence of an existing canopy, whether plantings came from on-site or off-site and from habitats similar to or different from the restoration site, and whether irrigation, fertilization, or burning occurred after planting.

Our first recommendation is that careful consideration be given to the timing of outplanting. For restoration sites located in forests of the temperate Southeast, seeding and planting should occur during the dormant season, preferably late fall or winter (November through February). The mean survivorship of outplantings established at sites during spring was 22 percentage points lower than the collective group of fall, winter, and summer planted sites (46% vs. 68% survivorship). However, in subtropical central and south Florida, establishing outplantings during the summer (the season when ample rainfall is most predictable) leads to higher outplant survivorship.

Second, it is recommended that practitioners restoring native groundcover species to pine plantation sites maintain some level of canopy coverage during the restoration process.

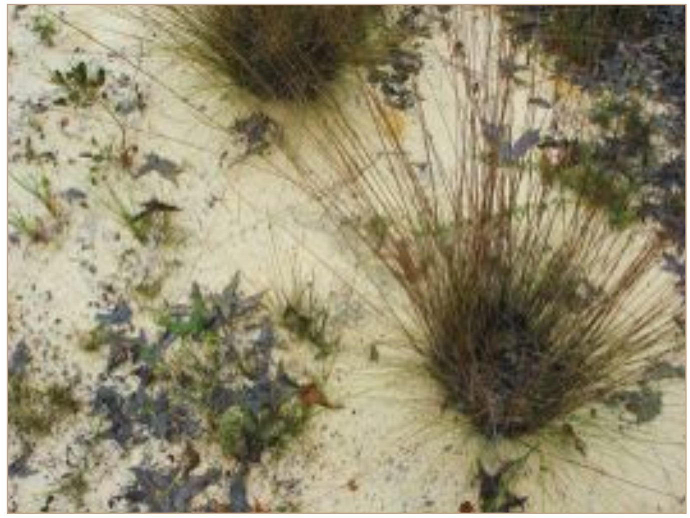
Third, although implementing a prescribed fire regime in many forested ecosystems in the Southeast is important to overall project success, it is recommended that burning not be initiated prior to 2 years after outplanting. Plants that were burned earlier after outplanting had lower survivorship than those that were not burned until later.

Finally, consideration should be given to how closely the source habitat from which outplantings were obtained matches those of the restoration site. Survivorship of outplantings that used materials obtained from similar source habitat was significantly higher than survivorship of outplantings that used materials from dissimilar habitat.

Direct Seeding

The factors we considered in these analyses included planting season, whether seeds were planted into intact or severely degraded habitat, use of 4 different site prep activities, presence of an existing canopy or of invasive species, whether plantings came from on-site or off-site and from habitats similar to or different from the restoration site, the seeding method employed, whether the soil was rolled after seeding, and whether irrigation occurred after seeding.

The single most important factor to ensure high germination rates of seeds sown on restoration sites was the use of herbicide to prepare planting sites. Chemical treatment is recommended prior to the introduction of native groundcover seeds to reduce or eliminate existing competing vegetation. Planting season was also important, with lowest germination rates occurring during spring.



Outplantings at The Nature Conservancy's Apalachicola Bluffs and Ravines Preserve. *Credits: L. DeGroote.*

Chapter 5

Costs Associated with Groundcover Restoration

Finances ought to be a fundamental consideration when determining the feasibility of a groundcover restoration project. The costs associated with both initial restoration activities and long-term maintenance of the site need to be budgeted. Many restoration efforts ultimately fail because planning efforts were inadequate and costs were higher than anticipated. Although the greatest expenditure may be in the initial purchase price of the property, an estimation of the costs associated with restoration activities is necessary to make an informed purchase and to develop a funding plan for the eventual restoration of the site. Once the property is purchased, the next most important expenditures will be to hire personnel responsible for project management, implementation of restoration activities, funding acquisition, coordinating volunteers, and community outreach.

The actual costs associated with restoration implementation include:

- Assessment of both reference and restoration sites
- Purchase and maintenance of mechanical equipment
- Mechanical preparation of the site
- Chemical preparation of the site
- Pyric preparation and maintenance of the site
- Acquisition or propagation of plants and/or seeds
- Seeding and planting
- Monitoring

Cost estimates for each of these activities have been compiled from previous restoration projects. Estimates of costs associated with site preparation are listed in Table 1, for seeding and planting in Table 2, for site assessment and monitoring in Table 3, and for entire projects in Table 4. Each of the prices listed was accurate for a specific project at a particular location at a particular time: differences in available contractors, personnel costs, and travel expenses are likely to change the actual costs of the restoration of your site from those listed here. Finally, equipment costs vary by size and brand (Table 5). Networking with restorationists in your area may help increase the accuracy of the budgeting process and provide contact information for reputable and experienced contractors.

As can be seen in Table 1, site prep costs vary dramatically among methods, with fire typically costing the least and mechanical methods the most. Also, having work done in-house rather than contracting out can result in substantial economic savings, although the cost of renting or purchasing and maintaining the equipment must be considered. Seed collection, handling, and sowing methods also vary appreciably in cost (Table 2), and typically cost more than site prep activities. Broadcast sowing is typically less expensive than no-till seeding, but both of these activities are much less costly than planting wiregrass tubelings. One of the largest, but albeit most important components of the overall project budget, is that associated with site assessment and monitoring (Table 3).

One recommendation for saving time and expenses is to include multiple activities within a single contract. For example, when restoring gopher tortoise (*Gopherus polyphemus*) habitats in the Desoto National Forest in Mississippi, canopy thinning harvests (profit-generating) are combined with mid-story removal and chemical application (cost-incurring) in the same contract by adjusting the timber value to reflect the cost of the management activities (A. Barwick, De Soto National Forest, pers. comm.). In the South Florida Water Management District, wiregrass and native seed harvests are being conducted by contractors who are paid a fixed price for a set amount of bulk seed required for restoration in the district (cost-incurring) but pay the district for additionally harvested seed (profit-generating) that they can then sell to other sites (S. Miller, South Florida Water Management District, pers. comm.). To save time and money in producing wiregrass seed needed for groundcover restoration, the Fort Blanding Joint Military Installation in Florida has converted a field into a wiregrass donor site to simplify prescribed burning and harvest (P. Catlett, Camp Blanding Joint Training Center, pers. comm.).

Once the costs of restoration have been determined, the next step is to secure funding. A number of local, state, and federal funding opportunities are available for groundcover restoration projects (see list of funding resources in Chapter 9). In order to be prepared for funding opportunities as they arise, it is important to have detailed descriptions of the seven restoration steps outlined in Chapter 1 written out in digital format and to have a budget prepared for each restoration activity.

Although there are a wide variety of potential reasons for conducting groundcover restoration projects, many funding opportunities exist to address one of two objectives: improving soil and water quality (ecosystem services), or conserving habitat for rare species. Funding for ecosystem services is generally targeted towards wetlands and coastal habitats. In contrast, funding for upland sites is more likely to come from sources interested in the conservation of rare species. Gathering data on the presence of rare plant and animal species and on the potential importance of the restored habitat to any state or federally threatened and endangered species may be a good first step towards obtaining funding for upland restoration. Information on rare species and habitats can be obtained on the websites for the Department of Natural Resources/Natural Heritage Programs of each state (website addresses are listed in Chapter 9).

Finally, be sure to contact local plant societies, botanical gardens, county agricultural extension agents, high schools, and colleges with information on the project site and the restoration needs. The value of dedicated students and volunteers at a restoration site is enormous and is invaluable for encouraging community involvement and perpetuating environmental education programs. The Student Conservation Association (www.sca.org) is an organization involved in matching interested students with restoration activities on public lands.

TABLE 1. Costs associated with preparing a site for restoration.

INITIAL HABITAT	SITE PREP METHOD	RESTORATION ACTIVITY	COST ($)
Intact	chemical	herbicide application	$47/acre
Intact	mechanical	kershaw mowing	$175-500/acre
Intact	mechanical	roller chopping	$100-175/acre
Intact	mechanical	root raking	$.49/linear foot
Intact	thinning	hardwood removal	$2-4/ton removed
Mine	chemical	herbicide (contracted)	$78/acre
Mine	mechanical	earthmoving	$4235/acre
Pasture	chemical	herbicide application	$48/acre
Pasture	chemical	herbicide application	$25/acre
Pasture	chemical	herbicide (helicopter)	$214/acre
Pasture	fire	prescribed fire	$6.5/acre
Pasture	fire	prescribed fire	$10.70/acre
Pasture	mechanical	cultipacker	$576/acre
Pasture	mechanical	disking	$24/acre
Pasture	mechanical	disking	$29.8/acre
Pasture	mechanical	disking	$39/acre
Pasture	mechanical	disking	$14/acre
Pasture	mechanical	disking (in-house)	$6/acre
Pasture	mechanical	mowing (in-house)	$6/acre
Pasture	mechanical	mowing (in-house)	$7/acre
Pasture	mechanical	rolling (contracted)	$46/acre
Pasture	mechanical	rolling (in-house)	$12.66/acre
Pasture	mechanical	root raking	$21/acre
Pasture	thinning	pre-commercial	$224.5/acre
Plantation	chemical	herbicide application	$40-300/acre
Plantation	fire	prescribed fire	$20-75/acre
Plantation	mechanical	disking	$31.75/acre

INITIAL HABITAT	SITE PREP METHOD	RESTORATION ACTIVITY	COST ($)
Plantation	mechanical	site prep: mowing, drum chopping, or mulching	$40–1200/acre
Plantation	thinning	commercial	$450–3000/acre
Plantation	thinning	pre-commercial	$50–1325/acre

*Estimated site preparation performance for gyro-trac mechanical site preparation is 6 acres/day.

TABLE 2. Costs associated with restoration seeding and planting.

INITIAL HABITAT	ACTIVITY	COST ($)
Mine	planting bare root herbaceous species	$.59/plant
Mine	planting sawgrass	$.85/plant
Mine	planting seedling trees	$1.78/plant
Mine	planting St. Johns wort	$2.65/plant
Mine	upland tree planting	$984–2028/acre
Mine	planting herbaceous plants	$871/acre
Pasture	seed collection and sowing	$845/acre
Pasture	seed collection and sowing	$800–1200/acre
Pasture	seed sowing (grasslander)	$88/acre
Pasture	seed collection of Lopsided indiangrass (flail-vac)	$1.6/lb bulk
Pasture	seed collection of Lopsided indiangrass (flail-vac)	$10.8/lb bulk
Pasture	collecting wiregrass mix (flail-vac)	$1.03/lb bulk
Pasture	collecting wiregrass mix (flail-vac)	$8.72/lb bulk
Pasture	collecting wiregrass mix (flail-vac)	$16.35/lb
Pasture	seed handling	$31/acre
Pasture	seed handling	$72/acre
Pasture	seed sowing (grasslander)	$14.65/acre
Pasture	seed sowing (grasslander)	$48/acre
Plantation	seed sowing (broadcast)	$38.99/acre
Plantation	seed sowing (grasslander)	$45–90/acre
Plantation	seed collection and sowing	$350/acre
Plantation	planting wiregrass plugs	$700/acre
All	planting wiregrass plugs	$.30–.40/plug
All	planting wiregrass plugs	$.17/plug

*Estimated performance for ATV mounted flail-vac seed collection is 6.7-8 acres/day and green silage cutter seed collection is 24 acres/day.

TABLE 3. Costs associated with site assessment & monitoring.

INITIAL HABITAT	CATEGORY	COST ($)
Mine	monitoring (intensive)	$310–375/acre
Mine	monitoring (forested sites)	$265/acre
Mine	monitoring (non-forested sites)	$100/acre
Pasture	seed bank study	$3000
Pasture	site surveys (donor or recipient)	$2500

TABLE 4. Total project costs for select restoration sites.

INITIAL HABITAT	CATEGORY	COST ($)
Mine	total restoration (16 acres)	$1350/acre
Pasture	total restoration (10 acres or less)	$5000–6000/acre
Pasture	total restoration (100 acres or more)	$2,900/acre
Pasture	total restoration (20–100 acres)	$3,500/acre
Pasture	total restoration (400 acres)	$730/acre
Pasture	total restoration (first year)	$1295/acre
Pasture	total restoration (first year, contracted)	$1450–2000/acre
Pasture	maintenance restoration (second year)	$670/acre

TABLE 5. Estimates of costs associated with equipment required for groundcover restoration.

EQUIPMENT	COMPANY	ADDRESS	SPECIFICATIONS	COST ($)	SHIPPING ($)
Landscape roller	Ferguson Manufacturing Company	Suffolk, VA	6 ft roller; 3 point hitch	$541	$74
Landscape roller	Ferguson Manufacturing Company	Suffolk, VA	6 ft roller; trailer hitch	$460	$65
Landscape roller	JD Swearingen Company	Marianna, FL	5 ft roller	$417	.
Landscape roller	JD Swearingen Company	Marianna, FL	6 ft roller	$855	.
Seed stripper	Ag-renewal	Weatherford, OK	4 ft; ATV mount	$7,800	.
Seed stripper	Ag-renewal	Weatherford, OK	6 ft; PTO driven	$9,500	.
Seed stripper	Ag-renewal	Weatherford, OK	12 ft; PTO driven	$11,950	.
Seed stripper	Prairie Habitats	Manitoba, Canada	4 ft; pull behind	$7,874	$325
Seed stripper	Prairie Habitats	Manitoba, Canada	6 ft; pull behind	$9,785	$425
Seed stripper	Prairie Habitats	Manitoba, Canada	8 ft; front end loader	$14,625	
Mulch Spreader	Finn Corporation	Tampa, FL	B40 mulch spreader	$6,299	$400
Mulcher	Reinco	Plainfield, NJ	skid mount; 18 hp	$6,900	$300
Mulcher	Reinco	Plainfield, NJ	skid mount; 20 hp	$7,300	$300
Mulcher	Reinco	Plainfield, NJ	trailer mount; 18 hp	$9,900	$1,015
Mulcher	Reinco	Plainfield, NJ	trailer mount; 20 hp	$10,300	$1,015
ATV harrow	Jones Tractor Company	Tallahassee, FL	4 ft	$379	
No-till seeder	Truax Company	New Hope, MN	FlexII 88 series grass drill	$9,579	$900
No-till seeder	Grasslander	Hennessey, OK	5 ft	$10,500	$2,750
No-till seeder	Grasslander	Hennessey, OK	8 ft	$15,000	

Collecting native groundcover seed with a flail-vac seed-stripper.
Credits: NWFL TNC

Literature Cited

Abrahamson, W. G. and D. C. Harnett. 1990. Pine flatwoods and dry prairies. Pp. 103-149 *in* R. L. Myers and J. J. Ewel, editors. Ecosystems of Florida. University of Central Florida Press, Orlando, FL.

Abrahamson, W. G., A. F. Johnson, J. N. Layne, and P. A. Peroni. 1984. Vegetation of the Archbold Biological Station, Florida: an example of the southern Lake Wales Ridge. Florida Scientist **47**:209-250.

Abrams, M. D. and L. C. Hulbert. 1987. Effects of burning regime on buried seed banks and canopy coverage in a Kansas tallgrass prairie. Southwestern Naturalist **33**:65-70.

Aizen, M. A. and P. Feinsinger. 2003. Bees not to be? Responses of insect pollinator faunas and flower pollination to habitat fragmentation. Pp. 111-129 *in* G. A. Bradshaw, P. A. Marquet, and H. A. Mooney, editors. How Landscapes Change: Human Disturbance and Ecosystem Fragmentation in the Americas. Springer-Verlag, Berlin, Germany.

Andreu, M. G., C. W. Hedman, and M. H. Friedman, Andreu, A. G. 2008. Can managers bank on seed banks when restoring *Pinus taeda* L. plantations in southwest Georgia? Restoration Ecology 10.1111/j.1526-100x.2009.00541.

Apfelbaum, S. I., B. J. Bader, F. Faessler, and D. Mahler. 1997. Obtaining and processing seeds. Pp. 99-126 *in* S. Packard and C. F. Mutel, editors. The Tallgrass Prairie Restoration Handbook. Island Press, Washington, D.C.

Aronson, J. and J. van Andel. 2006. Challenges for ecological theory. Pp. 223-233 *in* J. Aronson and J. van Andel, editors. Restoration Ecology: the New Frontier. Blackwell Publishing, Malden, MA.

Aschenbach, T. A., B. L. Foster, and D. W. Imm. 2009. The initial phase of a longleaf pine-wiregrass savannah restoration: species establishment and community responses. Restoration Ecology 10.1111/j.1526-100x.2009.00541.x.

Bailey, R. G. 1978. Descriptions of the ecoregions of the United States. USDA Forest Service misc. publication no. 139, Ogden, UT.

Balmford, A., A. Bruner, P. Cooper, R. Costanza, S. Farber, R. E. Green, M. Jenkins, P. Jefferiss, V. Jessamy, J. Madden, K. Munro, N. Myers, S. Naeem, J. Paavola, M. Rayment, S. Rosendo, J. Roughgarden, K. Trumper, and R. K. Turner. 2002. Economic reasons for conserving wild nature. Science **297**:950-953.

Barrett, S. C. H. and J. R. Kohn. 1991. Genetic and evolutionary consequences of small population size in plants: implications for conservation. Pp. 3-30 *in* D. A. Falk and K. E. Holsinger, editors. Genetics and Conservation of Rare Plants. Oxfords University Press, Oxford, UK.

Baskin, C. C. and J. M. Baskin. 1998. Seeds: Ecology, Biogeography, and Evolution of Dormancy and Germination. Academic Press, San Diego, CA.

Bissett, N. J. 1996. Upland restoration challenge: direct seeding of wiregrass and associated species. The Palmetto **Summer**:8-11.

Bissett, N. J. 2006. Restoration of dry prairie by direct seeding: methods and examples. Pp. 231-237 *in* Proceedings of the Florida Dry Prairie Conference. October 5-7, 2004. Sebring, FL.

Bissett, N. J. 2007. Direct seeding native groundcover and upland restoration. Society for Range Management and Tall Timbers Research Station, Tallahassee, FL.

Bledsoe, B. P. and T. H. Shear. 2000. Vegetation along hydrological and edaphic gradients in a North Carolina coastal plain creek bottom and implications for restoration. Wetlands **20**:126-147.

Booth, D. T. and T. A. Jones. 2001. Plants for ecological restoration: a foundation and a philosophy for the future. Native Plants Journal **2**:12-20.

Bradshaw, A. D. and M. J. Chadwick. 1980. The Restoration of Land, the Ecology and Reclamation of Derelict and Degraded Land. University of California Press, Berkeley, CA.

Breininger, D. R., B. W. Duncan, and N. J. Dominy. 2002. Relationships between fire frequency and vegetation type in pine flatwoods of east-central Florida, USA. Natural Areas Journal **22**:186-193.

Brewer, J. S. and W. J. Platt. 1994. Effects of fire season and herbivory on reproductive success in a clonal forb, *Pityopsis graminifolia*. Journal of Ecology **82**:665-675.

Brockway, D. G., K. W. Outcalt, D. J. Tomczak, and E. E. Johnson. 2005. Restoration of longleaf pine ecosystems. USDA Forest Service GTR-SRS-083. Southern Research Station, Asheville, NC.

Brockway, D. G., K. W. Outcalt, and R. N. Wilkins. 1998. Restoring longleaf wiregrass ecosystems: plant cover, diversity and biomass following low-rate hexazinone application on Florida sandhills. Forest Ecology and Management **102**:159-175.

Brooks, M. L., C. M. D'Antonio, D. M. Richardson, J. B. Grace, J. E. Keeley, J. M. DiTomaso, R. J. Hobbs, M. Pellant, and D. Pyke. 2004. Effects of invasive alien plants on fire regimes. Bioscience **54**:677-688.

Buchmann, S. L. and G. P. Nabhan. 1996. The Forgotten Pollinators. Island Press, Washington, D. C.

Cairns, J., Jr. 1995. Restoration ecology: protecting our national and global life support systems. Pp. 1-12 *in* J. Cairns, Jr., editor. Rehabilitating Damaged Ecosystems. 2nd Edition. CRC Press, Boca Raton, FL.

Caswell, H. 2006. Matrix Population Models. 2nd Edition. Sinauer Associates Inc., Sunderland, MA.

Center for Plant Conservation. 1991. Genetic sampling guidelines for conservation collections of endangered plants. Pp. 225-238 *in* D. A. Falk, C. I. Millar, and M. Olwell, editors. Genetics and Conservation of Rare Plants. Island Press, Washington, D.C.

Christensen, N. L. 1981. Fire regimes in southeastern ecosystems. Pp. 112-136 *in* H. A. Mooney, T. M. Bonnickson, J. E. Christensen, and W. A. Reiners, editors. Fire Regimes and Ecosystem Properties: Proceedings of the Conference. December 11-15, 1978. USDA Forest Service GTR WO-26, Washington, D.C.

Clewell, A. F. 1989. Natural history of wiregrass (*Aristida stricta* Michx., Gramineae). Natural Areas Journal **9**:223-233.

Clewell, A. F. 1999. Restoration of riverine forest at Hall Branch on phosphate-mined land, Florida. Restoration Ecology **7**:1-14.

Clewell, A. F. and J. Aronson. 2006. Motivations for the restoration of ecosystems. Conservation Biology **20**:420-428.

Clewell, A. F. and J. Aronson. 2007. Ecological Restoration: Principles, Values and Structure of an Emerging Discipline. Island Press, Washington D.C.

Clewell, A. J., J. A. Goolsby, and A. G. Shuey. 1982. Riverine forests of the south prong Alfia River system, Florida. Wetlands **2**:21-72.

Clewell, A. F., J. Reiger, and J. Munro. 2005. Guidelines for developing and managing ecological restoration projects. 2nd edition. Society for Ecological Restoration International, Tucson, AZ. <www.ser.org>.

Coffey, K. L. and L. L. Kirkman. 2006. Seed germination strategies of species with restoration potential in a fire-maintained pine savanna. Natural Areas Journal **26**:289-299.

Cohen, S., R. Braham, and F. Sanchez. 2004. Seed bank viability in disturbed longleaf pine sites. Restoration Ecology **12**:503-515.

Collins, E. A., C. D. Monk, and R. H. Spielman. 1964. White cedar stands in northern Florida. Quarterly Journal of the Florida Academy of Sciences **27**:107-110.

Cox, A. C., D. R. Gordon, J. L. Slapcinsky, and G. S. Seamon. 2004. Understory restoration in longleaf pine sandhills. Natural Areas Journal **24**:4-14.

Cramer, V. and R. J. Hobbs. 2007. Old Fields: Dynamics and Restoration of Abandoned Farmland. Island Press, Washington, D.C.

Cramer, V. A., R. J. Hobbs, and R. J. Standish. 2008. What's new about old fields? Land abandonment and ecosystem assembly. Trends in Ecology and Evolution **23**:104-112.

D'Antonio, C. and L. A. Meyerson. 2002. Exotic plant species as problems and solutions in ecological restoration: a synthesis. Restoration Ecology **10**:705-713.

Daly, H. E. and J. E. Cobb. 1994. For the Common Good: Redirecting the Economy Towards Community the Environment, and a Sustainable Future. 2nd Edition. Beacon, Boston, MA.

Dodson, S. I., T. F. H. Allen, S. R. Carpenter, A. R. Ives, R. L. Jeanne, J. F. Kitchell, N. E. Lanston, and M. G. Turner. 1998. Ecology. Oxford University Press, New York, NY.

Drewa, P. B., W. J. Platt, and E. B. Moser. 2002. Fire effects on resprouting of shrubs in headwaters of southeastern longleaf pine savannas. Ecology **83**:735-761.

Ecological Restoration Workshop 1996. Summary of discussion on donor sites of native plant propagules for restoration projects. Ecosystem Restoration Workshop Proceedings. April 25-26, 1996. Lakeland, FL. Florida Institute for Phosphate Research publication no. 03-000-143. Society for Ecological Restoration.

Egan, D. and E. A. Howell. 2001. The Historical Ecology Handbook: A Restorationist's Guide to Reference Ecosystems. Island Press, Washington, D.C.

Elzinga, C. L., D. W. Salzer, and J. W. Willoughby. 1998. Measuring and monitoring plant populations. BLM Technical Reference 1730-1. Bureau of Land Management, Denver, CO.

Florida Division of Forestry. 2007. State Forest Hydrological Restoration Activity Report. Florida DoF, Tallahassee, FL. <http://www.fl-dof.com/forest_management/hydrology_wetlands.html>.

FNAI (Florida Natural Areas Inventory). 1990. Guide to the Natural Communities of Florida. <http://fnai.org/PDF/Natural_Communities_Guide.pdf>.

Frankel, O. H. 1970. Genetic dangers in the green revolution. World Agriculture **19**:9-13.

Frankham, R., J. D. Ballou, and D. A. Briscoe. 2002. Introduction to Conservation Genetics. Cambridge University Press, Cambridge, UK.

Freeman, J. E. and S. Jose. 2009. The role of herbicide in savanna restoration: effects of shrub reduction treatments on the understory and overstory of a longleaf pine flatwoods. Forest Ecology and Management **257**:978-986.

Frost, C. 1998. Presettlement fire frequency regimes of the United States: a first approximation. Pp. 70-81 *in* T. L. Pruden and L. A. Brennan, editors. Fire in Ecosystem Management: Shifting the Paradigm from Suppression to Prescription. Proceedings of the 20th Tall Timbers Fire Ecology Conference. May 7-10, 1996. Tall Timbers Research Station, Tallahassee, FL.

Garren, K. H. 1943. Effects of fire on vegetation of the Southeastern United States. Botanical Review **9**:617-674.

Gilliam, F. S. and N. L. Christensen. 1986. Herb-layer response to burning in pine flatwoods of the lower Coastal Plain of South Carolina. Journal of the Torrey Botanical Society **113**:42-45.

Glitzenstein, J. S., W. J. Platt, and D. R. Streng. 1995. Effects of fire regime and habitat on tree dynamics in north Florida longleaf pine savannas. Ecological Monographs **65**:441-476.

Glitzenstein, J. S., D. R. Streng, and D. D. Wade. 2003. Fire frequency effects on longleaf pine (*Pinus palustris*, P. Miller) vegetation in South Carolina and northeast Florida, USA. Pp. 22-37. Natural Areas Association.

Glitzenstein, J. S., D. R. Streng, D. D. Wade, and J. Brubaker. 2001. Starting new populations of longleaf pine ground-layer plants in the outer Coastal Plain of South Carolina, USA. Natural Areas Journal **21**:89-110.

Gordon, D. 1994. Translocation of species into conservation areas: a key for natural resource managers. Natural Areas Journal **14**:31-37.

Gordon, D. R., A. C. Cox, G. S. Seamon, J. L. Slapcinsky, and D. A. Jones. 2001. Native sandhill species revegetation techniques. Final Report to the Florida Department of Transportation. Pp. 1-98. University of Florida, Gainesville, FL.

Gordon, D. R. and K. J. Rice. 1998. Patterns of differentiation in wiregrass (*Aristida beyrichiana*): Implications for restoration efforts. Restoration Ecology **6**:166-174.

Hardin, E. D. and D. L. White. 1989. Rare vascular plant taxa associated with wiregrass (*Aristida stricta*) in the Southeastern United States. Natural Areas Journal **9**:234-245.

Harker, D., G. Libby, K. Harker, S. Evans, and M. Evans. 1999. Principles for maintaining and restoring natural diversity. Pp. 41-62 Landscape Restoration Handbook. 2nd edition. Lewis Publishers, Boca Raton, FL.

Harper, R. M. 1962. Historical notes on the relation of fires to forests. Pp. 11-29 *in* Proceedings of the Tall Timbers Fire Ecology Conference. Tall Timbers Research Station, Tallahassee, FL.

Harrington, T. B. and M. B. Edwards. 1999. Understory vegetation, resource availability, and litterfall responses to pine thinning and woody vegetation control in longleaf pine plantations. Canadian Journal of Forest Research **29**:1055-1064.

Hatcher, P. E. and B. Melander. 2003. Combining physical, cultural and biological methods: prospects for integrating non-chemical weed management strategies. Weed Research **43**:303-322.

Hattenbach, M. J., D. R. Gordon, G. S. Seamon, and R. G. Studenmund. 1998. Development of direct-seeding techniques to restore native groundcover in a sandhill ecosystem. Pp. 64-70 *in* Proceedings of the Longleaf Pine Restoration Session. 1997 meeting of the Society for Ecological Restoration. Longleaf Alliance, Auburn, AL.

Hedman, C. W., S. L. Grace, and S. E. King. 2000. Vegetation composition and structure of southern coastal plain pine forests: an ecological comparison. Forest Ecology and Management **134**:233-247.

Helm, A. C., N. S. Nicholas, S. M. Zedaker, and S. T. Young. 1991. Maritime forests on Bull Island, Cape Romain, South Carolina. Journal of the Torrey Botanical Society **118**.

Herring, B. J. and W. S. Judd. 1995. A floristic study of Ichetucknee Springs State Park, Suwannee and Columbia Counties, Florida. Castanea **60**:318-369.

Hess, C. A. and A. Laniray. 2008. Landscape changes on the Apalachicola National Forest, a fire-dependent system. 93rd Ecological Society of America Meeting. August 3-8 2008. Milwaukee, WI.

Heuberger, K. A. and F. E. Putz. 2003. Fire in the suburbs: ecological impacts of prescribed fire in small remnants of longleaf pine (*Pinus palustris*) sandhill. Restoration Ecology **11**:72-81.

Hiers, J. K., J. J. O'Brian, R. E. Will, and R. J. Mitchell. 2007. Forest floor depth mediates understory vigor in xeric *Pinus palustris* ecosystems. Ecological Applications **17**:806-814.

Holl, K. D. and J. J. Cairns. 2002. Monitoring and appraisal. Pp. 411-432 *in* M. R. Perrow and A. J. Davy, editors. Handbook of Ecological Restoration, vol. I. Handbook of Ecological Restoration. Cambridge University Press, Cambridge, UK.

Houseal, G. and D. Smith. 2000. Source-identified seed: the Iowa roadside experience. Ecological Restoration **18**:173-183.

Huenneke, L. F. 1991. Ecological implications of genetic variation in plant populations. Pp. 31-44 *in* D. A. Falk and K. E. Holsinger, editors. Genetics and Conservation of Rare Plants. Oxford University Press, Oxford, UK.

Institute for Regional Conservation (IRC). 2009. The floristic inventory of south Florida database online. <http://regionalconservation.org/ircs/database/site/Habitats.asp>.

Jenkins, A. M., D. R. Gordon, and M. T. Renda. 2004. Native alternatives for non-native turfgrasses in central Florida: Germination and responses to cultural treatments. Restoration Ecology **12**:190-199.

Joint Fire Science Program. 2008. FireStem: a stem heating tree mortality model. <http://jfsp.nifc.gov/documents/FireStemUserGuide.pdf>.

Kesler, H. C., J. L. Trusty, S. M. Hermann, and C. Guyer. 2008. Demographic responses of *Pinguicula ionantha* to prescribed fire a regression design LTRE approach. Oecologia **156**:545-557.

Kindell, C. E., A. A. Winn, and T. E. Miller. 1996. The effects of surrounding vegetation and transplant age on the detection of local adaptation in the perennial grass *Aristida stricta*. Journal of Ecology **84**:745-754.

Kirkman, L. K., K. L. Coffey, R. J. Mitchell, and E. B. Moser. 2004. Ground cover recovery patterns and life-history traits: implications for restoration obstacles and opportunities in a species-rich savanna. Journal of Ecology **92**:409-421.

Kirkman, L. K. and R. J. Mitchell. 2002. A forest gap approach to restoring longleaf pine-wiregrass ecosystems (Georgia and Florida). Ecological Restoration **20**:50-51.

Kirkman, L. K., R. J. Mitchell, M. J. Kaeser, S. D. Pecot, and K. L. Coffey. 2007. The perpetual forest: using undesirable species to bridge restoration. Journal of Applied Ecology **44**:604-614.

Küchler A. W. 1975. Potential Natural Vegetation of the Conterminous United States. 2nd Edition. American Geographical Society special publication no. 36. New York, NY.

Kush, J. S. and R. S. Meldahl. 2000. Composition of a virgin stand of longleaf pine in south Alabama. Castanea **65**:56-63.

Kusler, J. A. and M. E. Kentula. 1990. Wetland Creation and Restoration: the Status of the Science. Island Press, Washington, D.C.

Lackey, R. T. 2004. Societal values and the proper role of restoration ecologists. Frontiers in Ecology and the Environment **2**:45-46.

Laderman, A. D. 1987. Atlantic White Cedar Wetlands. Westview Press, Boulder, CO.

Laderman, A. D. 1989. The ecology of Atlantic white cedar wetlands: a community profile. USFWS biological report no. 85. National Wetlands Research Center, Washington, DC.

Lambeth, C. C. and R. B. McCullough. 1997. Genetic diversity in managed loblolly pine forests in the southeastern United States: perspective of private industrial forest land owners. Canadian Journal of Forest Research **27**:409-414.

Landers, J. L., D. H. Van Lear, and W. D. Boyer. 1995. The longleaf pine forest of the Southeast: requiem or renaissance? Journal of Forestry **93**:39-44.

Langeland, K. A. and K. C. Burks. 1998. Identification and Biology of Non-native Plants in Florida's Natural Areas. University of Florida Press, Gainesville, FL.

Leopold, A. 1949. A Sand County Almanac. Oxford University Press, Oxford, UK.

Lippencott, C. L. 2000. Effects of *Imperata cylindrica* (cogongrass) invasion on fire regime in Florida sandhill (USA). Natural Areas Journal **20**:140-149.

Litt, A. R., B. J. Herring, and L. Provencher. 2001. Herbicide effects on ground-layer vegetation in southern pinelands, USA: a review. Natural Areas Journal **21**:177-188.

Liu, H. and R. W. Pemberton. 2008. Differential soil seed bank longevity of *Paederia foetida* L., an invasive woody vine across three habitats in Florida. Journal of the Torrey Botanical Society **135**:491-496.

Long, A. J. 2001. Environmentally sound forest harvesting. University of Florida, Institute of Food and Agricultural Sciences. Florida Cooperative Extension Service SS-FOR-6.

Louisiana Natural Heritage Program. 2004. Natural Communities of Louisiana. Louisiana Department of Wildlife and Fisheries. <http://www.wlf.louisiana.gov/pdfs/experience/naturalheritage/naturalcommuniities/LA NAT COM 0504.pdf>.

Mack, A. L. 1992. Vegetation analysis of a hardwood hammock in Dade County, Florida: changes since 1940. Florida Scientist **55**:258-263.

Marks, M., B. Lapin, and J. Randall. 1993. Element stewardship abstract for *Phragmites australis*, Common reed. The Nature Conservancy. <http://tncweeds.ucdavis.edu/esadocs/phraaust.html>.

Maschinski, J. and J. Duquesnel. 2006. Successful reintroductions of the endangered long-lived Sargent's cherry palm, *Pseudopheonix sargentii*, in the Florida Keys. Biological Conservation **134**:122-129.

Masters, L. A. 1997. Monitoring vegetation. Pp. 279-301 *in* S. Packard and C. F. Mutel, editors. The Tallgrass Restoration Handbook for Prairies, Savannas, and Woodlands. Island Press, Washington, D.C.

Matson, C. (*in prep.*). Longleaf pine flatwoods ecological restoration: A practitioner's guide for Florida.

McCutchan, B. G., G. R. Askew, T. D. Blush, and F. C. Wise. 1997. Genetic diversity in commercial forest tree plantations. Canadian Journal of Forest Research **27**:393-446.

McKay, J. K., C. E. Christian, S. Harrison, and K. J. Rice. 2005. "How local is local?" - A review of practical and conceptual issues in the genetics of restoration. Restoration Ecology **13**:432-440.

McNabb, K. 1996. Forestry herbicide facts. Alabama Cooperative Extension System, ANR 629. Auburn University, Auburn, AL.

Means, D. B. 1997. Wiregrass restoration: probable shading effects in a slash pine plantation. Restoration and Management Notes **15**:52-55.

Menges, E. S., W. G. Abrahamson, K. T. Givens, N. P. Gallo, and J. N. Layne. 1993. Twenty years of vegetation change in five long-unburned Florida plant communities. Journal of Vegetation Science **4**:375-386.

Middleton, B. A. 1999. Wetland Restoration, Flood Pulsing and Disturbance Dynamics. John Wiley and Sons, New York, NY.

Miller, J. H. 2003. Non-native invasive plants of southern forests: a field guide for identification and control. USDA Forest Service GTR SRS-62. Southern Research Station, Asheville, NC.

Mulligan, M. K. and L. K. Kirkman. 2002a. Burning influences on wiregrass (*Aristida beyrichiana*) restoration plantings: natural seedling recruitment and survival. Restoration Ecology **10**:334-339.

Mulligan, M. K. and L. K. Kirkman. 2002b. Competition effects on wiregrass (*Aristida beyrichiana*) growth and survival. Plant Ecology **167**:39-50.

Mulligan, M. K., L. K. Kirkman, and R. J. Mitchell. 2002. *Aristida beyrichiana* (wiregrass) establishment and recruitment: implications for restoration. Restoration Ecology **10**:68-76.

Murphy, S. D., J. Flanagan, K. Noll, D. Wilson, and B. Duncan. 2007. How incomplete exotic species management can make matters worse: experiments in forest restoration in Ontario, Canada. Ecological Restoration **25**:85-93.

Myers, R. L. and D. L. White. 1987. Landscape history and changes in sandhill vegetation in north-central and south-central Florida. Journal of the Torrey Botanical Society **114**:21-32.

Myers, R. L., J. J. Ewel. 1990. Ecosystems of Florida. University of Central Florida Press, Orlando, FL.

Nagid, S. M. 2006. Ground Cover Restoration Annual Report 2005-2006. Florida Fish and Wildlife Conservation Commission., Tallahassee, FL. <http://myfwc.com/docs/Conservation/Ground_Cover_Restoration_Annual_Report_2005_06.pdf>.

Norcini, J. G. and J. H. Aldrich. 2004. Establishment of native wildflower plantings by seed. University of Florida, Institute of Food and Agricultural Sciences. Florida Cooperative Extension Service ENH 968.

Norcini, J. G., J. H. Aldrich, L. A. Halsey, and J. G. Lilly. 1998. Seed source affects performance of six wildflower species. Proceedings of the Florida State Horticulture Society **111**:4-9.

Odum, W. E. and C. C. McIvor. 1990. Mangroves. Pp. 517-548 *in* R. L. Myers and J. J. Ewel, editors. Ecosystems of Florida. University of Central Florida Press, Orlando, FL.

Outcalt, K. W. 1994. Seed production of wiregrass in central Florida following growing-season prescribed burns. International Journal of Wildland Fire **4**:123-125.

Outcalt, K. W. 2006. Prescribed burning or understory restoration. Pp. 327-329 *in* S. Jose, E. J. Jokela, and D. L. Miller, editors. The Longleaf Pine Ecosystem: Ecology, Silviculture and Restoration. Springer, New York, NY.

Outcalt, K. W. and C. E. Lewis. 1990. Response of wiregrass (*Aristida stricta*) to mechanical site preparation. Pp. 1-12 *in* L. C. Duever, and R. F. Noss, editors. Proceedings of the Symposium of Wiregrass Biology and Management: Maintaining Groundcover Integrity in Longleaf Pine Ecosystems. KBN Engineering and Applied Sciences, Gainesville, FL.

Outcalt, K. W. and D. D. Wade. 2004. Fuels management reduces tree mortality from wildfires in southeastern United States. Southern Journal of Applied Forestry **28**:28-34.

Outcalt, K. W., M. E. Williams, and O. Onokpise. 1999. Restoring *Aristida stricta* to *Pinus palustris* ecosystems on the Atlantic Coastal Plain, USA. Restoration Ecology **7**:262-270.

Pavlik, B. M. 1996. Defining and measuring success. Pp. 127-155 *in* D. A. Falk, C. I. Millar, and M. Olwell, editors. Restoring Diversity: Strategies for Reintroduction of Endangered Plants. Island Press, Washington, D.C.

Pfaff, S. and M. A. Gonter. 2000. Seeding two native grass species on reclaimed phosphate mined lands. *In* W. L. Daniels, and S. G. Richardson, editors. Proceedings of the 2000 Annual Meeting of the American Society for Surface Mining and Reclamation. June 11-15, 2000. Tampa, FL. American Society of Surface Mining and Reclamation, Lexington, KY.

Pfaff, S., M. A. Gonter, and C. Maura. 2002. Florida Native Seed Production Manual. USDA Natural Resources Conservation Service, Brooksville, FL.

Platt, W. J., G. W. Evans, and M. M. Davis. 1988. Effects of fire season on flowering forbs and shrubs in longleaf pine forests. Oecologia **76**:353-363.

Platt, W. J. and M. W. Schwartz. 1990. Temperate hardwood forests. Pp. 194-229 *in* R. L. Myers and J. J. Ewel, editors. Ecosystems of Florida. University of Central Florida Press, Orlando, FL.

Prach, K. and P. Pysek. 2001. Using spontaneous succession for restoration of human-disturbed habitats: experience from Central Europe. Ecological Engineering **17**:55-62.

Provencher, L., A. R. Litt, D. R. Gordon, H. L. Rodgers, B. J. Herring, K. E. M. Galley, J. P. McAdoo, N. M. Gobris, and J. L. Hardesty. 2001. Restoration fire and hurricanes in longleaf pine sandhills. Ecological Restoration **19**:92-98.

Quarterman, E. 1981. A fresh look at climax forests of the Coastal Plain. ASB Bulletin **28**:143-148.

Quarterman, E., B. H. Turner, and T. E. Hemmerly. 1972. Analysis of virgin mixed mesophytic forests in Savage Gulf, Tennessee. Journal of the Torrey Botanical Society **99**:228-232.

Radosevich, S., J. Holt, and C. Ghersa. 1997. Weed Ecology: Implications for Management. 2nd edition. John Wiley and Sons, New York, NY.

Rayamajhi, M. B., M. F. Purcell, T. K. Van, T. D. Center, P. D. Pratt, and G. R. Buckingham. 2002. Australian Paperbark Tree (Melaleuca). *In* R. Van Driesche, B. Blossey, M. Hoddle, S. Lyon, and R. Reardon, editors. Biological Control of Invasive Plants in the Eastern United States. USDA Forest Service publication FHTET-2002-04. Washington, D.C.

Reburtus, A. J., G. B. Williamson, and E. B. Moser. 1989. Longleaf pine pyrogenicity and turkey oak mortality in Florida xeric sandhills. Ecology **70**:60-70.

Rice, P. M. 2005. Fire as a tool for controlling nonnative invasive plants. Montana State University Center for Invasive Plant Management, Bozeman, MT. <http://www.weedcenter.org/management/burning_weeds.pdf>.

Ries, P., M. E. Dix, M. Ielmini, and D. Thomas. 2004. National strategy and implementation plan for invasive species management. USDA Forest Service publication FS-805. Washington, D.C.

Robbins, L. E. and R. L. Myers. 1992. Seasonal Effects of Prescribed Burning in Florida. Misc. publication no. 8. Tall Timbers Research Station, Tallahassee, FL.

Rodgers, H. L. and L. Provencher. 1999. Analysis of longleaf pine sandhill vegetation in northwest Florida. Castanea **64**:138-162.

Roncoby, R. 2004. Xeric reclamation techniques and prescribed fire: Florida phosphate mines. Proceedings of the 16th Annual International Society for Ecological Restoration Conference. August 24-26 2004. Victoria, Canada.

Roth, L. (*In prep*.). Restoration of ground layer vegetation in dry-site longleaf pine communities: a working guide to practical methods.

Ruth, A. D., S. Jose, and D. L. Miller. 2008. Seed bank dynamics of sand pine scrub and longleaf pine flatwoods of the Gulf Coastal Plain. Ecological Restoration **26**:19-21.

Salter, R. and S. C. Dial. 1984. Hammock vegetation of Little Talbot Island State Park, Florida. Journal of the Torrey Botanical Society **111**:494-497.

Schafale, M. P. and A. S. Weakley. 1990. Classification of the natural communities of North Carolina: third approximation. North Carolina Natural Heritage Program, Natural Resources Division of Parks and Recreation, Raleigh, NC.

Schultz, R. P. 1976. Environmental changes after site preparation and slash pine planting on a flatwoods site. USDA Forest Service research paper SE-156. Southeastern Forest Experiment Station, Asheville, NC.

Seamon, G. 1998. A longleaf pine sandhill restoration in northwest Florida. Restoration and Management Notes **16**:46-50.

Seamon, P. A., R. L. Myers, L. E. Robbins, and G. S. Seamon. 1989. Wiregrass reproduction and community restoration. Natural Areas Journal **9**:264-265.

Sharitz, R. R. and W. J. Mitsch. 1993. Southern floodplain forests. Pp. 311-372 *in* W. H. Martin, S. G. Boyce, and A. Echternacht, editors. Biodiversity of the Southeastern United States: Lowland Terrestrial Communities. John Wiley and Sons, New York, NY.

Skoloff, B. 2006. Florida, Big Sugar in Everglades Negotiation. USA Today (6/23/2008). <http://www.usatoday.com/money/economy/2008-23-3394574388_x.htm>.

Slocum, M. G., W. J. Platt, and H. C. Cooley. 2003. Effects of differences in prescribed fire regimes on patchiness and intensity of fires in subtropical savannas of Everglades National Park, Florida. Restoration Ecology **11**:91-102.

Snyder, J. R., A. Herndon, and W. B. Robertson. 1990. South Florida rockland. Pp. 230-277 *in* R. L. Myers and J. J. Ewel, editors. Ecosystems of Florida. University of Central Florida Press, Orlando, FL.

SER (Society for Ecological Restoration). 2004. The SER Primer on Ecological Restoration. SER Science and Policy Working Group, Tucson, Arizona. <http://www.ser.org/.>

Stambaugh, M., R. Guyette, and C. and Putnam. 2005. Fire in the pines. Park Science **23**:43-47.

Swearingen, J. M. 2000. Japanese stilt grass (*Microstegium vimineum*) fact sheet. Virginia Natural Heritage Program. <http://www.nps.gov/plants/alien/fact/mivi1.htm>.

Tamang, B., D. L. Rockwood, M. Langholtz, M. Maehr, B. Becker, and S. Segrest. 2008. Fast-growing trees for cogongrass (*Imperata cylindrica*) suppression and enhanced colonization of understory plant species on a phosphate-mine clay settling area. Ecological Engineering **32**:329-336.

Teasdale, J. R. and C. L. Mohler. 2000. The quantitative relationship between weed emergence and the properties of mulches. Weed Science **48**:385-392.

TNC (The Nature Conservancy). 1998. Restoration Procedures Manual for Public Lands in Florida. Florida Department of Environmental Protection, Tallahassee, FL. <http://www.dep.state.fl.us/water/wetlands/docs/mitigation/mitman.pdf>.

TNC (The Nature Conservancy). 2008. EEL Fire Management Manual. <http://www.eelbrevard.com/pubs/eel_firemanual.pdf>.

Thieret, J. W. 1970. Quadrat study of a bottomland forest in St. Martin Parish, Louisiana. Castanea **36**:174-181.

Thomas, S. C., C. B. Halpern, D. A. Falk, D. A. Liguori, and K. A. Austin. 1999. Plant diversity in managed forests: understory responses to thinning and fertilization. Ecological Application **9**:864-879.

Tockner, K. and J. A. Stanford. 2002. Riverine flood plains: present state and future trends. Environmental Conservation **29**:308-330.

Toth, L. A. 2009. Hydrologic restoration of wetlands on the Kissimmee River floodplain: complimentarity of an herbicide treatment of the exotic vine *Lygodium microphyllum*. Florida Scientist.

Tu, M., C. Hurd, and J. M. Randall. 2001. Invasive Species Team's Control Methods Handbook: Tools and Techniques for Use in Natural Areas. The Nature Conservancy. <http://tncweeds.ucdavis.edu/handbook.htm>.

USDA Natural Resources Conservation Service. 2008. Range planting: Conservation practice standard 550 guidance. Field office technical guide, section 4. < http://www.plant-materials.nrcs.usda.gov/pubs/flpmsfo8066.pdf>.

Van Kley, J. E. 1999. The vegetation of the High Terrace Rolling Uplands, Louisiana. Castanea **64**:318-336.

Varner, J. M., D. R. Gordon, F. E. Putz, and J. K. Hiers. 2005. Restoring fire to long-unburned *Pinus palustris* ecosystems: novel fire effects and consequences for long-unburned ecosystems. Restoration Ecology **13**:536-544.

Vitousek, P. M., C. M. D'Antonio, L. L. Loope, M. Rejmanek, and R. Westbrooks. 1997. Introduced species: a significant component of human-caused global change. New Zealand Journal of Ecology **21**:1-16.

Walker, J. and R. K. Peet. 1983. Composition and species diversity of pine-wiregrass savannas of the Green Swamp, North Carolina. Vegetatio **55**:163-179.

Walker, J. L. and A. M. Silletti. 2006. Restoring the ground layer of longleaf pine ecosystems. Pp. 297-325 *in* S. Jose, E. J. Jokela, and D. L. Miller, editors. The Longleaf Pine Ecosystem: Ecology, Silviculture, and Restoration. Springer, New York, NY.

Wendelberger, K. S., M. Q. N. Fellows, and J. Maschinski. 2008. Rescue and restoration: experimental translocation of *Amorpha herbacea* Walter var. *crenulata* (Rybd.) Isley into a novel urban habitat. Restoration Ecology **16**:542-552.

Wheeden, C. R., A. M. Shelton, and M. P. Hoffman. 2008. Biological control: a guide to natural enemies in North America. <http://www.nysaes.cornell.edu/ent/biocontrol/>.

Wheeler, B. D., S. C. Shaw, W. J. Fojt, and R. A. Robertson. 1995. Restoration of Temperate Wetlands. John Wiley and Sons, New York, NY.

Whelan, K. R. T. 2005. The Successional Dynamics of Lightning-initiated Canopy Gaps in the Mangrove Forests of Shark River, Everglades National Park, USA. Dissertation, Florida International University, Miami, FL.

White, P. S. and J. L. Walker. 1997. Approximating nature's variation: selecting and using reference information in restoration ecology. Restoration Ecology **5**:338-349.

Wright, H. A. and A. W. Bailey. 1982. Fire ecology: United States and Southern Canada. John Wiley and Sons, New York, NY.

Zedler, P. H. and G. A. Scheid. 1988. Invasion of *Carpobrotus edulis* and *Salix lasiolepis* after fire in a coastal chaparral site in Santa Barbary County, California. Madrono **35**:196-201.

PART II

Resources to Help Get the Job Done

Chapter 6

Location of Groundcover Restoration Projects

Interest in forest groundcover restoration has grown rapidly growing during the past 2 decades. Due to the newness of this interest, many of the land managers who have conducted groundcover restoration projects have not yet documented their efforts in the formal or informal literature. For this reason, much of the valuable information these practitioners have accumulated has not been captured in Part 1 of this manual, and will not be easy for others to access.

In an effort to increase the ability of restoration practitioners to learn from one another's successes and mistakes, we have assembled information on current groundcover restoration projects. Figure 1 shows a map of forest groundcover restoration sites across the Southeast. Because our primary interest was restoration in Florida, Figure 2 shows more detailed information on the location of sites in this state. Information on each of the restoration sites that appears in Figures 1 and 2 is presented in Table 6. The names of restoration sites are listed according to state and county. Details on the ownership and size of each site are listed as well.

FIGURE 1. Map of current forest groundcover restoration sites across the Southeastern U.S.

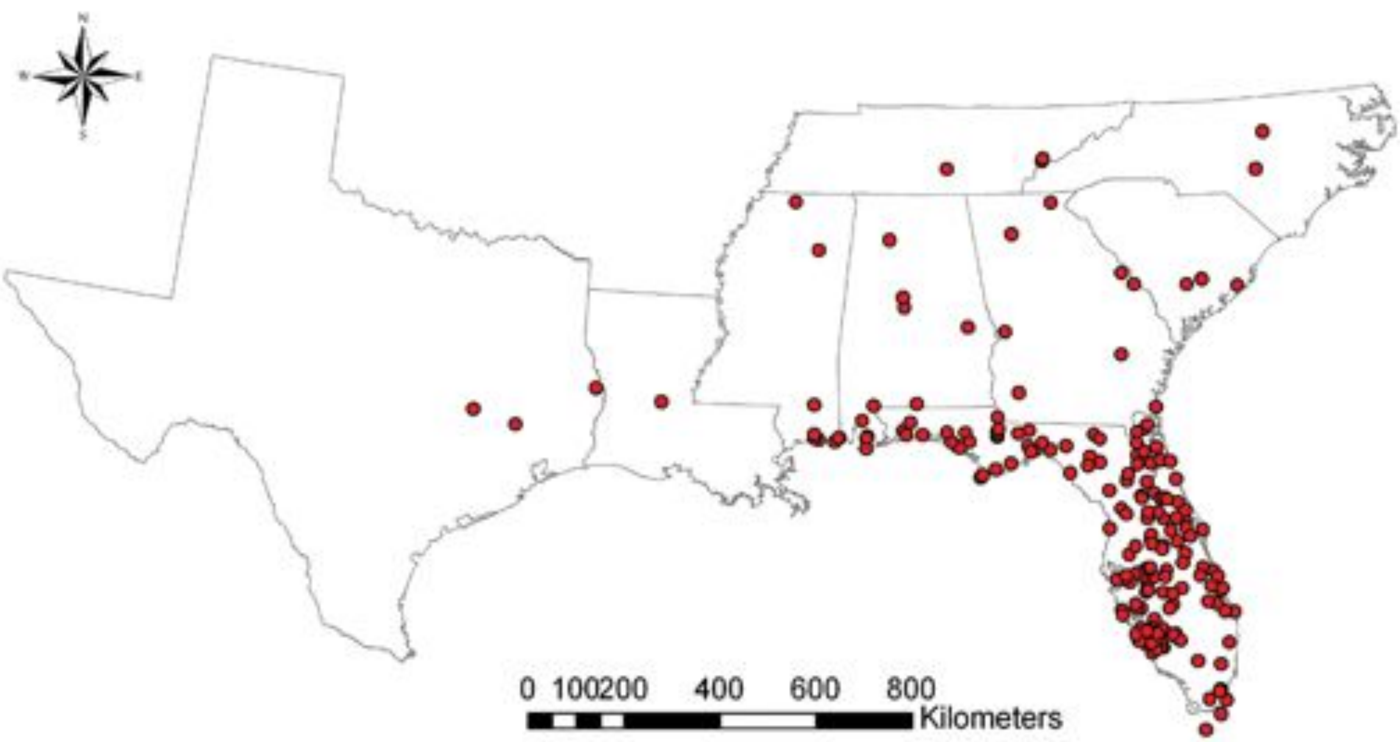


FIGURE 2. Map of current forest groundcover restoration sites in Florida.

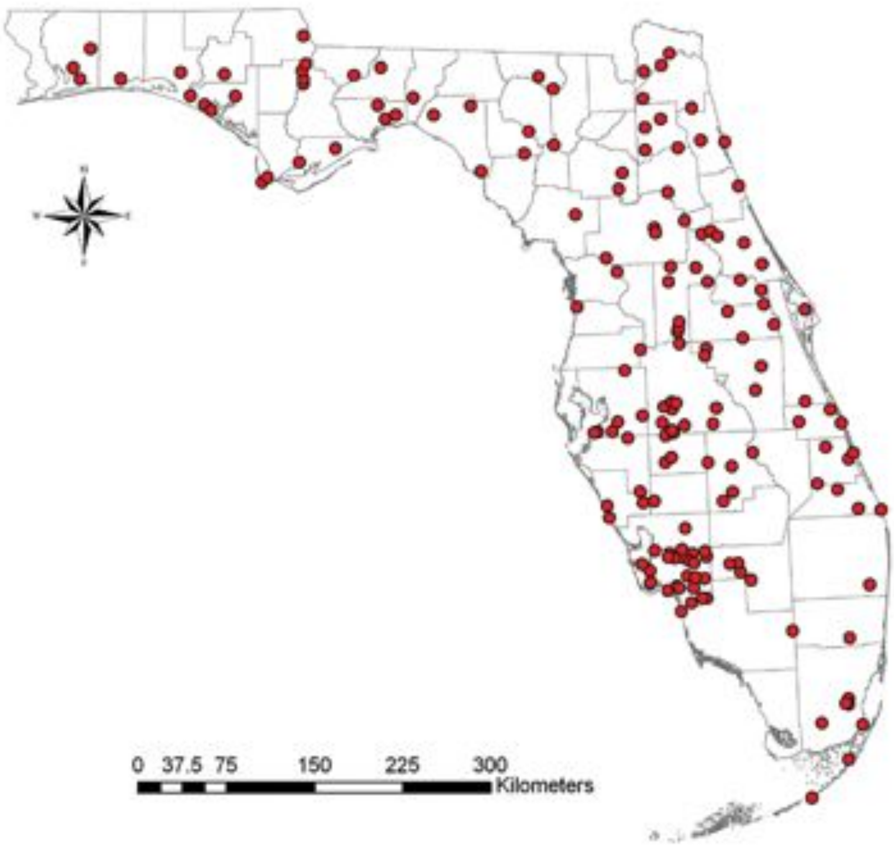


TABLE 6. Groundcover restoration sites of the Southeastern U.S. listed according to state and county.

STATE	COUNTY	SITE NAME	OWNERSHIP	SIZE (ACRES)
AL	Baldwin	Blakeley State Park	public	2,100
AL	Baldwin	Bon Secour Dune Restoration	public	0
AL	Baldwin	Juniper Fish River	public	13.5
AL	Baldwin	Splinter Hill Bog	private	20
AL	Baldwin	Weeks Bay National Estuarine Research Reserve	public	63
AL	Baldwin	Weeks Bay Pitcher Plant Bog	public	50
AL	Bibb	Bibb County Glades Preserve	private	80
AL	Bibb	Talladega National Forest	public	.
AL	Escambia	Conecuh National Forest	public	.
AL	Macon	Tuskegee National Forest	public	.
AL	Winston	Bankhead National Forest	public	.
FL	Alachua	Longleaf Flatwoods Reserve	public	.
FL	Alachua	Newnan's Lake Conservation Area	public	6,504
FL	Bay	Devil's Swamp Mitigation Bank	private	5031
FL	Bay	Econfina Creek	public	.
FL	Bay	St. Joe Tract of Apalachicola National Forest	public	320
FL	Brevard	Mary A Ranch Mitigation Bank	private	2,069
FL	Brevard	Merritt Island National Wildlife Refuge	public	.
FL	Broward	Florida Wetlandsbank/Pembroke Pines Mitigation Bank	public	420

STATE	COUNTY	SITE NAME	OWNERSHIP	SIZE (ACRES)
FL	Charlotte	Babcock Ranch Preserve	public	5,620
FL	Citrus	Withlacoochee State Forest	public	.
FL	Clay	Black Creek Ravines Conservation Area	public	.
FL	Clay	Camp Blanding Joint Training Center	military	42,000
FL	Clay	Devils Wash Basin	public	.
FL	Clay	Sundew Mitigation Bank	private	2,107
FL	Collier	Big Cypress National Preserve	private	1,280
FL	Collier	Corkscrew Swamp Sanctuary	private	635
FL	Collier	Delnor–Wiggins Pass State Park	public	13.7
FL	Collier	Panther Island Mitigation Bank	private	2,788
FL	DeSoto	Boran Ranch Mitigation Bank	private	407
FL	Duval	Julington Durban Preserve	public	2,006
FL	Duval	Loblolly Mitigation Bank	private	6,247
FL	Duval	Northeast Florida Mitigation Banks	private	779
FL	Duval	Thomas Creek Conservation Area	public	.
FL	Flagler	Graham Swamp Mitigation Bank	private	66
FL	Franklin	Doyle Creek	public	25
FL	Gadsden	Joe Budd Wildlife Management Area	public	55
FL	Gilchrist	Fort White Wildlife & Environmental Area	public	6
FL	Gulf	Apalachicola Wildlife & Environmental Area	public	54
FL	Gulf	St. Joseph's Bay Buffer Preserve	public	.
FL	Hamilton	PCS Phosphate Mine Site	private	.
FL	Hamilton	Stephen Foster Folk Culture Center State Park	public	.
FL	Hardee	Hardee Lakes	private	8
FL	Hardee	Ona Phosphate Mine Site	private	>2.47
FL	Hardee	Peace River	private	487
FL	Hendry	Dinner Island Ranch Wildlife Management Area	public	139
FL	Hendry	Okaloacoochee Slough Restoration Site	public	.
FL	Hendry	Okaloacoochee Slough WMA	public	135
FL	Hendry	Spirit of the Wild Wildlife Management Area	public	100
FL	Hernando	Bald Mountain Phosphate Mine Site	private	200
FL	Highlands	Archbold Biological Station	private	.
FL	Highlands	Disney Wilderness Preserve	private	.
FL	Highlands	Highlands Hammock State Park	public	80
FL	Highlands	Lake Wales Ridge Wildlife & Environmental Area	public	.
FL	Hillsborough	Cockroach Bay	public	21
FL	Hillsborough	Balm Phosphate Mine Site	private	32
FL	Hillsborough	Hillsborough River State Park	public	40
FL	Hillsborough	Little Manatee River State Park	public	189
FL	Hillsborough	Margaret Gilbert	private	100
FL	Hillsborough	Tampa Bay	private	161
FL	Indian River	Blue Cypress Conservation Area	public	.
FL	Indian River	CGW Mitigation Bank	private	150
FL	Indian River	Sebastian Storm Water Park	public	175

STATE	COUNTY	SITE NAME	OWNERSHIP	SIZE (ACRES)
FL	Jackson	Apalachee Wildlife Management Area	public	16
FL	Jefferson	Aucilla Wildlife Management Area	public	42
FL	Lafayette	Mallory Swamp (Kissimmee)	public	.
FL	Lake	Crooked River Preserve	public	.
FL	Lake	Emeralda Marsh Conservation Area	public	.
FL	Lake	Lake Harris	public	.
FL	Lake	Lake Louisa and Green Swamp Mitigation Bank	private	1,007
FL	Lake	Lake Louisa State Park	public	1,237
FL	Lake	Lake Norris Conservation Area	public	.
FL	Lake	Wekiva River Mitigation Bank	private	1,643
FL	Lee	Alva Scrub Preserve	public	170.6
FL	Lee	Caloosahatchee Creeks Preserve	public	1,290.2
FL	Lee	Columbus G. MacLeod Preserve (CGMP)	public	8.7
FL	Lee	Daniels Preserve at Spanish Creek	public	243.2
FL	Lee	Estero Marsh Preserve	public	243.4
FL	Lee	Flag Pond Preserve (FPP)	public	66.9
FL	Lee	Galt Preserve	public	266
FL	Lee	Gator Hole Preserve (GHP)	public	175
FL	Lee	Hickory Swamp Preserve	public	66.6
FL	Lee	Imperial Marsh Preserve Mitigation Bank	public	926.2
FL	Lee	Little Pine Island County Reserve	public	1,565
FL	Lee	Matanzas Pass Preserve	public	59.1
FL	Lee	Mullock Creek Preserve	public	4.3
FL	Lee	Orange River Preserve (ORP)	public	58.5
FL	Lee	Pine Island Flatwoods Reserve	public	729.4
FL	Lee	Pine Lake Preserve	public	130.7
FL	Lee	Pineland Site Complex	public	8.6
FL	Lee	Pop Ash Creek Preserve	public	307.5
FL	Lee	Powell Creek Preserve	public	77.2
FL	Lee	Prairie Pines Preserve	public	2,709
FL	Lee	West Marsh Preserve	public	205.9
FL	Lee	Wild Turkey Strand Preserve	public	3,137
FL	Lee	Yellow Fever Creek Preserve	public	339.4
FL	Lee	Yucca Pens Preserve	public	231
FL	Leon	Phipps Park Mitigation Bank	private	.
FL	Levy	Watermelon Pond Unit at Goethe State Forest	public	.
FL	Liberty	Apalachicola Bluffs and Ravines Preserve/TNC	private	.
FL	Liberty	Sweetwater Mitigation Site	private	850
FL	Liberty	Torreya State Park	public	4,400
FL	Manatee	Moody Branch Wildlife & Environmental Area	public	159
FL	Manatee	Myakka Dry Prairie State Park	public	.
FL	Marion	Church Lake in Ocala National Forest	public	.
FL	Marion	Lacota area in Ocala National Forest	public	.
FL	Marion	Marion Mitigation project	public	458

STATE	COUNTY	SITE NAME	OWNERSHIP	SIZE (ACRES)
FL	Marion	Scrub Jay area in Ocala National Forest	public	1,000
FL	Martin	Allapattah Flats Wildlife Management Area	public	.
FL	Martin	Blowing Rocks Preserve	private	.
FL	Martin	R. G. Reserve Mitigation Bank	private	638
FL	Miami-Dade	Camp Owaissa Bauer	public	.
FL	Miami-Dade	Castellow Hammock Park	public	.
FL	Miami-Dade	Everglades Mitigation Bank	private	13,146
FL	Miami-Dade	Hattie Bauer Hammock	public	.
FL	Miami-Dade	Hole-in-the-Donut	public	6,250
FL	Monroe	Everglades National Park	public	.
FL	Monroe	Long Key State Park	public	10
FL	Nassau	Longleaf Mitigation Bank	private	3,021
FL	Okaloosa	Eglin Air Force Base	military	.
FL	Okeechobee	Starvation Slough Management Unit	public	160
FL	Okeechobee	River Runt Management Unit	public	10
FL	Orange	East Central Mitigation Bank	private	952
FL	Orange	Lake Baldwin and Lake Susannah City Parks	public	.
FL	Orange	Split Oak Mitigation Bank	public	1,049
FL	Orange	Tosohatchee Mitigation Bank	public	1,312
FL	Osceola	Florida Mitigation Bank	private	1,582
FL	Osceola	Reedy Creek Mitigation Bank	private	186
FL	Osceola	Three Lakes Wildlife Management Area	public	151
FL	Osceola	Triple N Ranch Wildlife Management Area	public	88
FL	Palm Beach	Loxahatchee Mitigation Bank	private	1,264
FL	Pasco	Green Swamp Wilderness Preserve	public	200
FL	Polk	Bartow Phosphate Mine Site	private	.
FL	Polk	Best of the West Phosphate Mine Site	private	156
FL	Polk	Clear Springs Phosphate Mine Site	private	1,168
FL	Polk	Estech Topsoil Mine Site	private	2
FL	Polk	Gopher Hills Phosphate Mine Site	private	300
FL	Polk	Hilochee Wildlife Management Area	public	158
FL	Polk	Lake Wales Forest Mitigation Site	private	.
FL	Polk	Noralyn Phosphate Mine South	private	127
FL	Polk	Phosphate Mine Site 16 Acre Site	private	16
FL	Polk	Tiger Creek Preserve	private	.
FL	Polk	Wildlife Corridor Phosphate Mine Site	private	58
FL	Putnam	Caravelle Ranch Wildlife Management Area	public	39
FL	Saint Johns	Anastasia State Park	public	.
FL	Saint Johns	Tupelo Mitigation Bank	private	1,525
FL	Saint Lucie	Bear Point Mitigation Bank	public	317
FL	Saint Lucie	Bluefield Ranch Mitigation Bank	private	2,695
FL	Saint Lucie	Platt's Creek Mitigation Bank	private	82
FL	Saint Lucie	Treasure Coast Mitigation Bank	private	2,545
FL	Santa Rosa	Blackwater River State Park	public	0.25

STATE	COUNTY	SITE NAME	OWNERSHIP	SIZE (ACRES)
FL	Santa Rosa	Garcon Peninsula Mitigation Bank	private	337
FL	Santa Rosa	Yellow River Mitigation Bank	public	.
FL	Sarasota	Curry Hammocks State Park	public	.
FL	Sarasota	Lemon Bay Preserve	public	90
FL	Sarasota	Myakka River State Park	private	380
FL	Sumter	Half Moon Wildlife Management Area	public	49
FL	Suwannee	Little River Tract	public	2,202
FL	Taylor	Cabbage Creek Tract	public	2,387
FL	Taylor	San Pedro Bay Mitigation Bank	private	6,748
FL	Taylor	Tide swamp unit of Big Bend Wildlife Management Area	public	205
FL	Volusia	Barberville Conservation Area Mitigation Bank	public	366
FL	Volusia	Colbert-Cameron Mitigation Bank	private	2,604
FL	Volusia	De Leon Springs State Park	public	200
FL	Volusia	Farmton Mitigation Bank	private	23,922
FL	Volusia	Lake George Conservation Area	public	19,648
FL	Volusia	Lake Monroe Mitigation Bank	public	603
FL	Volusia	Port Orange Mitigation Bank	private	5,719
FL	Wakulla	Phosphate Mine Site, site B	private	.
FL	Wakulla	St. Marks National Wildlife Refuge	public	.
FL	Wakulla	Wakulla Springs State Park	public	155
FL	Walton	Choctawhatchee River/Holmes Creek	public	.
FL	Washington	Sand Hill Lakes Mitigation Bank	private	160
GA	Appling	Ward Creek Tract	public	140
GA	Baker	Jones Ecological Research Center/Ichuaway	private	.
GA	Burke	Savannah River Ecological Site	public	.
GA	Camden	Cabin Bluff Hunting Reserve	private	58,000
GA	Chattahoochee	Ft. Benning Military Installation	military	.
GA	Cherokee	Allatoona Wildlife Management Area	public	60
GA	Habersham	Chattahoochee-Oconee National Forest	public	.
GA	Richmond	Fort Gordon Military Installation	military	46,000
LA	Rapides Parish	Kisatchie National Forest	public	2.83
MS	Chickasaw	Tombigbee National Forest	public	.
MS	Harrison	Deer Island Restoration Project	public	.
MS	Harrison	Oyster Bayou/Beauvoir-Jefferson Davis Home Site	public	3.95
MS	Harrison	Tchoutacabouffa River Preserve	public	22.2
MS	Jackson	Greenwood Island Mitigation Site	private	54.11
MS	Jackson	Grand Bay National Estuarine Research Reserve/National Wildlife Refuge	public	213
MS	Marshall	Strawberry Plains Preserve	private	.
MS	Perry	De Soto National Forest	public	3,000
NC	Cumberland	Long Valley Farm Lake	public	280
NC	Wake	William B. Umstead State Park	public	.
SC	Charleston	Francis Marion National Forest	public	.
SC	Dorchester	Beidler Forest Sanctuary	private	9

STATE	COUNTY	SITE NAME	OWNERSHIP	SIZE (ACRES)
SC	Dorchester	McAlhany Nature Preserve	private	37
TN	Blount	Cades Cove	public	.
TN	Coffee	May Prairie State Natural Area	public	.
TX	Brazos	Turkey Creek Greenway	private	22.24
TX	Montgomery	Gum Branch	public	.
TX	Sabine	Fox Hunters Hill	public	.

In an effort to increase the ability of restoration practitioners to learn from one another, we have also included contact information for individuals currently engaged in groundcover restoration activities. Names, email addresses, websites, and/or phone numbers for individuals engaged in restoration in flatwoods communities are presented in Table 7. Similar information for individuals involved in restoration of sandhill communities appears in Table 8, and for scrub and scrubby flatwoods communities in Table 9. This information was current as of 2009.

TABLE 7. Contact information for practitioners working to restore flatwoods sites in Florida.

COUNTY	CONTACT NAME	EMAIL OR WEBSITE	PHONE
Alachua	Crystal Morris	.	386-329-4883
Bay	John Tobe	jtobe@ecoresource.com	850-636-3229
Charlotte	Cathy Olson	.	239-533-7455
Clay	Ernest Hale	ernest@flmitigation.com	904-821-4322
Collier	John Donahue	.	941-695-2000
Collier	Shawn Liston	sliston@audubon.org	239-354-4469
Collier	.	www.wetlandsbank.com	888-301-1707
DeSoto	Christine Borowski	.	888-536-2855
Duval	Ernest Hale	ernest@flmitigation.com	904-821-4322
Duval	St. Johns River WMD	.	386-329-4404
Franklin	.	Faith.Eidse@nwfwmd.state.fl.us	850-539-5999
Gulf	Kent Willeges	Kent.Willeges@MyFWC.com	352-955-2081 x116
Hamilton	Sandra Cashes	.	386-397-2733
Hardee	Jeff Norcini	wldflowr@ufl.edu	.
Hendry	Kent Willeges	Kent.Willeges@MyFWC.com	352-955-2081 x116
Hillsborough	Brandt Henningsen	brandt.henningsen@swfwmd.state.fl.us	813-985-7481 x2202
Hillsborough	James Blincoe	James.Blincoe@dep.state.fl.us	.
Hillsborough	Kathryn Smithson	Kathryn.Smithson@dep.state.fl	813-987-6870
Indian River	John Abendroth	John.Abendroth@dep.state.fl.us	850-245-8682
Jefferson	Kent Willeges	Kent.Willeges@MyFWC.com	352-955-2081 x116
Lake	Nancy Bissett	nbissett@thenatives.net	.
Lee	Laura Greeno	.	239-707-2206
Lee	Laura Wewerka	.	239-707-0874
Lee	Lee Waller	.	239-707-0862

COUNTY	CONTACT NAME	EMAIL OR WEBSITE	PHONE
Lee	Ray Pavelka	www.littlepineisland.com	239-481-2011
Lee	Sherry Furnari	.	239-533-7454
Liberty	John Tobe	jtobe@ecoresource.com	.
Manatee	Kent Willeges	Kent.Willeges@MyFWC.com	352-955-2081 x116
Martin	Beth Kacvinsky	Bkacvinsky@sfwmd.gov	.
Martin	Brian Smith	bws@floridaequities.net	954-776-7900 x2220
Miami-Dade	Craig Smith	craig_s_smith@nps.gov	305-242-7849
Monroe	Janice Duquesnel	.	305-664-8455
Orange	Nancy Bissett	nbissett@thenatives.net	.
Osceola	Kent Willeges	Kent.Willeges@MyFWC.com	352-955-2081 x116
Osceola	Nancy Bissett	nbissett@thenatives.net	.
Polk	Kent Willeges	Kent.Willeges@MyFWC.com	352-955-2081 x116
Putnam	Kent Willeges	Kent.Willeges@MyFWC.com	352-955-2081 x116
Saint Johns	Ernest Hale	ernest@flmitigation.com	904-821-4322
Saint Lucie	Dave McIntosh	www.bluefieldranch.com	561-355-3900
Sumter	Kent Willeges	Kent.Willeges@MyFWC.com	352-955-2081 x116
Taylor	Bob Heeke	rgh@srwmd.org	386-329-4399
Volusia	Graham Williams	Graham.E.Williams@dep.state.fl.us	407-884-2000
Volusia	Steve Miller	srmiller@sjrwmd.com	386-329-4399
Volusia	Tom Roberts	troberts@ems-sep.com.	407-262-0219
Volusia	Victoria Colangelo	www.mitigationmarketing.com	407-481-0677
Volusia	.	.	386-329-4404
Wakulla	James Burnett	.	850-925-6121

TABLE 8. Contact information for practitioners working to restore sandhill sites in Florida.

COUNTY	CONTACT NAME	EMAIL OR WEBSITE	PHONE
Alachua	Crystal Morris	.	386-329-4883
Bay	Haven Cook	hcook@fs.fed.us	850-523-8572
Clay	Matthew Corby	.	904-529-2380
Clay	Paul Catlett	paul.catlett.fl.ngb.army.mil	.
Gadsden	Kent Willeges	Kent.Willeges@MyFWC.com	352-955-2081 x116
Gilchrist	Kent Willeges	Kent.Willeges@MyFWC.com	352-955-2081 x116
Hamilton	Sandra Cashes	.	386-397-2733
Jackson	Kent Willeges	Kent.Willeges@MyFWC.com	352-955-2081 x116
Lake	Charles McIntire	Charles.McIntire@dep.state.fl.us	352-394-3969
Lake	Nancy Bissett	nbissett@thenatives.net	.
Lake	Victoria Colangelo	www.mitigationmarketing.com	407-481-0677
Levy	Mike Penn	.	352-465-8585
Liberty	David Printiss	dprintiss@tnc.org	850-643-2756
Liberty	Mark Ludlow	mark.ludlow@dep.fl.us	.
Monroe	Janice Duquesnel	.	305-664-8455
Pasco	Nancy Bissett	nbissett@thenatives.net	.
Suwannee	Bob Heeke	rgh@srwmd.org	386-362-1001

COUNTY	CONTACT NAME	EMAIL OR WEBSITE	PHONE
Taylor	Kent Willeges	Kent.Willeges@MyFWC.com	352-955-2081 x116
Volusia	Steve Miller	srmiller@sjrwmd.com	386-329-4399
Wakulla	Jeff Norcini	wldflowr@ufl.edu	.
Washington	Northwest FL WMD	Faith.Eidse@nwfwmd.state.fl.us	850-539-5999

TABLE 9. Contact information for practitioners working to restore scrub and scrubby flatwoods sites in Florida.

COUNTY	CONTACT NAME	EMAIL	PHONE
Brevard	.	.	407-935-0002
Clay	Jason Cutshaw	Jason.Cutshaw@dep.state.fl.us	352-473-3419
Clay	Paul Catlett	paul.catlett.fl.ngb.army.mil	.
Highlands	Carl Weekley	CWeekley@archbold-station.org	.
Hillsborough	James Blincoe	James.Blincoe@dep.state.fl.us	
Hillsborough	Nancy Bissett	nbissett@thenatives.net	.
Indian River	John Abendroth	John.Abendroth@dep.state.fl.us	850-245-8682
Lake	Nancy Bissett	nbissett@thenatives.net	.
Lee	Sherry Furnari	.	239-533-7454
Marion	Janet Hinchee	jhinchee@fs.fed.us	352-669-3153 x5529
Monroe	Janice Duquesnel	.	305-664-8455
Okeechobee	Earth Balance	.	.
Osceola	Nancy Bissett	nbissett@thenatives.net	.
Polk	Carl Weekley	CWeekley@archbold-station.org	.
Sarasota	Nancy Edmondson	.	941-861-6230

Chapter 7

Forested Communities of the Southeastern U.S.

The 2 major natural regions covered in this manual are the Southern Coastal Plain and the Southeastern Plains, as identified by Harker et al. (1999), whose map was based on the work of Küchler (1975) and Bailey (1980). These natural regions include the non-montane areas of Alabama, Florida, Georgia, Louisiana, Mississippi, North Carolina, South Carolina, and east Texas. Harker et al.'s (1999) natural regions are broken down into their dominant ecological communities as listed below. The Southeastern Coastal Plain community descriptions are largely dependent on Myers and Ewel's (1990) book "Ecosystems of Florida", and an additional source for the description of the ecological communities of the Southern Plain is Schafale and Weakley (1990). Finally, the NatureServe organization, which has described and mapped over 550 ecological systems throughout the United States (www.natureserve.org), is recommended as a good source of additional information. Detailed lists of plant species typically found in each of these forest communities is provided in Chapter 8.

Southern Coastal Plain Communities

Southern Mixed Hardwoods

Upland hardwood forests and upland mixed forests are widespread from the Carolinas to eastern Texas and vary in their floristic composition with more evergreen species occurring as you move from north to south (Platt and Schwartz 1990). Fire and drought are thought to set the upslope limits of hardwood forests while seepage and flooding control the downslope extent. Fire is considered a rare, catastrophic event in most deciduous forests of North America although the role of fire in deciduous forests of the Southeast is under debate (Harper 1962; Quarterman 1981). Hardwood leaf litter maintains high moisture content and the accumulation of hardwood litter suppresses grasses and compacts fuel beds which reduces the likelihood of fire and may act to perpetuate hardwood forests (Platt and Schwartz 1990). The composition of mixed forests is dependent on the history of fire; as fire frequency increases, the dominance of pine and fire-tolerant hardwood species increases as well. Common canopy species include pines (*Pinus taeda* and *P. echinata*), oaks (*Quercus alba, Q. falcata, Q. hemisphaerica, Q. laurifolia, Q. nigra, and Q. virginiana*), southern magnolia (*Magnolia virginiana*), red maple (*Acer rubrum*), Florida maple (*Acer saccharinum var. floridanum)*, black cherry (*Prunus serotina*), pignut hickory (*Carya glabra*) and sweetgum (*Liquidambar styraciflua*). More northern upland hardwood/mixed forests include American beech (*Fagus grandifolia*), white oak (*Quercus alba*), large-flowered magnolia (*Magnolia grandiflora*), black walnut (*Juglans nigra*), basswood (*Tilia americana*) and sourwood (*Oxydendron arboreum*).

Flatwoods and Dry Prairies

The pine (*Pinus palustris*, *P. elliottii*) flatwoods and dry prairie ecosystems are characterized by low, flat topography and relatively poorly drained, acidic, sandy soils (Abrahamson and Harnett 1990). The only difference between these two communities is that flatwoods have an overstory canopy of pine while the prairies do not have tree cover. Both communities have a dense groundcover of saw palmetto, grasses, herbs, and low shrubs. These habitats are also defined by the high frequency of fire, usually 1-8 years. Longer fire return intervals lead to proliferation of woody shrubs and a reduction of herbaceous groundcover (Glitzenstein et al. 2003). Fires in these communities are usually low and fast. Fires burn completely, leaving few unburned patches and rarely kill existing vegetation (Abrahamson and Harnett 1990). The matrix of flatwoods vegetation includes seasonal ponds, wet depression, bayheads, cypress ponds, bogs, titi swamps, and cabbage palm hammocks, each of which are associated with elevational and hydrological ecotones. Dry prairies merge with pine flatwoods, open pine savannas, and cabbage palm hammocks.

Pine savannas

Pine savannas are a variation of the flatwoods community type that exist is poorly drained flatlands and have a sparse canopy of pine species and a diverse herb layer with few shrub species. Natural fires in pine savannas usually occur every 2-10 years (FNAI 1990).

Scrubby flatwoods

This is a variant of the pine flatwoods that exists at the ecotone between flatwoods and scrub. It has a variable tree layer but a higher frequency of shrub oak species and a sparser herb layer than is typically found in flatwoods.

Scrubby flatwoods soils are sufficiently well drained such that there is typically no standing water, yet the water table is higher than in flatwoods scrub or sandhill habitats. Scrubby flatwoods have less flammable vegetation and burn at a frequency of 8-15 years but usually burn higher and hotter due to the heavy shrub layer (TNC 2008). These fires can kill the pines present but have less complete coverage due to less herbaceous cover and greater areas of open ground.

Sandhill (Xeric Pine, High Pine)

Sandhills occur on hilltops and are characterized by deep, well-drained soils. Sandhill communities, like pine flatwoods, require frequent, low-intensity fire every 2-5 years. Sandhill communities have a pine canopy (*P. palustris*) with midstory oak tree species. Fire acts to regulate the midstory component; the more regular the fire intervals, the less abundant the oaks. Typical oak species are deciduous and include turkey oak (*Quercus laevis*), bluejack oak (*Q. incana*), and sand post oak (*Q. margaretta*). Common groundcover species include wiregrass, Indian grass (*Sorghastrum* spp.), and a variety of herbaceous species.

Scrub

Sand pine scrub is a xeromophic community dominated by a layer of (mostly evergreen) oak species (*Quercus geminata*, *Q. myrtifolia*, *Q. inopina, Q. chapmanii*) and/or Florida rosemary (*Ceratiola ericoides*). Scrub can have no overstory (oak or rosemary scrub) or an overstory of sand pine (*Pinus clausa*; sand pine scrub) or slash pine (*P. elliottii;* slash pine scrub). Sand pine scrub is maintained by infrequent high intensity fires, often termed catastrophic or stand-replacing, every 15-100 years (TNC 2008). In contrast, oak scrub fire frequencies are between 2-20 years but more frequent burning (2-10 year interval) should occur in coastal oak scrub that is maintained for optimal scrub-jay habitat (Breininger et al. 2002). Often the overstory is killed outright by fire and the shrubs are killed back to the root systems to resprout.

Pine Rockland

Pine rockland communities are fire-maintained habitats restricted to southern Florida and associated with outcroppings of limestone. Pine rocklands are notable for their lack of soil, varying from solid surface of uneven limestone to loose rock rubble where the rooting medium is in the rock channels and fissures (Snyder et al. 1990). Pine rocklands occur in locally elevated areas of limestone bedrock in a mosaic of wet prairies, mangroves, and rockland hammocks. The single canopy species is south Florida slash pine (*Pinus elliottii* var. *densa*) found at low densities with a reduced or non-existent subcanopy. Temperate and tropical shrubs and palms are often present, as are a variety of grasses and herbs. Fire is required to maintain pine rockland habitat and is estimated to occur at intervals from 2-15 years. Fires in pine rocklands, like those of pine flatwoods, are surface fires that consume only litter and understory biomass (Snyder et al. 1990).

Rockland Hammock

Rockland hammock communities, like pine rockland, are restricted to south Florida limestone outcroppings. In contrast to pine rockland, rockland hammocks lack fire and are composed of dense broadleaved tropical tree species. More than 150 tree species were identified by Snyder et al. (1990), with gumbo limbo (*Bursera simaruba*), pigeon plum (*Coccoloba diversifolia*) and white stopper (*Eugenia axillaris*) most commonly found in rockland hammocks. Rockland hammocks are not fire-dependent; hurricanes and salt inundation serve as disturbances that influence community composition and structure (Snyder et al. 1990). Although the understory is usually depauperate in rockland hammocks, a number of epiphytic species are present in this community.

Maritime Hammock (Live Oak Woodland)

Maritime hammocks are evergreen hardwood forests restricted to a narrow band along the coast on former coastal dunes that have been stabilized. Maritime forests are composed of live oak (*Quercus virginiana*), cabbage palm (*Sabal palmetto*) and redbay (*Persea borbonia*) tree species that are short-statured and have dense canopies due to wind and hurricane damage (FNAI 1990). The buildup of hardwood leaf litter and mesic conditions of maritime hammocks generally inhibit fire and the fire return interval is estimated at 25-100 years (FNAI 1990).

Cypress–Tupelo Swamp Forest (Southern Swamp Forest)

Floodplain swamp forests occur on flooded soils within river floodplains and are recognizable by their buttressed tree species such as bald cypress (*Taxodium distichum*), water tupelo (*Nyssa aquatica*), Ogechee tupelo (*N. ogechee*), and swamp tupelo (*N. biflora*). Little shrub cover or groundcover persists. Soils of cypress-tupelo swamps are flooded for most of the year and prolonged inundations restrict the growth of most understory shrubs and herbs. Cypress-tupelo swamp forests are usually too wet to support fire (FNAI 1990).

Bay Swamp/Bayhead

Bay swamps or bayheads are seepage depressions that have high water tables (FNAI 1990). Bayheads have a thick top-layer of peat over deep sands and impermeable clay (Myers and Ewel 1990). Bayheads rarely dry out which prohibits fire from entering the community; the typical fire frequency is estimated at 50-100 years. The canopy is composed of evergreen hardwood species and dominated by sweetbay (*Magnolia virginiana*), swamp red bay (*Persea palustris*), and loblolly bay (*Gordonia lasianthus*). Shrubs and ferns are typically present in low densities, with little groundcover.

Cypress Dome/Strand

Cypress (*Taxodium adscendens* and *T. distichum*) dominated communities include cypress domes (circular depressions that are dome-shaped) and cypress strands (irregular shaped cypress communities that border paths of water flow). Although canopy species are typically found in the temperate zone, understory and epiphytic plants are often tropical. The soils of cypress communities are composed of peat underlain with acidic sands followed by limestone. Cypress communities are normally inundated for 200-300 days each year but fire is critical to the maintenance of these communities (FNAI 1990). Fire frequency is estimated at 100-150 years to reach the interior of the dome or strand but is necessary to reduce hardwood invasion and reduce peat accumulation. Without the reduction of peat, the community will succeed to bottomland forest or bog (FNAI 1990).

Mangrove

Mangrove communities are composed of a dense canopy of tropical tree species (*Avicennia germinans, Laguncularia racemosa* and *Rhizophora mangle*) found in sub-tropical coastal regions with saturated, saline soils. Mangrove distribution is dependent on climate, freshwater and tidal inundation, substrate, and wave energy (Odum and McIvor 1990). Fire is not a common occurrence in mangrove communities although hurricanes and lightning strikes do shape community characteristics (Whelan 2005).

Southeastern Plains Communities

Magnolia–Beech Forest (Mesic Hardwood)

This community is not common on the Southeastern plains and develops on deep fertile neutral to slightly acidic or alkaline soils in the northern piedmont or where topographic characteristics (ravines and steep slopes) create cool, moist microclimatic conditions (Louisiana Natural Heritage 2004). Overstory species include beech (*Fagus grandifolia*), red oak (*Quercus rubra*), pignut hickory (*Carya glabra*), tulip poplar (*Liriodendron tulipifera*), sugar maple (*Acer saccharum*/*A. floridanum*) and southern magnolia (*Magnolia grandiflora*). Appalachian characteristic species such as cucumber magnolia (*M. acuminata*) and pyramid magnolia (*M. pyramidata*) may also be present. These communities are not fire-maintained.

Oak–Hickory(–Pine) Forest

Oak-hickory forests occur on dry to mesic sites that have infrequent fire. They are dominated by white oak (*Quercus alba*), southern red oak (*Q. falcata*), post oak (*Q. stellata*), mockernut hickory (*Carya alba*) and pignut hickory (*C. glabra*). These forests can also be mixed with shortleaf (*Pinus echinata*) or loblolly pine (*P. taeda*).

Southern Mixed Hardwoods

(See Southern Coastal Plain).

Pine Flatwoods

(See Southern Coastal Plain).

Sandhill

(See Southern Coastal Plain).

Maritime Hammock

(See Southern Coastal Plain).

Southern Floodplain Forest (Bottomland forest)

Floodplain forests are hardwood forests near large rivers that flood seasonally and are maintained by alternating wet and dry periods. The dominant trees are overcup oak (*Quercus lyrata*), diamond leaf oak (*Q. laurifolia*), swamp chestnut oak (*Q. michauxii*), swamp tupelo (*Nyssa biflora*), green ash (*Fraxinus pennsylvanica*), pop ash (*F. caroliniana*), sweetbay (*Magnolia virginiana*), and water hickory (*Carya aquatica*). On drier sites near streams or with less pronounced flooding, water oak (*Quercus nigra*), southern magnolia (*Magnolia grandiflora*), and sweetgum (*Liquidambar styraciflua*) become more common. Species composition is regulated by the tolerance of different species to anaerobic soil conditions created by flooding. The anaerobic gradient is related to topography, flood depth and duration, and drainage rates of the soil in a particular floodplain (Louisiana Natural Heritage Program 2004). Most sites are characterized by either a dense shrub layer with sparse groundcover or a sparse shrub layer with a mix of ferns, herbs, and grasses. Floodplain forests are stable communities that require over 100 years to mature. These forests do not usually burn but are dependent on flooding events for the input of minerals and nutrients (FNAI 1990).

Cypress–Tupelo Swamp Forest

(See Southern Coastal Plain).

Atlantic White Cedar Swamp

Atlantic white cedar (C*hamaecyparis thyoides*) swamps are restricted to freshwater wetlands along the coasts of the eastern United States and occur near lakes, river channels and river floodplains. These swamps are on peat substrates that are seasonally or permanently flooded by shallow, usually acidic, surface water with low nutrient content (Laderman 1987). White cedar forest can exist as monospecific stands or mixed with red maple (*Acer rubrum*), swamp tupelo (*Nyssa biflora*), sweetbay (*Magnolia virginiana*), and/or loblolly pine (*P. taeda*) and are not fire maintained although lightning may play an important role in creating canopy gaps in Florida (Laderman 1989).

Chapter 8

Plant Species of the Forest Communities of the Southeastern U.S.

Plant species found in forests of the Southeastern United States, listed alphabetically within each community type. Abbreviations for vegetative layer: O = overstory; U = understory. Sources include: Collins et al. 1964, Thieret 1970, Quarterman et al. 1972, Clewell et al. 1982, Walker and Peet 1983, Abrahamson et al. 1984, Salter and Dial 1984, Gilliam and Christensen 1986, Myers and White 1987, White 1987, Helm et al. 1991, Mack 1992, Herring and Judd 1995, Harker et al. 1999, Rogers and Provencher 1999, Van Kley 1999, Bledsoe and Shear 2000, Kush and Meldahl 2000, Institute for Regional Conservation 2009.

TABLE 1. Plant species found in Bayhead communities.

GENUS	SPECIES	LAYER
Acer	*rubrum*	O
Acoelorraphe	*wrightii*	U
Acrostichum	*danaeifolium*	U
Apteria	*aphylla*	U
Aster	*carolinianus*	U
Bidens	*mitis*	U
Blechnum	*serrulatum*	U
Boehmeria	*cylindrica*	U
Bucida	*spinosa*	U
Campyloneurum	*phyllitidis*	U
Catopsis	*berteroniana*	U
Cephalanthus	*occidentalis*	U
Chrysobalanus	*icaco*	U
Cladium	*jamaicense*	U
Cyperus	*odoratus*	U
Drosera	*capillaris*	U
Encyclia	*tampensis*	U
Ficus	*aurea*	O
Fraxinus	*caroliniana*	O
Gelsemium	*sempervirens*	U
Gordonia	*lasianthus*	O , U
Ilex	*cassine*	U
Ipomoea	*alba*	U
Ipomoea	*indica var. acuminata*	U
Jacquemontia	*pentanthos*	U
Ludwigia	*alata*	U
Ludwigia	*octovalvis*	U
Ludwigia	*pilosa*	U
Magnolia	*virginiana*	O , U
Malaxis	*spicata*	U
Melothria	*pendula*	U
Mikania	*cordifolia*	U
Mikania	*scand ens*	U
Myrcianthes	*fragrans*	O
Myrica	*cerifera*	U
Nephrolepis	*exaltata*	U
Osmunda	*cinnamomea*	U
Osmunda	*regalis var. spectabilis*	U
Panicum	*hemitomon*	U
Parthenocissus	*quinquefolia*	U
Passiflora	*pallens*	U
Peltandra	*virginica*	U
Persea	*borbonia*	O
Persea	*palustris*	O , U
Phlebodium	*aureum*	U
Pinus	*elliotii*	O , U
Pleopeltis	*polypodioides var. michauxiana*	U
Pontederia	*cordata*	U
Psilotum	*nudum*	U
Psychotria	*nervosa*	U
Quercus	*laurifolia*	O
Rapanea	*punctata*	U
Rhizophora	*mangle*	O
Sabal	*palmetto*	O
Sagittaria	*lancifolia*	U
Salix	*caroliniana*	U
Sambucus	*canadensis*	U
Sapindus	*saponaria*	U
Sarcostemma	*clausum*	U

GENUS	SPECIES	LAYER
Schizaea	*pennula*	U
Smilax	*laurifolia*	U
Taxodium	*ascendens*	O
Thelypteris	*kunthii*	U
Tillandsia	*balbisiana*	U
Tillandsia	*fasciculata var. densispica*	U
Tillandsia	*paucifolia*	U
Tillandsia	*recurvata*	U
Tillandsia	*setacea*	U
Tillandsia	*usneoides*	U
Tillandsia	*utriculata*	U
Tillandsia	*variabilis*	U
Tournefortia	*hirsutissima*	U
Toxicodendron	*radicans*	U
Trichostigma	*octandrum*	U
Typha	*domingensis*	U
Vanilla	*barbellata*	U
Verbena	*scabra*	U
Vitis	*rotundifolia*	U
Woodwardia	*areolata*	U
Woodwardia	*virginica*	U
Ximenia	*americana*	U

TABLE 2. Plant species found in Cypress Dome and Cypress Strand communities.

GENUS	SPECIES	LAYER
Cladium	*mariscus*	U
Clethra	*alnifolia*	U
Coelorachis	*tuberculosa*	U
Crinum	*americanum*	U
Cyperus	*odoratus*	U
Cyperus	*stenolepis*	U
Cyrilla	*racimiflora*	U
Cyrtopodium	*punctatum*	U
Decodon	*verticillatus*	U
Dichanthelium	*commutatum*	U
Diodia	*virginiana*	U
Echinochloa	*walteri*	U
Eleocharis	*cellulosa*	U
Eleocharis	*microcarpa*	U
Encyclia	*cochleata*	U
Encyclia	*tampensis*	U
Epidendrum	*nocturnum*	U
Epidendrum	*rigidum*	U
Eriocaulon	*compressum*	U
Eriocaulon	*decangulare*	U
Eulophia	*alta*	U
Eupatorium	*capillifolium*	U
Ficus	*aurea*	O
Gland ularia	*tampensis*	U
Gordonia	*lasianthus*	O
Habenaria	*floribunda*	U
Habenaria	*repens*	U
Harrisella	*porrecta*	U
Hydrocotyle	*umbellata*	U
Hydrocotyle	*verticillata*	U
Hydrolea	*corymbosa*	U
Hypericum	*cistifolium*	U
Hypericum	*tetrapetalum*	U
Hyptis	*alata*	U
Ilex	*cassine*	U
Ilex	*coriacea*	U
Ilex	*glabra*	U
Ipomoea	*indica var. acuminata*	U
Itea	*virginica*	U
Iva	*microcephala*	U
Juncus	*polycephalos*	U
Kosteletzkya	*virginica*	U
Lachnanthes	*caroliniana*	U
Lemna	*valdiviana*	U
Leucothoe	*racemosa*	U
Lindernia	*dubia var. anagallidea*	U
Ludwigia	*octovalvis*	U
Ludwigia	*palustris*	U
Ludwigia	*repens*	U
Lycopus	*rubellus*	U
Lyonia	*lucida*	U
Magnolia	*virginiana*	O
Melothria	*pendula*	U
Mikania	*scandens*	U
Myrica	*cerifera*	U
Najas	*guadalupensis*	U
Nephrolepis	*biserrata*	U
Nephrolepis	*exaltata*	U

GENUS	SPECIES	LAYER
Nuphar	*lutea subsp. Advena*	U
Nymphaea	*elegans*	U
Nymphaea	*odorata*	U
Nymphoides	*aquatica*	U
Nyssa	*biflora*	O
Ophioglossum	*petiolatum*	U
Osmunda	*cinnamomea*	U
Osmunda	*regalis var. spectabilis*	U
Oxypolis	*filiformis*	U
Panicum	*hematomon*	U
Panicum	*hemitomon*	U
Panicum	*rigidulum*	U
Panicum	*verrucosum*	U
Parietaria	*floridana*	U
Parthenocissus	*quinquefolia*	U
Paspalidium	*geminatum*	U
Peltandra	*virginica*	U
Persea	*palustris*	O
Phlebodium	*aureum*	U
Phoradendron	*leucarpum*	U
Physalis	*arenicola*	U
Pilea	*microphylla*	U
Pinus	*elliottii var. densa*	O
Pistia	*stratiotes*	U
Pleopeltis	*polypodioides var. michauxiana*	U
Pluchea	*odorata*	U
Polygala	*ramosa*	U
Polygonum	*densiflorum*	U
Polygonum	*hydropiperoides*	U
Polygonum	*punctatum*	U
Polyradicion	*lindenii*	U
Polystachya	*concreta*	U
Pontederia	*cordata*	U
Psilotum	*nudum*	U
Psychotria	*nervosa*	U
Psychotria	*sulzneri*	U
Pteris	*quadriaurita*	U
Rapanea	*punctata*	U
Rhizophora	*mangle*	U
Rhynchospora	*colorata*	U
Rhynchospora	*corniculata*	U
Rhynchospora	*harperi*	U
Rhynchospora	*inundata*	U

GENUS	SPECIES	LAYER
Rhynchospora	*miliacea*	U
Rhynchospora	*tracyi*	U
Sabal	*palmetto*	O
Sagittaria	*filiformis*	U
Sagittaria	*graminea*	U
Sagittaria	*lancifolia*	U
Salix	*caroliniana*	U
Sambucus	*canadensis*	U
Sarcostemma	*clausum*	U
Saururus	*cernuus*	U
Setaria	*magna*	U
Smilax	*laurifolia*	U
Smilax	*walteri*	U
Solidago	*stricta*	U
Spiranthes	*odorata*	U
Spirodela	*polyrhiza*	U
Stillingia	*aquatica*	U
Taxodium	*adscendens*	O
Taxodium	*distichum*	O
Thalia	*geniculata*	U
Thelypteris	*interrupta*	U
Thelypteris	*kunthii*	U
Thelypteris	*palustris var. pubsecens*	U
Thelypteris	*reticulata*	U
Tillandsia	*balbisiana*	U
Tillandsia	*fasciculata var. densispica*	U
Tillandsia	*flexuosa*	U
Tillandsia	*paucifolia*	U
Tillandsia	*recurvata*	U
Tillandsia	*setacea*	U
Tillandsia	*usneoides*	U
Tillandsia	*utriculata*	U
Tillandsia	*variabilis*	U
Tillandsia	*floridana*	U
Tillandsia	*smalliana*	U
Toxicodendron	*radicans*	U
Trachelospermum	*difforme*	U
Triadenum	*virginicum*	U
Typha	*domingensis*	U
Utricularia	*foliosa*	U
Utricularia	*gibba*	U
Utricularia	*inflata*	U
Utricularia	*purpurea*	U
Utricularia	*radiata*	U

GENUS	SPECIES	LAYER
Vaccinium	*spp.*	U
Vallisneria	*americana*	U
Vittaria	*lineata*	U
Woodwardia	*areolata*	U
Woodwardia	*virginica*	U

TABLE 3. Plant species found in Cypress-Tupelo Swamp communities

GENUS	SPECIES	LAYER
Acer	*rubrum*	O
Aster	*dumosus*	U
Azolla	*caroliniana*	U
Berchamia	*scandens*	U
Boehmeria	*cylindrica*	U
Brunnicia	*ovata*	U
Campsis	*radicans*	U
Carex	*gigantea*	U
Carpinus	*caroliniana*	O
Carya	*aquatica*	O
Centella	*erecta*	U
Cephalanthus	*occidentalis*	O
Chamaecyparis	*thyoides*	O
Clethra	*alnifolia*	U
Cornus	*foemina*	O
Crataegus	*marshallii*	U
Cyrilla	*racemiflora*	U
Decumaria	*barbara*	U
Drosera	*capillaris*	U
Dulichium	*arundinaceum*	U
Eryngium	*baldwinii*	U
Forestiera	*acuminata*	U
Fraxinus	*caroliniana*	O
Fraxinus	*profunda*	O
Gaylussacia	*frondosa*	U
Gordonia	*lasianthus*	U
Hydrochotyle	*verticillata*	U
Ilex	*coriacea*	U
Ilex	*decidua*	U
Ilex	*glabra*	U
Itea	*virginiana*	U
Lemna	*minor*	U
Lyonia	*ligustrina*	U
Lyonia	*lucida*	U

GENUS	SPECIES	LAYER
Magnolia	*virginiana*	U
Mayaca	*fluviatilis*	U
Mitchella	*repens*	U
Myrica	*cerifera*	U
Myrica	*heterophylla*	U
Nyssa	*aquatica*	O
Nyssa	*biflora*	O
Osmunda	*regalis*	U
Panicum	*rigidulum*	U
Pannicum	*commutatum*	U
Peltandra	*virginica*	U
Persea	*borbonia*	U
Persea	*palustris*	U
Pinus	*elliottii*	O
Pinus	*serotina*	O
Pinus	*taeda*	O
Planera	*aquatica*	U
Polygonum	*punctatum*	U
Populus	*heterophylla*	O
Quercus	*laurifolia*	O
Quercus	*nigra*	O
Rhynchospora	*miliacea*	U
Salix	*nigra*	O
Sarracenia	*flava*	U
Sarracenia	*rubra*	U
Saururus	*cernuus*	U
Smilax	*bona-nox*	U
Smilax	*tamnoides*	U
Taxodium	*ascendens*	O
Taxodium	*distichum*	O
Thelypteris	*kunthii*	U
Toxicodendron	*radicans*	U
Ulmus	*americana*	O
Utricularia	*subulata*	U

GENUS	SPECIES	LAYER
Vitis	*aestivalis*	O
Woodwardia	*areolata*	U
Zephyranthes	*atamasco*	U

TABLE 4. Plant species found in Flatwoods and Dry Prairie communities.

GENUS	SPECIES	LAYER
Acmella	*oppositifolia var. repens*	U
Agalinis	*fasciculate*	U
Agalinis	*obtusifolia*	U
Ageratina	*jucunda*	U
Aletris	*lutea*	U
Amorpha	*fruticosa*	U
Ampelopsis	*arborea*	U
Amphicarpum	*muhlenbergianum*	U
Anagallis	*minima*	U
Anagallis	*pumila*	U
Andropogon	*arctatus*	U
Andropogon	*brachystachyus*	U
Andropogon	*glomeratus var. glaucopsis*	U
Andropogon	*glomeratus var. hirsutior*	U
Andropogon	*glomeratus var. pumilus*	U
Andropogon	*gyrans*	U
Andropogon	*ternarius*	U
Andropogon	*virginicus*	U
Andropogon	*virginicus var. decipiens*	U
Andropogon	*virginicus var. glaucus*	U
Aristida	*beyrichiana*	U
Aristida	*patula*	U
Aristida	*purpurascens*	U
Aristida	*spiciformis*	U
Asclepias	*connivens*	U
Asclepias	*feayi*	U
Asclepias	*incarnata*	U
Asclepias	*lanceolata*	U
Asclepias	*longifolia*	U
Asclepias	*pedicellata*	U
Asclepias	*tuberosa*	U
Asclepias	*verticillata*	U
Asimina	*incana*	U
Asimina	*reticulata*	U
Aster	*adnatus*	U
Aster	*bracei*	U
Aster	*concolor*	U
Aster	*dumosus*	U
Aster	*reticulatus*	U
Aster	*tortifolius*	U
Axonopus	*compressus*	U
Axonopus	*fissifolius*	U
Axonopus	*furcatus*	U
Baccharis	*glomeruliflora*	U
Baccharis	*halimifolia*	U
Bacopa	*monnieri*	U
Bartonia	*paniculata*	U
Bartonia	*verna*	U
Bartonia	*virginica*	U
Bejaria	*racemosa*	U
Bidens	*alba var. radiata*	U
Bigelowia	*nudata subsp. Australis*	U
Blechnum	*serrulatum*	U
Boehmeria	*cylindrica*	U
Buchnera	*americana*	U
Bulbostylis	*ciliatifolia*	U
Burmannia	*biflora*	U
Burmannia	*capitata*	U
Burmannia	*flava*	U
Callicarpa	*americana*	U
Calopogon	*multiflorus*	U
Calopogon	*pallidus*	U
Caperonia	*castaneifolia*	U
Carphephorus	*corymbosus*	U
Carphephorus	*odoratissimus*	U
Carphephorus	*paniculatus*	U
Cassytha	*filiformis*	U
Centrosema	*virginianum*	U
Chamaecrista	*fasciculata*	U
Chamaecrista	*nictitans*	U
Chaptalia	*tomentosa*	U
Chromolaena	*odorata*	U

GENUS	SPECIES	LAYER
Chrysopogon	*pauciflorus*	U
Chrysopsis	*mariana*	U
Chrysopsis	*subulata*	U
Cirsium	*horridulum*	U
Cladium	*jamaicense*	U
Clematis	*baldwinii*	U
Clitoria	*mariana*	U
Cnidoscolus	*stimulosus*	U
Coelorachis	*rugosa*	U
Commelina	*erecta*	U
Conoclinium	*coelestinum*	U
Crotalaria	*rotundifolia*	U
Croton	*glandulosus*	U
Croton	*michauxii*	U
Ctenium	*aromaticum*	U
Cuscuta	*indecora*	U
Cuscuta	*obtusiflora var. glandulosa*	U
Cyperus	*cuspidatus*	U
Cyperus	*haspan*	U
Cyperus	*polystachyos*	U
Cyperus	*retrorsus*	U
Cyperus	*surinamensis*	U
Dalea	*carnea*	U
Dalea	*pinnata*	U
Deeringothamnus	*pulchellus*	U
Desmodium	*marilandicum*	U
Desmodium	*paniculatum*	U
Dichanthelium	*aciculare*	U
Dichanthelium	*dichotomum*	U
Dichanthelium	*ensifolium*	U
Dichanthelium	*ensifolium var. unciphyllum*	U
Dichanthelium	*erectifolium*	U
Dichanthelium	*laxiflorum*	U
Dichanthelium	*leucothrix*	U
Dichanthelium	*ovale*	U
Dichanthelium	*portoricense*	U
Dichanthelium	*strigosum var. glabrescens*	U
Digitaria	*serotina*	U
Diospyros	*virginiana*	U
Drosera	*brevifolia*	U
Drosera	*capillaris*	U
Dyschoriste	*angusta*	U
Dyschoriste	*oblongifolia*	U
Eleocharis	*baldwinii*	U

GENUS	SPECIES	LAYER
Eleocharis	*flavescens*	U
Eleocharis	*geniculata*	U
Elephantopus	*elatus*	U
Elionurus	*tripsacoides*	U
Elytraria	*caroliniensis var. angustifolia*	U
Encyclia	*tampensis*	U
Eragrostis	*elliottii*	U
Eragrostis	*virginica*	U
Erechtites	*hieracifolia*	U
Erigeron	*quercifolius*	U
Erigeron	*vernus*	U
Eriochloa	*michauxii*	U
Eryngium	*aromaticum*	U
Eryngium	*yuccifolium*	U
Erythrina	*herbacea*	U
Eulophia	*alta*	U
Eupatorium	*capillifolium*	U
Eupatorium	*leptophyllum*	U
Eupatorium	*mikanioides*	U
Eupatorium	*mohrii*	U
Eupatorium	*rotundifolium*	U
Euphorbia	*inundata*	U
Euphorbia	*polyphylla*	U
Eustachys	*petraea*	U
Euthamia	*caroliniana*	U
Evolvulus	*sericeus*	U
Fimbristylis	*autumnalis*	U
Fimbristylis	*caroliniana*	U
Fimbristylis	*puberula*	U
Flaveria	*linearis*	U
Froelichia	*floridana*	U
Fuirena	*breviseta*	U
Fuirena	*pumila*	U
Fuirena	*scirpoidea*	U
Galactia	*elliottii*	U
Galactia	*regularis*	U
Galactia	*volubilis*	U
Galium	*hispidulum*	U
Gaylussacia	*dumosa*	U
Gland ularia	*maritima*	U
Gnaphalium	*obtusifolium*	U
Gratiola	*hispida*	U
Gratiola	*pilosa*	U
Gratiola	*ramosa*	U

GENUS	SPECIES	LAYER
Gymnopogon	*brevifolius*	U
Habenaria	*floribunda*	U
Habenaria	*quinqueseta*	U
Hedyotis	*procumbens*	U
Helenium	*amarum*	U
Helenium	*pinnatifidum*	U
Helianthemum	*corymbosum*	U
Helianthus	*angustifolius*	U
Helianthus	*radula*	U
Heliotropium	*polyphyllum*	U
Hibiscus	*furcellatus*	U
Hieracium	*megacephalon*	U
Hymenocallis	*punta-gordensis*	U
Hypericum	*brachyphyllum*	U
Hypericum	*cistifolium*	U
Hypericum	*crux-andreae*	U
Hypericum	*edisonianum*	U
Hypericum	*fasciculatum*	U
Hypericum	*gentianoides*	U
Hypericum	*hypericoides*	U
Hypericum	*mutilum*	U
Hypericum	*myrtifolium*	U
Hypericum	*reductum*	U
Hypericum	*tetrapetalum*	U
Hypoxis	*juncea*	U
Hypoxis	*wrightii*	U
Hyptis	*alata*	U
Ilex	*ambigua*	O
Ilex	*cassine*	U
Ilex	*glabra*	U
Imperata	*brasiliensis*	U
Indigofera	*caroliniana*	U
Jacquemontia	*curtisii*	U
Juncus	*dichotomus*	U
Juncus	*marginatus*	U
Juncus	*megacephalus*	U
Juncus	*scirpoides*	U
Justicia	*angusta*	U
Lachnanthes	*caroliana*	U
Lachnocaulon	*anceps*	U
Lachnocaulon	*beyrichianum*	U
Lachnocaulon	*engleri*	U
Lactuca	*graminifolia*	U
Lechea	*torreyi*	U

GENUS	SPECIES	LAYER
Liatris	*garberi*	U
Liatris	*gracilis*	U
Liatris	*graminifolia*	U
Licania	*michauxii*	U
Lilium	*catesbaei*	U
Lindernia	*dubia var. anagallidea*	U
Lindernia	*grandiflora*	U
Linum	*floridanum*	U
Linum	*medium var. texanum*	U
Lobelia	*feayana*	U
Lobelia	*gland ulosa*	U
Lobelia	*homophylla*	U
Lobelia	*paludosa*	U
Ludwigia	*arcuata*	U
Ludwigia	*curtissii*	U
Ludwigia	*maritima*	U
Ludwigia	*microcarpa*	U
Lycopodiella	*appressa*	U
Lycopodiella	*cernua*	U
Lygodesmia	*aphylla*	U
Lyonia	*fruticosa*	U
Lyonia	*lucida*	U
Mecardonia	*acuminata var. peninsularis*	U
Melanthera	*nivea*	U
Melochia	*spicata*	U
Melothria	*pendula*	U
Metopium	*toxiferum*	O
Mimosa	*quadrivalvis var. angustata*	U
Mimosa	*quadrivalvis var. floridana*	U
Mitreola	*petiolata*	U
Mitreola	*sessilifolia*	U
Muhlenbergia	*capillaris*	U
Myrica	*cerifera*	U
Nephrolepis	*exaltata*	U
Nolina	*atopocarpa*	U
Nothoscordum	*bivalve*	U
Ophioglossum	*nudicaule*	U
Ophioglossum	*palmatum*	U
Opuntia	*humifusa*	U
Osmunda	*cinnamomea*	U
Osmunda	*regalis var. spectabilis*	U
Panicum	*abscissum*	U
Panicum	*hians*	U
Panicum	*rigidulum*	U

GENUS	SPECIES	LAYER
Panicum	*tenerum*	U
Panicum	*virgatum*	U
Parthenocissus	*quinquefolia*	U
Paspalum	*floridanum*	U
Paspalum	*laeve*	U
Paspalum	*monostachyum*	U
Paspalum	*praecox*	U
Paspalum	*setaceum*	U
Penstemon	*multiflorus*	U
Phlebodium	*aureum*	U
Physalis	*arenicola*	U
Physalis	*pubescens*	U
Physalis	*walteri*	U
Physostegia	*purpurea*	U
Phytolacca	*americana*	U
Piloblephis	*rigida*	U
Pinguicula	*lutea*	U
Pinguicula	*pumila*	U
Pinus	*elliottii var. densa*	O
Pinus	*palustris*	O
Piriqueta	*caroliniana*	U
Pityopsis	*graminifolia*	U
Pleopeltis	*polypodioides var. michauxiana*	U
Pluchea	*foetida*	U
Polygala	*balduinii*	U
Polygala	*boykinii*	U
Polygala	*cruciata*	U
Polygala	*grandiflora*	U
Polygala	*incarnata*	U
Polygala	*lutea*	U
Polygala	*nana*	U
Polygala	*polygama*	U
Polygala	*rugelii*	U
Polygala	*setacea*	U
Polygonella	*ciliata*	U
Ponthieva	*racemosa*	U
Prunus	*umbellata*	O
Psilotum	*nudum*	U
Pteridium	*aquilinum var. caudatum*	U
Pteridium	*aquilinum var. pseudocaudatum*	U
Pterocaulon	*pycnostachyum*	U
Quercus	*laurifolia*	O

GENUS	SPECIES	LAYER
Quercus	*minima*	U
Quercus	*myrtifolia*	O , U
Quercus	*nigra*	O
Quercus	*pumila*	U
Quercus	*virginiana*	O
Rapanea	*punctata*	U
Rhexia	*cubensis*	U
Rhexia	*mariana*	U
Rhexia	*nashii*	U
Rhexia	*nuttallii*	U
Rhus	*copallinum*	U
Rhynchosia	*minima*	U
Rhynchospora	*baldwinii*	U
Rhynchospora	*breviseta*	U
Rhynchospora	*chapmanii*	U
Rhynchospora	*ciliaris*	U
Rhynchospora	*colorata*	U
Rhynchospora	*divergens*	U
Rhynchospora	*eximia*	U
Rhynchospora	*fascicularis*	U
Rhynchospora	*fernaldii*	U
Rhynchospora	*globularis*	U
Rhynchospora	*intermedia*	U
Rhynchospora	*nitens*	U
Rhynchospora	*plumosa*	U
Rhynchospora	*pusilla*	U
Rhynchospora	*rariflora*	U
Rorippa	*palustris subp. Fernaldiana*	U
Rotala	*ramosior*	U
Rubus	*cuneifolius*	U
Rubus	*trivialis*	U
Rudbeckia	*hirta*	U
Ruellia	*caroliniensis*	U
Ruellia	*ciliosa*	U
Ruellia	*succulenta*	U
Sabal	*palmetto*	O
Sabatia	*brevifolia*	U
Sabatia	*grandiflora*	U
Sabatia	*stellaris*	U
Saccharum	*giganteum*	U
Sacoila	*lanceolata*	U
Salvia	*lyrata*	U
Schizachyrium	*gracile*	U
Schizachyrium	*scoparium*	U

GENUS	SPECIES	LAYER
Schizachyrium	*stoloniferum*	U
Schizaea	*pennula*	U
Schoenocaulon	*dubium*	U
Schoenolirion	*albiflorum*	U
Schoenus	*nigricans*	U
Scleria	*ciliata*	U
Scleria	*georgiana*	U
Scleria	*hirtella*	U
Scleria	*reticularis*	U
Scleria	*triglomerata*	U
Scleria	*verticillata*	U
Scutellaria	*integrifolia*	U
Serenoa	*repens*	U
Setaria	*parviflora*	U
Sida	*elliottii*	U
Sisyrinchium	*angustifolium*	U
Sisyrinchium	*nashii*	U
Smilax	*auriculata*	U
Smilax	*bona-nox*	U
Solidago	*fistulosa*	U
Solidago	*gigantea*	U
Solidago	*odora var. chapmanii*	U
Solidago	*stricta*	U
Solidago	*tortifolia*	U
Sorghastrum	*secundum*	U
Spiranthes	*brevilabris*	U
Spiranthes	*floridana*	U
Spiranthes	*longilabris*	U
Spiranthes	*tuberosa*	U
Spiranthes	*vernalis*	U
Sporobolus	*junceus*	U
Stenandrium	*dulce*	U
Stillingia	*sylvatica*	U
Stipulicida	*setacea*	U
Syngonanthus	*flavidulus*	U
Tephrosia	*angustissima var. curtissii*	U
Tephrosia	*chrysophylla*	U
Tephrosia	*florida*	U
Tephrosia	*hispidula*	U
Tephrosia	*rugelii*	U
Teucrium	*canadense*	U
Thelypteris	*kunthii*	U
Thelypteris	*palustris var. pubsecens*	U
Tillandsia	*fasciculata var. densispica*	U

GENUS	SPECIES	LAYER
Tillandsia	*paucifolia*	U
Tillandsia	*recurvata*	U
Tillandsia	*usneoides*	U
Tillandsia	*utriculata*	U
Toxicodendron	*radicans*	U
Trichostema	*dichotomum*	U
Utricularia	*amethystina*	U
Utricularia	*cornuta*	U
Utricularia	*simulans*	U
Utricularia	*subulata*	U
Vaccinium	*darrowii*	U
Vaccinium	*myrsinites*	U
Vaccinium	*stamineum*	O , U
Verbena	*scabra*	U
Vernonia	*angustifolia*	U
Vernonia	*blodgettii*	U
Viburnum	*obovatum*	U
Viola	*lanceolata*	U
Viola	*palmata*	U
Viola	*primulifolia*	U
Viola	*sororia*	U
Vitis	*rotundifolia*	U
Vittaria	*lineata*	U
Ximenia	*americana*	U
Xyris	*ambigua*	U
Xyris	*brevifolia*	U
Xyris	*caroliniana*	U
Xyris	*difformis var. floridana*	U
Xyris	*elliottii*	U
Xyris	*flabelliformis*	U
Xyris	*platylepis*	U
Yucca	*filamentosa*	U
Zephyranthes	*simpsonii*	U

TABLE 5. Plant species found in Magnolia–Beech Forest communities.

GENUS	SPECIES	LAYER
Acer	*rubrum*	O
Callicarpa	*americana*	U
Carpinus	*caroliniana*	O
Cornus	*florida*	O
Fagus	*grandiflora*	O
Halesia	*diptera*	O
Ilex	*opaca*	O
Ilex	*verticillata*	O
Illicium	*floridanum*	U
Liquidambar	*styraciflua*	O
Liriodendron	*tulipifera*	O
Magnolia	*grandiflora*	O
Nyssa	*sylvatica*	O
Osmanthus	*americana*	O
Oxydendrum	*arboreum*	O
Persea	*borbonia*	O
Pinus	*glabra*	O
Pinus	*taeda*	O
Prunus	*serotina*	O
Quercus	*alba*	O
Quercus	*michauxii*	O
Quercus	*nigra*	O
Quercus	*phellos*	O
Sassafras	*albidum*	O
Stewartia	*malacodendron*	U
Symplocus	*tinctoria*	O
Vaccinium	*arboreum*	O

TABLE 6. Plant species found in Mangrove communities.

GENUS	SPECIES	LAYER
Acrostichum	*aureum*	U
Acrostichum	*danaeifolium*	U
Avicennia	*germinans*	O
Batis	*maritima*	U
Borrichia	*arborescens*	U
Borrichia	*frutescens*	O
Catopsis	*berteroniana*	U
Conocarpus	*erectus*	O
Dalbergia	*brownii*	U
Distichlis	*spicata*	U
Eleocharis	*spp.*	U
Encyclia	*boothiana var. erythroniodes*	U
Encyclia	*tampensis*	U
Juncus	*roemarianus*	U
Laguncularia	*racemosa*	O
Limonium	*carolinianum*	U
Lycium	*carolinianum*	U
Nevrodium	*lanceolatum*	U
Pavonia	*paludicola*	U
Rhabdadenia	*biflora*	U
Rhipsalis	*baccifera*	U
Rhizophora	*mangle*	O
Salicornia	*perennis*	U
Sesuvium	*portulacastrum*	U
Spartina	*spartinae*	U
Tillandsia	*balbisiana*	U
Tillandsia	*fasciculata var. densispica*	U
Tillandsia	*flexuosa*	U
Tillandsia	*paucifolia*	U
Tillandsia	*recurvata*	U
Tillandsia	*usneoides*	U
Tillandsia	*utriculata*	U
Vanilla	*barbellata*	U

TABLE 7. Plant species found in Maritime Hammock communities.

GENUS	SPECIES	LAYER
Acanthocereus	*tetragonus*	U
Agave	*decipiens*	U
Alternanthera	*flavescens*	U
Amyris	*elemifera*	U
Andropogon	*glomeratus var. pumilus*	U
Ardisia	*escallonioides*	U
Baccharis	*glomeruliflora*	U
Baccharis	*halimifolia*	U
Bidens	*alba var. radiata*	U
Bursera	*simaruba*	O
Caesalpinia	*bonduc*	U
Caesalpinia	*major*	U
Callicarpa	*americana*	U
Capparis	*cynophallophora*	O
Capparis	*flexuosa*	O
Capsicum	*annuum var. glabriusculum*	U
Cassytha	*filiformis*	U
Celtis	*laevigata*	O , U
Chasmanium	*sessilifolia*	U
Chiococca	*alba*	U
Chrysobalanus	*icaco*	U
Chrysophyllum	*oliviforme*	O
Cissus	*verticillata*	U
Clusia	*rosea*	O
Coccoloba	*diversifolia*	O
Coccoloba	*uvifera*	U
Coccothrinax	*argentata*	O
Conocarpus	*erectus*	O
Cynanchum	*scoparium*	U
Cyperus	*tetragonus*	U
Dalbergia	*ecastaphyllum*	U
Dicliptera	*sexangularis*	U
Drypetes	*lateriflora*	U
Erythrina	*herbacea*	U
Eugenia	*axillaris*	U
Eugenia	*foetida*	O
Exothea	*paniculata*	O
Ficus	*aurea*	O
Ficus	*citrifolia*	U
Forestiera	*segregata*	U
Galium	*hispidulum*	U
Genipa	*clusiifolia*	U
Gouania	*lupuloides*	O
Guapira	*discolor*	O
Guettarda	*elliptica*	U
Guettarda	*scabra*	U
Gymnanthes	*lucida*	U
Habenaria	*floribunda*	U
Hamelia	*patens*	U
Heliotropium	*angiospermum*	U
Hippocratea	*volubilis*	U
Hymenocallis	*latifolia*	U
Ilex	*opaca*	O
Ilex	*vomitoria*	U
Ipomoea	*alba*	U
Ipomoea	*indica var. acuminata*	U
Ipomoea	*violacea*	U
Iresine	*diffusa*	U
Jacquinia	*keyensis*	U
Juniperus	*silicicola*	O
Krugiodendron	*ferreum*	O
Lantana	*involucrata*	U
Lasiacis	*divaricata*	U
Magnolia	*grandiflora*	O
Melothria	*pendula*	U
Mentzelia	*floridana*	U
Metopium	*toxiferum*	O
Mikania	*cordifolia*	U
Mitchella	*repens*	U
Morus	*rubra*	O , U
Myrcianthes	*fragrans*	O
Myrica	*cerifera*	U
Nephrolepis	*exaltata*	U
Ocotea	*coriacea*	U
Oplismenus	*hirtellus*	U
Opuntia	*stricta*	U
Parietaria	*floridana*	U
Parthenocissus	*quinquefolia*	U
Passiflora	*suberosa*	U
Persea	*borbonia*	O
Petiveria	*alliacea*	U
Phlebodium	*aureum*	U
Physalis	*arenicola*	U
Pilea	*microphylla*	U

GENUS	SPECIES	LAYER
Pinus	*elliotii*	O
Pinus	*taeda*	O
Piscidia	*piscipula*	O
Pisonia	*aculeata*	U
Pithecellobium	*keyense*	U
Pleopeltis	*polypodioides var. michauxiana*	U
Psilotum	*nudum*	U
Psychotria	*nervosa*	U
Psychotria	*sulzneri*	U
Pteridium	*aquilinum var. caudatum*	U
Quercus	*geminata*	O
Quercus	*laurifolia*	O
Quercus	*virginiana*	O
Randia	*aculeata*	U
Rapanea	*punctata*	U
Rhus	*copallinum*	U
Rivina	*humilis*	U
Sabal	*palmetto*	O
Sambucus	*canadensis*	U
Sassafras	*albidum*	O
Schizachyrium	*scoparium*	U
Schoepfia	*chrysophylloides*	U
Scleria	*triglomerata*	U
Serenoa	*repens*	U
Setaria	*macrosperma*	U
Setaria	*parviflora*	U
Sideroxylon	*celastrinum*	U
Sideroxylon	*foetidissimum*	U
Sideroxylon	*salicifolium*	O , U
Sideroxylon	*tenax*	U
Simarouba	*glauca*	O

GENUS	SPECIES	LAYER
Smilax	*auriculata*	U
Smilax	*bona-nox*	U
Smilax	*laurifolia*	U
Solanum	*bahamense*	U
Solanum	*erianthum*	U
Sophora	*tomentosa var. truncata*	U
Spartina	*alternifolia*	U
Spartina	*patens*	U
Spiranthes	*polyantha*	U
Stenotaphrum	*secundatum*	U
Strophostyles	*helvula*	U
Thelypteris	*kunthii*	U
Thrinax	*radiata*	O , U
Toxicodendron	*radicans*	U
Trema	*micranthum*	U
Triplasis	*purpurea*	U
Uniola	*paniculata*	U
Verbesina	*virginica*	U
Vitis	*munsoniana*	U
Vitis	*rotundifolia*	U
Vittaria	*lineata*	U
Ximenia	*americana*	U
Yucca	*alnifolia*	U
Yucca	*aloifolia*	U
Yucca	*filamentosa*	U
Zamia	*integrifolia*	U
Zamia	*pumila*	U
Zanthoxylum	*clava-herculis*	U
Zanthoxylum	*coriaceum*	U
Zanthoxylum	*fagara*	U

TABLE 8. Plant species found in Oak-Hickory-Pine communities.

GENUS	SPECIES	LAYER
Acer	*leucoderme*	U
Acer	*rubrum*	O
Aesculus	*sylvatica*	U
Agrimonia	*gryposepala*	U
Amainthium	*muscaetoxicum*	U
Amelanchier	*spp.*	U
Andropogon	*virginicus*	U
Arisotlochia	*serpentaria*	U

GENUS	SPECIES	LAYER
Asimina	*parviflora*	U
Aster	*dumosus*	U
Aster	*paternus*	U
Aster	*solidagineus*	U
Aureolaria	*flava*	U
Calcycanthus	*floridus*	U
Carex	*albicans*	U
Carex	*nigromarginata*	U

GENUS	SPECIES	LAYER
Carpinus	*caroliniana*	U
Carya	*alba*	O
Carya	*carolinae-septrionalis*	O
Carya	*cordiformis*	O
Carya	*glabra*	O
Carya	*ovalis*	O
Carya	*ovata*	O
Carya	*pallida*	O
Cercis	*canadensis*	U
Chimiphila	*maculata*	U
Chionanthus	*virginicus*	U
Chrysopsis	*mariana*	U
Coreopsis	*major*	U
Cornus	*florida*	U
Cunila	*mariana*	U
Cypripedium	*acaule*	U
Desmodium	*laevigatum*	U
Desmodium	*nudiflorum*	U
Desmodium	*obtusum*	U
Desmodium	*perplexum*	U
Desmodium	*rotundifolium*	U
Dichanthelium	*spharocarpon*	U
Diospyros	*virginiana*	O
Elaphantopus	*spp.*	U
Euonymus	*americanus*	U
Euphorbia	*corollata*	U
Fraxinus	*americana*	O
Galium	*circaezans*	U
Galium	*pilosum*	U
Goodyera	*pubescens*	U
Hexastylis	*arifolia*	U
Hexastylis	*virginica*	U
Hieracium	*venosum*	U
Hypericum	*hypericoides*	U
Ilex	*decidua*	U
Juglans	*cinerea*	O
Lespedeza	*repens*	U
Liquidambar	*styraciflua*	O
Liriodendron	*tulipifera*	O
Nyssa	*sylvatica*	O
Ostrya	*virginiana*	U
Oxydendron	*arboreum*	O
Panicum	*spp.*	U
Persea	*borbonia*	O

GENUS	SPECIES	LAYER
Phyrma	*leptostachya*	U
Pinus	*echinata*	O
Pinus	*strobus*	O
Pinus	*taeda*	O
Pinus	*virginiana*	O
Piptochaetium	*avenaceum*	U
Polygonatum	*biflorum*	U
Prunus	*serotina*	O
Pycnanthemum	*flexuosum*	U
Quercus	*alba*	O
Quercus	*coccinea*	O
Quercus	*falcata*	O
Quercus	*marilandica*	O
Quercus	*muhlenburgii*	O
Quercus	*rubra*	O
Quercus	*shumardii*	O
Quercus	*stellata*	O
Quercus	*velutina*	O
Rhododendron	*canescens*	U
Rhododendron	*pericyclymenoides*	U
Rhus	*aromatica*	U
Rhynchosia	*tomentosa*	U
Scleria	*oligantha*	U
Solidago	*nemoralis*	U
Strophostyles	*umbellata*	U
Strylosanthes	*biflora*	U
Symphoricarpus	*orbiculatus*	U
Symplocos	*tinctoria*	U
Tephrosia	*virginiana*	U
Tipularia	*discolor*	U
Toxicodendron	*pubescens*	U
Trillium	*catesbaei*	U
Uvularia	*perfoliata*	U
Uvularia	*sessilifolia*	U
Vaccinium	*arboreum*	U
Viburnum	*acerifolium*	U
Viburnum	*prunifolium*	U
Viburnum	*rafinesquianum*	U
Viburnum	*rufidulum*	U

TABLE 9. Plants found in Pine Rockland communities.

GENUS	SPECIES	LAYER
Abildgaardia	*ovata*	U
Acacia	*choriophylla*	U
Acacia	*farnesiana*	U
Acacia	*pinetorum*	U
Acalypha	*chamaedrifolia*	U
Aeschynomene	*viscidula*	U
Agalinis	*fasciculata*	U
Agalinis	*obtusifolia*	U
Aletris	*bracteata*	U
Aletris	*lutea*	U
Alvaradoa	*amorphoides*	O
Amorpha	*herbacea var. crenulata*	U
Ampelopsis	*arborea*	U
Andropogon	*glomeratus var. pumilus*	U
Andropogon	*gyrans*	U
Andropogon	*longiberbis*	U
Andropogon	*ternarius*	U
Andropogon	*tracyi*	U
Andropogon	*virginicus var. decipiens*	U
Anemia	*adiantifolia*	U
Angadenia	*berteroi*	U
Ardisia	*escallonioides*	U
Argythamnia	*blodgettii*	U
Aristida	*beyrichiana*	U
Aristida	*condensata*	U
Aristida	*patula*	U
Aristida	*purpurascens*	U
Arnoglossum	*ovatum*	U
Asclepias	*connivens*	U
Asclepias	*lanceolata*	U
Asclepias	*longifolia*	U
Asclepias	*tuberosa*	U
Asclepias	*verticillata*	U
Asclepias	*viridis*	U
Aster	*adnatus*	U
Aster	*bracei*	U
Aster	*concolor*	U
Aster	*dumosus*	U
Aster	*elliottii*	U
Aster	*tortifolius*	U
Ayenia	*euphrasiifolia*	U
Baccharis	*angustifolia*	U
Baccharis	*glomeruliflora*	U

GENUS	SPECIES	LAYER
Baccharis	*halimifolia*	U
Bacopa	*monnieri*	U
Balduina	*angustifolia*	U
Basiphyllaea	*corallicola*	U
Berlandiera	*subacaulis*	U
Bidens	*alba var. radiata*	U
Blechnum	*serrulatum*	U
Bletia	*patula*	U
Bletia	*purpurea*	U
Boehmeria	*cylindrica*	U
Bourreria	*cassinifolia*	U
Bouteloua	*hirsuta*	U
Brickellia	*mosieri*	U
Buchnera	*americana*	U
Bulbostylis	*ciliatifolia*	U
Bulbostylis	*stenophylla*	U
Bursera	*simaruba*	O
Byrsonima	*lucida*	U
Caesalpinia	*pauciflora*	U
Callicarpa	*americana*	U
Capraria	*biflora*	U
Cardiospermum	*microcarpum*	U
Cassytha	*filiformis*	U
Catesbaea	*parviflora*	U
Catopsis	*berteroniana*	U
Cenchrus	*echinatus*	U
Cenchrus	*gracillimus*	U
Cenchrus	*incertus*	U
Centella	*erecta*	U
Centrosema	*virginianum*	U
Chamaecrista	*deeringiana*	U
Chamaecrista	*fasciculata*	U
Chamaecrista	*lineata var. keyensis*	U
Chamaecrista	*nictitans var. aspera*	U
Chamaesyce	*blodgettii*	U
Chamaesyce	*conferta*	U
Chamaesyce	*deltoidea subsp. Adhaerens*	U
Chamaesyce	*deltoidea subsp. Pinetorum*	U
Chamaesyce	*deltoidea subsp. Serpyllum*	U
Chamaesyce	*garberi*	U
Chamaesyce	*pergamena*	U
Chamaesyce	*porteriana*	U
Chaptalia	*albicans*	U

GENUS	SPECIES	LAYER
Chiococca	*alba*	U
Chiococca	*parvifolia*	U
Chloris	*elata*	U
Chromolaena	*odorata*	U
Chrysobalanus	*icaco*	U
Chrysophyllum	*oliviforme*	O
Chrysopogon	*pauciflorus*	U
Chrysopsis	*linearifolia var. Dressii*	U
Cirsium	*horridulum*	U
Cissus	*verticillata*	U
Citharexylum	*spinosum*	U
Cladium	*jamaicense*	U
Clematis	*baldwinii*	U
Clitoria	*mariana*	U
Cnidoscolus	*stimulosus*	U
Coccoloba	*uvifera*	U
Coccothrinax	*argentata*	O
Colubrina	*arborescens*	U
Colubrina	*cubensis var. floridana*	U
Commelina	*erecta*	U
Conocarpus	*erectus*	O
Conoclinium	*coelestinum*	U
Cordia	*bahamensis*	U
Coreopsis	*leavenworthii*	U
Crinum	*americanum*	U
Crossopetalum	*ilicifolium*	U
Crossopetalum	*rhacoma*	U
Crotalaria	*pumila*	U
Crotalaria	*rotundifolia*	U
Croton	*glandulosus*	U
Croton	*linearis*	U
Croton	*lobatus*	U
Cuscuta	*americana*	U
Cynanchum	*blodgettii*	U
Cyperus	*filiculmis*	U
Cyperus	*floridanus*	U
Cyperus	*ligularis*	U
Cyperus	*retrorsus*	U
Cyrtopodium	*punctatum*	U
Dalea	*carnea*	U
Dalea	*carthagenensis var. floridana*	U
Desmanthus	*virgatus*	U
Desmodium	*floridanum*	U

GENUS	SPECIES	LAYER
Desmodium	*incanum*	U
Desmodium	*lineatum*	U
Desmodium	*marilandicum*	U
Desmodium	*paniculatum*	U
Desmodium	*strictum*	U
Dichanthelium	*aciculare*	U
Dichanthelium	*commutatum*	U
Dichanthelium	*dichotomum*	U
Dichanthelium	*ensifolium var. unciphyllum*	U
Dichanthelium	*ovale*	U
Dichanthelium	*portoricense*	U
Dichanthelium	*strigosum var. glabrescens*	U
Digitaria	*filiformis var. dolicophylla*	U
Digitaria	*pauciflora*	U
Diodia	*teres*	U
Dodonaea	*angustifolia*	U
Dodonaea	*elaeagnoides*	U
Dyschoriste	*angusta*	U
Echites	*umbellata*	U
Elytraria	*caroliniensis var. angustifolia*	U
Encyclia	*tampensis*	U
Eragrostis	*elliottii*	U
Erechtites	*hieracifolia*	U
Erigeron	*quercifolius*	U
Eriochloa	*michauxii*	U
Ernodea	*cokeri*	U
Ernodea	*littoralis*	U
Eryngium	*baldwinii*	U
Erythrina	*herbacea*	U
Eugenia	*axillaris*	U
Eulophia	*alta*	U
Eupatorium	*capillifolium*	U
Eupatorium	*compositifolium*	U
Eupatorium	*leptophyllum*	U
Eupatorium	*mikanioides*	U
Eupatorium	*mohrii*	U
Eupatorium	*serotinum*	U
Euphorbia	*polyphylla*	U
Eustachys	*petraea*	U
Evolvulus	*grisebachii*	U
Evolvulus	*sericeus*	U
Exothea	*paniculata*	O
Ficus	*aurea*	O

GENUS	SPECIES	LAYER
Ficus	*citrifolia*	U
Fimbristylis	*caroliniana*	U
Flaveria	*linearis*	U
Forestiera	*segregata*	U
Galactia	*floridana*	U
Galactia	*pinetorum*	U
Galactia	*regularis*	U
Galactia	*smallii*	U
Galactia	*volubilis*	U
Galium	*hispidulum*	U
Gaura	*angustifolia*	U
Glandularia	*maritima*	U
Gnaphalium	*obtusifolium*	U
Guapira	*discolor*	O
Guettarda	*elliptica*	U
Guettarda	*scabra*	U
Gymnopogon	*ambiguus*	U
Gymnopogon	*brevifolius*	U
Habenaria	*quinqueseta*	U
Hamelia	*patens*	U
Hedyotis	*nigricans var. floridana*	U
Hedyotis	*procumbens*	U
Helenium	*flexuosum*	U
Helianthemum	*corymbosum*	U
Heliotropium	*angiospermum*	U
Heliotropium	*polyphyllum*	U
Herissantia	*crispa*	U
Heteropogon	*contortus*	U
Heterotheca	*subaxillaris*	U
Hieracium	*megacephalon*	U
Hymenocallis	*palmeri*	U
Hypelate	*trifoliata*	U
Hypericum	*hypericoides*	U
Hypoxis	*sessilis*	U
Hypoxis	*wrightii*	U
Hyptis	*alata*	U
Ilex	*cassine*	U
Ilex	*krugiana*	U
Imperata	*brasiliensis*	U
Indigofera	*miniata var. floridana*	U
Ipomoea	*cordatotriloba*	U
Ipomoea	*indica var. acuminata*	U
Ipomoea	*microdactyla*	U
Ipomoea	*sagittata*	U
Ipomoea	*tenuissima*	U
Iresine	*diffusa*	U
Jacquemontia	*curtisii*	U
Jacquemontia	*pentanthos*	U
Jacquinia	*keyensis*	U
Juncus	*megacephalus*	U
Juniperus	*virginiana*	O
Justicia	*angusta*	U
Koanophyllon	*villosum*	U
Lactuca	*graminifolia*	U
Lantana	*canescens*	U
Lantana	*depressa*	U
Lantana	*involucrata*	U
Lechea	*deckertii*	U
Lechea	*divaricata*	U
Lechea	*sessiliflora*	U
Lechea	*torreyi*	U
Liatris	*chapmanii*	U
Liatris	*gracilis*	U
Liatris	*tenuifolia*	U
Licania	*michauxii*	U
Lindernia	*dubia var. anagallidea*	U
Linum	*arenicola*	U
Linum	*carteri*	U
Linum	*carteri var. smallii*	U
Linum	*medium var. texanum*	U
Lobelia	*glandulosa*	U
Lobelia	*paludosa*	U
Ludwigia	*curtissii*	U
Ludwigia	*microcarpa*	U
Lyonia	*fruticosa*	U
Lysiloma	*latisiliquum*	O
Manilkara	*jaimiqui var. Emarginata*	U
Mecardonia	*acuminata var. Peninsularis*	U
Melanthera	*angustifolia*	U
Melanthera	*nivea*	U
Melanthera	*parvifolia*	U
Melochia	*tomentosa*	U
Melothria	*pendula*	U
Metopium	*toxiferum*	O
Mikania	*sandens*	U
Mimosa	*quadrivalvis var. angustata*	U
Mitreola	*petiolata*	U
Mitreola	*sessilifolia*	U

GENUS	SPECIES	LAYER
Morinda	*royoc*	U
Muhlenbergia	*capillaris*	U
Myrica	*cerifera*	U
Nephrolepis	*exaltata*	U
Neptunia	*pubescens*	U
Ocimum	*campechianum*	U
Odontosoria	*clavata*	U
Oncidium	*ensatum*	U
Opuntia	*humifusa*	U
Oxalis	*corniculata*	U
Palafoxia	*integrifolia*	U
Panicum	*tenerum*	U
Panicum	*virgatum*	U
Parietaria	*floridana*	U
Parthenocissus	*quinquefolia*	U
Paspalum	*blodgettii*	U
Paspalum	*caespitosum*	U
Paspalum	*floridanum*	U
Paspalum	*laxum*	U
Paspalum	*monostachyum*	U
Paspalum	*setaceum*	U
Passiflora	*suberosa*	U
Pectis	*glaucescens*	U
Penstemon	*multiflorus*	U
Pentalinon	*luteum*	U
Persea	*palustris*	O , U
Phaseolus	*polystachios var. sinuatus*	U
Phlebodium	*aureum*	U
Phyla	*nodiflora*	U
Phyla	*stoechadifolia*	U
Phyllanthus	*caroliniensis subsp. Saxicola*	U
Phyllanthus	*pentaphyllus var. floridanus*	U
Physalis	*walteri*	U
Physostegia	*purpurea*	U
Phytolacca	*americana*	U
Pilea	*microphylla*	U
Piloblephis	*rigida*	U
Pinguicula	*pumila*	U
Pinus	*elliottii var. densa*	O
Piriqueta	*caroliniana*	U
Pisonia	*rotundata*	U
Pithecellobium	*keyense*	U
Pityopsis	*graminifolia*	U

GENUS	SPECIES	LAYER
Pleopeltis	*polypodioides var. michauxiana*	U
Pluchea	*odorata*	U
Pluchea	*rosea*	U
Poinsettia	*cyathophora*	U
Poinsettia	*pinetorum*	U
Polanisia	*tenuifolia*	U
Polygala	*balduinii*	U
Polygala	*boykinii*	U
Polygala	*grandiflora*	U
Polygala	*incarnata*	U
Polygala	*smallii*	U
Polygonella	*ciliata*	U
Polygonella	*gracilis*	U
Polygonella	*polygama var. brachystachya*	U
Polypremum	*procumbens*	U
Ponthieva	*brittoniae*	U
Ponthieva	*racemosa*	U
Psidium	*longipes*	U
Psilotum	*nudum*	U
Psychotria	*ligustrifolia*	U
Psychotria	*nervosa*	U
Psychotria	*sulzneri*	U
Pteridium	*aquilinum var. caudatum*	U
Pteris	*bahamensis*	U
Pterocaulon	*pycnostachyum*	U
Pteroglossaspis	*ecristata*	U
Quercus	*minima*	U
Quercus	*pumila*	U
Quercus	*virginiana*	O
Randia	*aculeata*	U
Rapanea	*punctata*	U
Rayjacksonia	*phyllocephala*	U
Reynosia	*septentrionalis*	U
Rhus	*copallinum*	U
Rhynchosia	*cinerea*	U
Rhynchosia	*michauxii*	U
Rhynchosia	*minima*	U
Rhynchosia	*parvifolia*	U
Rhynchosia	*reniformis*	U
Rhynchospora	*colorata*	U
Rhynchospora	*divergens*	U
Rhynchospora	*floridensis*	U
Rhynchospora	*globularis*	U

GENUS	SPECIES	LAYER
Rhynchospora	*grayi*	U
Rhynchospora	*microcarpa*	U
Rhynchospora	*plumosa*	U
Ruellia	*succulenta*	U
Sabal	*etonia*	U
Sabal	*palmetto*	O
Sabatia	*stellaris*	U
Sachsia	*polycephala*	U
Salix	*caroliniana*	U
Salvia	*micrantha*	U
Samolus	*ebracteatus*	U
Schizachyrium	*gracile*	U
Schizachyrium	*rhizomatum*	U
Schizachyrium	*sanguineum*	U
Schoenus	*nigricans*	U
Schoepfia	*chrysophylloides*	U
Scleria	*ciliata*	U
Scleria	*verticillata*	U
Scutellaria	*havanensis*	U
Selaginella	*arenicola*	U
Selaginella	*armata var. eatonii*	U
Senna	*ligustrina*	U
Senna	*mexicana var. chapmanii*	U
Serenoa	*repens*	U
Setaria	*parviflora*	U
Seymeria	*pectinata*	U
Sida	*acuta*	U
Sida	*elliottii*	U
Sida	*rhombifolia*	U
Sideroxylon	*celastrinum*	U
Sideroxylon	*foetidissimum*	O , U
Sideroxylon	*reclinatum*	U
Sideroxylon	*reclinatum var. austrofloridense*	U
Sideroxylon	*salicifolium*	O , U
Sisyrinchium	*angustifolium*	U
Sisyrinchium	*nashii*	U
Smilax	*auriculata*	U
Smilax	*bona-nox*	U
Smilax	*havanensis*	U
Solanum	*americanum*	U
Solanum	*chenopodioides*	U
Solanum	*donianum*	U
Solanum	*erianthum*	U

GENUS	SPECIES	LAYER
Solidago	*gigantea*	U
Solidago	*odora var. chapmanii*	U
Solidago	*stricta*	U
Solidago	*tortifolia*	U
Sorghastrum	*secundum*	U
Spermacoce	*assurgens*	U
Spermacoce	*prostrata*	U
Spermacoce	*terminalis*	U
Spiranthes	*amesiana*	U
Spiranthes	*torta*	U
Sporobolus	*compositus var. clandestinus*	U
Sporobolus	*junceus*	U
Stachytarpheta	*jamaicensis*	U
Stenandrium	*dulce*	U
Stillingia	*sylvatica*	U
Strumpfia	*maritima*	U
Stylisma	*villosa*	U
Stylosanthes	*calcicola*	U
Swietenia	*mahagoni*	U
Symphoricarpus	*albus*	U
Tephrosia	*angustissima*	U
Tephrosia	*chrysophylla*	U
Tephrosia	*florida*	U
Tephrosia	*spicata*	U
Tetrazygia	*bicolor*	U
Teucrium	*canadense*	U
Thelypteris	*kunthii*	U
Thrinax	*morrisii*	O , U
Thrinax	*radiata*	O , U
Tillandsia	*balbisiana*	U
Tillandsia	*fasciculata var. densispica*	U
Tillandsia	*flexuosa*	U
Tillandsia	*paucifolia*	U
Tillandsia	*recurvata*	U
Tillandsia	*setacea*	U
Tillandsia	*usneoides*	U
Tillandsia	*utriculata*	U
Tillandsia	*variabilis*	U
Tillandsia	*smalliana*	U
Toxicodendron	*radicans*	U
Tragia	*saxicola*	U
Tragia	*urens*	U
Trema	*lamarckianum*	U
Trema	*micranthum*	U

GENUS	SPECIES	LAYER
Trichostema	*dichotomum*	U
Tripsacum	*floridanum*	U
Vaccinium	*myrsinites*	U
Verbesina	*virginica*	U
Vernonia	*blodgettii*	U
Vigna	*luteola*	U
Vitis	*aestivalis*	U
Vitis	*cinerea var. floridana*	U
Vitis	*rotundifolia*	U
Vitis	*shuttleworthii*	U
Vittaria	*lineata*	U
Waltheria	*indica*	U
Warea	*carteri*	U
Ximenia	*americana*	U
Zamia	*integrifolia*	U
Zamia	*pumila*	U
Zornia	*bracteata*	U

TABLE 10. Plant species found in Pine Savanna communities.

GENUS	SPECIES	LAYER
Acer	*rubrum*	O
Acmella	*oppositifolia var. repens*	U
Acrostichum	*danaeifolium*	U
Agalinis	*aphylla*	U
Agalinis	*obtusifolia*	U
Amorpha	*herbacea*	U
Amphicarpum	*muhlenbergianum*	U
Andropogon	*glomeratus var. pumilus*	U
Andropogon	*virginicus var. glomeratous*	U
Antheanantia	*villosa*	U
Aristida	*purpurascens*	U
Aristida	*virgata*	U
Arundinaria	*gigantea*	U
Asclepias	*incarnata*	U
Asclepias	*lanceolata*	U
Aster	*bracei*	U
Aster	*pilosus*	U
Aster	*squarrosus*	U
Bacopa	*caroliniana*	U
Bacopa	*monnieri*	U
Baptisia	*tinctoria*	U
Bartonia	*virginiana*	U
Blechnum	*serrulatum*	U
Bletia	*purpurea*	U
Boehmeria	*cylindrica*	U
Buchnera	*americana*	U
Calopogon	*spp.*	U
Carduus	*virginiana*	U
Carex	*verrucosa*	U
Carphephorus	*tomentosus*	U
Cassia	*fasciculata*	U
Centella	*erecta*	U
Chamaelirium	*luteum*	U
Chaptalia	*tomentosa*	U
Cirsium	*horridulum*	U
Cladium	*jamaicense*	U
Cleistes	*divaricata*	U
Conoclinium	*coelestinum*	U
Coreopsis	*falcata*	U
Coreopsis	*leavenworthii*	U
Crinum	*americanum*	U
Crotalaria	*purshii*	U
Cyperus	*odoratus*	U
Desmodium	*lineatum*	U
Desmodium	*tenuifolium*	U
Dichanthelium	*erectifolium*	U
Dichromena	*latifolia*	U
Diodia	*virginiana*	U
Dionaea	*muscipula*	U
Drosera	*intermedia*	U
Dyschoriste	*angusta*	U
Echinochloa	*walteri*	U
Elaphantopus	*nudatus*	U
Eleocharis	*cellulosa*	U
Eleocharis	*geniculata*	U
Elytraria	*caroliniensis var. angustifolia*	U
Eragrostis	*elliottii*	U
Eragrostis	*refracta*	U
Erigeron	*quercifolius*	U

GENUS	SPECIES	LAYER
Erigeron	*verna*	U
Eriocaulon	*decangulare*	U
Eryngium	*integrifolium*	U
Eryngium	*yuccafolium*	U
Eulophia	*alta*	U
Eupatorium	*capillifolium*	U
Eupatorium	*curtisii*	U
Eupatorium	*mikanioides*	U
Eupatorium	*rotundifolium*	U
Eustachys	*glauca*	U
Fimbristylis	*spadicea*	U
Flaveria	*linearis*	U
Fuirena	*scirpoidea*	U
Gymnopogon	*breviseta*	U
Helenium	*pinnatifidum*	U
Helianthus	*angustifolius*	U
Helianthus	*heterophyllus*	U
Heterotheca	*mariana*	U
Hibiscus	*grandiflorus*	U
Hydrolea	*corymbosa*	U
Hymenocallis	*palmeri*	U
Hypericum	*brachyphyllum*	U
Hypoxis	*micrantha*	U
Hyptis	*alata*	U
Ilex	*cassine*	U
Ipomoea	*sagittata*	U
Justicia	*angusta*	U
Lachnanthes	*caroliniana*	U
Lachnocaulon	*anceps*	U
Leersia	*hexandra*	U
Lespedeza	*captitata*	U
Liatris	*graminifolia*	U
Liatris	*spicata*	U
Lilium	*catesbaei*	U
Linum	*virginianum*	U
Lobelia	*gland ulosa*	U
Lobelia	*nuttalii*	U
Ludwigia	*repens*	U
Ludwigia	*virgata*	U
Lycopodium	*alopecuroides*	U
Mikania	*scand ens*	U
Muhlenbergia	*capillaris*	U
Myrica	*cerifera*	U
Nymphoides	*aquatica*	U

GENUS	SPECIES	LAYER
Osmunda	*cinnamomea*	U
Osmunda	*regalis var. spectabilis*	U
Oxypolis	*filiformis*	U
Oxypolis	*ternata*	U
Panicum	*ciliatum*	U
Panicum	*hemitomon*	U
Paspalum	*monostachyum*	U
Pelandra	*virginica*	U
Phlebodium	*aureum*	U
Pinguicula	*pumila*	U
Piriqueta	*caroliniana*	U
Pleea	*tenuifolia*	U
Pluchea	*odorata*	U
Pluchea	*rosea*	U
Polygala	*cruciata*	U
Polygala	*grandiflora*	U
Polygala	*hookeri*	U
Polygala	*lutea*	U
Polygala	*ramosa*	U
Polygonum	*densiflorum*	U
Pontederia	*cordata*	U
Prenanthes	*autumnalis*	U
Pteridium	*aquilinum*	U
Pterocaulon	*pychnostachyum*	U
Rhexia	*lutea*	U
Rhexia	*mariana*	U
Rhynchospora	*ciliaris*	U
Rhynchospora	*colorata*	U
Rhynchospora	*inundata*	U
Rhynchospora	*plumosa*	U
Ruellia	*succulenta*	U
Sabal	*palmetto*	O
Sabatia	*difformis*	U
Sabatia	*stellaris*	U
Saccharum	*giganteum*	U
Sagittaria	*lancifolia*	U
Samolus	*ebracteatus*	U
Sarcostemma	*clausum*	U
Sarracenia	*flava*	U
Sarracenia	*rubra*	U
Schizachyrium	*rhizomatum*	U
Schoenolirion	*albiflorum*	U
Scleria	*pauciflora*	U
Scleria	*reticularis*	U

GENUS	SPECIES	LAYER
Serenoa	*repens*	U
Seymeria	*cassiodes*	U
Sisyrinchium	*angustifolium*	U
Smilax	*glauca*	U
Smilax	*laurifolia*	U
Smilax	*walteri*	U
Solidago	*gigantea*	U
Solidago	*stricta*	U
Spartina	*bakeri*	U
Spiranthes	*praecox*	U
Stenandrium	*dulce*	U
Stillingia	*aquatica*	U
Stylosanthes	*biflora*	U
Sysyrinchium	*arenicola*	U
Tephrosia	*hispidula*	U
Teucrium	*canadense*	U
Thalia	*geniculata*	U
Thelypteris	*kunthii*	U
Thelypteris	*palustris var. pubsecens*	U
Tillandsia	*recurvata*	U
Trilisa	*paniculata*	U
Typha	*domingensis*	U
Utricularia	*foliosa*	U
Utricularia	*purpurea*	U
Vernonia	*blodgettii*	U
Viola	*primulaefolia*	U
Viola	*septemloba*	U
Woodwardia	*virginica*	U
Xyris	*ambigua*	U
Xyris	*smallii*	U

TABLE 11. Plant species found in Rockland Hammock communities.

GENUS	SPECIES	LAYER
Abutilon	*permolle*	U
Acacia	*choriophylla*	U
Acacia	*farnesiana*	U
Acacia	*macracantha*	U
Acacia	*pinetorum*	U
Acanthocereus	*tetragonus*	U
Acer	*rubrum*	O
Adiantum	*capillus-veneris*	U
Adiantum	*melanoleucum*	U
Adiantum	*tenerum*	U
Adiantum	*villosum*	U
Agave	*decipiens*	U
Ageratum	*littorale*	U
Alvaradoa	*amorphiodes*	O
Alvaradoa	*amorphoides*	O
Ampelopsis	*arborea*	U
Amphitecna	*latifolia*	U
Amyris	*balsamifera*	U
Amyris	*elemifera*	U
Andropogon	*glomeratus var. pumilus*	U
Anemia	*adiantifolia*	U
Annona	*glabra*	U
Ardisia	*escallonioides*	U
Ardisia	*escallonoides*	U
Argythamnia	*blodgettii*	U
Aristolochia	*pentandra*	U
Asplenium	*abscissum*	U
Asplenium	*dentatum*	U
Asplenium	*serratum*	U
Asplenium	*verecundum*	U
Asplenium	*Xbiscaynianum*	U
Baccharis	*angustifolia*	U
Baccharis	*dioica*	U
Baccharis	*glomeruliflora*	U
Baccharis	*halimifolia*	U
Berchemia	*scandens*	U
Bidens	*alba var. radiata*	U
Blechnum	*serrulatum*	U
Boehmeria	*cylindrica*	U
Bourreria	*ovata*	U
Bourreria	*radula*	U
Bourreria	*succulenta*	U
Brassia	*caudata*	U
Bursera	*simaruba*	O
Byrsonima	*lucida*	U
Caesalpinia	*bonduc*	U
Caesalpinia	*crista*	U
Caesalpinia	*major*	U
Caesalpinia	*pauciflora*	U

GENUS	SPECIES	LAYER
Callicarpa	*americana*	U
Calyptranthes	*pallens*	U
Calyptranthes	*zuzygium*	U
Campyloneurum	*angustifolium*	U
Campyloneurum	*costatum*	U
Campyloneurum	*phyllitidis*	U
Canella	*winterana*	U
Canella	*winteriana*	U
Capparis	*cynophallophora*	O
Capparis	*flexuosa*	O
Capsicum	*annuum var. glabriusculum*	U
Cardiospermum	*corindum*	U
Cardiospermum	*microcarpum*	U
Cassytha	*filiformis*	U
Catesbaea	*parviflora*	U
Catopsis	*berteroniana*	U
Catopsis	*floribunda*	U
Cayaponia	*americana*	U
Celosia	*nitida*	U
Celtis	*laevigata*	O , U
Cenchrus	*brownii*	U
Centrosema	*virginianum*	U
Cephalanthus	*occidentalis*	U
Chamaesyce	*blodgettii*	U
Chiococca	*alba*	U
Chiococca	*parvifolia*	U
Chloris	*elata*	U
Chromolaena	*frustrata*	U
Chromolaena	*odorata*	U
Chrysobalanus	*icaco*	U
Chrysophyllum	*oliviforme*	O
Chyrsobalanus	*icaco*	U
Cissampelos	*pareira*	U
Cissus	*trifoliata*	U
Cissus	*verticillata*	U
Citharexylum	*spinosum*	U
Citherexylum	*fruticosum*	U
Clusia	*rosea*	O
Coccoloba	*diversifolia*	O
Coccoloba	*uvifera*	U
Coccothrinax	*argentata*	O
Colubrina	*arborescens*	U
Colubrina	*cubensis*	U
Colubrina	*elliptica*	U

GENUS	SPECIES	LAYER
Conocarpus	*erectus*	O
Corchorus	*siliquosus*	U
Cordia	*foemina*	U
Cordia	*globosa*	U
Cordia	*sebestena*	U
Cranichis	*muscosa*	U
Crossopetalum	*ilicifolium*	U
Crossopetalum	*rhacoma*	U
Croton	*humilis*	U
Croton	*lobatus*	U
Ctenitis	*sloanei*	U
Ctenitis	*submarginalis*	U
Cupania	*glabra*	U
Cuscuta	*americana*	U
Cynanchum	*northropiae*	U
Cynanchum	*scoparium*	U
Cyperus	*fuligineus*	U
Cyperus	*ligularis*	U
Cyperus	*planifolius*	U
Cyperus	*retrorsus*	U
Cyperus	*tetragonus*	U
Dalbergia	*brownii*	U
Dalbergia	*ecastaphyllum*	U
Desmanthus	*virgatus*	U
Dichanthelium	*commutatum*	U
Dicliptera	*sexangularis*	U
Diospyros	*virginiana*	U
Dipholis	*salicifolia*	O
Dodonaea	*elaeagnoides*	U
Dodonaea	*viscosa*	U
Drypetes	*diversifolia*	U
Drypetes	*lateriflora*	U
Echinodorus	*berteroi*	U
Echites	*umbellata*	U
Eltroplectris	*calcarata*	U
Encyclia	*boothiana var. erythroniodes*	U
Encyclia	*cochleata*	U
Encyclia	*tampensis*	U
Epidendrum	*floridense*	U
Epidendrum	*nocturnum*	U
Epidendrum	*rigidum*	U
Erithalis	*fruticosa*	U
Ernodea	*cokeri*	U
Erythrina	*herbacea*	U

GENUS	SPECIES	LAYER
Erythrodes	*querceticola*	U
Eugenia	*axillaris*	U
Eugenia	*confusa*	U
Eugenia	*foetida*	O
Eugenia	*rhombea*	O
Eupatorium	*villosum*	U
Exostema	*caribaeum*	O
Exothea	*paniculata*	O
Ficus	*aurea*	O
Ficus	*citrifolia*	U
Forestiera	*segregata*	U
Galactia	*striata*	U
Galeandra	*beyrichii*	U
Galium	*hispidulum*	U
Genipa	*clusiifolia*	U
Gossypium	*hirsutum*	U
Gouania	*lupuloides*	O
Govenia	*utriculata*	U
Guajacum	*sanctum*	O
Guapira	*discolor*	O
Guettarda	*eliptica*	U
Guettarda	*scabra*	U
Guzmania	*monostachia*	U
Gyminda	*latifolia*	U
Gymnanthes	*lucida*	U
Habenaria	*floribunda*	U
Hamelia	*patens*	U
Harrisia	*fragrans*	U
Harrisia	*simpsonii*	U
Heliotropium	*fruticosum*	U
Herissantia	*crispa*	U
Hibiscus	*poeppigii*	U
Hippocratea	*volubilis*	U
Hippomane	*mancinella*	U
Hypelate	*trifoliata*	U
Hypolepis	*repens*	U
Ilex	*cassine*	U
Ilex	*krugiana*	U
Indigofera	*mucronata var. keyensis*	U
Ipomoea	*alba*	U
Ipomoea	*indica var. acuminata*	U
Ipomoea	*violacea*	U
Jacquemontia	*havanensis*	U
Jacquemontia	*pentanthos*	U

GENUS	SPECIES	LAYER
Jacquinia	*keyensis*	U
Koanophyllon	*villosum*	U
Krugiodendron	*ferreum*	O
Lantana	*involucrata*	U
Lasiacis	*divaricata*	U
Leersia	*monandra*	U
Leiphaimos	*parasitica*	U
Licaria	*triandra*	U
Lomariopsis	*kunzeana*	U
Lysiloma	*bahamensis*	O
Lysiloma	*latisiliquum*	O
Macradenia	*lutescens*	U
Magnolia	*virginiana*	U
Manilkara	*jaimiqui*	U
Mastichodendron	*foetidissimum*	O
Maytenus	*phyllanthoides*	U
Melothria	*pendula*	U
Metopium	*toxiferum*	O
Microgramma	*heterophylla*	U
Mikania	*cordifolia*	U
Mikania	*scandens*	U
Morinda	*royoc*	U
Morus	*rubra*	O , U
Mucuna	*sloanei*	U
Myrcianthes	*fragrans*	O
Myrica	*cerifera*	U
Myrsine	*floridana*	U
Nama	*jamaicensis*	U
Nectandra	*coriacea*	O
Nephrolepis	*biserrata*	U
Nephrolepis	*exaltata*	U
Nephrolepis	*xaveryi*	U
Ocimum	*campechianum*	U
Ocotea	*coriacea*	U
Odontosoria	*clavata*	U
Oncidium	*ensatum*	U
Oncidium	*undulatum*	U
Ophioglossum	*palmatum*	U
Oplismenus	*hirtellus*	U
Opuntia	*cubensis*	U
Oxalis	*corniculata*	U
Parietaria	*floridana*	U
Parietaria	*praetermissa*	U
Parthenocissus	*quinquefolia*	U

GENUS	SPECIES	LAYER
Paspalidium	*chapmanii*	U
Paspalum	*blodgettii*	U
Paspalum	*caespitosum*	U
Paspalum	*laxum*	U
Passiflora	*multiflora*	U
Passiflora	*pallens*	U
Passiflora	*sexflora*	U
Passiflora	*suberosa*	U
Pecluma	*dispersa*	U
Pecluma	*plumula*	U
Pecluma	*ptilodon var. caespitosa*	U
Pelexia	*adnata*	U
Pentalinon	*luteum*	U
Peperomia	*magnoliifolia*	U
Peperomia	*obtusifolia*	U
Persea	*borbonia*	O
Persea	*palustris*	O , U
Petiveria	*alliacea*	U
Phlebodium	*aureum*	U
Phoradendron	*rubrum*	U
Phytolacca	*americana*	U
Picramnia	*pentandra*	U
Pilea	*microphylla*	U
Piscidia	*piscipula*	O
Pisonia	*aculeata*	U
Pisonia	*rotundata*	U
Pithecellobium	*keyense*	U
Pithecellobium	*unguis-cati*	U
Pleopeltis	*polypodioides var. michauxiana*	U
Plumbago	*scandens*	U
Polystachya	*concreta*	U
Ponthieva	*racemosa*	U
Prescotia	*oligantha*	U
Prunus	*myrtifolia*	U
Pseudophoenix	*sargentii*	O
Psidium	*longipes*	U
Psilotum	*nudum*	U
Psuedophoenix	*sargentii*	U
Psychotria	*ligustrifolia*	U
Psychotria	*nervosa*	U
Psychotria	*sulzneri*	U
Pteridium	*aquilinum var. caudatum*	U
Pteris	*bahamensis*	U

GENUS	SPECIES	LAYER
Quercus	*laurifolia*	O
Quercus	*virginiana*	O
Randia	*aculeata*	U
Rapanea	*punctata*	U
Reynosia	*septentrionalis*	U
Rhus	*copallinum*	U
Rhynchosia	*minima*	U
Rhynchosia	*parvifolia*	U
Rhynchosia	*phaseoloides*	U
Rhynchosia	*swartzii*	U
Rivina	*humilis*	U
Roystonea	*regia*	U
Sabal	*palmetto*	O
Sacoila	*lanceolata var. paludicola*	U
Salix	*caroliniana*	U
Salvia	*micrantha*	U
Sapindus	*saponaria*	U
Sarcostemma	*clausum*	U
Savia	*bahamensis*	U
Schaefferia	*frutescens*	U
Schizaea	*pennula*	U
Schoepfia	*chrysophylloides*	U
Scleria	*lithosperma*	U
Senna	*ligustrina*	U
Senna	*mexicana var. chapmanii*	U
Serenoa	*repens*	U
Setaria	*macrosperma*	U
Setaria	*parviflora*	U
Sida	*abutifolia*	U
Sideroxylon	*celastrinum*	U
Sideroxylon	*foetidissimum*	U
Sideroxylon	*reclinatum*	U
Sideroxylon	*salicifolium*	U
Simarouba	*glauca*	U
Smilax	*auriculata*	U
Smilax	*bona-nox*	U
Smilax	*havanensis*	U
Smilax	*laurifolia*	U
Solanum	*americanum*	U
Solanum	*bahamense*	U
Solanum	*donianum*	U
Solanum	*erianthum*	U
Sophora	*tomentosa var. truncata*	U
Spiranthes	*costaricensis*	U

GENUS	SPECIES	LAYER
Spiranthes	*cranichoides*	U
Spiranthes	*elata*	U
Spiranthes	*polyantha*	U
Swietenia	*mahagoni*	U
Tectaria	*fimbriata*	U
Tectaria	*heracleifolia*	U
Tetrazygia	*bicolor*	U
Thelypteris	*augescens*	U
Thelypteris	*hispidula var. versicolor*	U
Thelypteris	*kunthii*	U
Thelypteris	*ovata*	U
Thelypteris	*patens*	U
Thelypteris	*reptans*	U
Thelypteris	*reticulata*	U
Thelypteris	*sclerophylla*	U
Thrinax	*morrisii*	O , U
Thrinax	*radiata*	U
Tillandsia	*balbisiana*	U
Tillandsia	*fasciculata*	U
Tillandsia	*flexuosa*	U
Tillandsia	*paucifolia*	U
Tillandsia	*recurvata*	U
Tillandsia	*setacea*	U
Tillandsia	*usneoides*	U
Tillandsia	*utriculata*	U
Tillandsia	*variabilis*	U
Tillandsia	*floridana*	U
Tillandsia	*smalliana*	U
Tournefortia	*hirsutissima*	U
Tournefortia	*volubilis*	U
Toxicodendron	*radicans*	U
Trema	*lamarckianum*	U
Trema	*micranthum*	U
Trichomanes	*krausii*	U
Trichomanes	*punctatum subsp. Floridanum*	U
Trichostigma	*octandrum*	U
Tridens	*flavus*	U
Triphora	*gentianoides*	U
Tropidia	*polystachya*	U
Turbina	*corymbosa*	U
Urochloa	*adspersa*	U
Vallesia	*antillana*	U
Vallesia	*glabra*	U
Vanilla	*barbellata*	U
Vanilla	*dilloniana*	U
Verbesina	*virginica*	U
Viburnum	*obovatum*	U
Vitis	*cinerea var. floridana*	U
Vitis	*labrusca*	U
Vitis	*rotundifolia*	U
Vitis	*shuttleworthii*	U
Vittaria	*lineata*	U
Ximenia	*americana*	U
Yucca	*aloifolia*	U
Zamia	*integrifolia*	U
Zamia	*pumila*	U
Zanthoxylum	*clava-herculis*	U
Zanthoxylum	*fagara*	U
Zanthoxylum	*flavum*	U

TABLE 12. Plant species found in Sandhill communities.

GENUS	SPECIES	LAYER
Acer	*rubrum*	O
Ageratina	*aromatica*	O
Amelanchier	*americana*	U
Andropogon	*gerardii*	U
Andropogon	*gyrans*	U
Andropogon	*ternarius*	U
Andropogon	*virginicus*	U
Aralia	*spinosa*	U
Aristida	*beyrichiana*	U
Aristida	*mohrii*	U
Aristida	*purpurescens var. purpurescens*	U
Aristida	*spiciformis*	U
Aristolochia	*tomentosa*	U
Asimina	*incarna*	U
Aster	*dumosus*	U
Aster	*latiflorus*	U
Aster	*linarifolius*	U
Aster	*patens*	U
Balduina	*angustifolia*	U

GENUS	SPECIES	LAYER
Berchamia	*scandens*	U
Bidens	*alba var. radiata*	U
Bignonia	*capreolata*	U
Bulbostylis	*ciliatifolia*	U
Bumelia	*lanuginosa*	U
Callicarpa	*americana*	U
Carpinus	*caroliniana*	U
Carya	*floridana*	O , U
Cassytha	*filiformis*	U
Castanea	*pumila*	U
Chasmanium	*laxum*	U
Clitoria	*mariana*	U
Cnidoscolus	*stimulosus*	U
Cnidoscolus	*texanus*	U
Commelina	*erecta*	U
Cornus	*florida*	O
Crataegus	*spp.*	O , U
Crotalaria	*rotundifolia*	U
Croton	*argyranthemus*	U
Desmodium	*rotundifolium*	U
Dichanthelium	*aciculare*	U
Dichanthelium	*acuminatum*	U
Dichanthelium	*oligosanthes*	U
Digitaria	*cognata*	U
Diodea	*teres*	U
Diospyros	*virginiana*	U
Elaphantopus	*spp.*	U
Eragrostis	*spp.*	U
Eriogonum	*tomentosum*	U
Eryngium	*aromaticum*	U
Euphorbia	*corollata*	U
Euphorbia	*floridana*	U
Evolvulus	*sericeus*	U
Froelichia	*floridana*	U
Fuirena	*scirpoidea*	U
Galactia	*microphylla*	U
Gelsemium	*sempervirens*	U
Gymnopogon	*spp.*	U
Hedyotis	*procumbens*	U
Helianthus	*angustifolius*	U
Hieracium	*megacephalon*	U
Hypericum	*megacephalon*	U
Hypericum	*gentianoides*	U
Ilex	*ambigua*	U

GENUS	SPECIES	LAYER
Ilex	*deciduas*	U
Ilex	*glabra*	U
Ilex	*opaca*	O , U
Ilex	*vomitoria*	U
Ionactus	*linariifolius*	U
Juncus	*spp.*	U
Lachnocaulon	*beyrichianum*	U
Lechea	*sessiflora*	U
Lechea	*torreyi*	U
Liatris	*chapmanii*	U
Licania	*michauxii*	U
Liquidambar	*styraciflua*	O
Lyonia	*ferruginea*	O , U
Lyonia	*fruticosa*	U
Magnolia	*grandiflora*	O
Magnolia	*virginiana*	O
Mimosa	*quadrivalvis var. angustata*	U
Mitchella	*repens*	U
Myrica	*cerifera*	U
Nyssa	*sylvatica*	O , U
Opuntia	*humifusa*	U
Osmanthus	*americana*	U
Panicum	*capillare*	U
Panicum	*dichotimiflorum*	U
Panicum	*virgatum*	U
Parthenocissus	*quinquefolia*	U
Paspalum	*setaceum*	U
Persea	*borbonia*	O , U
Phlebodium	*aureum*	U
Piloblephis	*rigida*	U
Pinus	*clausa*	O , U
Pinus	*elliotii*	O , U
Pinus	*palustris*	O
Pityopsis	*aspera*	U
Pityopsis	*graminifolia*	U
Pleopeltis	*polypodioides var. michauxiana*	U
Polanisia	*tenuifolia*	U
Polygala	*grandiflora*	U
Polygala	*smallii*	U
Polygonella	*ciliata*	U
Polygonella	*polygama*	U
Polygonella	*robusta*	U
Prunus	*serotina*	U

GENUS	SPECIES	LAYER
Pteridium	*aquilinum*	U
Quercus	*chapmanii*	O , U
Quercus	*falcata*	O , U
Quercus	*geminata*	O , U
Quercus	*hemisphaerica*	U
Quercus	*incana*	O , U
Quercus	*laevis*	O , U
Quercus	*laurifolia*	O , U
Quercus	*margarettiae*	O
Quercus	*marilandica*	O
Quercus	*minima*	U
Quercus	*myrtifolia*	O , U
Quercus	*nigra*	O , U
Quercus	*stellata*	O
Rhus	*copallina*	U
Rhus	*copallinium*	U
Rhynchosia	*cystoides*	U
Rhynchosia	*reniformis*	U
Rhynchospora	*grayi*	U
Rhynchospora	*intermedia*	U
Rhynchospora	*megalocarpa*	U
Rubus	*argutus*	U
Rudbeckia	*hirta*	U
Sabal	*palmetto*	O
Sabatia	*brevifolia*	U
Sassafras	*albidum*	O
Schizachyrium	*scoparium*	U
Schizachyrium	*tenerum*	U
Schoenocaulon	*dubium*	U
Scleria	*ciliata*	U
Selaginella	*arenicola*	U
Serenoa	*repens*	U
Setaria	*parviflora*	U
Sisyrinchium	*nashii*	U
Smilax	*auriculata*	U
Smilax	*bona-nox*	U
Smilax	*glauca*	U
Smilax	*laurifolia*	U
Smilax	*pumila*	U

GENUS	SPECIES	LAYER
Smilax	*rodundifolia*	U
Smilax	*smallii*	U
Solidago	*odora*	U
Sorghastrum	*nutans*	U
Sorghastrum	*secundum*	U
Sporobolus	*junceus*	U
Stillingia	*sylvatica*	U
Stylisma	*humistrata*	U
Styllingia	*sylvatica*	U
Stylodon	*carneum*	U
Stylosanthes	*biflora*	U
Sylisma	*patens*	U
Symplocos	*tinctoria*	U
Tephrosia	*mohrii*	U
Tephrosia	*onobrychiodes*	U
Tephrosia	*virginiana*	U
Tillandsia	*fasciculata var. densispica*	U
Tillandsia	*flexuosa*	U
Tillandsia	*paucifolia*	U
Tillandsia	*recurvata*	U
Tillandsia	*usneoides*	U
Tillandsia	*utriculata*	U
Toxicodendron	*radicans*	U
Tragia	*smallii*	U
Tragia	*urticifolia*	U
Trichostema	*dichotomum*	U
Triplasis	*americana*	U
Vaccinium	*arboreum*	U
Vaccinium	*darrowii*	
Vaccinium	*elliotii*	U
Vaccinium	*myrsinites*	U
Vaccinium	*stamineum*	U
Viburnum	*dentatum*	U
Viburnum	*rufidulum*	U
Viola	*septemloba*	U
Vitis	*labrusca*	U
Vitis	*rotundifolia*	U
Ximenia	*americana*	U
Yucca	*filamentosa*	U

TABLE 13. Plant species found in Scrub communities.

GENUS	SPECIES	LAYER
Amorpha	*herbacea*	U
Andropogon	*floridanus*	U
Andropogon	*longiberbis*	U
Andropogon	*ternarius*	U
Andropogon	*virginicus var. glaucus*	U
Aristida	*beyrichiana*	U
Aristida	*condensata*	U
Aristida	*gyrans*	U
Asclepias	*curtissii*	U
Asclepias	*feayi*	U
Asclepias	*humistrata*	U
Asclepias	*tomentosa*	U
Asimina	*obovata*	U
Asimina	*reticulata*	U
Asimina	*tetramera*	U
Balduina	*angustifolia*	U
Bidens	*alba var. radiata*	U
Bulbostylis	*ciliatifolia*	U
Bulbostylis	*warei*	U
Bumelia	*lanuginosa*	O , U
Bumelia	*tenax*	U
Calamintha	*ashei*	U
Callisia	*ornata*	U
Carya	*floridana*	O , U
Carya	*glabra*	O , U
Cassytha	*filiformis*	U
Cenchrus	*incertus*	U
Ceratiola	*ericoides*	U
Chamaecrista	*fasciculata*	U
Chamaesyce	*cumulicola*	U
Chapmannia	*floridana*	U
Chrysobalanus	*icaco*	U
Chrysopsis	*scabrella*	U
Cnidoscolus	*stimulosus*	U
Commelina	*erecta*	U
Conradina	*grandiflora*	U
Crotalaria	*rotundifolia*	U
Croton	*glandulosus*	U
Cuscuta	*exaltata*	U
Cyperus	*retrorsus*	U
Dalea	*feayi*	U
Dichanthelium	*ensifolium var. breve*	U
Dichanthelium	*portoricense*	U
Dodonaea	*angustifolia*	U
Encyclia	*tampensis*	U
Euphorbia	*polyphylla*	U
Ficus	*aurea*	O
Froelichia	*floridana*	U
Galactia	*regularis*	U
Gymnopogon	*chapmanianus*	U
Helianthemum	*corymbosum*	U
Helianthemum	*nashii*	U
Heterotheca	*subaxillaris*	U
Hypericum	*reductum*	U
Ilex	*opaca*	O , U
Ilex	*opaca var. arenicola*	O , U
Lantana	*involucrata*	U
Lechea	*cernua*	U
Lechea	*deckertii*	U
Lechea	*divaricata*	U
Lechea	*lakelae*	U
Lechea	*sessiliflora*	U
Lechea	*torreyi*	U
Liatris	*chapmanii*	U
Liatris	*tenuifolia var. quadriflora*	U
Licania	*michauxii*	U
Linaria	*floridana*	U
Lupinus	*diffusus*	U
Lyonia	*ferruginea*	O , U
Lyonia	*fruticosa*	U
Magnolia	*grandiflora*	O , U
Metopium	*toxiferum*	O
Mimosa	*quadrivalvis var. angustata*	U
Monotropa	*uniflora*	U
Myrica	*cerifera*	U
Opuntia	*compressa*	U
Opuntia	*humifusa*	U
Osmanthus	*americana*	O , U
Palafoxia	*feayi*	U
Palafoxia	*integrifolia*	U
Panicum	*spp.*	U
Paronychia	*americana*	U
Persea	*borbonia var. humilis*	O , U
Persea	*humilis*	O , U
Phlebodium	*aureum*	U
Phoebanthus	*grandiflorus*	U

GENUS	SPECIES	LAYER
Phyllanthus	*abnormis*	U
Physalis	*walteri*	U
Piloblephis	*rigida*	U
Pinus	*clausa*	O , U
Pityopsis	*graminifolia*	U
Pleopeltis	*polypodioides var. michauxiana*	U
Polanisia	*tenuifolia*	U
Polygala	*grandiflora*	U
Polygala	*smallii*	U
Polygonella	*ciliata*	U
Polygonella	*gracilis*	U
Polygonella	*polygama*	U
Polygonella	*robusta*	U
Psilotum	*nudum*	U
Quercus	*chapmanii*	O , U
Quercus	*geminata*	O , U
Quercus	*hemisphaerica*	O , U
Quercus	*inopina*	O
Quercus	*laevis*	O , U
Quercus	*myrtifolia*	O , U
Rhus	*copallinum*	O , U
Rhynchosia	*cinerea*	U
Rhynchospora	*megalocarpa*	U
Sabal	*etonia*	U
Sabal	*palmetto*	O
Schizachyrium	*niveum*	U
Schizachyrium	*sanguineum*	U
Schoenocaulon	*dubium*	U
Scleria	*triglomerata*	U
Selaginella	*arenicola*	U
Serenoa	*repens*	U
Seymeria	*pectinata*	U

GENUS	SPECIES	LAYER
Sideroxylon	*celastrinum*	U
Sideroxylon	*tenax*	U
Sisyrinchium	*xerophyllum*	U
Smilax	*auriculata*	U
Smilax	*bona-nox*	U
Solidago	*odora var. chapmanii*	U
Sophora	*tomentosa*	U
Stipulicida	*setacea*	U
Stylisma	*abdita*	U
Stylisma	*villosa*	U
Tillandsia	*fasciculata var. densispica*	U
Tillandsia	*flexuosa*	U
Tillandsia	*paucifolia*	U
Tillandsia	*recurvata*	U
Tillandsia	*usneoides*	U
Tillandsia	*utriculata*	U
Tolumnia	*bahamensis*	U
Toxicodendron	*radicans*	U
Trichostema	*dichotomum*	U
Triplasis	*americana*	U
Triplasis	*purpurea*	U
Vaccinium	*arboreum*	O , U
Vaccinium	*darrowii*	U
Vaccinium	*myrsinites*	U
Vaccinium	*stamineum*	O , U
Vitis	*munsoniana*	U
Vitis	*rotundifolia*	U
Warea	*carteri*	U
Ximenia	*americana*	O , U
Yucca	*aloifolia*	U
Zanthoxylum	*clava-herculis*	U

TABLE 14. Plant species found in Scrubby Flatwoods communities.

GENUS	SPECIES	LAYER
Aeschynomene	*viscidula*	U
Agalinis	*fasciculata*	U
Agalinis	*filifolia*	U
Amorpha	*herbacea*	U
Andropogon	*floridanus*	U
Andropogon	*gyrans*	U
Andropogon	*longiberbis*	U
Andropogon	*ternarius*	U
Andropogon	*virginicus var. glaucus*	U
Aristida	*beyrichiana*	U
Aristida	*condensata*	U
Aristida	*gyrans*	U
Aristida	*purpurascens*	U
Aristida	*spiciformis*	U

GENUS	SPECIES	LAYER
Asclepias	*curtissii*	U
Asclepias	*feayi*	U
Asclepias	*tomentosa*	U
Asclepias	*tuberosa*	U
Asimina	*reticulata*	U
Asimina	*tetramera*	U
Aster	*tortifolius*	U
Aureolaria	*pedicularia var. pectinata*	U
Balduina	*angustifolia*	U
Bejaria	*racemosa*	U
Bidens	*alba var. radiata*	U
Bulbostylis	*ciliatifolia*	U
Callisia	*ornata*	U
Carphephorus	*odoratissimus*	U
Carya	*floridana*	O , U
Cassytha	*filiformis*	U
Cenchrus	*incertus*	U
Centrosema	*virginianum*	U
Chamaecrista	*fasciculata*	U
Chamaecrista	*nictitans var. aspera*	U
Chamaesyce	*cumulicola*	U
Chapmannia	*floridana*	U
Chrysobalanus	*icaco*	U
Clitoria	*mariana*	U
Cnidoscolus	*stimulosus*	U
Coccoloba	*uvifera*	O
Commelina	*erecta*	U
Conradina	*grandiflora*	U
Crotalaria	*rotundifolia*	U
Croton	*glandulosus*	U
Cuscuta	*exaltata*	U
Cyperus	*retrorsus*	U
Dalbergia	*ecastaphyllum*	U
Dalea	*feayi*	U
Dalea	*pinnata var. adenopoda*	U
Desmodium	*floridanum*	U
Dichanthelium	*aciculare*	U
Dichanthelium	*ensifolium var. breve*	U
Dichanthelium	*portoricense*	U
Encyclia	*tampensis*	U
Eragrostis	*elliottii*	U
Eryngium	*aromaticum*	U
Erythrina	*herbacea*	U
Eupatorium	*mohrii*	U

GENUS	SPECIES	LAYER
Euphorbia	*polyphylla*	U
Evolvulus	*sericeus*	U
Ficus	*aurea*	O
Froelichia	*floridana*	U
Galactia	*elliottii*	U
Galactia	*regularis*	U
Gaylussacia	*dumosa*	U
Gratiola	*hispida*	U
Hedyotis	*nigricans*	U
Hedyotis	*procumbens*	U
Helianthemum	*corymbosum*	U
Helianthemum	*nashii*	U
Helianthus	*angustifolius*	U
Helianthus	*debilis*	U
Heterotheca	*subaxillaris*	U
Hieracium	*megacephalon*	U
Hypericum	*brachyphyllum*	U
Hypericum	*cistifolium*	U
Hypericum	*hypericoides*	U
Hypericum	*reductum*	U
Ilex	*glabra*	U
Ipomoea	*pes-caprae subsp. brasiliensis*	U
Juncus	*scirpoides*	U
Lachnocaulon	*beyrichianum*	U
Lantana	*depressa var. floridana*	U
Lechea	*cernua*	U
Lechea	*deckertii*	U
Lechea	*divaricata*	U
Lechea	*lakelae*	U
Lechea	*sessiliflora*	U
Lechea	*torreyi*	U
Liatris	*chapmanii*	U
Liatris	*tenuifolia var. quadriflora*	U
Licania	*michauxii*	U
Linaria	*floridana*	U
Lupinus	*diffusus*	U
Lyonia	*ferruginea*	O , U
Lyonia	*fruticosa*	U
Lyonia	*lucida*	U
Mimosa	*quadrivalvis var. angustata*	U
Muhlenbergia	*capillaris*	U
Myrica	*cerifera*	U
Opuntia	*humifusa*	U
Opuntia	*stricta*	U

GENUS	SPECIES	LAYER
Palafoxia	*feayi*	U
Palafoxia	*integrifolia*	U
Panicum	*abscissum*	U
Panicum	*amarum*	U
Paronychia	*americana*	U
Parthenocissus	*quinquefolia*	U
Paspalum	*setaceum*	U
Persea	*borbonia var. humilis*	O , U
Phlebodium	*aureum*	U
Phyllanthus	*abnormis*	U
Physalis	*walteri*	U
Phytolacca	*americana*	U
Piloblephis	*rigida*	U
Pinus	*clausa*	O , U
Pinus	*elliottii var. densa*	O
Piriqueta	*caroliniana*	U
Pityopsis	*graminifolia*	U
Pleopeltis	*polypodioides var. michauxiana*	U
Polanisia	*tenuifolia*	U
Polygala	*grandiflora*	U
Polygala	*nana*	U
Polygala	*polygama*	U
Polygala	*smallii*	U
Polygonella	*ciliata*	U
Polygonella	*gracilis*	U
Polygonella	*polygama*	U
Polygonella	*robusta*	U
Psilotum	*nudum*	U
Pteridium	*aquilinum var. caudatum*	U
Pterocaulon	*pycnostachyum*	U
Quercus	*chapmanii*	O , U
Quercus	*geminata*	O
Quercus	*inopina*	O
Quercus	*minima*	U
Quercus	*myrtifolia*	O , U
Quercus	*pumila*	
Quercus	*virginiana*	O
Quercus	*xrolfsii*	O
Rhus	*copallinum*	U
Rhynchosia	*cinerea*	U
Rhynchosia	*michauxii*	U
Rhynchospora	*intermedia*	U
Rhynchospora	*megalocarpa*	U

GENUS	SPECIES	LAYER
Sabal	*etonia*	U
Sabal	*palmetto*	O
Sabatia	*brevifolia*	U
Schoenocaulon	*dubium*	U
Scleria	*ciliata*	U
Scleria	*triglomerata*	U
Scutellaria	*arenicola*	U
Serenoa	*repens*	U
Setaria	*parviflora*	U
Seymeria	*pectinata*	U
Sideroxylon	*reclinatum*	U
Sisyrinchium	*nashii*	U
Sisyrinchium	*xerophyllum*	U
Smilax	*auriculata*	U
Smilax	*bona-nox*	U
Solidago	*odora var. chapmanii*	U
Sorghastrum	*secundum*	U
Sporobolus	*junceus*	U
Stillingia	*sylvatica*	U
Stipulicida	*setacea*	U
Stipulicida	*setacea var. lacerata*	U
Stylisma	*villosa*	U
Syngonanthus	*flavidulus*	U
Tephrosia	*florida*	U
Tephrosia	*rugelii*	U
Thelypteris	*kunthii*	U
Tillandsia	*fasciculata var. densispica*	U
Tillandsia	*paucifolia*	U
Tillandsia	*recurvata*	U
Tillandsia	*usneoides*	U
Tillandsia	*utriculata*	U
Toxicodendron	*radicans*	U
Tragia	*urens*	U
Trichostema	*dichotomum*	U
Triplasis	*americana*	U
Triplasis	*purpurea*	U
Vaccinium	*corymbosum*	U
Vaccinium	*darrowii*	U
Vaccinium	*myrsinites*	U
Vaccinium	*stamineum*	U
Viola	*primulifolia*	U
Vitis	*rotundifolia*	U
Warea	*carteri*	U
Ximenia	*americana*	U

GENUS	SPECIES	LAYER
Xyris	*brevifolia*	U
Xyris	*caroliniana*	U
Xyris	*elliottii*	U
Xyris	*flabelliformis*	U

TABLE 15. Plant species found in Southern Floodplain Forest communities.

GENUS	SPECIES	LAYER
Acer	*drummondii*	O , U
Acer	*rubrum*	O
Acrostichum	*danaeifolium*	U
Amelanchier	*canadensis*	O , U
Ampelopsis	*arboria*	U
Andropogon	*spp.*	U
Annona	*glabra*	U
Apios	*americana*	U
Arisaema	*dracontium*	U
Asclepias	*perennis*	U
Asimina	*triloba*	U
Aster	*caroliniana*	U
Athyrium	*aspleniodes*	U
Axonopus	*affinis*	U
Baccharis	*halimifolia*	U
Berchamia	*sandens*	U
Bidens	*mitis*	U
Blechnum	*serrulatum*	U
Boehmeria	*cylindrica*	U
Bumelia	*lanuginosa*	U
Campsis	*radicans*	U
Campyloneurum	*phyllitidis*	U
Carex	*albolutescens*	U
Carex	*amphibola*	U
Carex	*bromoides*	U
Carex	*caroliniana*	U
Carex	*cherokeensis*	U
Carex	*lupulina*	U
Carex	*oxylepis*	U
Carpinus	*caroliniana*	O , U
Carya	*aquatica*	O
Carya	*tomentosa*	O , U
Celtis	*laevigata*	O , U
Centella	*asiatica/erecta*	U
Cephalanthus	*occidentalis*	U
Chasmanthium	*nitidum*	U
Cicuta	*mexicana*	U
Circium	*muticum*	U
Clethra	*alnifolia*	U
Commelina	*diffusa*	U
Cornus	*drummondii*	U
Cornus	*florida*	O , U
Cornus	*foemina*	U
Crataegus	*viridis*	O , U
Crinum	*americanum*	U
Cryptotaenia	*canadensis*	U
Cucurbita	*okeechobeensis*	U
Cynosciadium	*digitatum*	U
Cyperus	*distinctus*	U
Cyperus	*globulosus*	U
Cyperus	*haspan*	U
Cyperus	*odoratus*	U
Cyrilla	*racemiflora*	O , U
Decumaria	*barbara*	U
Dichanthelium	*commutatum*	U
Dichanthelium	*dichotomum*	U
Dichondra	*repens*	U
Diodia	*virginica*	U
Drymeria	*cordata*	U
Dyschoriste	*humistrata*	U
Eclipta	*alba*	U
Eleocharis	*baldwinii*	U
Encyclia	*tampensis*	U
Euonymus	*americana*	U
Eupatorium	*capillifolium*	U
Fagus	*grandiflora*	O , U
Ficus	*aurea*	O
Fraxinus	*caroliniana*	O
Fraxinus	*pennsylvanica*	O , U
Fraxinus	*profunda*	O

GENUS	SPECIES	LAYER
Galium	*aparine*	U
Galium	*tinctorium*	U
Gelsemium	*sempervirens*	U
Geranium	*carolinianum*	U
Geum	*canadense*	U
Gleditsia	*aquatica*	O
Gordonia	*lasianthus*	O , U
Habenaria	*odontopetala*	U
Hamamelis	*virginiana*	O , U
Hedyotis	*uniflora*	U
Hibiscus	*grandiflorus*	U
Hydrocotyle	*umbellata*	U
Hydrocotyle	*verticillata*	U
Hypericum	*hypericoides*	U
Hypericum	*mutilum*	U
Hypoxis	*curtissii*	U
Hypoxis	*leptocarpa*	U
Hyptis	*alata*	U
Ilex	*cassine*	U
Ilex	*coriacea*	O , U
Ilex	*decidua*	U
Ilex	*glabra*	U
Ilex	*opaca*	O , U
Ilex	*verticillata*	O , U
Iris	*hexagona*	U
Isoetes	*flaccida*	U
Itea	*virginica*	U
Juncus	*effusus*	U
Juncus	*polyscephalus*	U
Kosteletzkya	*virginica*	U
Lemna	*spp.*	U
Leucothoe	*axillaris*	O , U
Leucothoe	*racemosa*	O , U
Liquidambar	*styraciflua*	O , U
Liriodendron	*tulipifera*	O , U
Ludwigia	*octovalvis*	U
Ludwigia	*palustris*	U
Ludwigia	*peruviana*	U
Ludwigia	*pilosa*	U
Ludwigia	*repens*	U
Lycopus	*rubellus*	U
Lyona	*lucida*	O , U
Lyonia	*ligustrina*	U
Magnolia	*virginiana*	O , U

GENUS	SPECIES	LAYER
Micania	*scandens*	U
Micranthemum	*umbrosum*	U
Mitchella	*repens*	U
Morus	*rubra*	O , U
Myosotis	*macrosperma*	U
Myrica	*cerifera*	U
Najas	*guadalupensis*	U
Nephrolepis	*exaltata*	U
Nyssa	*aquatica*	O , U
Nyssa	*biflora*	O
Nyssa	*sylvatica var. biflora*	O , U
Oplismenus	*setarius*	U
Osmunda	*cinnamomea*	U
Osmunda	*regalis*	U
Osmunda	*regalis var. spectabilis*	U
Oxalis	*corniculata*	U
Oxydendrum	*arboreum*	O , U
Panicum	*hemitomon*	U
Panicum	*rigidulum*	U
Panicum	*verrucosum*	U
Parietaria	*floridana*	U
Parthenocissus	*quinquefolia*	U
Paspalum	*notatum*	U
Paspalum	*urvillei*	U
Peltandra	*sagittifolia*	U
Peltandra	*virginica*	U
Persea	*borbonia*	O , U
Persea	*palustris*	O , U
Phanopyrum	*gymnocarpon*	U
Phlebodium	*aureum*	U
Pilea	*microphylla*	U
Pinus	*elliotii*	O
Pinus	*taeda*	O , U
Pistia	*stratiotes*	U
Pleopeltis	*polypodioides var. michauxiana*	U
Pluchea	*odorata*	U
Poa	*annua*	U
Polygonum	*hydropiperoides*	U
Polygonum	*punctatum*	U
Polygonum	*virginianum*	U
Pontederia	*cordata*	U
Pontederia	*lanceolata*	U
Proserpinaca	*palustris*	U

GENUS	SPECIES	LAYER
Proserpinaca	*pectinata*	U
Psilotum	*nudum*	U
Psychotria	*sulzneri*	U
Pteridium	*aquilinum var. pseudocaudatum*	U
Ptilimnium	*capillaceum*	U
Quecus	*laurifolia*	O , U
Quercus	*alba*	O , U
Quercus	*falcata*	O , U
Quercus	*laurifolia*	O
Quercus	*michauxii*	O , U
Quercus	*nigra*	O , U
Quercus	*nuttallii*	O , U
Ranunculus	*recurvatus*	U
Rapanea	*punctata*	U
Rhododendron	*viscosum*	U
Rhynchospora	*corniculata*	U
Rhynchospora	*fasciculata*	U
Rhynchospora	*inundata*	U
Rhynchospora	*miliacea*	U
Rubus	*betulifolia*	U
Rubus	*hispidus*	U
Rumex	*verticillata*	U
Sabal	*minor*	U
Sabal	*palmetto*	O
Sacciolepis	*indicus*	U
Sacciolepis	*striata*	U
Sagittaria	*lancifolia*	U
Salix	*caroliniana*	U
Salix	*nigra*	O , U
Sambucus	*canadensis*	U
Samolus	*parviflorus*	U
Sarcostemma	*clausum*	U
Saururus	*cernuus*	U
Senecio	*glabellus*	U
Serenoa	*repens*	U
Setaria	*geniculata*	U
Smilax	*bona-nox*	U
Smilax	*laurifolia*	U
Smilax	*rotundifolia*	U
Smilax	*walteri*	U
Solidago	*fistulosa*	U
Sparganium	*americanum*	U
Spilanthes	*americana*	U

GENUS	SPECIES	LAYER
Spiranthes	*cernua*	U
Staphylea	*trifolia*	U
Stellaria	*prostrata*	U
Symplocos	*tinctoria*	O , U
Taxodium	*distichum*	O
Thalia	*geniculata*	U
Thelypteris	*interrupta*	U
Thelypteris	*kunthii*	U
Thelypteris	*palustris*	U
Thelypteris	*reticulata*	U
Thelypteris	*serrata*	U
Tillandsia	*balbisiana*	U
Tillandsia	*fasciculata var. densispica*	U
Tillandsia	*paucifolia*	U
Tillandsia	*recurvata*	U
Tillandsia	*setacea*	U
Tillandsia	*usneoides*	U
Tillandsia	*utriculata*	U
Tillandsia	*variabilis*	U
Toxicodendron	*pubescens*	U
Toxicodendron	*radicans*	U
Tradescantia	*virginiana*	U
Trisetum	*pennsylvanicum*	U
Typha	*domingensis*	U
Typha	*latifolia*	U
Ulmus	*alata*	O
Ulmus	*americana*	O
Ulmus	*crassifolia*	O , U
Urtica	*chamaedryoides*	U
Vaccinium	*corymbosum*	U
Vaccinium	*elliottii*	U
Vaccinium	*stamineum*	U
Veroica	*peregrina*	U
Viburnum	*acerifolium*	U
Viburnum	*dentatum*	U
Viburnum	*nudum*	U
Viburnum	*prunifolium*	U
Viola	*affinis*	U
Viola	*lanceolata*	U
Vitis	*aestivalis*	U
Vitis	*cinerea*	U
Vitis	*rotundifolia*	U
Vittaria	*lineata*	U
Woodwardia	*areolata*	U

GENUS	SPECIES	LAYER
Woodwardia	*virginica*	U
Zepharanthes	*atamasco*	U
Zizaniopsis	*miliacea*	U

TABLE 16. Plant species found in Southern Mixed Hardwood communities.

GENUS	SPECIES	LAYER
Acer	*pennsylvanicum*	U
Acer	*saccharum*	O , U
Aesculus	*octandra*	O , U
Asplenium	*platyneuron*	U
Betula	*lutea*	U
Bignonia	*capreolata*	U
Carpinus	*caroliniana*	O, U
Carya	*cordiformis*	O , U
Carya	*glabra*	O , U
Carya	*ovata*	O , U
Carya	*tomentosa*	O , U
Celtis	*laevigata*	O
Cercis	*canadensis*	U
Cornus	*asperifolia*	U
Cornus	*florida*	U
Crataegus	*uniflora*	O
Diospyros	*virginiana*	O
Euonymus	*americanus*	U
Fagus	*grandiflora*	O , U
Fraxinus	*americana*	U
Galium	*hispidulum*	U
Gelsemium	*sempervirens*	U
Hamamelis	*virginiana*	U
Ilex	*ambigua*	O
Ilex	*opaca*	O
Juniperus	*virginiana*	O
Liquidambar	*styraciflua*	O , U
Liriodendron	*tulipifera*	O , U
Magnolia	*acuminata*	O , U
Magnolia	*grandiflora*	O , U
Michella	*repens*	U
Myrica	*cerifera*	U
Nyssa	*sylvatica*	U
Oplismenus	*hirtellus*	U
Osmanthus	*americanus*	O , U
Ostrya	*virginiana*	U
Oxydendrum	*arboreum*	U
Panicum	*commutatum*	U
Persea	*borbonia*	O , U
Pinus	*palustris*	O
Pinus	*taeda*	O
Pinus	*virginiana*	O
Prunus	*caroliniana*	O , U
Prunus	*serotina*	O , U
Prunus	*umbellata*	O
Quercus	*austrina*	O
Quercus	*falcata*	O
Quercus	*hemisphaerica*	U
Quercus	*laurifolia*	O , U
Quercus	*michauxii*	O
Quercus	*nigra*	O , U
Quercus	*prinus*	O , U
Quercus	*rubra*	O , U
Quercus	*shumardii*	O
Robinia	*pseudoacacia*	O
Rubus	*trivialis*	U
Sassafras	*albidum*	O
Scleria	*triglomerata*	U
Scutellaria	*ovata*	U
Sebastiania	*fruitcosa*	U
Siderxoylon	*lanuginosum*	O , U
Silene	*stellata*	U
Smilax	*bona-nox*	U
Smilax	*glauca*	U
Smilax	*pumila*	U
Smilax	*smallii*	U
Smilax	*tamnoides*	U
Staphylea	*trifolia*	U
Stewartia	*malacodendron*	U
Styrax	*grandifolia*	U
Symplocos	*tinctoria*	U
Thaspium	*trifoliatum*	U
Tiarella	*cordifolia*	U
Tilia	*americana*	O , U

GENUS	SPECIES	LAYER
Tilia	*heterophylla*	O , U
Tipularia	*discolor*	U
Toxicodendron	*radicans*	U
Trillium	*cuneatum*	U
Trillium	*erectum*	U
Tsuga	*canadensis*	U
Ulmus	*alata*	O
Ulmus	*americana*	O
Ulmus	*rubra*	O
Ulmus	*serotina*	U
Vaccinium	*arboreum*	U
Vaccinium	*stamineum*	U
Viburnum	*rufidulum*	U
Vitis	*aestivalis*	U
Vitis	*rotundifolia*	U
Zanthoxylum	*clava-herculis*	U

TABLE 17. Plant species found in White Cedar Swamp communities.

GENUS	SPECIES	LAYER
Acer	*pennsylvanicum*	U
Acer	*saccharum*	O , U
Aesculus	*octandra*	O , U
Asplenium	*platyneuron*	U
Betula	*lutea*	U
Bignonia	*capreolata*	U
Carpinus	*caroliniana*	O, U
Carya	*cordiformis*	O , U
Carya	*glabra*	O , U
Carya	*ovata*	O , U
Carya	*tomentosa*	O , U
Celtis	*laevigata*	O
Cercis	*canadensis*	U
Cornus	*asperifolia*	U
Cornus	*florida*	U
Crataegus	*uniflora*	O
Diospyros	*virginiana*	O
Euonymus	*americanus*	U
Fagus	*grandiflora*	O , U
Fraxinus	*americana*	U
Galium	*hispidulum*	U
Gelsemium	*sempervirens*	U
Hamamelis	*virginiana*	U
Ilex	*ambigua*	O
Ilex	*opaca*	O
Juniperus	*virginiana*	O
Liquidambar	*styraciflua*	O , U
Liriodendron	*tulipifera*	O , U
Magnolia	*acuminata*	O , U
Magnolia	*grandiflora*	O , U
Michella	*repens*	U
Myrica	*cerifera*	U
Nyssa	*sylvatica*	U
Oplismenus	*hirtellus*	U
Osmanthus	*americanus*	O , U
Ostrya	*virginiana*	U
Oxydendrum	*arboreum*	U
Panicum	*commutatum*	U
Persea	*borbonia*	O , U
Pinus	*palustris*	O
Pinus	*taeda*	O
Pinus	*virginiana*	O
Prunus	*caroliniana*	O , U
Prunus	*serotina*	O , U
Prunus	*umbellata*	O
Quercus	*austrina*	O
Quercus	*falcata*	O
Quercus	*hemisphaerica*	U
Quercus	*laurifolia*	O , U
Quercus	*michauxii*	O
Quercus	*nigra*	O , U
Quercus	*prinus*	O , U
Quercus	*rubra*	O , U
Quercus	*shumardii*	O
Robinia	*pseudoacacia*	O
Rubus	*trivialis*	U
Sassafras	*albidum*	O
Scleria	*triglomerata*	U
Scutellaria	*ovata*	U
Sebastiania	*fruitcosa*	U
Siderxoylon	*lanuginosum*	O , U
Silene	*stellata*	U

GENUS	SPECIES	LAYER
Smilax	*bona-nox*	U
Smilax	*glauca*	U
Smilax	*pumila*	U
Smilax	*smallii*	U
Smilax	*tamnoides*	U
Staphylea	*trifolia*	U
Stewartia	*malacodendron*	U
Styrax	*grandifolia*	U
Symplocos	*tinctoria*	U
Thaspium	*trifoliatum*	U
Tiarella	*cordifolia*	U
Tilia	*americana*	O , U
Tilia	*heterophylla*	O , U
Tipularia	*discolor*	U
Toxicodendron	*radicans*	U
Trillium	*cuneatum*	U
Trillium	*erectum*	U
Tsuga	*canadensis*	U
Ulmus	*alata*	O
Ulmus	*americana*	O
Ulmus	*rubra*	O
Ulmus	*serotina*	U
Vaccinium	*arboreum*	U
Vaccinium	*stamineum*	U
Viburnum	*rufidulum*	U
Vitis	*aestivalis*	U
Vitis	*rotundifolia*	U
Zanthoxylum	*clava-herculis*	U

Chapter 9

Online Resources for Restoration

TOPIC	ORGANIZATION	WEB ADDRESS
Education	Conserved Forest Ecosystems: Outreach and Reserch	http://www.sfrc.ufl.edu/cfeor/
Education	Natural Areas Training Academy	http://nata.snre.ufl.edu
Education	Univ. of FL School of Natural Resources and Environment	http://snre.ufl.edu/
Education	Univ. of WA Restoration Ecology Network	http://depts.washington.edu/uwren/
Fire	Southeast Fire Ecology Partnership	www.talltimbers.org/SEFEP/contact.html
Fire	Tall Timbers Research Station Fire Ecology Database	www.talltimbers.org/fedb-intro.html
Fire	USDA Forest Service: Fire Effects Information System	www.fs.fed.us/database/feis/index.html
Funding	USFWS Coastal Restoration Program	www.fws.gov/coastal/
Funding	Conservation Reserve Program	http://www.nrcs.usda.gov/programs/CRP/
Funding	Environmental Quality Incentives Program	http://www.nrcs.usda.gov/PROGRAMS/EQIP/
Funding	Forests for Watershed and Wildlife	http://www.forestfoundation.org/ccs_forests.html
Funding	National Fish and Wildlife Foundation	www.nfwf.org
Funding	NOAA Restoration Center Community-based Program	www.nmfs.noaa.gov/habitat/restoration/funding_ opportunities/funding_ser.html
Funding	Partners for Fish and Wildlife Program	www.fws.gov/partners
Funding	Private Stewardship Grant Program	www.fws.gov/endangered/grants/private_stewardship
Funding	Wildlife Habitat Incentives Program	http://www.nrcs.usda.gov/Programs/whip/
Funding	FL Fish & Wildlife Conservation Commission Landowner Assistance Program	http://myfwc.com/CONSERVATION/ConservationYou_ LAP_index.htm
Images	FL Historical Aerial Photography	web.uflib.ufl.edu/digital/collections/FLAP
Journal	Conservation Biology journal	http://www.wiley.com/bw/journal.asp?ref=0888-8892
Journal	Ecological Engineering journal	http://aeesociety.org/publication/pubs.htm
Journal	Ecological Restoration journal	www.ecologicalrestoration.info
Journal	Land and Water magazine	www.landandwater.com
Journal	Natural Areas Journal	http://www.naturalarea.org/journal.asp
Journal	Restoration Ecology journal	http://www.wiley.com/bw/journal.asp?ref=1061-2971&site=1
Organization	Alabama Natural Heritage Program (ALNHP)	http://www.alnhp.org/
Organization	FL Natural Areas Inventory (FNAI)	http://www.fnai.org/
Organization	GA Natural Heritage Program	http://georgiawildlife.dnr.state.ga.us/content/ displaycontent.asp?txtDocument=87
Organization	LA Natural Heritage Program (LNHP)	http://www.wlf.louisiana.gov/experience/naturalheritage/
Organization	MS Natural Heritage Program	http://museum.mdwfp.com/science/nhp.html
Organization	The Nature Conservancy	www.nature.org
Organization	South FL Ecosystem Restoration Task Force	http://www.sfrestore.org/
Organization	South FL Restoration Science Forum	http://sofia.usgs.gov/sfrsf/index.html
Organization	FL Department of Environmental Protection	http://www.dep.state.fl.us/
Organization	FL Fish and Wildlife Research Institute	http://research.myfwc.com/
Organization	Northwest FL Water Management District	http://www.nwfwmd.state.fl.us/

TOPIC	ORGANIZATION	WEB ADDRESS
Organization	Southwest FL Water Management District	http://www.swfwmd.state.fl.us/
Organization	Suwanee River Water Management District	http://www.srwmd.state.fl.us/
Organization	FL Exotic Pest Plant Council	www.fleppc.org
Plant Id	Atlas of Florida Vascular Plants	www.plantatlas.usf.edu
Plant Id	Flora of North America	http://www.fna.org/
Plant Id	Grass Manual on the Web	herbarium.usu.edu/webmanual
Plant Id	USDA Natural Resources Conservation Service plant database	plants.usda.gov
References	Conserve Online	www.conserveonline.org
References	FL Wetland Restoration Information Center	www.dep.state.fl.us/water/wetlands/fwric
References	Forest Stewardship/Extension	www.sfrc.ufl.edu/Extension/florida_forestry_information/index.html
References	Global Restoration Network	www.globalrestorationnetwork.org
References	Longleaf Alliance	http://www.auburn.edu/academic/forestry_wildlife/longleafalliance/
References	National Wetlands Inventory	www.nwi.fws.gov
References	Stream Corridor Restoration	http://www.nrcs.usda.gov/technical/stream_restoration/
References	UC Irvine's Restoration Ecology Web Server	darwin.bio.uci.edu/~sustain/EcologicalRestoration
References	US EPA River Corridor and Wetland Restoration	www.epa.gov/owow/wetlands/restore
References	USDA Forest Service Research Publications	www.treesearch.fs.fed.us
References	USDA Forest Service Restoration Ecology of Disturbed Lands	www.fs.fed.us/rm/logan/4301
References	FL Exotic Pest Plant Council	www.fleppc.org
Restoration Sites	Archbold Biological Research Station	www.archbold-station.org
Restoration Sites	Joseph W. Jones Ecological Research Center	www.jonesctr.org
Restoration Sites	FL Ecological Restoration Inventory	www.dep.state.fl.us/water/wetlands/feri
Restoration Sites	Tall Timbers Research Station	www.talltimbers.org
Society	American Society of Landscape Architects	www.asla.org
Society	FL Native Plant Society	www.fnps.org
Society	Society for Ecological Restoration	www.ser.org
Society	Society for Range Management	www.rangelands.org
Society	Society of Wetlands Scientists	www.sws.org
Society	The Association for State Wetlands Managers	http://www.aswm.org/

*This information was current as of 2009.

Chapter 10

Comprehensive Bibliography

Abrahamson, W. G. and C. R. Abrahamson. 1996. Effects of fire on long-unburned Florida uplands. Journal of Vegetation Science **7**:565-574.

Abrahamson, W. G. and J. R. Abrahamson. 1996. Effects of a low-intensity winter fire on long-unburned Florida sand pine scrub. Natural Areas Journal **16**:171-183.

Abrahamson, W. G. and D. C. Harnett. 1990. Pine flatwoods and dry prairies. Pp. 103-149 *in* R. L. Myers and J. J. Ewel, editors. Ecosystems of Florida. University of Central Florida Press, Orlando, FL.

Abrahamson, W. G., A. F. Johnson, J. N. Layne, and P. A. Peroni. 1984. Vegetation of the Archbold Biological Station, Florida: an example of the southern Lake Wales Ridge. Florida Scientist **47**:209-250.

Abrams, M. D. and L. C. Hulbert. 1987. Effects of burning regime on buried seed banks and canopy coverage in a Kansas tallgrass prairie. Southwestern Naturalist **33**:65-70.

Aizen, M. A. and P. Feinsinger. 2003. Bees not to be? Responses of insect pollinator faunas and flower pollination to habitat fragmentation. Pp. 111-129 *in* G. A. Bradshaw, P. A. Marquet, and H. A. Mooney, editors. How Landscapes Change: Human Disturbance and Ecosystem Fragmentation in the Americas. Springer-Verlag, Berlin, Germany.

Andreu, M. G., C. W. Hedman, and M. H. Friedman, Andreu, A. G. 2008. Can managers bank on seed banks when restoring *Pinus taeda* L. plantations in southwest Georgia? Restoration Ecology 10.1111/j.1526-100x.2009.00541.

Apfelbaum, S. I., B. J. Bader, F. Faessler, and D. Mahler. 1997. Obtaining and processing seeds. Pp. 99-126 *in* S. Packard and C. F. Mutel, editors. The Tallgrass Prairie Restoration Handbook. Island Press, Washington, D.C.

Archer, J. K., D. L. Miller, and G. W. Tanner. 2007. Changes in understory vegetation and soil characteristics following silvicultural activities in a southeastern mixed pine forest. Journal of the Torrey Botanical Society **134**:489-504.

Aronson, J. and J. van Andel. 2006. Challenges for ecological theory. Pp. 223-233 *in* J. Aronson and J. van Andel, editors. Restoration Ecology: the New Frontier. Blackwell Publishing, Malden, MA.

Aschenbach, T. A., B. L. Foster, and D. W. Imm. 2009. The initial phase of a longleaf pine-wiregrass savannah restoration: species establishment and community responses. Restoration Ecology 10.1111/j.1526-100x.2009.00541.x.

Bailey, R. G. 1978. Descriptions of the ecoregions of the United States. USDA Forest Service misc. publication no. 139, Ogden, UT.

Balmford, A., A. Bruner, P. Cooper, R. Costanza, S. Farber, R. E. Green, M. Jenkins, P. Jefferiss, V. Jessamy, J. Madden, K. Munro, N. Myers, S. Naeem, J. Paavola, M. Rayment, S. Rosendo, J. Roughgarden, K. Trumper, and R. K. Turner. 2002. Economic reasons for conserving wild nature. Science **297**:950-953.

Barrett, S. C. H. and J. R. Kohn. 1991. Genetic and evolutionary consequences of small population size in plants: implications for conservation. Pp. 3-30 *in* D. A. Falk and K. E. Holsinger, editors. Genetics and Conservation of Rare Plants. Oxfords University Press, Oxford, UK.

Baskin, C. C. and J. M. Baskin. 1998. Seeds: Ecology, Biogeography, and Evolution of Dormancy and Germination. Academic Press, San Diego, CA.

Bissett, N. J. 1996. Upland restoration challenge: direct seeding of wiregrass and associated species. The Palmetto **Summer**:8-11.

Bissett, N. J. 2006. Restoration of dry prairie by direct seeding: methods and examples. Pp. 231-237 *in* Proceedings of the Florida Dry Prairie Conference. October 5-7, 2004. Sebring, FL.

Bledsoe, B. P. and T. H. Shear. 2000. Vegetation along hydrological and edaphic gradients in a North Carolina coastal plain creek bottom and implications for restoration. Wetlands **20**:126-147.

Block, W. A., A. B. Franklin, J. P. Ward, J. L. Ganey, and G. C. White. 2001. Design and implementation of monitoring studies to evaluate the success of ecological restoration on wildlife. Restoration Ecology **9**:293-303.

Booth, D. T. and T. A. Jones. 2001. Plants for ecological restoration: a foundation and a philosophy for the future. Native Plants Journal **2**:12-20.

Boughton, E. A., P. F. Quintana-Ascencio, E. S. Menges, and R. K. Boughton. 2006. Association of ecotones with relative elevation and fire in an upland Florida landscape. Journal of Vegetation Science **17**:361-368.

Bradshaw, A. D. and M. J. Chadwick. 1980. The Restoration of Land, the Ecology and Reclamation of Derelict and Degraded Land. University of California Press, Berkeley, CA.

Breininger, D. R. and P. A. Schmalzer. 1990. Effects of fire and disturbance on plants and birds in a Florida oak palmetto scrub community. American Midland Naturalist **123**:64-74.

Breininger, D. R., B. W. Duncan, and N. J. Dominy. 2002. Relationships between fire frequency and vegetation type in pine flatwoods of east-central Florida, USA. Natural Areas Journal **22**:186-193.

Brewer, J. S. and W. J. Platt. 1994. Effects of fire season and herbivory on reproductive success in a clonal forb, *Pityopsis graminifolia*. Journal of Ecology **82**:665-675.

Bridges, E. L. 1989. Longleaf pine communities of the west Gulf coastal plain. Natural Areas Journal **9**:246-263.

Brockway, D. G., K. W. Outcalt, and R. N. Wilkins. 1998. Restoring longleaf wiregrass ecosystems: plant cover, diversity and biomass following low-rate hexazinone application on Florida sandhills. Forest Ecology and Management **102**:159-175.

Brockway, D. G., K. W. Outcalt, D. J. Tomczak, and E. E. Johnson. 2005. Restoration of longleaf pine ecosystems. USDA Forest Service GTR-SRS-083. Southern Research Station, Asheville, NC.

Brockway, D. G., K. W. Outcalt, D. J. Tomczak, and E. E. Johnson. 2005. Restoring longleaf pine forest ecosystems in the southern U.S. Pages 501-519 *in* J. A. Stanturf and P. Madsen, editors. Restoration of Boreal and Temperate Forests. CRC Press, Boca Raton, FL.

Brooks, M. L., C. M. D'Antonio, D. M. Richardson, J. B. Grace, J. E. Keeley, J. M. DiTomaso, R. J. Hobbs, M. Pellant, and D. Pyke. 2004. Effects of invasive alien plants on fire regimes. Bioscience **54**:677-688.

Brown, J. K. and J. K. Smith. 2000. Wildland fire in ecosystems: Effects of fire on flora. USDA Forest Service RMRS-GTR-42, vol. 2. Rocky Mountain Research Station, Ogden, UT.

Buchmann, S. L. and G. P. Nabhan. 1996. The Forgotten Pollinators. Island Press, Washington, D. C.

Cairns, J., Jr. 1995. Restoration ecology: protecting our national and global life support systems. Pp. 1-12 *in* J. Cairns, Jr., editor. Rehabilitating Damaged Ecosystems. 2nd Edition. CRC Press, Boca Raton, FL.

Carlson, P. C., G. W. Tanner, J. M. Wood, and S. R. Humphrey. 1993. Fire in key deer habitat improves browse, prevents succession, and preserves endemic herbs. Journal of Wildlife Management **57**:914-928.

Carrington, M. E. 1997. Soil seed bank structure and composition in Florida sand pine scrub. American Midland Naturalist **137**:39-47.

Carrington, M. E. 1999. Post-fire seedling establishment in Florida sand pine scrub. Journal of Vegetation Science **10**:403-412.

Carter, R. E. and M. D. G. D. H. MacKenzie. 1999. Ecological land classification in the Southern Loam Hills of south Alabama. Forest Ecology and Management **114**:395-404.

Caswell, H. 2006. Matrix Population Models. 2nd Edition. Sinauer Associates Inc., Sunderland, MA.

Center for Plant Conservation. 1991. Genetic sampling guidelines for conservation collections of endangered plants. Pp. 225-238 *in* D. A. Falk, C. I. Millar, and M. Olwell, editors. Genetics and Conservation of Rare Plants. Island Press, Washington, D.C.

Christensen, N. L. 1981. Fire regimes in southeastern ecosystems. Pp. 112-136 *in* H. A. Mooney, T. M. Bonnickson, J. E. Christensen, and W. A. Reiners, editors. Fire Regimes and Ecosystem Properties: Proceedings of the Conference. December 11-15, 1978. USDA Forest Service GTR WO-26, Washington, D.C.

Clewell, A. F. 1989. Natural history of wiregrass (*Aristida stricta* Michx., Gramineae). Natural Areas Journal **9**:223-233.

Clewell, A. F. 1999. Restoration of riverine forest at Hall Branch on phosphate-mined land, Florida. Restoration Ecology **7**:1-14.

Clewell, A. F. and J. Aronson. 2006. Motivations for the restoration of ecosystems. Conservation Biology **20**:420-428.

Clewell, A. F. and J. Aronson. 2007. Ecological Restoration: Principles, Values and Structure of an Emerging Discipline. Island Press, Washington D.C.

Clewell, A. J., J. A. Goolsby, and A. G. Shuey. 1982. Riverine forests of the south prong Alfia River system, Florida. Wetlands **2**:21-72.

Clewell, A. F., J. Reiger, and J. Munro. 2005. Guidelines for developing and managing ecological restoration projects. 2nd edition. Society for Ecological Restoration International, Tucson, AZ. <www.ser.org>.

Coffey, K. L. and L. L. Kirkman. 2006. Seed germination strategies of species with restoration potential in a fire-maintained pine savanna. Natural Areas Journal **26**:289-299.

Cohen, S., R. Braham, and F. Sanchez. 2004. Seed bank viability in disturbed longleaf pine sites. Restoration Ecology **12**:503-515.

Collins, E. A., C. D. Monk, and R. H. Spielman. 1964. White cedar stands in northern Florida. Quarterly Journal of the Florida Academy of Sciences **27**:107-110.

Cox, A. C., D. R. Gordon, J. L. Slapcinsky, and G. S. Seamon. 2004. Understory restoration in longleaf pine sandhills. Natural Areas Journal **24**:4-14.

Craft, C., S. Broome, and C. l. Campbel. 2002. Fifteen years of vegetation and soil development after brackish-water marsh creation. Restoration Ecology **10**:248-258.

Cramer, V. and R. J. Hobbs. 2007. Old Fields: Dynamics and Restoration of Abandoned Farmland. Island Press, Washington, D.C.

Cramer, V. A., R. J. Hobbs, and R. J. Standish. 2008. What's new about old fields? Land abandonment and ecosystem assembly. Trends in Ecology and Evolution **23**:104-112.

D'Antonio, C. and L. A. Meyerson. 2002. Exotic plant species as problems and solutions in ecological restoration: a synthesis. Restoration Ecology **10**:705-713.

Daly, H. E. and J. E. Cobb. 1994. For the Common Good: Redirecting the Economy Towards Community the Environment, and a Sustainable Future. 2nd Edition. Beacon, Boston, MA.

Daneshgar, P., S. Jose, A. Collins, and C. Ramsey. 2008. Cogongrass (*Imperata cylindrica*), an alien invasive grass, reduces survival and productivity of an establishing pine forest. Forest Science **54**:579-587.

Dodson, S. I., T. F. H. Allen, S. R. Carpenter, A. R. Ives, R. L. Jeanne, J. F. Kitchell, N. E. Lanston, and M. G. Turner. 1998. Ecology. Oxford University Press, New York, NY.

Dolan, R. W., P. F. Quintana-Ascencio, and E. S. Menges. 2008. Genetic change following fire in populations of a seed-banking perennial plant. Oecologia **158**:355-360.

Doren, R. F., R. E. Roberts, D. R. Richardson. 1991. Sand pine scrub burning: some positive steps for management. Pp. 408-409 *in* High intensity fire in wildlands: management challenges and options. Proceedings of the 17th Tall Timbers Fire Ecology Conference. May 18-21, 1989. Tall Timbers Research Station, Tallahassee, FL.

Drewa, P. B., W. J. Platt, and E. B. Moser. 2002. Fire effects on resprouting of shrubs in headwaters of southeastern longleaf pine savannas. Ecology **83**:735-761.

Duncan, B. W. and P. A. Schmalzer. 2004. Anthropogenic influences on potential fire spread in a pyrogenic ecosystem of Florida, USA. Landscape Ecology **19**:153-165.

Ecological Restoration Workshop 1996. Summary of discussion on donor sites of native plant propagules for restoration projects. Ecosystem Restoration Workshop Proceedings. April 25-26, 1996. Lakeland, FL. Florida Institute for Phosphate Research publication no. 03-000-143. Society for Ecological Restoration.

Egan, D. and E. A. Howell. 2001. The Historical Ecology Handbook: A Restorationist's Guide to Reference Ecosystems. Island Press, Washington, D.C.

Elzinga, C. L., D. W. Salzer, and J. W. Willoughby. 1998. Measuring and monitoring plant populations. BLM Technical Reference 1730-1. Bureau of Land Management, Denver, CO.

Florida Division of Forestry. 2007. State Forest Hydrological Restoration Activity Report. Florida DoF, Tallahassee, FL. <http://www.fl-dof.com/forest_management/hydrology_wetlands.html>.

FNAI (Florida Natural Areas Inventory). 1990. Guide to the Natural Communities of Florida. <http://fnai.org/PDF/Natural_Communities_Guide.pdf>.

Frankel, O. H. 1970. Genetic dangers in the green revolution. World Agriculture **19**:9-13.

Frankham, R., J. D. Ballou, and D. A. Briscoe. 2002. Introduction to Conservation Genetics. Cambridge University Press, Cambridge, UK.

Freeman, J. E. and S. Jose. 2009. The role of herbicide in savanna restoration: effects of shrub reduction treatments on the understory and overstory of a longleaf pine flatwoods. Forest Ecology and Management **257**:978-986.

Frost, C. 1998. Presettlement fire frequency regimes of the United States: a first approximation. Pp. 70-81 *in* T. L. Pruden and L. A. Brennan, editors. Fire in Ecosystem Management: Shifting the Paradigm from Suppression to Prescription. Proceedings of the 20th Tall Timbers Fire Ecology Conference. May 7-10, 1996. Tall Timbers Research Station, Tallahassee, FL.

Garren, K. H. 1943. Effects of fire on vegetation of the Southeastern United States. Botanical Review **9**:617-674.

Gilliam, F. S. and N. L. Christensen. 1986. Herb-layer response to burning in pine flatwoods of the lower Coastal Plain of South Carolina. Journal of the Torrey Botanical Society **113**:42-45.

Gilliam, F. S. and W. J. Platt. 2006. Conservation and restoration of the *Pinus palustris* ecosystem. Applied Vegetation Science **9**:7-10.

Glitzenstein, J. S., W. J. Platt, and D. R. Streng. 1995. Effects of fire regime and habitat on tree dynamics in north Florida longleaf pine savannas. Ecological Monographs **65**:441-476.

Glitzenstein, J. S., D. R. Streng, and D. D. Wade. 2003. Fire frequency effects on longleaf pine (*Pinus palustris*, P. Miller) vegetation in South Carolina and northeast Florida, USA. Natural Areas Journal **23**:22-37.

Glitzenstein, J. S., D. R. Streng, D. D. Wade, and J. Brubaker. 2001. Starting new populations of longleaf pine ground-layer plants in the outer Coastal Plain of South Carolina, USA. Natural Areas Journal **21**:89-110.

Gordon, D. 1994. Translocation of species into conservation areas: a key for natural resource managers. Natural Areas Journal **14**:31-37.

Gordon, D. R. 1996. Experimental translocation of the endangered shrub Apalachicola rosemary *Conradina glabra* to the Apalachicola Bluffs and Ravines Preserve, Florida. Biological Conservation **77**:19-26.

Gordon, D. R., A. C. Cox, G. S. Seamon, J. L. Slapcinsky, and D. A. Jones. 2001. Native sandhill species revegetation techniques. Final Report to the Florida Department of Transportation, contract #BB 937. University of Florida and The Nature Conservancy, Gainesville, FL.

Gordon, D. R. and K. J. Rice. 1998. Patterns of differentiation in wiregrass (*Aristida beyrichiana*): Implications for restoration efforts. Restoration Ecology **6**:166-174.

Greenberg, C. H., D. G. Neary, L. D. Harris, S. P. Linda. 1994. Vegetation recovery following high-intensity wildfire and silvicultural treatments in sand pine scrub. American Midland Naturalist **133**:149-163.

Hammond, H. E., J. G. Norcini, S. B. Wilson, R. K. Schoellhorn, and D. L. Miller. 2007. Growth, flowering, and survival of firewheel (*Gaillardia pulchella* Foug.) based on seed source and growing location. Native Plants Journal **8**:25-39.

Hardin, E. D. and D. L. White. 1989. Rare vascular plant taxa associated with wiregrass (*Aristida stricta*) in the Southeastern United States. Natural Areas Journal **9**:234-245.

Harker, D., G. Libby, K. Harker, S. Evans, and M. Evans. 1999. Principles for maintaining and restoring natural diversity. Pp. 41-62 Landscape Restoration Handbook. 2nd edition. Lewis Publishers, Boca Raton, FL.

Harper, J. L. 1987. The heuristic value of restoration. Pages 35-45 *in* W. R. Jordan, M. E. Gilpin, and J. D. Aber, editors. Restoration Ecology. Cambridge University Press, Cambridge, UK.

Harper, R. M. 1962. Historical notes on the relation of fires to forests. Pp. 11-29 *in* Proceedings of the Tall Timbers Fire Ecology Conference. Tall Timbers Research Station, Tallahassee, FL.

Harrington, T. B., C. M. Dagley, and M. B. Edwards. 2003. Above- and belowground competition from longleaf pine plantations limits performance of reintroduced herbaceous species. Forest Science **49**:681-695.

Harrington, T. B. and M. B. Edwards. 1999. Understory vegetation, resource availability, and litterfall responses to pine thinning and woody vegetation control in longleaf pine plantations. Canadian Journal of Forest Research **29**:1055-1064.

Hatcher, P. E. and B. Melander. 2003. Combining physical, cultural and biological methods: prospects for integrating non-chemical weed management strategies. Weed Research **43**:303-322.

Hattenbach, M. J., D. R. Gordon, G. S. Seamon, and R. G. Studenmund. 1998. Development of direct-seeding techniques to restore native groundcover in a sandhill ecosystem. Pp. 64-70 *in* Proceedings of the Longleaf Pine Restoration Session. 1997 meeting of the Society for Ecological Restoration. Longleaf Alliance, Auburn, AL.

Hawkes, C. V. and E. S. Menges. 1996. The relationship between open space and fire for species in a xeric Florida shrubland. Bulletin of the Torrey Botanical Club **123**:81-92.

Haywood, J. D., F. L. Harris, H. E. Grelen, and H. A. Pearson. 2001. Vegetative response to 37 years of seasonal burning on a Louisiana longleaf pine site. Southern Journal of Applied Forestry **25**:122-130.

Hedman, C. W., S. L. Grace, and S. E. King. 2000. Vegetation composition and structure of southern coastal plain pine forests: an ecological comparison. Forest Ecology and Management **134**:233-247.

Helm, A. C., N. S. Nicholas, S. M. Zedaker, and S. T. Young. 1991. Maritime forests on Bull Island, Cape Romain, South Carolina. Journal of the Torrey Botanical Society **118**.

Herring, B. J. and W. S. Judd. 1995. A floristic study of Ichetucknee Springs State Park, Suwannee and Columbia Counties, Florida. Castanea **60**:318-369.

Hess, C. A. and A. Laniray. 2008. Landscape changes on the Apalachicola National Forest, a fire-dependent system. 93rd Ecological Society of America Meeting. August 3-8 2008. Milwaukee, WI.

Heuberger, K. A. and F. E. Putz. 2003. Fire in the suburbs: ecological impacts of prescribed fire in small remnants of longleaf pine (*Pinus palustris*) sandhill. Restoration Ecology **11**:72-81.

Hiers, J. K., R. J. Mitchell, L. R. Boring, J. J. Hendricks, and y. R. 2003. Legumes native to longleaf pine savannas exhibit capacity for high N2-fixation rates and negligible impacts due to timing of fire. New Phytologist **157**:327-338.

Hiers, J. K., J. J. O'Brian, R. E. Will, and R. J. Mitchell. 2007. Forest floor depth mediates understory vigor in xeric *Pinus palustris* ecosystems. Ecological Applications **17**:806-814.

Hiers, J. K., R. Wyatt, and R. J. Mitchell. 2000. The effects of fire regime on legume reproduction in longleaf pine savannas: is a season selective? Oecologia **125**:521-530.

Holl, K. D. and J. J. Cairns. 2002. Monitoring and appraisal. Pp. 411-432 *in* M. R. Perrow and A. J. Davy, editors. Handbook of Ecological Restoration, vol. I. Handbook of Ecological Restoration. Cambridge University Press, Cambridge, UK.

Houseal, G. and D. Smith. 2000. Source-identified seed: the Iowa roadside experience. Ecological Restoration **18**:173-183.

Huenneke, L. F. 1991. Ecological implications of genetic variation in plant populations. Pp. 31-44 *in* D. A. Falk and K. E. Holsinger, editors. Genetics and Conservation of Rare Plants. Oxford University Press, Oxford, UK.

Hufford, K. M. and S. J. Mazer. 2003. Plant ecotypes: genetic differentiation in the age of ecological restoration. Trends in Ecology & Evolution **18**:147-155.

Institute for Regional Conservation (IRC). 2009. The floristic inventory of south Florida database online. <http://regionalconservation.org/ircs/database/site/Habitats.asp>.

Jenkins, A. M., D. R. Gordon, and M. T. Renda. 2004. Native alternatives for non-native turfgrasses in central Florida: Germination and responses to cultural treatments. Restoration Ecology **12**:190-199.

Johnson A. F., W. G. Abrahamson. 1984. A note on the fire responses of species in rosemary scrubs on the southern Lake Wales Ridge. Florida Scientist **53**:138-143.

Joint Fire Science Program. 2008. FireStem: a stem heating tree mortality model. <http://jfsp.nifc.gov/documents/FireStemUserGuide.pdf>.

Kalmbacher, R. and F. Martin. 1996. Shifts in botanical composition of flatwoods range following fertilization. Journal of Range Management **49**:530-534.

Kalmbacher, R., J. Norcini, T. Pittman, S. Pfaff, and M. F. 2004. Wiregrass grown from seeds obtained on Florida flatwood and sandhill sites. Native Plants **fall**:123-130.

Keller, M., J. Kollmann, and P. J. Edwards. 2000. Genetic introgression from distant provenances reduces fitness in local weed populations. Journal of Applied Ecology **37**:647-659.

Kesler, H. C., J. L. Trusty, S. M. Hermann, and C. Guyer. 2008. Demographic responses of *Pinguicula ionantha* to prescribed fire a regression design LTRE approach. Oecologia **156**:545-557.

Kindell, C. E., A. A. Winn, and T. E. Miller. 1996. The effects of surrounding vegetation and transplant age on the detection of local adaptation in the perennial grass *Aristida stricta*. Journal of Ecology **84**:745-754.

Kirkman, L. K. and R. J. Mitchell. 2002. A forest gap approach to restoring longleaf pine-wiregrass ecosystems (Georgia and Florida). Ecological Restoration **20**:50-51.

Kirkman, L. K., K. L. Coffey, R. J. Mitchell, and E. B. Moser. 2004. Ground cover recovery patterns and life-history traits: implications for restoration obstacles and opportunities in a species-rich savanna. Journal of Ecology **92**:409-421.

Kirkman, L. K., R. J. Mitchell, M. J. Kaeser, S. D. Pecot, and K. L. Coffey. 2007. The perpetual forest: using undesirable species to bridge restoration. Journal of Applied Ecology **44**:604-614.

Kocev, D., S. W. M. D. Dzeroski, G. R. Newell, and P. Griffioen. 2009. Using single- and multi-target regression trees and ensembles to model a compound index of vegetation condition. Ecological Modelling **220**:1159-1168.

Kosel, K., R. Nelson and I. J. Stout. 2001. Alternative methods for restoration of tamed pastures to native upland habitat. Proceedings from the 28th Annual Conference on Ecosystems Restoration and Creation. May 10-11, 2001. Tampa, FL.

Küchler A. W. 1975. Potential Natural Vegetation of the Conterminous United States. 2nd Edition. American Geographical Society special publication no. 36. New York, NY.

Kush, J. S. and R. S. Meldahl. 2000. Composition of a virgin stand of longleaf pine in south Alabama. Castanea **65**:56-63.

Kusler, J. A. and M. E. Kentula. 1990. Wetland Creation and Restoration: the Status of the Science. Island Press, Washington, D.C.

Lackey, R. T. 2004. Societal values and the proper role of restoration ecologists. Frontiers in Ecology and the Environment **2**:45-46.

Laderman, A. D. 1987. Atlantic White Cedar Wetlands. Westview Press, Boulder, CO.

Laderman, A. D. 1989. The ecology of Atlantic white cedar wetlands: a community profile. USFWS biological report no. 85. National Wetlands Research Center, Washington, DC.

Lambert, B.B., E. S. Menges. 1996. The effects of light, soil disturbance and presence of organic litter on the field germination and survival of the Florida goldeneaster, *Chrysopsis floridana* Small. Florida Scientist **59**:121–137.

Lambeth, C. C. and R. B. McCullough. 1997. Genetic diversity in managed loblolly pine forests in the southeastern United States: perspective of private industrial forest land owners. Canadian Journal of Forest Research **27**:409-414.

Landers, J. L., D. H. Van Lear, and W. D. Boyer. 1995. The longleaf pine forest of the Southeast: requiem or renaissance? Journal of Forestry **93**:39-44.

Langeland, K. A. and K. C. Burks. 1998. Identification and Biology of Non-native Plants in Florida's Natural Areas. University of Florida Press, Gainesville, FL.

Leopold, A. 1949. A Sand County Almanac. Oxford University Press, Oxford, UK.

Lippencott, C. L. 2000. Effects of *Imperata cylindrica* (cogongrass) invasion on fire regime in Florida sandhill (USA). Natural Areas Journal **20**:140-149.

Litt, A. R., B. J. Herring, and L. Provencher. 2001. Herbicide effects on ground-layer vegetation in southern pinelands, USA: a review. Natural Areas Journal **21**:177-188.

Liu, H. and E. S. Menges. 2005. Winter fires promote greater vital rates in the Florida Keys than summer fires. Ecology **86**:1483-1495.

Liu, H. and R. W. Pemberton. 2008. Differential soil seed bank longevity of *Paederia foetida* L., an invasive woody vine across three habitats in Florida. Journal of the Torrey Botanical Society **135**:491-496.

Long, A. J. 2001. Environmentally sound forest harvesting. University of Florida, Institute of Food and Agricultural Sciences. Florida Cooperative Extension Service SS-FOR-6. <http://edis.ifas.ufl.edu/pdffiles/FR/FR04200.pdf>.

Louisiana Natural Heritage Program. 2004. Natural Communities of Louisiana. Louisiana Department of Wildlife and Fisheries. <http://www.wlf.louisiana.gov/pdfs/experience/naturalheritage/naturalcommuniities/LA NAT COM 0504.pdf>.

Mack, A. L. 1992. Vegetation analysis of a hardwood hammock in Dade County, Florida: changes since 1940. Florida Scientist **55**:258-263.

Marks, M., B. Lapin, and J. Randall. 1993. Element stewardship abstract for *Phragmites australis*, Common reed. The Nature Conservancy. <http://tncweeds.ucdavis.edu/esadocs/phraaust.html>.

Maschinski, J. and J. Duquesnel. 2006. Successful reintroductions of the endangered long-lived Sargent's cherry palm, *Pseudopheonix sargentii*, in the Florida Keys. Biological Conservation **134**:122-129.

Masters, L. A. 1997. Monitoring vegetation. Pp. 279-301 *in* S. Packard and C. F. Mutel, editors. The Tallgrass Restoration Handbook for Prairies, Savannas, and Woodlands. Island Press, Washington, D.C.

Matson, C. (*in prep*) Longleaf pine flatwoods ecological restoration: A practitioner's guide for Florida.

McCollom, J. 2006. Restoration of native groundcover vegetation on abandoned improved pasture at Okaloacoochee Slough Wildlife Management Area. Contract no. OT051030 for South Florida Water Management District by Florida Fish and Wildlife Conservation Commission, Felda, FL.

McCutchan, B. G., G. R. Askew, T. D. Blush, and F. C. Wise. 1997. Genetic diversity in commercial forest tree plantations. Canadian Journal of Forest Research **27**:393-446.

McKay, J. K., C. E. Christian, S. Harrison, and K. J. Rice. 2005. "How local is local?" - A review of practical and conceptual issues in the genetics of restoration. Restoration Ecology **13**:432-440.

McNabb, K. 1996. Forestry herbicide facts. Alabama Cooperative Extension System, ANR 629. Auburn University, Auburn, AL. < http://www.aces.edu/pubs/docs/A/ANR-0629/>.

Means, D. B. 1997. Wiregrass restoration: probable shading effects in a slash pine plantation. Restoration and Management Notes **15**:52-55.

Menges, E.S. 1992. Habitat preferences and response to disturbance for *Dicerandra frutescens*, a Lake Wales Ridge, Florida, endemic plant. Bulletin of the Torrey Botanical Club **119**:303-313.

Menges, E.S. 1999. Ecology and conservation of Florida scrub. Pp. 7–22 *in* R. C. Anderson, J.S. Fralish, and J. Baskin, editors. The Savanna, Barrens, and Rock Outcrop Communities of North America. Cambridge University Press. Cambridge, Massachusetts.

Menges, E.S. and N.M. Kohfeldt. 1995. Life history strategies of Florida scrub plants in relation to fire. Bulletin of the Torrey Botanical Club122: 282-297.

Menges, E. S. and C. V. Hawkes. 1998. Interactive effects of fire and microhabitat on plants of Florida scrub. Ecological Applications **8**:935-946.

Menges, E. S., W. G. Abrahamson, K. T. Givens, N. P. Gallo, and J. N. Layne. 1993. Twenty years of vegetation change in five long-unburned Florida plant communities. Journal of Vegetation Science **4**:375-386.

Menges, E.S., R. W. Dolan, R.Yahr, D. R. Gordon. 2001. Comparative genetics of seven plants endemic to Florida's Lake Wales Ridge. Castanea **66**:98-114.

Middleton, B. A. 1999. Wetland Restoration, Flood Pulsing and Disturbance Dynamics. John Wiley and Sons, New York, NY.

Miller, J. H. 2003. Non-native invasive plants of southern forests: a field guide for identification and control. USDA Forest Service GTR SRS-62. Southern Research Station, Asheville, NC.

Monk, C. D. and D. W. P. R. L. Imm. 1990. Oak forests of eastern North America. Castanea **55**:77-96.

Moore, W. H. 1974. Some effects of chopping saw-palmetto-pineland threeawn range in south Florida. Journal of Range Management **27**:101-104.

Morse, L. E., J. M. Randall, N. Benton, R. Hiebert, and S. Lu. 2004. An invasive species assessment protocol: Evaluating non-native plants for their impact on biodiversity. Version 1. Natureserve, Arlington, VA. < http://www.natureserve.org/getData/plantData.jsp>.

Mulligan, M. K. and L. K. Kirkman. 2002. Burning influences on wiregrass (*Aristida beyrichiana*) restoration plantings: natural seedling recruitment and survival. Restoration Ecology **10**:334-339.

Mulligan, M. K. and L. K. Kirkman. 2002. Competition effects on wiregrass (*Aristida beyrichiana*) growth and survival. Plant Ecology **167**:39-50.

Mulligan, M. K., L. K. Kirkman, and R. J. Mitchell. 2002. *Aristida beyrichiana* (wiregrass) establishment and recruitment: implications for restoration. Restoration Ecology **10**:68-76.

Murphy, S. D., J. Flanagan, K. Noll, D. Wilson, and B. Duncan. 2007. How incomplete exotic species management can make matters worse: experiments in forest restoration in Ontario, Canada. Ecological Restoration **25**:85-93.

Myers, R. L. 1990. Scrub and high pine. Pp. 150-193 *in* R. L. Myers and J. L. Ewel, editors. Ecosystems of Florida. University of Central Florida Press, Orlando.

Myers, R. L. and D. L. White. 1987. Landscape history and changes in sandhill vegetation in north-central and south-central Florida. Journal of the Torrey Botanical Society **114**:21-32.

Myers, R. L. and J. J. Ewel. 1990. Ecosystems of Florida. University of Central Florida Press, Orlando, FL.

Nagid, S. M. 2006. Ground Cover Restoration Annual Report 2005-2006. Florida Fish and Wildlife Conservation Commission., Tallahassee, FL. <http://myfwc.com/docs/Conservation/Ground_Cover_Restoration_Annual_Report_2005_06.pdf>.

Nagid, S. M. 2007. In the beginning there was planning. Applied Management of Conservation Lands in Florida conference. June 20-22 2007, Orlando, FL. <http://www.ces.fau.edu/amclif/agenda.php>.

Nixon, E. S., G. A. Sullivan, S. D. Jones, G. D. Jones, and u. J. K. 1990. Species diversity of woody vegetation in the Trinity River Basin, Texas. Castanea **55**:97-105.

Norcini, J. G. and J. H. Aldrich. 2004. Establishment of native wildflower plantings by seed. University of Florida, Institute of Food and Agricultural Sciences. Florida Cooperative Extension Service ENH 968. < http://edis.ifas.ufl.edu/pdffiles/EP/EP22700.pdf>.

Norcini, J. G., J. H. Aldrich, L. A. Halsey, and J. G. Lilly. 1998. Seed source affects performance of six wildflower species. Proceedings of the Florida State Horticultural Society **111**:4-9.

Odum, W. E. and C. C. McIvor. 1990. Mangroves. Pp. 517-548 *in* R. L. Myers and J. J. Ewel, editors. Ecosystems of Florida. University of Central Florida Press, Orlando, FL.

Ostertag, R. and E. S. Menges. 1994. Patterns of reproductive effort with time since last fire in Florida scrub plants. Journal of Vegetation Science **5**:303-310.

Outcalt, K. W. 1994. Seed production of wiregrass in central Florida following growing-season prescribed burns. International Journal of Wildland Fire **4**:123-125.

Outcalt, K. W. 2006. Prescribed burning or understory restoration. Pp. 327-329 *in* S. Jose, E. J. Jokela, and D. L. Miller, editors. The Longleaf Pine Ecosystem: Ecology, Silviculture and Restoration. Springer, New York, NY.

Outcalt, K. W. and C. E. Lewis. 1990. Response of wiregrass (*Aristida stricta*) to mechanical site preparation. Pp. 1-12 *in* L. C. Duever, and R. F. Noss, editors. Proceedings of the Symposium of Wiregrass Biology and Management: Maintaining Groundcover Integrity in Longleaf Pine Ecosystems. KBN Engineering and Applied Sciences, Gainesville, FL.

Outcalt, K. W. and D. D. Wade. 2004. Fuels management reduces tree mortality from wildfires in southeastern United States. Southern Journal of Applied Forestry **28**:28-34.

Outcalt, K. W., M. E. Williams, and O. Onokpise. 1999. Restoring *Aristida stricta* to *Pinus palustris* ecosystems on the Atlantic Coastal Plain, USA. Restoration Ecology **7**:262-270.

Pavlik, B. M. 1996. Defining and measuring success. Pp. 127-155 *in* D. A. Falk, C. I. Millar, and M. Olwell, editors. Restoring Diversity: Strategies for Reintroduction of Endangered Plants. Island Press, Washington, D.C.

Pfaff, S. and M. A. Gonter. 2000. Seeding two native grass species on reclaimed phosphate mined lands. *In* W. L. Daniels, and S. G. Richardson, editors. Proceedings of the 2000 Annual Meeting of the American Society for Surface Mining and Reclamation. June 11-15, 2000. Tampa, FL. American Society of Surface Mining and Reclamation, Lexington, KY.

Pfaff, S., M. A. Gonter, and C. Maura. 2002. Florida Native Seed Production Manual. USDA Natural Resources Conservation Service, Brooksville, FL. <http://www.plant-materials.nrcs.usda. gov/pubs/flpmcpuflsdprod.pdf>.

Pfaff, S., C. Maura, Jr., and M. A. Gonter. 2002b. Development of seed sources and establishment methods for native upland reclamation. USDA Natural Resources Conservation Service publ. no. 03-120-189 for Florida Institute of Phosphate Research.

Platt, W. J., S. M. R. M. Carr, and J. Fahr. 2006. Pine savanna overstory influences on ground-cover biodiversity. Applied Vegetation Science **9**:37-50.

Platt, W. J., G. W. Evans, and M. M. Davis. 1988. Effects of fire season on flowering forbs and shrubs in longleaf pine forests. Oecologia **76**:353-363.

Platt, W. J. and M. W. Schwartz. 1990. Temperate hardwood forests. Pp. 194-229 *in* R. L. Myers and J. J. Ewel, editors. Ecosystems of Florida. University of Central Florida Press, Orlando, FL.

Possley, J. and J. Maschinski. 2006. Competitive effects of the invasive grass *Rhynchelytrum repens* (Willd.) CE Hubb. on pine rockland vegetation. Natural Areas Journal **26**:391-395.

Possley, J., J. Maschinski, C. Rodriguez, and J. G. Dozier. 2008. Alternatives for reintroducing a rare ecotone species: Manually thinned forest edge versus restored habitat remnant. Restoration Ecology.

Prach, K. and P. Pysek. 2001. Using spontaneous succession for restoration of human-disturbed habitats: experience from Central Europe. Ecological Engineering **17**:55-62.

Provencher, L., B. J. Herring, D. R. Gordon, H. L. Rodgers, G. W. Tanner, L. A. Brennan, and J. L. Hardesty. 2000. Restoration of northwest Florida sandhills through harvest of invasive *Pinus clausa*. Restoration Ecology **8**:175-185.

Provencher, L., B. J. Herring, D. R. Gordon, H. L. Rodgers, K. E. M. Galley, G. W. Tanner, J. L. Hardesty, and L. A. Brennan. 2001. Effects of hardwood reduction techniques on longleaf pine sandhill vegetation in northwest Florida. Restoration Ecology **9**:13-27.

Provencher, L., B. J. Herring, D. R. Gordon, H. L. Rodgers, G. W. Tanner, J. L. Hardesty, L. A. Brennan, and A. R. Litt. 2001. Longleaf pine and oak responses to hardwood reduction techniques in fire-suppressed sandhills in northwest Florida. Forest Ecology and Management **148**:63-77.

Provencher, L., A. R. Litt, D. R. Gordon, H. L. Rodgers, B. J. Herring, K. E. M. Galley, J. P. McAdoo, N. M. Gobris, and J. L. Hardesty. 2001. Restoration fire and hurricanes in longleaf pine sandhills. Ecological Restoration **19**:92-98.

Provencher, L., A. R. Litt, and D. R. Gordon. 2003. Predictors of species richness in northwest Florida longleaf pine sandhills. Conservation Biology **17**:1660-1671.

Quarterman, E. 1981. A fresh look at climax forests of the Coastal Plain. ASB Bulletin **28**:143-148.

Quarterman, E., B. H. Turner, and T. E. Hemmerly. 1972. Analysis of virgin mixed mesophytic forests in Savage Gulf, Tennessee. Journal of the Torrey Botanical Society **99**:228-232.

Radosevich, S., J. Holt, and C. Ghersa. 1997. Weed Ecology: Implications for Management. 2nd edition. John Wiley and Sons, New York, NY.

Rayamajhi, M. B., M. F. Purcell, T. K. Van, T. D. Center, P. D. Pratt, and G. R. Buckingham. 2002. Australian Paperbark Tree (Melaleuca). *In* R. Van Driesche, B. Blossey, M. Hoddle, S. Lyon, and R. Reardon, editors. Biological Control of Invasive Plants in the Eastern United States. USDA Forest Service publication FHTET-2002-04. Washington, D.C.

Reburtus, A. J., G. B. Williamson, and E. B. Moser. 1989. Longleaf pine pyrogenicity and turkey oak mortality in Florida xeric sandhills. Ecology **70**:60-70.

Rice, P. M. 2005. Fire as a tool for controlling nonnative invasive plants. Montana State University Center for Invasive Plant Management, Bozeman, MT. <http://www.weedcenter.org/management/burning_weeds.pdf>.

Richardson, D. R. 2004. The sand pine scrub community: An annotated bibliography, 1989-2001. Florida Scientist **67**:118-143.

Richardson, S.G., N. Bissett, C. Knott, and K. Himel. 2003. Weed control and upland native plant establishment on phosphate mined lands in Florida. 30th Annual Conference on Ecosystem Restoration and Creation. Tampa, FL. <http://www.fipr.state.fl.us/FIPRreport2003/research-highlights-habitat.htm>.

Ries, P., M. E. Dix, M. Ielmini, and D. Thomas. 2004. National strategy and implementation plan for invasive species management. USDA Forest Service publication FS-805. Washington, D.C.

Robbins, L. E. and R. L. Myers. 1992. Seasonal Effects of Prescribed Burning in Florida. Misc. publication no. 8. Tall Timbers Research Station, Tallahassee, FL.

Roberts, R.E. and A.C. Cox. 2000. Sand pine scrub vegetation response to two burning and two non-burning treatments. Pp.114–134 *in* W. Moser and F. Moser (editors). Fire and Forest Ecology: Innovative Silviculture and Vegetation Management. Proceedings of the 21st Tall Timbers Fire Ecology Conference. 14-16 April, 1998. Tall Timbers Research Station, Tallahassee, FL.

Rodgers, H. L. and L. Provencher. 1999. Analysis of longleaf pine sandhill vegetation in northwest Florida. Castanea **64**:138-162.

Roncoby, R. 2004. Xeric reclamation techniques and prescribed fire: Florida phosphate mines. Proceedings of the 16th Annual International Society for Ecological Restoration Conference. August 24-26, 2004. Victoria, Canada.

Ross, M. S. and J. J. F. L. J. O'Brien. 1992. Ecological site classification of Florida Keys terrestrial habitats. Biotropica **24**:488-502.

Roth, L. *In prep*. Restoration of ground layer vegetation in dry-site longleaf pine communities: a working guide to practical methods.

Ruth, A. D., S. Jose, and D. L. Miller. 2008. Seed bank dynamics of sand pine scrub and longleaf pine flatwoods of the Gulf Coastal Plain. Ecological Restoration **26**:19-21.

Salter, R. and S. C. Dial. 1984. Hammock vegetation of Little Talbot Island State Park, Florida. Journal of the Torrey Botanical Society **111**:494-497.

Schafale, M. P. and A. S. Weakley. 1990. Classification of the natural communities of North Carolina: third approximation. North Carolina Natural Heritage Program, Natural Resources Division of Parks and Recreation, Raleigh, NC.

Schmalzer, P. A. 2003. Growth and recovery of oak saw palmetto scrub through ten years after fire. Natural Areas Journal **23**:5-13.

Schmalzer, P.A. and C.R. Hinkle. 1992. Recovery of oak-saw palmetto scrub after fire. Castanea **53**:158-173.

Schmalzer, P.A. and C.R. Hinkle. 1992. Species composition and structure of oak-saw palmetto scrub vegetation. Castanea **57**:220-251.

Schmalzer, P.A. and S.R. Boyle. 1998. Restoring long-unburned oak-saw palmetto scrub requires mechanical cutting and prescribed burning (Florida). Restoration and Management Notes **16**:96-97.

Schultz, R. P. 1976. Environmental changes after site preparation and slash pine planting on a flatwoods site. USDA Forest Service research paper SE-156. Southeastern Forest Experiment Station, Asheville, NC.

Seamon, G. 1998. A longleaf pine sandhill restoration in northwest Florida. Restoration and Management Notes **16**:46-50.

Seamon, P. A., R. L. Myers, L. E. Robbins, and G. S. Seamon. 1989. Wiregrass reproduction and community restoration. Natural Areas Journal **9**:264-265.

Segal, D. S., V. D. Nair, D. A. Graetz, K. M. Portier, N. J. Bissett, and R. A. Garren. 2001. Post-mine reclamation of native upland communities: final report. Florida Institute for Phosphate Research, Bartow, FL.

Sharitz, R. R. and W. J. Mitsch. 1993. Southern floodplain forests. Pp. 311-372 *in* W. H. Martin, S. G. Boyce, and A. Echternacht, editors. Biodiversity of the Southeastern United States: Lowland Terrestrial Communities. John Wiley and Sons, New York, NY.

Skoloff, B. 2006. Florida, Big Sugar in Everglades Negotiation. USA Today (6/23/2008). <http://www.usatoday.com/money/economy/2008-23-3394574388_x.htm>.

Slocum, M. G., W. J. Platt, and H. C. Cooley. 2003. Effects of differences in prescribed fire regimes on patchiness and intensity of fires in subtropical savannas of Everglades National Park, Florida. Restoration Ecology **11**:91-102.

Snyder, J. R., A. Herndon, and W. B. Robertson. 1990. South Florida rockland. Pp. 230-277 *in* R. L. Myers and J. J. Ewel, editors. Ecosystems of Florida. University of Central Florida Press, Orlando, FL.

SER (Society for Ecological Restoration). 2004. The SER Primer on Ecological Restoration. SER Science and Policy Working Group, Tucson, Arizona. <http://www.ser.org/>.

Stambaugh, M., R. Guyette, and C. and Putnam. 2005. Fire in the pines. Park Science **23**:43-47.

Stanturf, J. A., S. H. Schoenholtz, C. J. Schweitzer, and J. P. Shepard. 2001. Achieving restoration success: Myths in bottomland hardwood forests. Restoration Ecology **9**:189-200.

Swearingen, J. M. 2000. Japanese stilt grass (*Microstegium vimineum*) fact sheet. Virginia Natural Heritage Program. <http://www.nps.gov/plants/alien/fact/mivi1.htm>.

Tamang, B., D. L. Rockwood, M. Langholtz, M. Maehr, B. Becker, and S. Segrest. 2008. Fast-growing trees for cogongrass (*Imperata cylindrica*) suppression and enhanced colonization of understory plant species on a phosphate-mine clay settling area. Ecological Engineering **32**:329-336.

Teasdale, J. R. and C. L. Mohler. 2000. The quantitative relationship between weed emergence and the properties of mulches. Weed Science **48**:385-392.

TNC (The Nature Conservancy). 1998. Restoration Procedures Manual for Public Lands in Florida. Florida Department of Environmental Protection, Tallahassee, FL. <http://www.dep.state.fl.us/water/wetlands/docs/mitigation/mitman.pdf>.

TNC (The Nature Conservancy). 2008. EEL Fire Management Manual. <http://www.eelbrevard.com/pubs/eel_firemanual.pdf>.

Thieret, J. W. 1970. Quadrat study of a bottomland forest in St. Martin Parish, Louisiana. Castanea **36**:174-181.

Thomas, S. C., C. B. Halpern, D. A. Falk, D. A. Liguori, and K. A. Austin. 1999. Plant diversity in managed forests: understory responses to thinning and fertilization. Ecological Application **9**:864-879.

Tockner, K. and J. A. Stanford. 2002. Riverine flood plains: present state and future trends. Environmental Conservation **29**:308-330.

Toth, L. A. 2009. Hydrologic restoration of wetlands on the Kissimmee River floodplain: complimentarity of an herbicide treatment of the exotic vine *Lygodium microphyllum*. Florida Scientist.

Tu, M., C. Hurd, and J. M. Randall. 2001. Invasive Species Team's Control Methods Handbook: Tools and Techniques for Use in Natural Areas. The Nature Conservancy. <http://tncweeds.ucdavis.edu/handbook.htm>.

USDA Natural Resources Conservation Service. 2008. Range planting: Conservation practice standard 550 guidance. Field office technical guide, section 4. <http://www.plant-materials.nrcs.usda.gov/pubs/flpmsfo8066.pdf>.

Van Kley, J. E. 1999. The vegetation of the High Terrace Rolling Uplands, Louisiana. Castanea **64**:318-336.

Van Lear, D. H., W. D. Carroll, P. R. Kapeluck, and R. Johnson. 2005. History and restoration of the longleaf pine-grassland ecosystem: Implications for species at risk. Forest Ecology and Management **211**:150-165.

Varner, J. M., D. R. Gordon, F. E. Putz, and J. K. Hiers. 2005. Restoring fire to long-unburned *Pinus palustris* ecosystems: novel fire effects and consequences for long-unburned ecosystems. Restoration Ecology **13**:536-544.

Varner, J. M., J. S. Kush, and R. S. Meldahl. 2000b. Ecological restoration of an old-growth longleaf pine stand utilizing prescribed fire. Pages 216-219 *in* W. K. Moser and C. E. Moser, editors. Proceedings of the 21st Tall Timbers Fire Ecology Conference. Tall Timbers Research Station, Tallahassee, FL.

Vaughan, E. 2001. The Apalachicola Bluffs and Ravines Preserve in northern Florida: a longleaf pine and wiregrass restoration project. <http://horticulture.cfans.umn.edu/vd/h5015/01papers/vaughan.htm>.

Vitousek, P. M., C. M. D'Antonio, L. L. Loope, M. Rejmanek, and R. Westbrooks. 1997. Introduced species: a significant component of human-caused global change. New Zealand Journal of Ecology **21**:1-16.

Walker, G. B. 2002. Developments in the restoration of upland pasture lands in Florida. University of Central Florida.

Walker, J. and R. K. Peet. 1983. Composition and species diversity of pine-wiregrass savannas of the Green Swamp, North Carolina. Vegetatio **55**:163-179.

Walker, J. L. and A. M. Silletti. 2006. Restoring the ground layer of longleaf pine ecosystems. Pp. 297-325 *in* S. Jose, E. J. Jokela, and D. L. Miller, editors. The Longleaf Pine Ecosystem: Ecology, Silviculture, and Restoration. Springer, New York, NY.

Walters, T. W., D. S. Deckerwalters, and D. R. Gordon. 1994. Restoration considerations for wiregrass (*Aristida stricta*) - allozymic diversity of populations. Conservation Biology **8**:581-585.

Wear, D. N. and J. G. Greis. 2002. Southern Forest Resource Assessment - Summary of findings. Journal of Forestry **100**:6-14.

Webster, C. R., M. A. Jenkins, and S. Jose. 2006. Woody invaders and the challenges they pose to forest ecosystems in the eastern United States. Journal of Forestry **104**:366-374.

Weekley, C. W., D. Gagnon, E. S. Menges, and P. F. Quintana-Ascencio. 2007. Variation in soil moisture in relation to rainfall, vegetation, gaps, and time-since-fire in Florida scrub. Ecoscience **14**:377-386.

Wendelberger, K. S., M. Q. N. Fellows, and J. Maschinski. 2008. Rescue and restoration: experimental translocation of *Amorpha herbacea* Walter var. *crenulata* (Rybd.) Isley into a novel urban habitat. Restoration Ecology **16**:542-552.

Wheeden, C. R., A. M. Shelton, and M. P. Hoffman. 2008. Biological control: a guide to natural enemies in North America. <http://www.nysaes.cornell.edu/ent/biocontrol/>.

Wheeler, B. D., S. C. Shaw, W. J. Fojt, and R. A. Robertson. 1995. Restoration of Temperate Wetlands. John Wiley and Sons, New York, NY.

Whelan, K. R. T. 2005. The Successional Dynamics of Lightning-initiated Canopy Gaps in the Mangrove Forests of Shark River, Everglades National Park, USA. Dissertation, Florida International University, Miami, FL.

White, P. S. and J. L. Walker. 1997. Approximating nature's variation: selecting and using reference information in restoration ecology. Restoration Ecology **5**:338-349.

Wilkins, R. N., G. T. Tanner, R. Mulholland, and D. G. Neary. 1993. Use of hexazinone for understory restoration of a successionally-advanced xeric sandhill in Florida. Ecological Engineering **2**:31-48.

Wright, H. A. and A. W. Bailey. 1982. Fire ecology: United States and Southern Canada. John Wiley and Sons, New York, NY.

Yahr, R., E. S. Menges, and D. Berry. 2000. Effects of drainage, fire exclusion, and time-since-fire on endemic cutthroat grass communities in central Florida. Natural Areas Journal **20**:3-11.

Zedler, P. H. and G. A. Scheid. 1988. Invasion of *Carpobrotus edulis* and *Salix lasiolepis* after fire in a coastal chaparral site in Santa Barbary County, California. Madrono **35**:196-201.

Zouhar, K., J. Kaplier, S. Sutherland, and M. L. Brooks. Wildland fire in ecosystems: fire and non-native invasive plants. USDA Forest Service RMRS-GTR -42, vol. 6. Rocky Mountain Research Station, Ogden, UT.