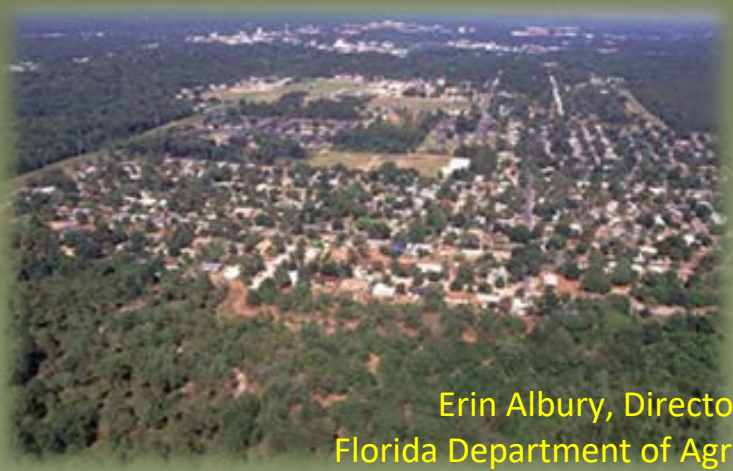
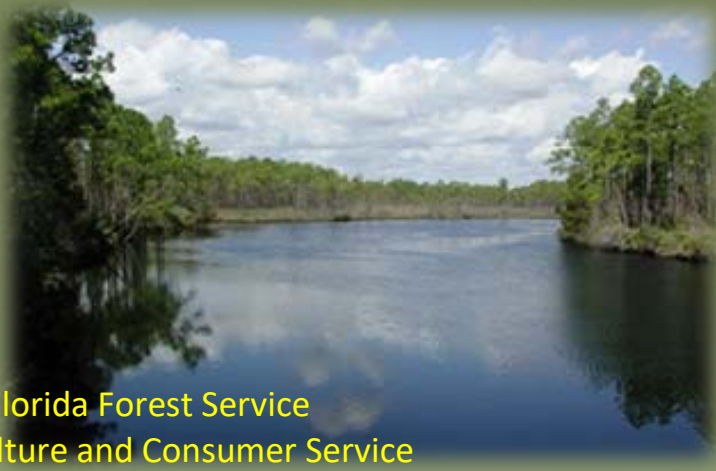
Florida's Forest Action Plan 2020 Update





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I. Introduction

This update of the 2010 Florida Forest Resource Strategy document represents the opportunity to reflect upon and build on the foundation of actions accomplished during the past decade in the State of Florida. Originally created in the Forestry Title of the 2008 Farm Bill, this process was updated as part of the amended Cooperative Forestry Assistance act in the 2014 Farm Bill. During the past decade much progress has been made, based upon issues important across the state, and this document focuses on continuing cooperative actions that positively impact all forests in Florida.

The Florida Forest Service, along with our many partners and stakeholders, continues to focus on issues that were agreed upon previously as the most important to our state. These issues remain essentially the same with one minor adjustment, updating the topic of meeting the challenge of climate change to forest resiliency to be more encompassing of taking a proactive approach to help all forests remain healthy and sustainable for future generations.

In addition to addressing our state's needs, each issue focuses on the national priorities of:

Conserve - Working Forest Landscapes

Protect - Forests from Harm

Enhance – Public Benefits from Trees and Forests

As with the 2010 Florida Forest Resource Strategy, this update utilizes issue by issue priority areas based upon the specific data needs to inform strategic actions to influence change.

These strategies take into account multi-state or regional priorities and consider collaborative actions across geographical and ownership boundaries, especially with adjacent states. These issues include forest fragmentation, forest markets, longleaf pine habitat, invasive species, and water quality.

This document also is informed by other natural resource documents as applicable. These plans include, Florida's current State Wildlife Action Plan, the Critical Lands and Waters Project, Florida's Community Wildfire Protection Plan, other entities guidance and action plans, the Southern Forest Futures Project, and will continue to be informed by the Southern Forest Outlook project focusing on Water, Fire and Markets.

This 2020 strategic document outlines, by issue, specific actions necessary to address the topics of concern based upon the current state of Florida's forests as noted in each issue area. It is our intent that this document become a guidebook for anyone seeking direction on sound activities to maintain and enhance healthy forests into the future in Florida.

II. Strategic Issues

Issue 1: Wildfire Threat/Use of Prescribed Fire

1) Current Issue Description

A wildfire can ignite at any time during the year in Florida. The peak of wildfire season occurs during the driest time of the year – March, April, and May. Over the past ten years, Florida averages almost 2,700 wildfires annually (approximately 2,100 of these are human caused) that burn nearly 100,000 acres. Due to the high population density, over 70% of all wildfires threaten some type of structure.

The future of prescribed fire in Florida is uncertain. Public perception, population growth, EPA regulations and related issues are challenging our ability to use the safest and best tool that we have available for applying a natural and essential process to the land.

About six of every ten acres in Florida—nearly 22 million acres—are considered fire-dependent. Research suggests that the optimum range of fire frequency ranges from one to five years, depending upon the types of plant and wildlife communities. Currently, about 2.2 million acres are authorized for burning each year. If that number approximates what is actually being burned, we are achieving an average 10-year fire return interval, dramatically longer than what fire- dependent ecosystems require. The lack of more frequent, but less intense fires could mean serious consequences for fire-dependent species, natural communities, and ecosystems, leading to ecosystem dysfunction at a staggering level.

In addition to its environmental benefits, prescribed fire reduces the risk of catastrophic wildfires, ensuring a safer environment and a greater measure of protection for human lives and property. In many places across Florida, prescribed fire has aided immensely in controlling or preventing wildfires. Prescribed fire reduces the build-up of dangerous fuels from rapidly growing brush and forest litter. It also reduces the intensity of wildfires when they do occur.

2) Key Attributes

<u>Policies that allow the use of prescribed fire</u>

Over the years, Florida has had legislation regarding open burning in the state. The modern era of prescribed fire legislation began in the late 1970's. In 1977, Florida passed the Hawkins Bill, which contained procedures under which the Florida Forest Service (FFS) could prescribe burn hazardous accumulations of wildland fuels on private land, FS 590.125(4), (Wade and Long 1979). The intent of the law was to reduce the conflagration potential on these absentee land holdings. Thousands of acres have been burned in Florida each year under its auspices.

By the 1980s, however, the acreage annually treated with prescribed fire was declining. Reasons for this decline were varied and included worries about liability. In 1990, the Florida Prescribed Burning Act became law. This legislation, with its associated administrative rules, outlined accepted forestry burn

practices in the state (Brenner and Wade 1992). It also protected prescribed burners from civil liability as long as they or their agents were not found generally negligent as defined in the 1990 Florida Supreme Court ruling *Midyette v.Madison*, No. 74,09 I. In addition, prescribed burns conducted in accordance with the statute could no longer be terminated because of nuisance complaints.

This law authorized and promoted the continued use of prescribed burning for ecological, silvicultural, and wildlife management purposes. The statute promoted the use of fire, described the benefits of prescribed fire, the value of public outreach initiatives, and the need for continued prescribed burner training as follows:

1) Prescribed burning reduces vegetative fuels within wildland areas. Reduction of the fuel load reduces the risk and severity of wildfire, thereby reducing the threat of loss of life and property, particularly in urban areas.

2) Most of Florida's natural communities require periodic fire for maintenance of their ecological integrity. Prescribed burning is essential to the perpetuation, restoration, and management of many plant and animal communities. Significant loss of the state's biological diversity will occur if fire is excluded from fire-dependent ecosystems.

3) Forestland and rangeland constitute significant economic, biological, and aesthetic resources of statewide importance. Prescribed burning on forest land prepares sites for reforestation, removes undesirable competing vegetation, expedites nutrient cycling, and controls or eliminates certain forest pathogens. On rangeland, prescribed burning improves the quality and quantity of herbaceous vegetation necessary for livestock production.

4) The state purchased hundreds of thousands of acres of land for parks, preserves, wildlife management areas, state forests, and other public purposes. The use of prescribed burning for management of public lands is essential to maintain the specific resource values for which these lands were acquired.

5) A public education program is necessary to make citizens and visitors aware of the public safety, resource, and economic benefits of prescribed burning.

6) Proper training in the use of prescribed burning is necessary to ensure maximum benefits and protection for the public.

7) As Florida's population continues to grow, pressures from liability issues and nuisance complaints inhibit the use of prescribed burning. Therefore, the Florida Forest Service is urged to maximize the opportunities for prescribed burning conducted during its daytime and nighttime authorization process.

In 1998, in the midst of a severe drought, Florida suffered a devastating wildfire season during which more than 505,000 acres burned, much of which was in the Wildland Urban Interface (WUI). One of the factors cited as a major contributor to the destructiveness of the fires was the unnaturally high accumulation of fuel. The Governor's Wildfire Response and Mitigation Review Committee met in the Fall of 1998 and identified 90 areas of critical concern. One of the recurring issues was why more acreage was not being treated with prescribed fire. The top four reasons given why private landowners do not use prescribed fire: 1) liability in general;2) liability in particular; 3) liability that would cause economic loss (time, expertise, etc.); and 4) liability including, but not limited to, fear of lawsuits, legal proceedings, etc.

Armed with the results of the Governor's Committee Report and a long-range weather forecast calling for the drought to extend through the spring 1999 fire season, the Florida Legislature modified the 1990 Prescribed Burning Act. The new Florida statute (590.125(3)), which goes by the same name, is intentionally general. It allows the Florida Department of Agriculture and Consumer Services, Florida Forest Service, through the rule-making process, to establish and update specific guidelines as necessary. In order to receive protection under this law, at least one certified prescribed burn manager (CPBM) must be present from ignition to completion of the prescribed burn. In addition, a written prescription must be prepared before the Florida Forest Service can grant an authorization to burn (under this law) and this prescription must be on-site during the burn. Permission or consent of the landowner or their designee must also be obtained prior to requesting authorization from the Florida Forest Service. The person getting the authorization must certify that the area to be burned has been properly prepared, including adequate firebreaks, and sufficient personnel and firefighting equipment will be on-site to assure control of the fire.

Prescription burns that adhere to these conditions receive the following protection under the law:

1) The burn is considered to be in the public interest and does not constitute a public or private nuisance when conducted under applicable state air pollution statutes and rules.

2) The burn is considered to be a property right of the property owner if vegetative fuels are burned as required in this subsection.

3) A property owner or his or her agent is neither liable for damage or injury caused by the fire or resulting smoke, nor considered to be in violation of subsection (2) for burns conducted in accordance with this subsection unless "gross negligence" is proven.

One of the most important requirements of Florida's prescribed burn law is the written plan or prescription. The rules define exactly how this document is to be prepared. It must include, but is not limited to: 1) stand or site description; 2) map of the area to be burned; 3) fire breaks to be constructed or reworked; 4) personnel and equipment to be used on the prescribed burn; 5) desired weather factors, including, but not limited to, surface wind speed and direction, transport wind speed and direction, minimum mixing height, minimum relative humidity, maximum temperature, and fine-fuel

moisture; 6) desired fire behavior factors such as type of burn, firing technique, flame length, and rate of spread; 7) the time and date the prescription was prepared; 8) the authorization date and the time period of the authorization; 9) an evaluation of the anticipated impact of the proposed burn on pertinent smoke-sensitive areas; and 10) the signature and number of the Certified Prescribed Burn Manager.

The rules require that the CPBM screen the prescription for possible negative smoke impacts on the surrounding landscape prior to signing it (which constitutes approval of all facets of the plan), and to submit his or her certified prescribed burn number at the time of the authorization request. As indicated above, the Florida Supreme Court found that land managers can only be found negligent if they do not follow "accepted forestry practices." The Florida Forest Service modified these rules in 1991, 1999, and again in 2014 to more clearly define accepted forestry practices.

CERTIFICATION AND RE-CERTIFICATION PROCEDURES

Individuals become CPBMs in Florida by completing the Florida Certified Prescribed Burn Manager Training Course, submitting a completed prescription to a Florida Forest Service field office for review, conducting the burn, and having the results inspected by a Florida Forest Service representative.

The Florida Certified Prescribed Burn Manager Training Course is offered in two formats. The classroom version and the self-study version. The self-study version, also called the correspondence course is limited to people with considerable prescribed burning experience. In order to take the correspondence course, individuals, must meet at least one of the following criteria; 1) have completed at least three acreage burns in their name in Florida; 2) been a participant in at least five burns in Florida and received a letter of recommendation from a current Florida Certified Burner; 3) be currently certified in another state; 4) hold a current federal RXB2 certification.

The classroom version of the course is open to people of all levels of experience. It provides 24 hours of intensive training in addition to 20-30 hours of pre-work, which requires a completed prescription and classroom discussions. A prerequisite to course completion and certification is experience in both the planning and execution phases on at least three prescribed burns. The demand for this course is very high. Class size is limited to 35 trainees, and the number of applicants often exceed the number of available slots, so some trainees have to wait a year or two to take the training. Since the program began 1987, there have been over 5,100 individuals obtain certification in Florida.

Changes made in Florida's Administrative Code (FAC) in 1999 now require that CPBMs maintain their certification by burning under their certification number at least twice every 5 years and taking at least 8 hours of approved prescribed fire training (participation in the North, Central, or South Florida Prescribed Fire Council meetings is approved training). Because many CPBMs work together, and not all their individual numbers are used, an individual which has participated in five or more certified burns (documented with authorization numbers) can substitute this for the burning experience. If, however, a

CPBM does not meet these requirements, they either must retake the training or be dropped from the CPBM list. The Commissioner of Agriculture will revoke the certification of any CPBM whose practices and procedures repeatedly violate Florida law or agency rules or are a threat to public health, safety, or property.

Public acceptance of the use of prescribed fire

The use of prescribed fire is generally accepted by Floridians. We understand that continued public acceptance is vital if we hope to continue to use prescribed fire as a land management tool. Education is the key in helping people understand the importance of using prescribed fire in Florida.

The FFS has taken a proactive approach in educating the citizens of Florida about prescribed burning. Here are a few examples of current projects relating to informing the public.

In 2008, a regional prescribed fire messaging campaign was developed with Federal funding assistance as a joint venture of the 13 states in the USDA Forest Service Southern Region and Tall Timbers Research Incorporated.

Using marketing research, a campaign was developed that advertised a website containing information on the benefits of prescribed fire. The site also provided links to state agencies' web pages where additional information could be obtained.

In 2011, the Florida Cabinet designated the fourth Sunday in January as the start of Prescribed Fire Awareness Week. Every year at the end of January, FFS field units and other state and private organizations host activities, across the state, to promote the use and acceptance of prescribed fire.

A Prescribed Fire Summit was held in 2013 where representatives from Florida and Georgia met to discuss future threats to prescribed burning. Attendees included State Regulators, Research Scientists, Timber Industry, Private Consultants, and Non-industrial Private Landowners. The result of the summit was a strategic plan which addressed these issues and included a timetable for addressing them.

FFS is currently working with Tall Timbers Research Incorporated on a revitalized media campaign to promote prescribed fire that launched in March 2020. The campaign will target residents living in the WUI and environmentally concerned citizens. Social media will be the primary avenue for distribution. The campaign will encourage citizens to help spread the word about why we use prescribed fire.

Prescribed fire practitioners, professionals with the knowledge, skills and willingness to conduct prescribed fires

A prescribed fire program could not exist without people who are passionate about prescribed burning. These people have led the way in making prescribed fire what it is today. They are not only

practitioners of prescribed fire, but they are advocates who express their views to decision makers. One way they do this is through Prescribed Fire Councils. Florida was the first state to form a prescribed fire council which has spread to the three councils currently in the state.

Fire councils are made up of a diverse group of people whose common objective is to promote the continued use of prescribed fire as a management tool. Most members are practicing prescribed burners from a variety of organizations ranging from private industry, government agencies, non-government organizations and private landowners.

The majority of members are also Certified Prescribed Burn Managers (CPBMs). Florida currently has over 1,700 active CPBMs.

Process that enables the use of prescribed fire

A successful prescribed fire program needs more than people willing to do the burning. It also needs to have a process for issuing and tracking burning authorizations. In Florida, we are fortunate to have the Fire Management Information System (FMIS). FMIS is a complex web-based application that is used for a variety of purposes. It is used to dispatch fire crews to wildfires and it also tracks information about those fires such as location, size and fuel type. Additionally, FMIS generates ICS-209 information when needed.

In addition to tracking wildfires, FMIS is also used in the prescribed fire permitting process. Contact information about the person requesting the authorization is gathered along with landowner information (if it is different). Specifics of the burn are also gathered such as location, size, firing technique and type of burn (Figure 5, Page 19). This database tracks the authorizations in real-time which also allows the generation of a detailed up-to-date report like the one below.

Burning Authorizations Summary
Statewide Summary
1/1/2010 through 1/1/2020

Burn Type	**Authorized Fires**	**Authorized Acres**	**Authorized Piles**
Agricultural--Pasture	262,943	3,145,106	487,569
Agricultural--Range management	16,177	1,230,272	33,666
Agricultural--Stubble (post-harvest)	14,842	56,462	28,251
Agricultural--Sugarcane	109,428	4,334,417	290
Agriculture--Citrus	78,243	3,242	161,291
Land clearing--Non-residential--With ACI	24,331	1,865	39,039
Land clearing--Non-residential--Without ACI	135,033	43,140	460,232

Land clearing--Residential--With ACI	5,980	584	8,411
Land clearing--Residential--Without ACI	101,506	18,080	227,566
Silvicultural--Disease control	539	12,601	859
Silvicultural--Ecological	19,017	5,361,874	4,372
Silvicultural--Hazard removal	46,157	7,401,455	43,390
Silvicultural--Other	0	0	0
Silvicultural--Prior to seed	1,995	39,550	7,681
Silvicultural--Site preparation	12,306	397,872	40,634
Silvicultural--Wildlife	4,763	1,614,440	893
Total	833,260	23,660,960	1,544,144

FMIS is a valuable tool which enables burning activity across the state to be monitored.

3) Public Benefits

It is paradoxical that while so much effort is devoted to suppressing wildfires, controlled fire is used extensively in the South to manage forests. By reducing fuel loads with prescribed burning, the risk of catastrophic wildfire is reduced. The history of fire in the South during the last century reflects the process of coming to terms with this paradox (Pyne 1997). In many places around Florida, prescribed fire has aided immensely in controlling or preventing wildfires. Prescribed fire reduces the build-up of dangerous fuels from rapidly growing brush and forest litter. It also reduces the intensity of wildfires when they do occur resulting in less smoke impacts and damage to trees.

Prescribed burning also improves access to the forest. Areas that have been burned have less woody underbrush which makes it easier to walk through the woods. A clear understory also improves the aesthetics of the forest.

4) Threats

Threats will continue to impact the future of prescribed fire in Florida. Public perception, population growth, Environmental Protection Agency regulations and related issues are challenging our ability to use the safest and best tool that we have available for applying a natural and essential process to the land.

Some of the state's most heavily populated areas are also some of the most fire-prone. Many of Florida's most rapidly growing population centers are also at high risk of catastrophic wildfires, such as along the Atlantic coast and the central part of the state. As Florida's population has grown, more and more people are living and working in the WUI, where development has encroached on formerly rural, forested areas.

The use of prescribed fire is perhaps most critical—and most controversial—in the WUI, locations where people live in close proximity to forests. This interface continues to expand at an increasing rate in Florida. As we have seen in the southeast and on many western landscapes, the incidence of catastrophic wildfires is increasing, placing people increasingly at risk. The cost of suppressing wildfires and the economic value of properties lost also continues to increase.

Human health concerns cannot be easily dismissed. Smoke can cause difficulties for people with breathing problems. However, many scientists believe the quantity and nature of smoke from wildfires is quite different from that of well conducted prescribed fires. Prescribed fires must be set under specific conditions to allow for adequate combustion and smoke dispersal, reducing particulate matter in the air. In the long run, a well-managed prescribed fire program produces less smoke, allowing better management of human health concerns.

5) Opportunities

Florida has a very active wildfire prevention and mitigation program. By providing education, information and fuel reduction throughout the state, Florida's efforts have both reduced the number of human-caused wildfires significantly and limited the damage to structures. However, there is much more left to do.

A large part of the fuel reduction program in the state is accomplished by prescribed burning. Although the state burns over 2.2 million acres each year, only one half of the area that needs to be burned is actually burned. As a result, the state continues to fall further behind each year in the prescribed fire portion of its fuel reduction efforts.

Florida's pre and post hazard mitigation plan encompasses the following items:

<u>Authorizations to Burn Outdoors</u>
The FFS must authorize all outdoor burning within the State of Florida (Florida Statutes, 590.125).

<u>Risk Assessment in Florida</u>
The Florida Forest Service has adopted the use of the Southern Wildfire Risk Assessment Portal (SouthWRAP) project to provide a foundation for wildfire mitigation and prevention planning in Florida, and it is also used in the other Southern states. SouthWRAP data has been in use since 2005 and continues to be updated and enhanced over time to reflect changes in the landscape that have occurred since then. Florida continues to help in the development and testing.

SouthWRAP is the primary mechanism by which Florida and the other southern states are creating awareness among the public and arming state and local government planners with information to support mitigation and prevention efforts. Data in SouthWRAP is used to help prioritize areas in the state where tactical analyses, community interaction and education, or mitigation treatments might be necessary to reduce the risk from wildfires. In addition, the information provided in the assessment can be used to support the following key priorities:

- Identify areas that are most prone to wildfire

- Identify areas that may require additional tactical planning, specifically related to mitigation projects and Community Wildfire Protection Planning
- Provide the information necessary to justify resource, budget and funding requests
- Allow agencies to work together to better define priorities and improve emergency response, particularly across jurisdictional boundaries
- Define wildland communities and identify the risk to those communities
- Increase communication with local residents and the public to address community priorities and needs
- Plan for response and suppression resource needs
- Plan and prioritize hazardous fuel treatment programs

SouthWRAP is located on the internet at: https://southernwildfirerisk.com/

Wildfire Mitigation

The Florida wildfire mitigation program has two major components designed to reduce wildfire risk throughout the state. These programs are coordinated locally through mitigation specialists located in FFS field offices across the state.

Fuel reduction

Florida uses prescribed fire and mechanical methods to reduce excess fuel loading on both public and privately owned lands. This process reduces the size and the intensity of wildfires. The FFS also provides technical assistance to communities contracting for fuel reduction on their own and is often able to provide fuel reduction activities at little or no cost to homeowners. There are currently four regional Fire Management Teams with equipment able to work in all types of fuel and terrain to provide fuel reduction services. Local agency field units have the ability to provide these services as well.

Information and Education

The FFS information and education component has several facets:

The Florida Firewise Communities Program is a part of the National Fire Protection Association Firewise USA Recognition Program. The simple goal of the program is to make residents of the WUI aware that they have a responsibility to assist with the prevention of community wildfire disasters by actively lowering their home and community's wildfire risk. The concept of creating defensible space around a structure is a core principle in the program. This awareness is accomplished through homeowner workshops and individual field visits designed to educate the homeowners about steps they can take to increase the probability that their home would survive a wildfire disaster, even if fire services cannot get to them. Communities that adopt and implement Firewise principles are encouraged to complete the process to become nationally recognized as a Firewise USA community. Florida currently has 31 nationally recognized communities (Figure 4, Page 18).

Communities – defined as a "group of residents" – are brought together as a planning group to develop and initiate a Community Wildfire Protection Plan (CWPP). Florida currently has 88 areas, many county-wide, in 53 counties covered by a CWPP (Figure 4, Page 18). At a minimum, these groups have representation from the local governing body (e.g., county officials), the local fire service, and

the FFS. To ensure that the plan is representative of local needs, other stakeholders – including community members – are also invited to participate in the development of the CWPP. These planning groups often involve Local Mitigation Strategy members.

Local FFS field units assist communities with a risk assessment detailing the factors which contribute to their wildfire risk. The assessments incorporate the risk information generated by SouthWRAP. A risk assessment provides the community with a list of actions they can take to lower their overall wildfire risk.

Since over 75% of the wildfires in Florida are human caused, Florida has an active wildfire prevention program. Prevention messages are carried to the public through multi-media methods including social media, television, newspapers, radio, billboards, movie theaters, and local flyer distribution.

Local FFS field units work with local governing bodies and Local Mitigation Strategy groups to change or institute local comprehensive plans, ordinances, and codes that encourage actions and strategies that will lower local wildfire risk.

The FFS uses many other tools to communicate information to residents and visitors. Information is constantly supplied to various media sources both from the state level and locally to provide information on current wildfire conditions, wildfire suppression progress, what actions homeowners can take to lower their wildfire risk, and FFS activities. Wildfire risk reduction information is also posted at: www.fdacs.gov/Divisions-Offices/Florida-Forest-Service.

Fireline Establishment

In many areas, pre-suppression firelines may be established to reduce the wildfire risk to residences in the WUI. Well maintained firelines can significantly reduce the chances of a wildfire reaching populated areas, as well as, reduce the time needed to contain a wildfire thereby allowing the most effective and efficient use of resources. The Florida Forest Service provides this service to landowners at specified rates.

6) Agency and Organization Roles

Florida Fish & Wildlife Conservation Commission

This agency provides equipment and personnel in supporting fire suppression and prescribed fire activities throughout Florida.

Florida Department of Environmental Protection

This agency also provides equipment and personnel in supporting fire suppression and prescribed fire activities throughout Florida. DEP is also Florida's air quality regulatory agency.

Local Fire Protection Organizations

Provide wildfire suppression support, especially in the Wildland Urban Interface.

National Interagency Prescribed Fire Training Center

Serve on the prescribed fire council. They also assist many agencies in Florida and other states by providing additional personnel to enhance their prescribed burning program.

Regional Prescribed Fire Councils
Provide a forum for the sharing of ideas and new trends in the prescribed fire community. In the past, these councils have been instrumental in creating new legislation regarding prescribed fire.

Tall Timbers Research Inc.
Provides leadership in prescribed fire research and promoting the use of prescribed fire as a land management tool.

University of Florida
Representatives serve on the Prescribed Fire Council and provide research services for wildland fire issues.

USDA Forest Service
Provide funding for projects involving prescribed fire and wildfire prevention and suppression. Also provide primary fire suppression on and around National Forests.

DOI
Provide primary fire suppression on and around National Wildlife Refuges, National Parks, and BIA lands.

7) Priority Areas

The Southern Wildfire Risk Assessment (SouthWRAP) is used to determine areas at most risk from wildfires. Fire prevention efforts will focus on these areas.

Most ecosystems in Florida are fire dependent or fire maintained. Regular application of fire is necessary to properly manage these areas. Resources such as the Florida Natural Areas Inventory (FNAI) are used by land managers to determine prescribed burning needs on land they manage.

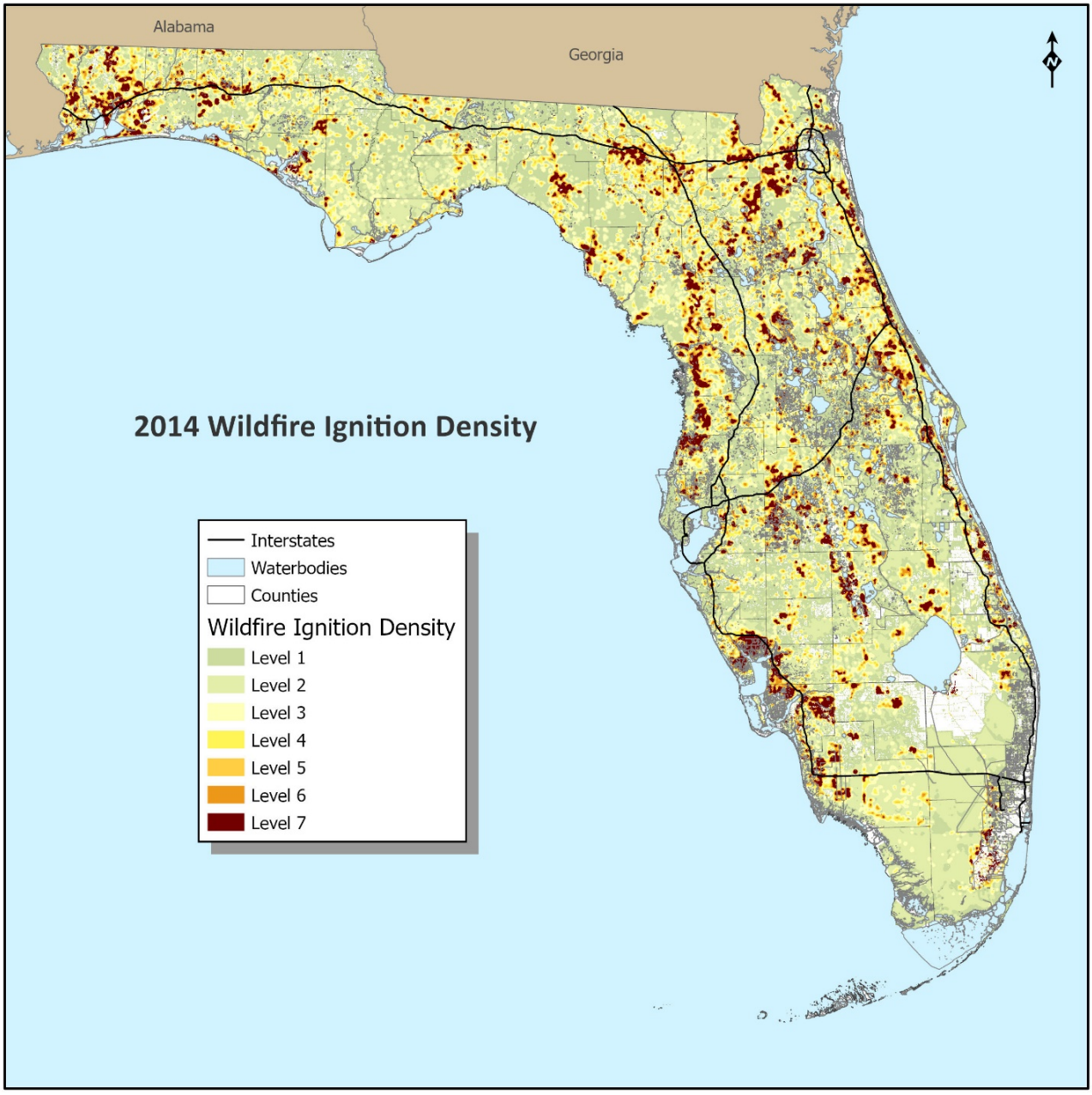

Figure 1. Statewide Wildfire Ignition Density

Source: Southern Wildfire Risk Assessment

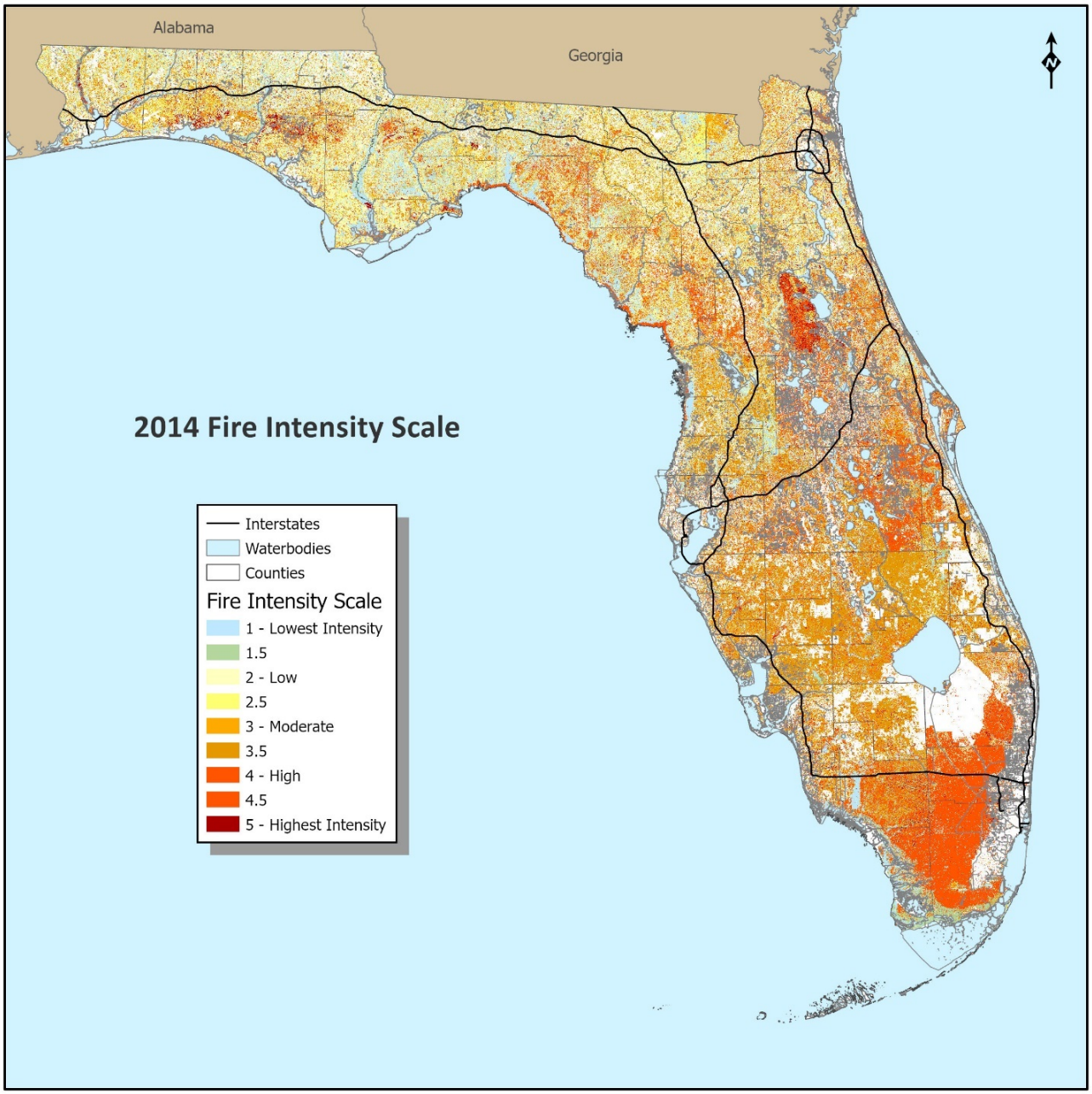

Figure 2. Statewide Fire Intensity Scale

Source: Southern Wildfire Risk Assessment

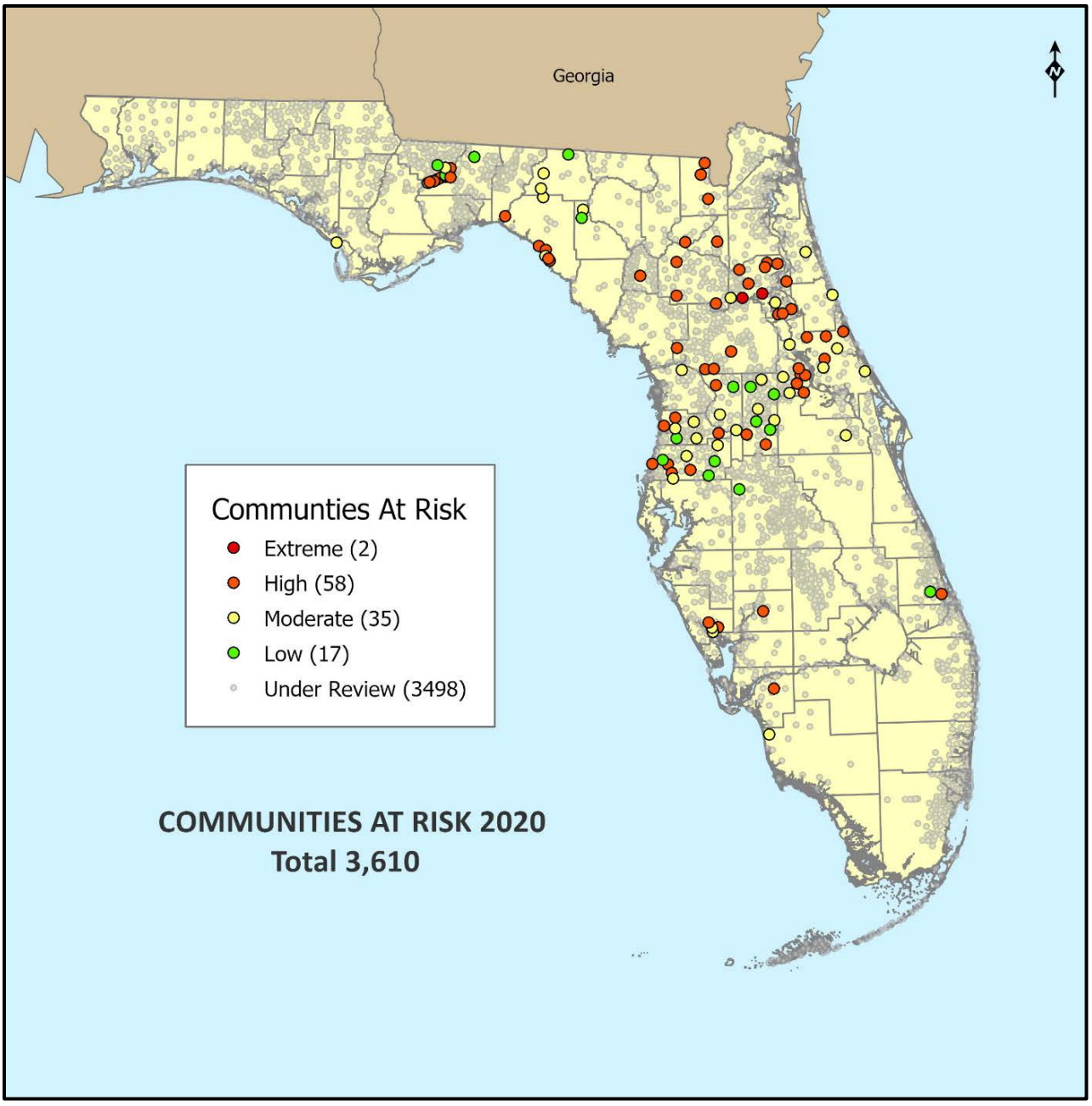

Figure 3. Florida Communities as Risk

Source: Southern Wildfire Risk Assessment

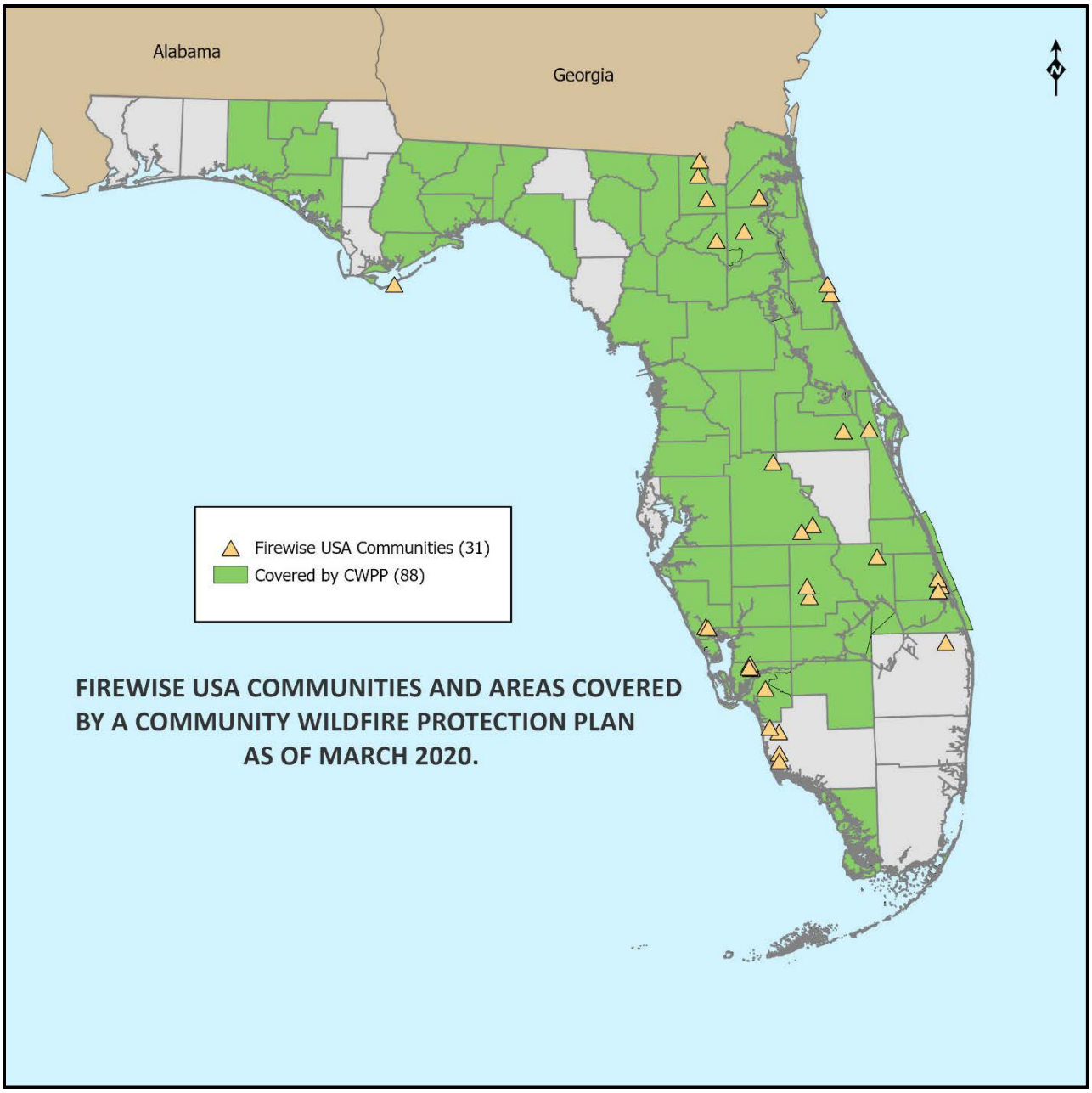

Figure 4. 2020 Firewise USA Communities and Community Wildfire Protectin Plan Areas

Source: Florid Forest Service

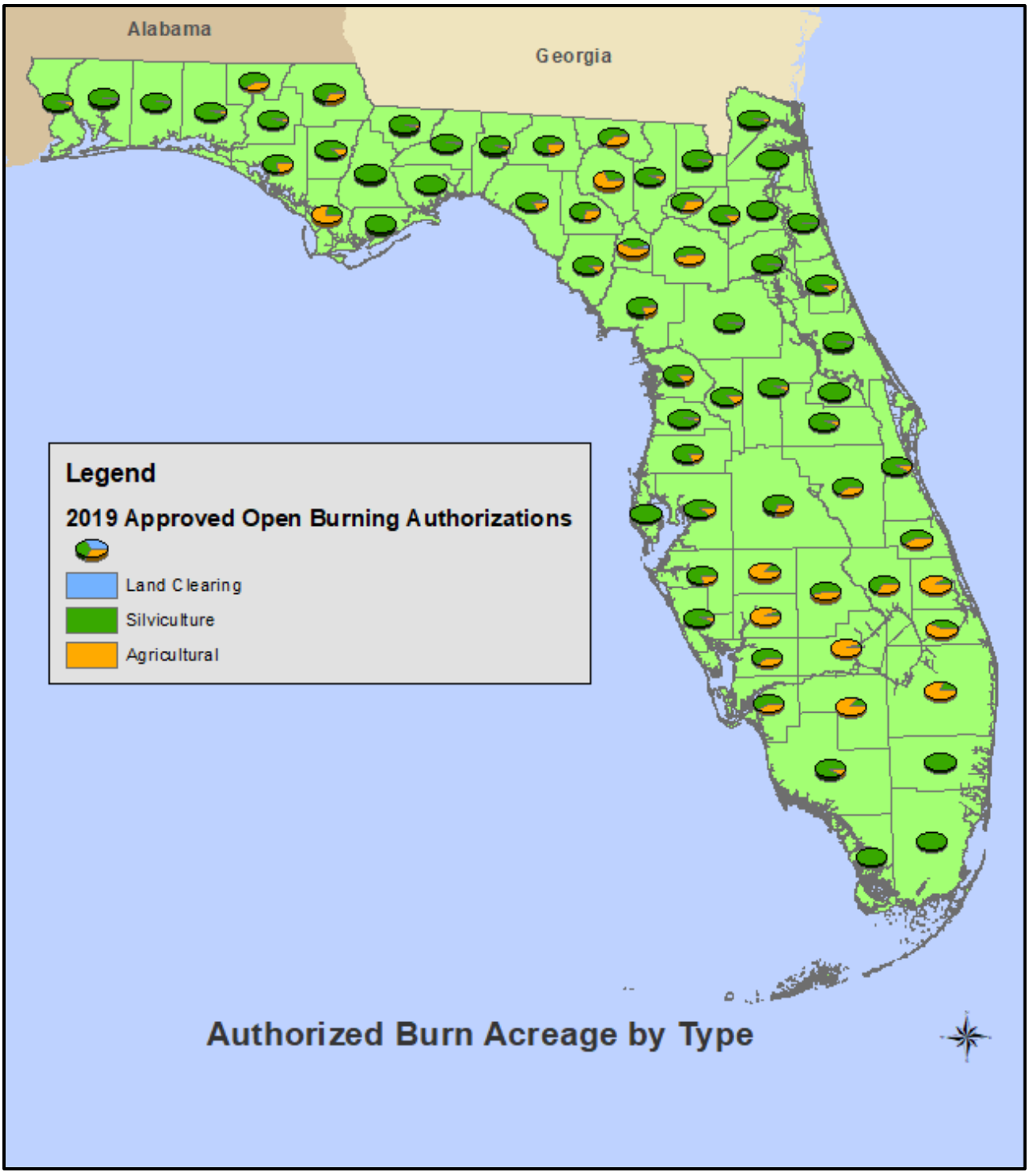

Figure 5. 2019 Approved Open Burn Authorization Acreage in each County by Burn Type

Source: Florid Forest Service

8) References

Brenner, J.D., and D. Wade. 1992. Florida's 1990 Prescribed Burning Act. Journal of Forestry 90(5):27-30.

Pyne, S.J. 1997. Fire in America: a cultural history of wildland and rural fire. 2nd ed. Seattle: University of Washington Press. 680p

Wade, D.D., and M.C. Long. 1979. New legislation aids hazard reduction burning in Florida. Journal of Forestry 77:725-726.

9) Goals, Objectives and Strategies

Goal 1: Maintain a prescribed fire program that protects the right to burn, encourages the wise use of prescribed fire, and promotes public understanding of prescribed fire with the effect of sustaining or increasing our current level of burning (roughly 2.2 million acres annually) to bring more fire-adapted systems to maintenance fire phase.

Objective 1.1: Continue to mitigate smoke impacts on air quality and vehicle traffic with better smoke management.

> **Strategy 1.1.1:** Use the latest technology to model and track smoke plumes and monitor visibility in smoke sensitive areas.
>
> **Strategy 1.1.2:** Integrate defensive driving tips for smoke and fog into the state licensing process.
>
> **Strategy 1.1.3:** Improve training and procedures for law enforcement personnel associated with prescribed fires.

Objective 1.2: Implement a focused, effective public communication and education campaign to garner support, acceptance and recognition of the value of prescribed fire.

> **Strategy 1.2.1:** Create and implement a standard communication plan.
>
> **Strategy 1.2.2**: Identify, develop and distribute key messages to the public showing the benefits of prescribed fire.
>
> **Strategy 1.2.3**: Develop a "brand" for prescribed fire.

Objective 1.3: Establish partnerships and significantly increase available resources (personnel, equipment, and expenses) to promote and implement increased prescribed fire operations to meet the acreage goal specified.

> **Strategy 1.3.1:** Develop a needs assessment that summarizes required resources for meeting prescribed fire needs statewide.
>
> **Strategy 1.3.2:** Develop a mechanism to create implementation-level partnerships for prescribed fire.

Strategy 1.3.3: Within the FFS, develop increased capacity to support prescribed fire operations on private and public lands.

Strategy 1.3.4: Develop funding mechanisms to support assistance to private landowners that request fire assistance for natural habitat management.

Objective 1.4: Take a strategic, proactive role in growth management and transportation planning to mitigate future impacts of increasing urbanization on prescribed fire.

Strategy 1.4.1: Address issues of local government intervention into the prescribed fire authorization process by keeping authorizations under state forestry authority.

Strategy 1.4.2: Engage the local growth management process to preserve the ability to burn in urban and suburban environments.

Strategy 1.4.3: Develop a smoke easement template to help reduce future conflicts between prescribed fire and new development.

Objective 1.5: Establish and sustain a high priority for prescribed fire on public lands.

Strategy 1.5.1: Provide continuous funding to hire and train new prescribed fire personnel.

Strategy 1.5.2: Reflect the high priority for prescribed fire in FFS District/Center manager's performance standards.

Strategy 1.5.3: Recommend to all agencies that prescribed fire goals for managed lands are incorporated into performance standards for site management staff.

Strategy 1.5.4: Review the state prescribed fire certification program. Improve and enhance as necessary.

Strategy 1.5.5: Use regional fire strike teams to significantly increase prescribed fire management to meet the goal.

Objective 1.6: Enhance the credibility and professionalism of our prescribed fire practitioners.

Strategy 1.6.1: Develop and implement a standard code of ethics for all prescribed fire professionals.

Strategy 1.6.2: Expedite the transfer of new prescribed fire technology to field use. Start a formal technology transfer program.

Strategy 1.6.3: Increase the number of Certified Prescribed Burn Managers to annually implement the prescribed fire goal on public lands.

Objective 1.7: Increase incentives and financial assistance to land managers using prescribed fire.

Strategy 1.7.1: Increase the amount of funding available through grants and cost share programs to private individuals to implement prescribed fire.

Strategy 1.7.2: Develop a system to inform private landowners of funding that is available for prescribed fire.

Goal 2: Maintain a wildfire mitigation and prevention program that reduces fire occurrence, hazardous conditions and the risk of loss from wildfires.

Objective 2.1: Select mitigation projects based on wildfire risk.

> **Strategy 2.1.1:** Use SouthWRAP, CWPP's, Communities at Risk data, Firewise Community/USA plans, and FFS district/center mitigation action plans to prioritize local mitigation projects.
>
> **Strategy 2.1.2:** Prioritize local area projects for each district/center.

Objective 2.2: Provide mitigation work – prescribed fire or mechanical treatment

> **Strategy 2.2.1**: Significantly increase the use of prescribed fire as a fuel management and hazard mitigation tool.
>
> **Strategy 2.2.2:** Increase the use of Regional Fire Management Teams and/or District/Center resources for prescribed fire or other fuel management assistance on private and public lands.
>
> **Strategy 2.2.3:** Provide technical assistance to project managers when private contractor assistance is required for project completion.

Objective 2.3: Initiate prevention efforts prior to a developing fire season.

> **Strategy 2.3.1:** Monitor indicators for increasing wildfire potential and focus prevention efforts in areas identified as having a high potential for wildfire occurrence.

Goal 3: Create and maintain relationships with paid and volunteer fire departments to increase their ability to assist in wildfire suppression through training opportunities and equipment acquisition.

Objective 3.1: Develop and maintain Cooperative Agreements with local, state, and federal firefighting and emergency response agencies.

> **Strategy 3.1.1:** Maintain cooperative agreements, loan/lease agreements, and fire protection agreements with county and other local firefighting agencies to efficiently manage resources, fire response, and interagency cooperation.
>
> **Strategy 3.1.2:** Maintain agreements with other state and federal agencies for fire protection and all-hazard disaster incident response.

Objective 3.2: Develop and implement programs to provide training and support to local fire departments and other cooperators

> **Strategy 3.2.1:** Provide training locally and on statewide level in Incident Command System (ICS) to improve local fire departments wildland fire response capabilities.
>
> **Strategy 3.2.2:** Ensure that local fire departments and local officials are recognized as our partners in fire suppression and prevention.

Strategy 3.2.3: Design and deliver programs to increase firefighter safety.

Strategy 3.2.4: Maintain a program to standardize ('card') personnel and equipment for resource deployment locally, statewide, and nationally for wildfire and other all-hazard incident response. Continue to coordinate with state and local partners.

Strategy 3.2.5: Maintain a leadership role in the wildland fire community by offering training opportunities, as well as ICS position experience on Interagency Incident Management Teams.

Objective 3.3: Develop and implement programs to provide equipment and support to establish and maintain local fire departments and other cooperators

Strategy 3.3.1: Screen and loan federal excess equipment to local fire departments and other fire agencies to assist in suppression, prescribed burning, and emergency response incidents through Federal Excess Personnel Property and Firefighter Property programs.

Strategy 3.3.2: Loan State surplus equipment to local fire departments and other fire agencies to assist in suppression, prescribed burning, and emergency response incidents.

Strategy 3.3.3: Provide efficient stewardship of program resources to effectively coordinate a minimum level of wildfire response with a minimum of bureaucracy.

Objective 3.4: Develop and implement programs to provide financial assistance to local fire departments and other cooperators

Strategy 3.4.1: Implement Rural Volunteer Fire Assistance grant programs to financially assist rural and volunteer fire departments with purchase and maintenance of wildfire suppression and emergency management resources, and to expand fire suppression capabilities.

Strategy 3.4.2: Provide assistance, coordination, and review of Cooperative Fire Program funding, as well as other funding sources to strengthen local response capabilities.

Objective 3.5: Liaison with Volunteer Fire Departments to facilitate sharing of resources and promote interagency cooperation.

Strategy 3.5.1: Liaison with Florida Fire Chief's Association for technical assistance, idea and information sharing.

Strategy 3.5.2: Liaison with Emergency Management for firefighting (ESF4/9) and other emergency management functions for disaster response.

Goal 4: Continue to provide adequate training for emergency response to wildfires, all-hazard incidents and prescribed fire implementation.

Objective 4.1: Provide for the safety of emergency responders and citizens.

Strategy 4.1.1: Ensure agency personnel participate in appropriate training, qualifications, and credentialing systems under NIMS, ICS, NWCG and other relevant systems.

Strategy 4.1.2: Work with local fire departments to ensure minimum training needs are being met.

Strategy 4.1.3: Track all non-federal wildland fire personnel's positions qualifications.

Objective 4.2: Conduct response efforts in a cost effective and responsible manner.

Strategy 4.2.1: Incident response personnel will monitor fire activity, predicted and observed weather conditions to determine appropriate staffing levels and release unnecessary resources.

Strategy 4.2.2: Where appropriate, use suppression techniques that minimize soil disturbance

Objective 4.3: Work with cooperators to maximize the effectiveness of suppression efforts.

Strategy 4.3.1: Maintain current and develop new working groups consisting of private and public entities to pre-plan suppression strategies in areas prone to significant wildfire activity.

Objective 4.4: Emphasize aggressive initial attack to minimize fire size and duration when a limited action approach is not appropriate.

Strategy 4.4.1: Respond with appropriate resources and tactics to safely suppress wildfires with the objective to keep wildfires to a minimal size and duration. This tactic should reduce the number of large campaign fires requiring long-term resource commitments.

Goal 5: (Environmental Control) Maintain an assessment of the wildfire risk across the state by: analyzing the presence and availability of vegetative fuels, monitoring weather conditions, tracking wildfire occurrence and monitoring development in the Wildland Urban Interface.

Objective 5.1: Develop a strategy that will allow the current wildland fire risk assessment to be updated without intensive field study and at a substantially lower cost than the latest update.

Strategy 5.1.1: Utilize a change detection strategy that will reduce the need for taking significant plot data for both surface and canopy fuels.

Strategy 5.1.2: Inventory available Florida data that is being collected by public and private sector that can be used to assist with both the canopy and surface fuels data in place of plot data inventory by FFS on a recurring basis.

Objective 5.2: Link the developing Florida fire danger rating system and the collection of weather data through WIMS (Federal Weather information Management System) with the SouthWRAP in Florida's fiResponse system.

Strategy 5.2.1: Complete the developing wildland fire danger rating system for Florida based on the national fire danger rating (NFDRS) 1988 system.

Strategy 5.2.2: Incorporate joint FFS / USFS fire danger operating plan into our response procedures.

Objective 5.3: Track fire occurrence and ignition sources.

Strategy 5.3.1: Implement the fiResponse system to track wildfire and incident occurrence to track wildfire occurrence.

Strategy 5.3.2: Develop and maintain a prescribed fire database that tracks annual fire accomplishments across public and private lands

Objective 5.4: Disseminate assessment information to cooperators, elected officials and the public.

Strategy 5.4.1: Develop and maintain a web-based version of the Risk Assessment that is accessible to interested parties.

Goal 6: Maintain an equipment fleet of sufficient size and ability to provide adequate fire suppression capabilities and prescribed fire support to meet the demands of increasing fire activity and intensity.

Objective 6.1: Maintain equipment for initial and extended attack response of all wildfires in Florida.

Strategy 6.1.1: Provide for cost effective general maintenance or all equipment, much of which is unique to wildland firefighting, through regular maintenance service.

Strategy 6.1.2: Establish a recurring refurbishment and purchase plan to allocate sufficient replacement equipment to maintain adequate response.

Objective 6.2: Provide Communication and Dispatch Center capabilities.

Strategy 6.2.1: Maintain communications centers to facilitate dispatch and coordination of resources on incidents.

Strategy 6.2.2: Provide for safety of personnel and resources through asset tracking.

Objective 6.3: Research and Develop new technology for fire suppression.

Strategy 6.3.1: Analyze, test, adapt, and develop prototype equipment for wildfire suppression. Specifically, for fuels and landscape characteristics unique to Florida.

Strategy 6.3.2: Review new techniques and strategies for effective and efficient suppression of wildfires.

Objective 6.4: Maintain support equipment to maintain firebreaks, and fuel management.

Strategy 6.4.1: Develop and maintain mitigation teams to reduce fuel hazards in interface areas.

Strategy 6.4.2: Maintain state forest firebreaks through road, bridge, and drainage equipment.

10) Performance Measures

Goal 1: Maintain a prescribed fire program that protects the right to burn, encourages the wise use of prescribed fire, and promotes public understanding of prescribed fire with the effect of doubling the acres (to roughly 4 million acres/year) burned annually to bring fire-adapted systems to maintenance fire phase.

- Prescribed burning activity increases from the current numbers
- Public awareness and acceptance of prescribed burning increases as measured by telephone surveys.

Goal 2: Maintain a wildfire mitigation and prevention program that reduces fire occurrence, hazardous conditions and the risk of loss from wildfires.

- Monitor the number of human-caused wildfires
- Track the amount of mitigation work being done
- Track the number of CWPPs

Goal 3: Create and maintain relationships with paid and volunteer fire departments to increase their ability to assist in wildfire suppression through training opportunities and equipment acquisition.

- Local fire departments acquire more equipment
- More fire department personnel assist in wildfire suppression

Goal 4: Continue to provide adequate training for emergency response to wildfires, all-hazard incidents and prescribed fire implementation.

- Track the number of qualified personnel for wildfire response and prescribed fire implementation
- Monitor average size of wildfires

Goal 5: (Environmental Control) Maintain an assessment of the wildfire risk across the state by: analyzing the presence and availability of vegetative fuels, monitoring weather conditions, tracking wildfire occurrence and monitoring development in the Wildland Urban Interface.

- Use of the SouthWRAP increases
- Development of Florida fire danger operating plan

Goal 6: Maintain an equipment fleet of sufficient size and ability to provide adequate fire suppression capabilities and prescribed fire support to meet the demands of increasing fire activity and intensity.

- Amount of out-of-service equipment will be reduced
- Capabilities of prescribed fire teams will be increased
- Requests for out of area equipment will be reduced

Issue 2: Forest Fragmentation

1) Current Issue Description

Both public and privately-owned forests play a critical role in supporting Florida's forest products industry and supplying building materials, consumer paper and packaging products, chemicals, and renewable biomass fuels. Florida's forests offer services well beyond consumable products, providing millions of acres for wildlife habitat, groundwater recharge and protection, recreation and tourism, and carbon sequestration among many others. Providing the backbone of forest ownership, private landowners are the cornerstone of economic and ecological benefits derived from the state's 17.16 million acres of forestland (Hodges et al. 2016).

Forestland ownership in Florida has changed over the past several decades as industrial forestlands were sold and divided up into smaller parcels. This trend has continued over the previous decade as non-industrial private forest landowners continue to own and manage the majority of forestland in Florida and across the greater Southeast. In the Southeast, private landowners own 86 percent of forest area, with 57 percent of all forests across this region owned by families or individuals (Butler and Wear 2013). The share of forests privately owned in Florida is smaller than in the Southeast, but still substantial at 65 percent in private ownership. Families and individuals comprise 26 percent of this ownership while private corporations own 39 percent of Florida's privately-owned forests (FDACS 2015). Parcelization continues to occur as forestland undergoes intergenerational transfer, a trend particularly salient in Florida as age distribution in the state is skewed toward an older population, continuing urban and suburban expansion, and competition from alternative land uses including annual crops. Parcelization is an outcome of these processes which yields smaller tract sizes and potentially an increase in diversity of management objectives as ownerships change.

Using USDA Forest Service Forest Inventory and Analysis (FIA) plot data, Caputo et al. (2020) analyzed changes in land use, ownership, and forest parcel size in the Southeast with data from 1998 through 2017. Caputo et al. found that over a 10-year period (2001 to 2011), 94 percent of the acreage studied did not change land use, and there was even a small net gain of forested acreage. Of the forested acreage, 85 percent did not change ownership type, with family ownership being the most common, but there was a small net loss of family-owned lands, primarily to corporate ownership. The same authors found an average 22-acre decrease of family owned forest parcels in Florida, compared to a 46-acre average decrease South-wide for the same time period. Overall, these changes over a relatively short time period demonstrate that privately owned forests remain the stronghold of forested habitat in the Southeast and Florida and that small shifts in ownership type and parcel size may have amplified effects on forest resources, ecosystem benefits, and management intensity into the future.

Fragmentation refers generally to the spatial patterns of forests as influenced by land use, disturbance, and other natural and anthropogenic drivers of forest change. This spatial process of forest patch creation and isolation across a landscape leads to secondary ecological problems of disrupted habitat connectivity, reduced capacity to support viable wildlife populations, increased deleterious edge effects, increased expansion of invasive pests and pathogens, and potentially reductions in the economic viability of conducting forest management practices (Hatcher et al. 2013; Guo et al. 2018; Riitters and Coulston 2013 in Potter et al. 2013). While not synonymous with forest fragmentation, creation of smaller forest tracts through parcelization leads to reduced efficiencies and increased expenses in carrying out forest

management activities and is related to how forests become fragmented in smaller, more isolated patches (Hatcher et al. 2013). Forest patch size, spatial distribution, and connectivity are directly affected as land ownerships change when tracts are sold or passed down through families (Riitters in Oswalt et al. 2019).

Though trends in ownership type and increases in parcelization continue across the Southeast and in Florida, acknowledging these circumstances and recognizing the distinct role non-industrial private landowners play as leaders in forest area ownership and resource management decision-making allows local, state, and federal partners to implement policies and programs that are most effective for and relevant to this sector. Many Floridians are aware of the fundamental importance of healthy forestlands to everyone's quality of life and to the sustainability of natural resources. Programs such as Florida Forever indicate the public's desire to maintain the quality and quantity of conserved areas of the state's varied natural landscapes. However, continued, updated information and education is necessary to keep natural resources in the forefront of an ever-increasing population base**.**

Over the previous decade, national economic trends and localized events have greatly influenced Florida's forests and their productivity. Economic uncertainty at the time of the 2010 State Forest Action Plan has played out in a marked economic recession that continues to show up in 2010-2020 data for harvest and production levels from private and public timberlands in the southeast. The impact of the 2007 recession on wood product demand is reflected in inventory data and impacts the decadal trends of wood removal from public and private lands, with a 19 percent decline in Southern timber removals between 2006 and 2016 (USDA 2019). Of the timber harvested annually in the United States, 89 percent comes from private lands. Private lands in the South account for 58 percent of the national timber removals (Oswalt et al. 2019).

In 2018, Hurricane Michael caused over $1.3 billion in damage and losses of timber in northwest Florida. Some uncertainty surrounds the long-term recovery of these lands and their ability to continue to serve as Florida's "wood basket." Since the majority of timberland in the Hurricane-impacted area is owned by private landowners, this group will play a key role in reforesting land damaged or destroyed by the storm. Sales or conversion of impacted forestland to more intense uses will greatly affect forest fragmentation rates and patterns over the coming years.

Forest Resource

Nationally, 58 percent of forests and woodlands are privately owned, with family forest ownership accounting for 43 percent of all forest and woodland ownership nationwide (Butler et al., 2016). Timberland, a subset of forests and woodlands, comprises 67 percent of forest land in the United States, with the clear majority (87 percent) being of natural origin (Oswalt et al. 2019). The remainder is planted forest, which includes plantations, augmented plantings of natural stands, and restored areas. Southern forests have the highest planted timberland rates; 31 percent of all timberland in Florida is of planted origin (Hartsell in USDA 2017). Across the Southeast, most planted timber is comprised of loblolly and shortleaf (71 percent) followed by longleaf and slash (14 percent, Hartsell in Oswalt et. al. 2019).

Forestland ownership is a fluid dynamic driven by many forces including economics, local policy, and personal values. Over the past decade, changes among ownership types have generally been small land transfers within different groups of private landowners (Butler 2017). Forestland once owned by traditional, industrial forestry companies has been sold to timber investment management organizations (TIMOs) and real estate investment trusts (REITs, Butler in USDA 2017). National trends in forest ownership

have been mirrored across the southeast and in Florida as well. Forest Inventory and Analysis data from 1995 indicated that timberland in Florida was owned by non-industrial private landowners (49 percent), forest industry (32 percent), and public lands (19 percent, Brown 1999). Data from 2005 shows timberland ownership shifted to non- industrial private landowners (61 percent), forest industry (12 percent) and public lands (27 percent, Brown 2007). More recent FIA data (2016) shows a slight decrease in private ownership, with 63.8% or 11,149,000 acres of forestland in Florida being privately owned. Of these, private corporate landowners owned 7,046,000 acres while non-corporate ownership comprised 4,103,000 acres. Total publicly-owned forestland acreage was 6,104,000 acres in 2016 (as reported in Oswalt et al. 2019).

The increase in private forestland ownership may be attributed to the parcelization of larger forest blocks and potential fragmentation of larger contiguous forest blocks. The reduced size of the forest parcels has impacts on wildlife, water quality and economically efficient management of working forests. As was the case when the 2010 State Forest Action Plan was developed, most non-industrial private forestland ownerships in Florida are 10 acres or less in area (Butler 2008; Butler et al. 2016). The increase in public timberland ownership over the past decade may reduce the potential for further parcelization of contiguous forest blocks. However, due to a variety of constraints, some of these lands may not be actively managed to provide maximum public benefits.

Currently, there are several programs nationally and at the state and local level that provide conservation easement opportunities to protect and maintain working forestlands. These include the Forest Legacy Program, the Florida Rural and Family Lands Protection Program as well as various county level programs. Each of these programs has specific requirements for participation.

Additionally, as Florida's population continues to increase, the pressure of urbanization will continue to be a significant component of land management decision processes for both rural forestland owners and the resultant urban developers and property owners. As of 2015, the state's population was growing by 1,000 new residents per day (O'Donnell 2015 in Volk et. al. 2017). Following the current trend in urbanization and development, by 2070 between 28.3-33.7 percent of Florida's total land area will be developed (Volk et al. 2017).

2) Key Attributes

Forestland in Florida covers 17,253,000 acres (FIA data in USDA 2017), with the majority being privately owned. Forest Inventory and Analysis(FIA) data shows the state's forest area has slightly increased from 17,040,000 in 1977 to its highest acreage in 2012 at 17,461,000 acres. Forest ownership type has been tracked by the FIA program in Florida since 1977 and shows ownership has continually been dominated by private landowners, though publicly owned forestland has grown by approximately 2 million acres from 1977-2017 (FIA Data in USDA 2017).

Of key importance to successfully maintaining forest resources for public benefits are contiguous connected healthy blocks of forestland that will provide adequate habitat for wildlife and sustainably support regional forest industry. Specific timber type components need to be available in large enough blocks and connected corridors to support varied wildlife species and water filtration benefits**.** The location of these blocks on the landscape is also important for sustaining forest industry and providing recreational opportunities accessible to all citizens of the state as well as our many visitors. Most of the various existing conservation easement programs have location requirements that help maximize benefits with limited funding available.

3) Public Benefits

Production forestry on public and private lands provides substantial benefits to the state of Florida, including the provision of ecosystem services, such as regulation of water quantity and quality, provision of wildlife habitat and carbon sequestration (Martin et al. 2017). Uniquely, forestry is one of the few industries that sequesters more carbon (during forest stand growth and from below ground root systems) than it emits (Martin et al. 2017). Florida's forests support over 80,000 jobs and generate $16.34 billion per year in economic activity (Martin et al. 2017).

Negative effects of forest fragmentation may impact the spectrum of public benefits including wildlife habitat, water quality, ecosystem function and services, recreation, forestry related jobs, carbon sequestration, biomass and renewable energy potential. Recognition of the effects forest fragmentation may have in relation to various public benefits has been addressed by resource professionals across the state. It is generally agreed that all public benefits can be maximized by economically efficient and effective management of larger blocks and corridors of forestland.

4) Threats

Private forest landowners must make decisions regarding their land in the same manner as any other investment decision. Benefits of owning forestland must be weighed with the costs associated with that ownership. Major reasons that forest landowners may sell or otherwise convert their forestland to other uses includes; adverse tax situations or other infringements on property rights, decline in forest product markets, or increase in land value for other purposes (i.e. urban development). Each of these scenarios plays out daily for Florida forestland owners. Rapid urbanization, uncertain markets, increased local taxes, and inconsistent interpretation of greenbelt agricultural assessment statutes from one county to the next have all impacted landowner's desires to continue to own and manage timber.

Across the Southeast, several key factors are expected to drive changes in the amount of forestland, its distribution across the landscape, and its overall health in the coming 20-30 years. Hanson et al. (2010) note residential and commercial development expanding from urban areas is projected to convert 19 million acres of forest between 2020 and 2040 and increase forest fragmentation. Martin et al. (2017) predicted that by 2060, we can expect to lose between 30 and 43 million acres of southern U.S. forests to urbanization. Transportation facilities go hand in hand with urban expansion and planning for new roads and multi-use corridors of regional economic significance must be carefully considered in light of their potential to fragment forests and wildlife habitat.

Changes in species composition may be expected as climate change drives shifts in the distribution of plant and animal species, potentially increasing the spread of invasive species and create forest edges for invasive exploitation due to fragmentation. Climate change coupled with difficulties in utilizing prescribed fire and responding to wildfire in an increasingly urbanized and fragmented landscape may mean wildfire risk increases as well (Hanson et al. 2010). As a changing climate affects the frequency and intensity of natural disasters, as well as the scale and time needed for recovery, landowners must grapple with the risk of lost income due to their long-term investment in forestland versus that associated with transitioning to yearly crops or other uses altogether.

Nationally, the average age of forest landowners is relatively high (63 years), meaning inter-generational transfers and sales are on the horizon for the next several decades (Butler in USDA 2017). Land sales outside of family ownerships are also increasing. An influx of new landowners may lead to a diversity of new management objectives and practices in the coming years (Butler in USDA 2017). As Florida's current generation of private landowners sell their forest property to new owners outside of their families or transfers their lands to the next generation, threats of increasing parcelization and forest fragmentation will become increasingly apparent. However, land transfers also offer an opportunity for the FFS and partners to reach a new audience of landowners with forest management programming and guidance.

5) Opportunities

Currently, two main opportunities exist to promote and maintain larger contiguous blocks of productive working forestland in the state; increased awareness by public and policy makers regarding forests and forest practices and supporting expansion of sustainable forest markets. Educating policy makers can provide opportunity for expanded conservation easement funding and tax structures that are more equitable for forestland ownership. Incorporating green infrastructure principles when planning development will help to create linkages between forested areas and mitigate the impact of fragmentation. The public must also be educated about the myriad of public benefits derived from forestlands that surround and weave through their communities for them to make informed policy and personal decisions.

Incentive programs such as the USDA Forest Service funded Forest Legacy Program, the Natural Resources Conservation Service's Farm and Ranchland Protection Program and Florida's Rural and Family Lands Program, if adequately funded, could provide for a reduction in further parcelization of important forestland areas.

Expanding sustainable forest markets is partly driven by local to global markets and is additionally a component of education of policy makers. The Florida Legislature currently has charged the Florida Forest Service along with the Department of Environmental Protection to conduct a sustainability study of forest resources to address potential increase in biomass energy production within the state. Additionally, opportunities exist to collaborate with other organizations sharing existing information and collaborating on planning efforts and updates. An excellent opportunity existed with the Florida Fish and Wildlife Conservation Commission as they updated their original State Wildlife Action Plan (SWAP) starting in the 2018 calendar year. Also, collaboration with other federal and non-governmental organizations regarding planning is occurring at national and state levels. Examples include:

- 2018 Farm Bill program implementation
    - Delivery and outreach with federal and state partners/NGOs and conservation groups
- SWAP Action plan update 2020
- Policy interventions – favorable tax policy designed to promote the retention of working forest lands
- Biomass market expansion – Enviva and others.
- Investments/research on improved silvicultural practices and tree breeding
- American Forest Foundation Program delivery/outreach
    - Landscape Scale Management Plans
    - WoodsCamp Landowner engagement platform
    - Florida Tree Farm program trends
- Intergenerational land transfer/Heirs Property issues with Federation of Southern Cooperatives, others.

- Partnering to protect the Military Mission with Department of Defense facilities
    - Sentinel Landscapes, REPI Challenge Grants, FORCES or other program opportunities

6) Agency and Organization Roles

The following organizations have been identified to participate in the following roles as they relate to forest fragmentation:

Research

USDA FS – Southern Research Station

USDI Fish & Wildlife Service

Universities & Natural Heritage Programs:

- Florida Natural Areas Inventory

Private Research Institutions

Florida Fish and Wildlife Conservation Commission – Fish and Wildlife Research Institute

Education

Florida Forest Service

Department of Environmental Protection

Fish and Wildlife Conservation Commission

Florida Forestry Association

USDA State Programs

Universities/Extension Service

Private NGO and non-profit partners:

- Project Learning Tree

Outreach

Florida Forest Service

Universities/Extension Service

Local Governments/Chambers of Commerce

USDA State Programs

The Longleaf Alliance

Conservation Organizations

Develop/Promote Sustainable Markets

Florida Forestry Association

National and Florida Tree Farm Program

Local Governments/Chambers of Commerce

Forest Landowners

7) Priority Areas

Understanding where areas of existing contiguous forested cover (Figure 1, page 35) overlap with threats of development (Figure 2, page 36) can help set the stage for prioritization of efforts to increase connectivity and protect adequate forest block sizes. Additionally, critical land (habitat) (Figure 3, page 37) further refines the prioritization process. Understanding the distribution of forest ownership type (Figure 4, page 38) can also provide opportunities to target services, programs, and outreach in areas of high need. This prioritization can guide land managers when making land use planning and management decisions. The FFS considered all these factors as well as others when developing Forest Stewardship priority areas in Figure 5, page 39. Stewardship priority areas are those where privately-owned forestland, resource needs, and management opportunities are present. Additional priority forest areas in Florida include the historic range of longleaf pine and Significant Geographic Areas for this species.

Examples of coordination efforts and information sharing with other states include:

- Regional/multi-state priority areas: Longleaf Pine historic range and Significant Geographic Areas

- Texas to Virginia in historic range of longleaf
- Total acres of longleaf forest type across SE: 3,549,644 (FIA data in USDA 2017 p. 34).
- Florida represents 27.1% of all current longleaf forest acres (963,566 acres; FIA data in USDA 2017 p. 34)
    - AL: 19.4% - 687,072
    - GA: 15.9% - 563,388
    - SC: 13.9% - 492,894

- Private lands priority areas map: Forest Stewardship Program Priority Areas

- Coordinate border priorities with GA and AL

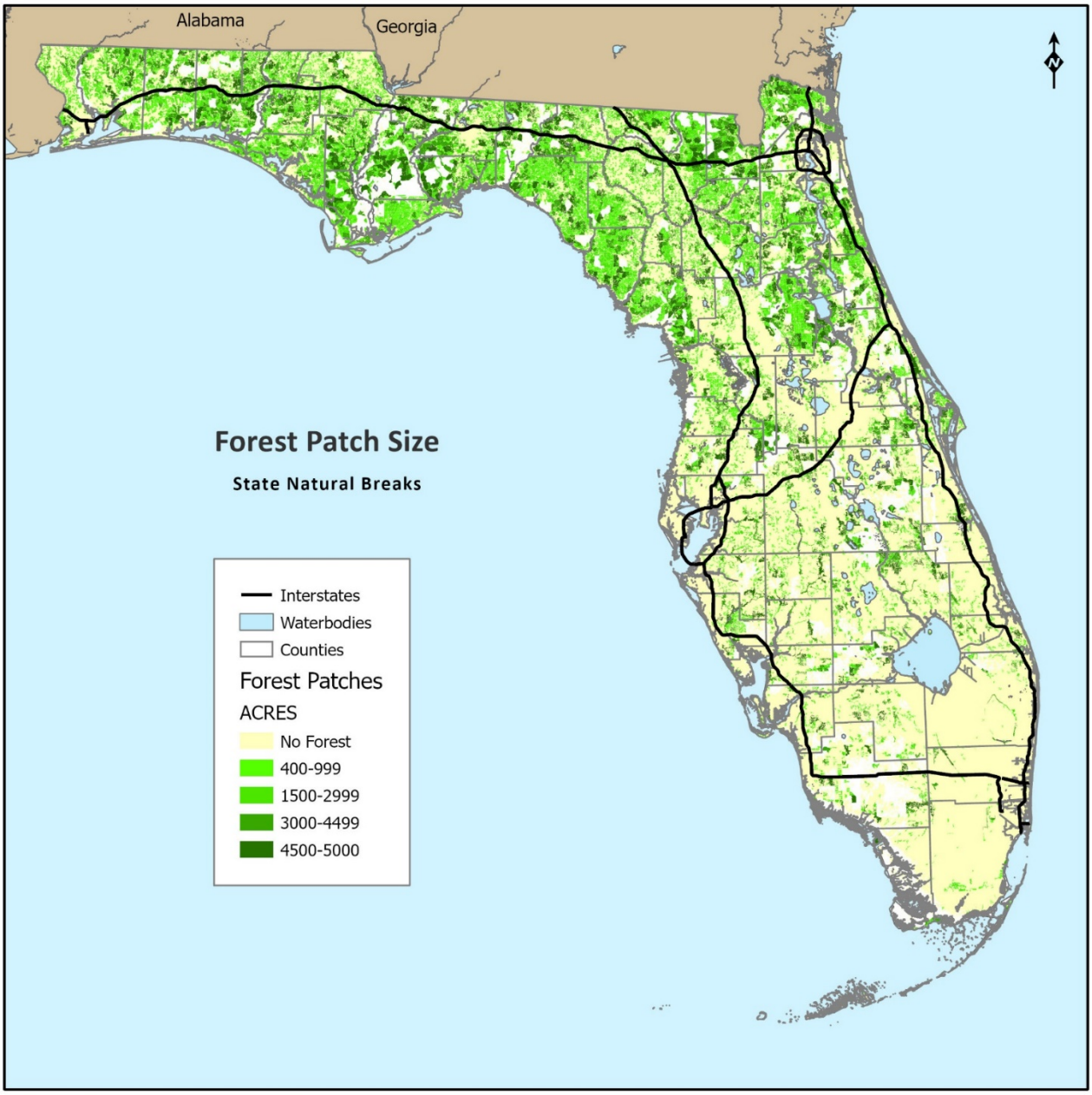

Figure 1. Forest acreage by contiguous block sizes.

Source: Southern Forest Land Assessment

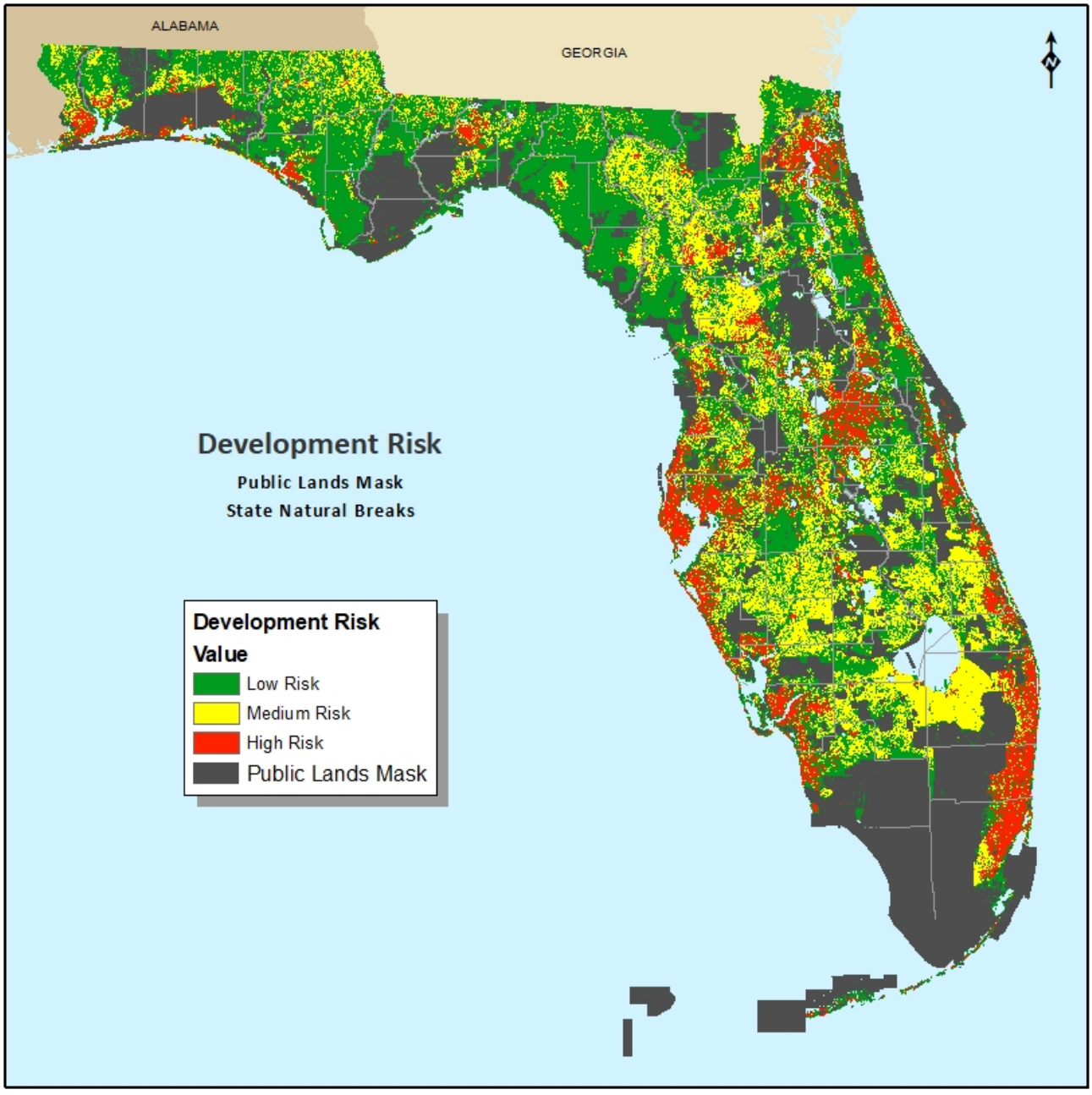

Figure 2: Development Risk

Source: Southern Forest Land Assessment

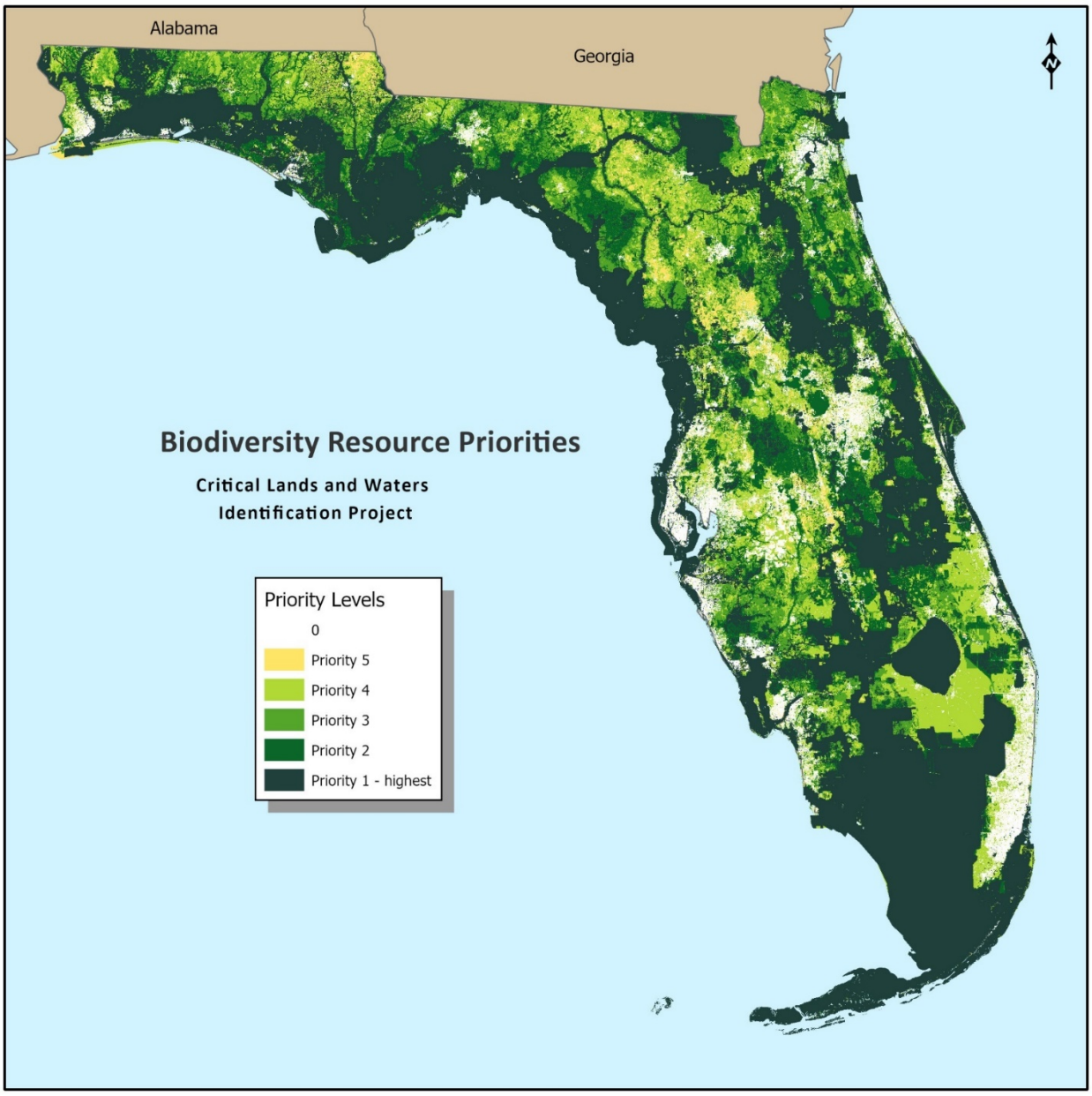

Figure 3. Priority areas from the Critical Lands and Waters Inventory Project of the Florida Fish and Wildlife Conservation Commission (2016 data).

Source: Florida Fish & Wildlife Conservation Commission

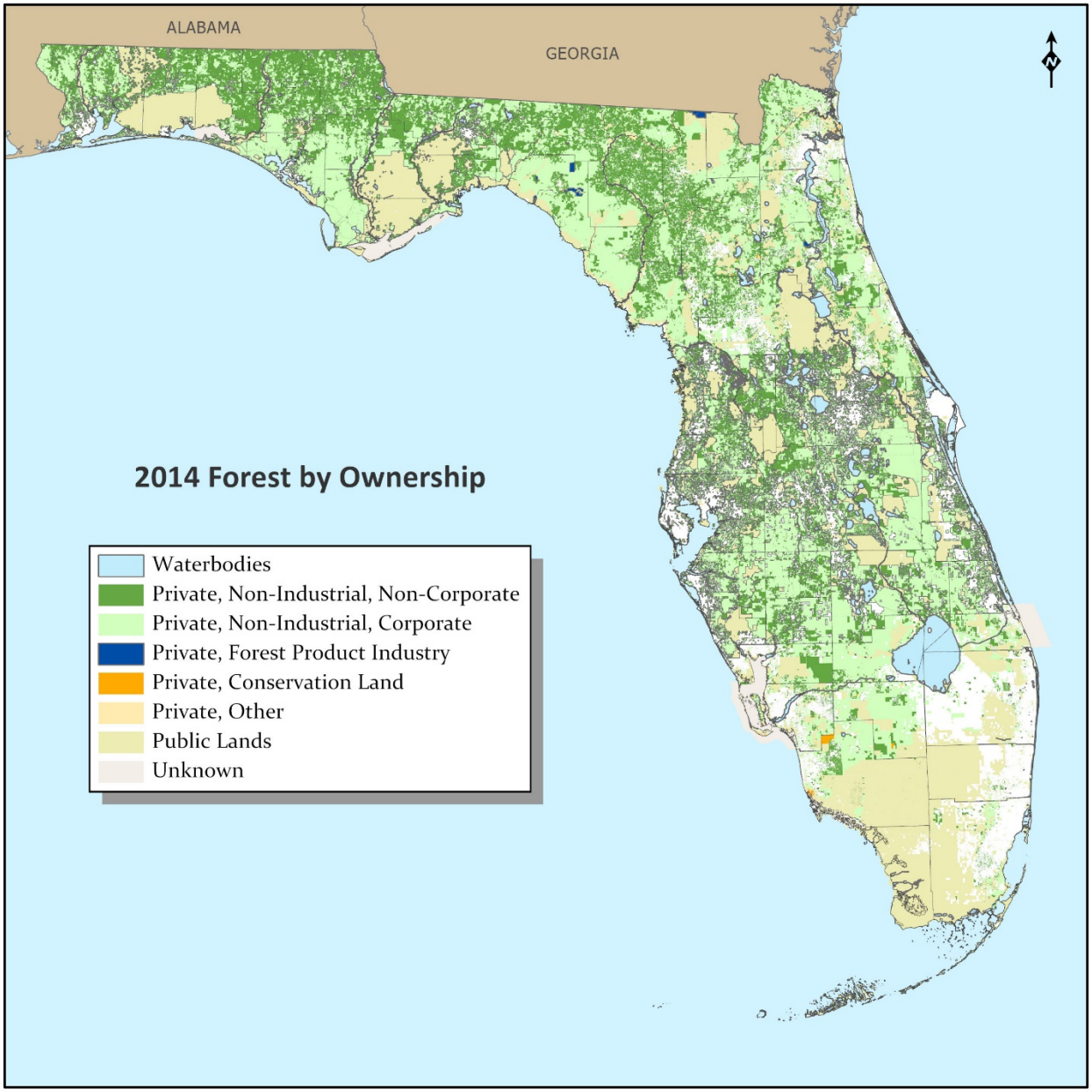

Figure 4. Ownership categories of forestland: Private non-industrial, private industrial/corporate, and public

Source: Forest Inventory and Analysis Program

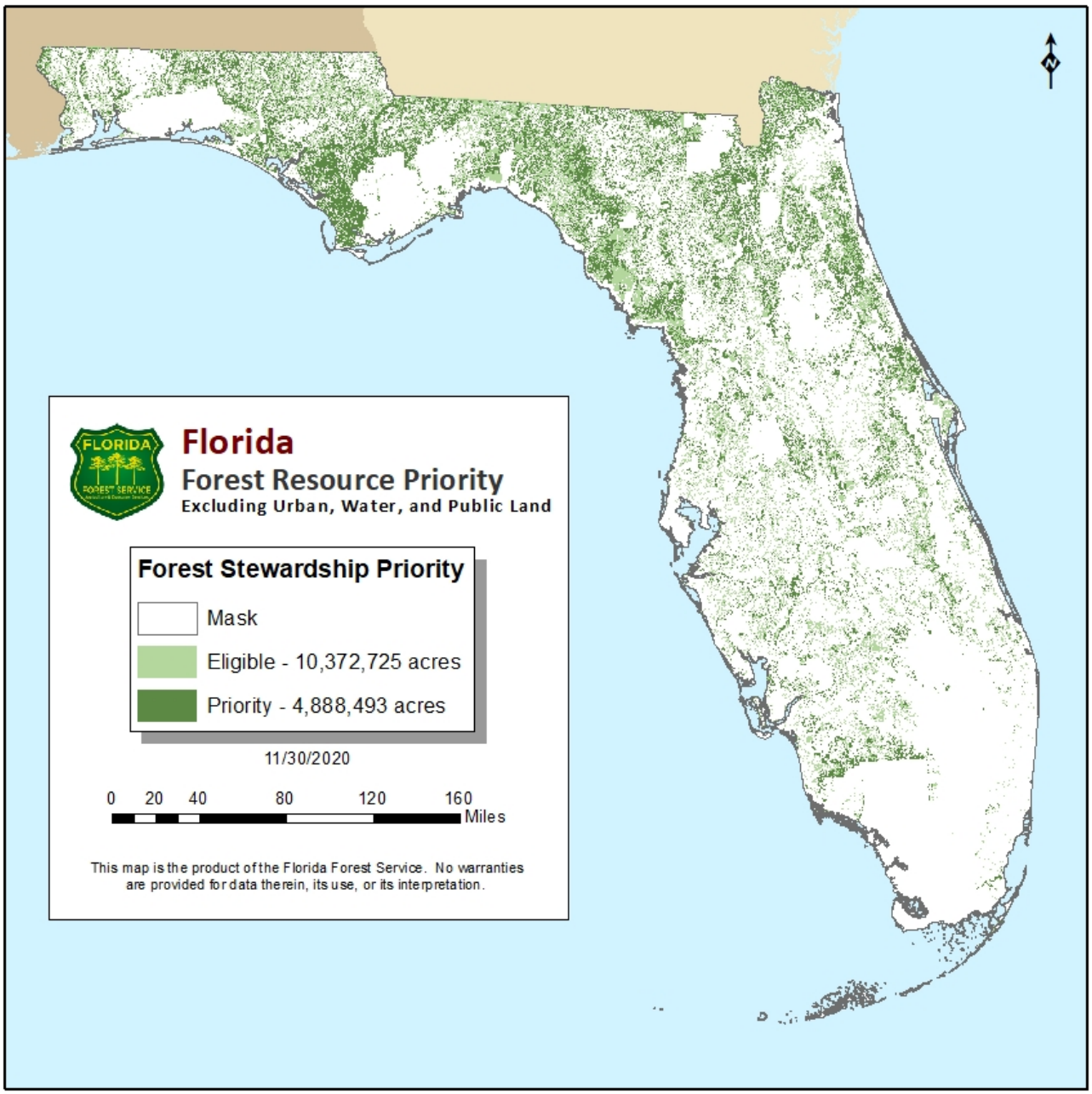

Figure 5. Private forest land priority areas for the Forest Stewardship Program

Source: Florida Forest Service

8) References

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Hanson et al. 2010

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9) Goals, Objectives and Strategies

Goal 1: Increased Awareness of the Importance of Sound Forest Management Practices.

Objective 1.1: Continue leading coalition of interested resource professionals in data and technology management and transfer of information to forest landowners, the public, and policy makers.

> **Strategy 1.1.1:** Provide service to landowners through the FFS Forest Stewardship Program, FFS-administered cost-share programs, and partner programs offered by NRCS, FSA, USFWS, and FWC to assist forest landowners in making informed decisions regarding forest management options and offer financial assistance when applicable.
>
> **Strategy 1.1.2:** Continue offering adaptive and clear messaging to reach urban, suburban, and rural residents regarding the connection of forest management practices to their daily quality of life.
>
> **Strategy 1.1.3:** Engage policy and decision makers, local governments, and community planners in educational sessions regarding the public benefits of forest management across the landscape. Introduce the principals of forest management including urban forestry and green infrastructure to these groups and assist them in establishing programs and partnerships to maintain and expand forests in and around developed areas.
>
> **Strategy 1.1.4:** Continue to promote existing land conservation efforts such as Florida Forever, the Forest Legacy Program, the Rural and Family Lands Protection Program, NRCS easement programs, and other state, federal, and NGO (e.g. DEP, TNC, WMDs) programs as a component of service foresters' and others' outreach.

Goal 2: Increased Support of Sustainable Forest Markets.

Objective 2.1: As they become available, promote results and findings of forest products, wood utilization, and other related studies through partners, including the Florida Forestry Association, to Florida's local and state decision-makers.

> **Strategy 2.1.1:** Provide information to forest management entities for inclusion in their newsletter or other media information services.
>
> **Strategy 2.1.2:** Promote and report economic contributions generated by ecosystem services on private lands enrolled in the Forest Stewardship Program, other FFS-administered programs, and partner programs.
>
> **Strategy 2.1.2:** Present results at educational venues as appropriate across the state.
>
> **Objective 2.2:** Reach broader audience in promoting incentive and other programs for emerging and traditional forest markets through partnerships with USDA, NRCS, FWC and other agencies.

Strategy 2.2.1: Utilize and expand upon existing networks including printed and web-based media to provide up-to-date information regarding cost-share, incentive and other information for non-industrial private landowners.

Strategy 2.2.2: Provide a platform for landowners and the public to explore and understand additional non-timber markets (i.e. ecosystem services).

Strategy 2.2.3: Continue partnership with Florida Tree Farm Program and American Forest Foundation to offer and promote Tree Farm Certification as a conduit for sustainable wood supplies.

Goal 3: Promote local ordinances and tax structures that support healthy forests for all public benefits (not just timber revenue).

Objective 3.1: Utilize partnerships and outreach networks to provide unified messaging of the importance of private forest resources and their management for the greater public.

Strategy 3.1.1: Maintain or enhance communication with county property appraisers to define requirements for forest resources and active forest management.

See Strategy 1.1.3 for additional action under this goal.

Goal 4: Fragmentation of longleaf pine ecosystems (LPE) by linear facilities and development is being avoided on public lands. Existing fragmentation is being addressed through restoration and acquisition.

Objective 4.1: Explore options to reduce fragmentation of public lands caused by incompatible utility placement and land use. Promote awareness of this issue and encourage compatible alternate routes and land uses.

Strategy 4.1.1: Continue to work with partner agencies and the Acquisition and Restoration Council, and through the Efficient Transportation Decision Making process to avoid sensitive public land with the siting of linear facilities, and to minimize and mitigate effects where avoidance is not possible.

Objective 4.2: Target acquisition funding for securing from willing sellers inholdings and critical additions to existing public lands to better enable management of LPE at the landscape level.

Strategy 4.2.1: Work with Florida Natural Areas Inventory and other state land managing agencies to identify and present to the Acquisition and Restoration Council the importance of targeting acquisition funding to acquire inholdings and additions critical to LPE conservation.

Strategy 4.2.2: Use conservation easements effectively to support protection of LPE on private land with willing landowners.

Strategy 4.2.3: Continue funding of Rural and Family Lands Protection program and include LPE targets.

Goal 5: Increased participation in forest management programs offered through local, state, and national entities.

Objective 5.1: Enhance participation in technical and financial assistance programs that benefit non-industrial private forest landowners.

Strategy 5.1.1: Utilize new technologies and enhance existing platforms for outreach to promote awareness of available technical and financial forest management assistance programs.

Strategy 5.1.2: Leverage existing partnerships through the Florida Land Steward network and utilize emerging landowner cooperative groups to reach a wider audience of landowners to engage them in forest management programs**.**

Strategy 5.1.3: Employ adaptive responses to changing conditions and markets such that outreach, education and messaging can be tailored based on outcomes and feedback from forest landowners.

Strategy 5.1.4: Continue pursuing financial support from partners in recognition of the considerable commitment FFS provides to servicing forest landowners through partner programs.

10) Performance Measures

Goal 1: Increased Awareness of the Importance of Sound Forest Management Practices.

- Landowners increasingly actively managing forest lands.
- Public awareness of importance of forest management for their benefit is improved.
- Funding for Conservation Programs is maintained or increased.
- Networks and partnerships offering forest management assistance to forest landowners are strengthened.

Goal 2: Increased Support of Sustainable Forest Markets.

- Results and findings from forest products, wood utilization, and other related studies spur additional interest in sustainable forestry activities.
- FFS and other partners promote and publicize economic benefits of ecosystem services generated by private forest lands; the public and policy makes have a greater understanding of the economic benefits generated from private lands.
- Enrollment in wood certification programs including Florida Tree Farm Certification is increased.

Goal 3: Promote local ordinances and tax structures that support healthy forests for all public benefits (not just timber revenue).

- New or revised local ordinances that provide incentive for private landowners to keep their land as healthy working forests for public benefits.
- FFS, partners, and landowners benefit from unified messaging to county property appraisers and expectations for timber agricultural classification are more clearly defined.

Goal 4: Fragmentation of longleaf pine ecosystems (LPE) by linear facilities and development is being avoided on public lands. Existing fragmentation is being addressed through restoration and acquisition.

- Participation by multiple agencies in Efficient Transportation Decision Making Process and in Acquisition and Restoration Council review of easement requests has resulted in fewer linear facilities fragmenting LPE, and those linear facilities that do are properly minimized and mitigated to reduce the effects of fragmentation.

- Multiple agency presentations to the Acquisition and Restoration Council emphasize the need to make as a priority the acquisition or protection through easements and agreements the inholdings and additions on public lands that facilitate management of LPE.

Goal 5: Increased participation in forest management programs offered through local, state, and national entities.

- Broader pool of forest landowners is engaged in active forest management.
- FFS and partners can demonstrate on-the-ground management outcomes to facilitate and/or leverage funding requests for forest management programs.
- Applying adaptive management and learning strategies leads to more efficient and effective outreach and increased forest management results.

Issue 3: Forest Health: Insects, Diseases and Non-Native Pest Plants

1) Current Issue Description

Florida's forest resources, both urban and rural, are continually challenged by a wide variety of insects, diseases, and pest plants. Broadly speaking, an important distinction can be made between the damaging organisms that are native to the region, and those that are invasive - i.e., non-native species that have been introduced by human activities, have established and are spreading independently, and are causing (or are likely to cause) a problem in the region.

Native pests and pathogens are the most common, diverse, and abundant organisms that can complicate forest management and cause economic losses through their effects on tree health and forest productivity. Although some of these native organisms can cause significant tree mortality, in most cases their impact can be minimized through a combination of proactive forest management and integrated pest management (IPM) strategies.

Unlike their native counterparts, some non-native invasive insects, pathogens, and pest plants have the potential to effectively eliminate native species from the landscape, and permanently alter the structure and function of our ecosystems. This is now recognized as a major issue in forest management and conservation globally, and due to the state's moderate climate and many ports of entry, Florida's forests are particularly vulnerable to the introduction of new invasive species.

The Florida Forest Service has successfully met many of the needs and goals identified in the 2010 Forest Resource Assessment and Strategy documents, to more efficiently and effectively support sound management of native pests and diseases, as well as enhance the capacity to prevent, detect, and respond to the introduction and spread of invasive species. As new problems emerge, and forest management priorities evolve, the FFS remains committed to adapting to them using the best available scientific information and newly available technologies.

2) Key Attributes

Many of the factors discussed in detail elsewhere in this report also have implications for the incidence and management of forest pests and diseases, such as forest fragmentation and land development, land ownership types, forest structure and composition, prescribed fire and wildfire frequency, and environmental factors.

As noted in Issue 2, the majority of forest land in Florida is owned by non-industrial private landowners, many of whom own relatively small tracts of land. Timber investment management organizations (TIMOs) are also becoming more important landowners, while the acreages owned by large-scale industrial corporations has declined. Although the ownership type does not directly impact the incidence of most forest pest or disease problems, it does mean that this audience must be considered a priority when formulating any responses at the state level, either in terms of outreach and education or in the form of landowner assistance programs.

Shifts in forest management priorities have lasting and sometimes unpredictable effects on forest health concerns. For example, loblolly pine forest that was planted during the early- to mid-20th century likely set the stage for large-scale outbreaks of southern pine beetle that occurred in the 1990s to early 2000s, while such outbreaks were previously unknown in Florida. Similarly, the effort to re-establish longleaf pine forest

across the region (see Issue 7) has been accompanied by a set of pests, diseases, and other management challenges that are particular to longleaf pine in a plantation setting.

Although invasive species are a significant issue affecting forests and trees across the United States, Florida is particularly at risk. The state's 24 international ports of entry provide many opportunities for non-native species to be introduced, and its relatively mild, tropical to subtropical climate and broad diversity of tree species and forest types provides suitable habitat for many of them to establish and spread. On a positive note, there is also a broad recognition of this problem among the community of Florida's private landowners, public land managers, researchers, regulators and policy makers. Florida has strong statutes regulating the sale and movement of invasive plant species (Rule Chapter 5B-57), and it leads the country with its law that regulates the movement of firewood and other untreated wood (5B-65), which is intended to prevent the introduction and spread of non-native pests and diseases that can be carried in infested/infected wood. However, even these measures are not enough to eliminate the threat.

Any environmental factors that can disturb the site and/or stress and damage trees will tend to promote a variety of forest pest and disease problems. Hurricanes and tropical storms that periodically impact regions of Florida are dramatic examples, frequently increasing the incidence of stress-responding pests and diseases, as well as facilitating the spread of invasive plant species, for years after the event. Less obvious are the effects of long-term trends in temperature and precipitation, sea level, wildfire risk, and the frequency and intensity of hurricanes related to climate change, all of which have implications for forest health.

3) Public Benefits

It would not be possible to prevent all forest pest and disease problems, and due to their important ecological roles, it would not even be desirable to do so. However, through preventative, management, survey and monitoring, research, outreach and education, and regulatory actions, the negative economic and ecological impacts of forest pests and diseases can be mitigated or prevented to a great extent. The cost of these activities is often far less than the damages that they prevent, in terms of lost ecosystem services (such as forest products, wildlife habitat, recreational value, and urban tree canopies) as well as the direct costs associated with unchecked outbreaks (such as removal and replacement of dead and dying trees).

4) Threats

NON-NATIVE/EXOTIC SPECIES (inclusive of insects, pathogens and invasive pest plants)

<u>Laurel Wilt Disease and the Redbay Ambrosia Beetle</u>

Laurel wilt is a vascular disease of woody plants in the laurel family (Lauraceae) that has spread rapidly in the southeastern United States and is perhaps the most devastating invasive pest/disease issue affecting native tree species in Florida. It is caused by a fungus (*Raffaelea lauricola*) that is transmitted by the redbay ambrosia beetle (RAB), *Xyleborus glabratus*, a non-native insect that was first detected in coastal Georgia in 2002 (Fraedrich et al. 2008). Laurel wilt is lethal to several native tree species, including redbay (*Persea palustris*) and sassafras (*Sassafras albidum*). When laurel wilt disease establishes in a new area, most mature trees of these species are killed within a few years. Laurel wilt also affects two shrub species of

conservation concern, the federally endangered pondspice (*Litsea aestivalis*) and state endangered pondberry (*Lindera melissifolia*), as well as the commercially important avocado tree (*Persea americana*).

As of early 2020, laurel wilt has spread into 11 states in the Southeast (Figure 1), including much of redbay's natural range in the southeastern Coastal Plains, as well as a distinct area of Kentucky and Tennessee (affecting sassafras). Its arrival in Florida was first confirmed in 2005, in the Jacksonville area. The laurel wilt fungus and RAB had spread into all Florida counties by 2017, causing devastating mortality of susceptible native tree species and impacting the state's avocado industry (which is worth about $100 million per year).

The Florida Forest Service has cooperated with other state, federal, and university scientists in efforts to monitor the spread and impacts of laurel wilt, determine the biology of the fungus that causes the disease and the beetle that transmits it, and develop methods and strategies to respond to it. This includes successful field trials of a preventative systemic fungicide treatment, the identification and propagation of redbay trees that show some resistance or tolerance to the fungus, and the development of a Recovery Plan for long-term conservation of redbay and other forest tree species affected by laurel wilt (Hughes et al. 2015).

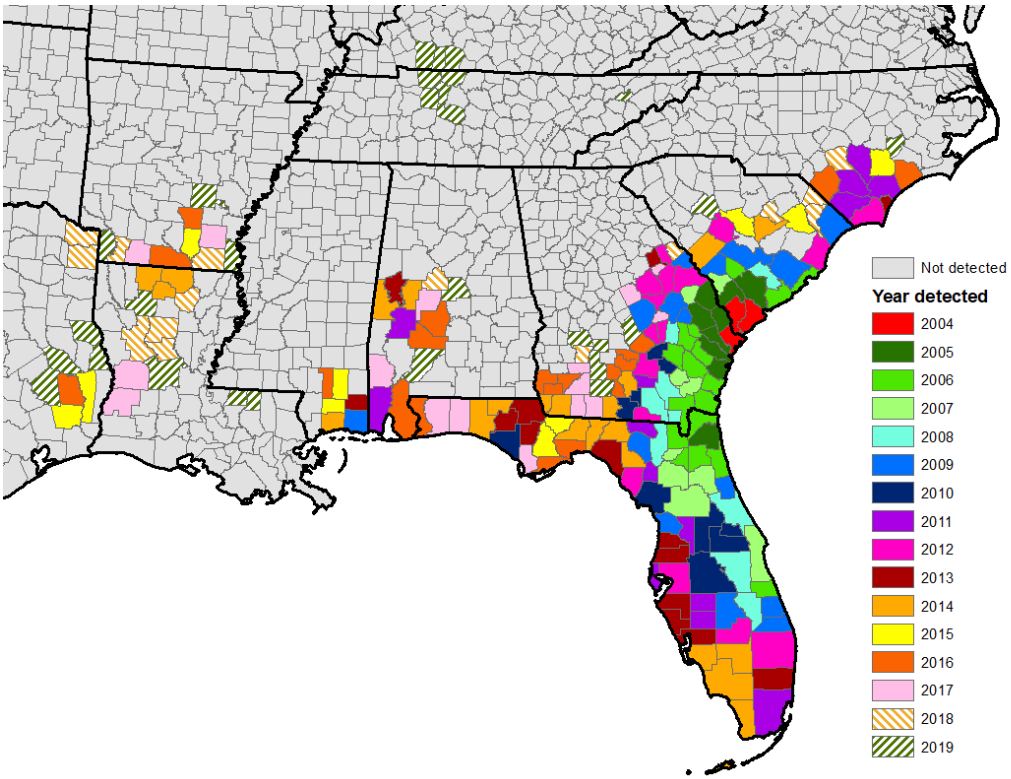


Figure 1. Counties with confirmed cases of laurel wilt disease as of January 2020, by year of initial detection.

Lethal Bronzing

Another apparently introduced exotic disease threat impacting Florida's natural resources is Lethal Bronzing Disease (LBD), formerly known as Texas Phoenix Palm Decline. This disease is caused by a phytoplasma (a bacterium without a cell wall) that is presumed to be transmitted by planthopper or

leafhopper insects, although the primary vector is yet to be determined. This disease is highly virulent on numerous ornamental palm species, and also infects and kills the native cabbage palm (*Sabal palmetto*), which is designated as Florida's official state tree. Since being detected in the Tampa area in 2006, this disease has rapidly spread through most of southern peninsular Florida, as well as several northern counties (Figure 2). Although the impact of LBD has been most evident in urban and residential areas, it has also been found killing cabbage palms in natural areas.

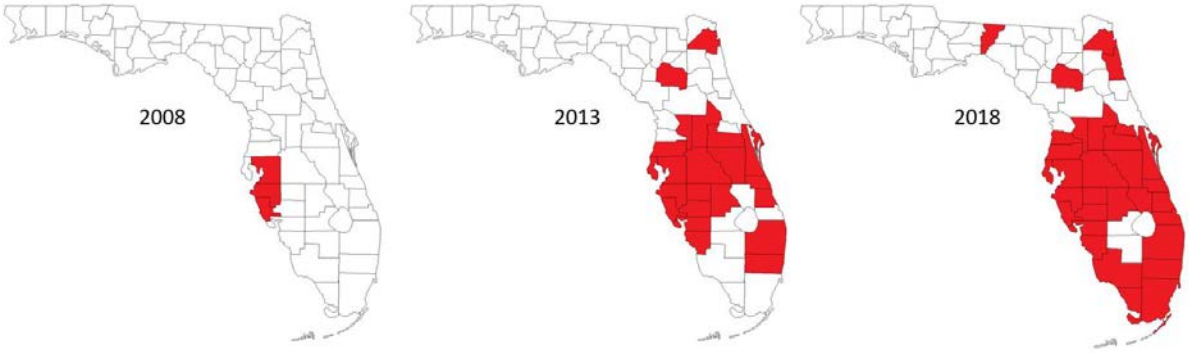


Figure 2. Historical and current distribution of Lethal Bronzing Disease in the state of Florida. Image by Brian Bahder, UF/IFAS.

Sudden Oak Death

In California and Oregon, the term Sudden Oak Death (SOD) refers to a disease caused by an apparently non-native pathogen (*Phytophthora ramorum*) that impacts oaks and other native tree species, in some areas resulting in significant tree mortality. The pathogen has been moved with shipments of infected nursery stock to multiple locations around the United States and has been found persisting and living freely in a stream below a nursery that received infected material in Gadsden County (Northwest FL). This area is surveyed annually, and although the pathogen continues to be detected in the water, to date it has not been found causing any disease symptoms in native forest species.

Non-native wood boring insects not yet established in Florida

There are several non-native invasive (NNI) wood boring insects that are not yet known to be present in Florida but are established in other parts of the United States and represent substantial threats to Florida's forest resources should they become established here. All of them are suspected to have been introduced into U.S. ports through solid wood packing material, and all have the potential to be transported into Florida in firewood or other unprocessed wood.

- The emerald ash borer (EAB), *Agrilus planipennis*, is native to Asia and was discovered killing ash (*Fraxinus* spp.) trees near Detroit, MI in 2002. Since then it has spread through much of the eastern U.S. and has reached as far south as Alabama and Georgia, aided in many cases by human transport of infested firewood. EAB infestations are devastating to ash populations and have the potential to effectively eliminate the genus *Fraxinus* from North America. Florida has four native species of ash trees with overlapping ranges covering most of the state. Although there is some question as to whether Florida's climate will prove to be too warm for EAB to establish (as has occurred with some other invasive organisms), the Florida Forest Service and other state agencies regard EAB as a potentially serious threat to both urban and rural forests.

- The Asian Longhorned Beetle (ALB), *Anaplophora glabripennis,* is also native to Asia and was detected in New York City in 1996. Since then infestations have been discovered in urban/residential landscape forests in other parts of New York, Illinois (Chicago), New Jersey, Massachusetts and Ontario, Canada. This insect can infest and kill healthy trees of many different hardwood genera, several of which are native to Florida including *Acer* (maples), *Salix* (willow), *Ulmus* (elm), *Betula* (birch), *Plantanus* (sycamore). This species could have devastating impacts if it were to establish in Florida.

Non-native wood boring insects not yet established in the United States

The preceding examples demonstrate the hazard posed to native forest species by the introduction of non-native wood boring insects into Florida. However, such insects are introduced and become established into the US (and into Florida in particular) with alarming regularity, presumably carried into ports of entry with infested solid wood packing material such as crates and pallets. Most of them cause no significant problems in their new range, typically infesting dead and dying trees (like most of their native counterparts). However, the minority that do attack and kill living trees are often not recognized as threats until they are well established, and it may be several years after that point before the biology of the pest is well documented, and effective methods for survey and control are developed.

Researchers from the University of Florida have begun work to proactively identify bark beetles and wood-boring insects native to Asia that may pose a threat to North American trees if they were to be introduced. Strategies have included collecting these insects in China and other countries and testing to see whether the fungi they carry are pathogenic to American tree species and establishing sentinel plantings of our tree species in those countries to monitor them for attack by the insects found there. The sweetgum inscriber (*Acanthotomicus* sp.) is one example; it is a previously-unknown bark beetle that has been found to aggressively attack and kill American sweetgum (*Liquidambar styraciflua*) trees planted in China.

Non-Native Invasive Pest Plants

Non-native invasive plants are currently one of the greatest threats to ecosystems worldwide, and the issue is of particular concern in Florida. Due to the mild sub-tropical peninsular climate and the constant influx of exotic species through Florida's many ports, there have been many opportunities for non-native plants to establish and become pests in this state. Over 30% of plant species growing in Florida's natural areas are now exotic, and approximately 10% of those are problem invaders. This includes 78 species identified by the Florida Exotic Pest Plant Council (FLEPPC) as "Category I" invasive species (exotic species that are spreading and altering native plant communities) and 74 identified as "Category II" invasive species (exotic species that are established and spreading, but not yet documented to be altering native plant communities). In addition to major negative effects on the diversity, structure, and habitat value of native plant communities, invasive plants also have significant economic and health impacts on human communities in the state. The University of Florida's Institute of Food and Agricultural Sciences (IFAS) maintains an important website for identification and management of non-native invasive pest plants in Florida (http://plants.ifas.ufl.edu/).

Invasive Plants of Special Concern in Florida

There are many invasive plant species that impact forest ecosystems and complicate land management in Florida, and a full accounting of them lies beyond the scope of this document. The following two species are examples that are of particular importance to forest management in Florida.

Cogongrass

Cogongrass (*Imperata cylindrica*), a perennial grass species native to southeast Asia, is currently one of the most ecologically and economically damaging invasive plants in the southeastern US, particularly Florida, Georgia, Alabama, and Mississippi. It can establish both by wind-dispersed seed and through the underground rhizomes which account for the majority of the plant's biomass. Well-adapted to a wide variety of soil and site conditions, cogongrass forms dense infestations which exclude other understory species, and inhibit tree growth and regeneration. It also greatly increases the risk and intensity of wildfires, and regenerates quickly after fire, thus increasing its dominance on the site. Human movement of seed and rhizomes, on vehicles and equipment and in contaminated fill dirt, is responsible for a large amount of long-distance dispersal of cogongrass.

As part of the strategy for reducing the spread of cogongrass, the FFS Forest Health Section implemented a Cogongrass Initiative from 2009 to 2018. This initiative included an effort to train and equip county road department staff to identify and treat cogongrass infestations in their borrow pits and right-of-ways, and a cost-share program to assist private landowners with the cost of eradicating cogongrass infestations on their properties. Road department staff from twelve counties in North Florida participated in training and received equipment and herbicide to treat infestations. Over the course of the cost-share program, 580 contracts were enrolled and over 3,846 acres of infestations were treated.

Old World and Japanese Climbing Ferns

Two exotic species of climbing fern, old world climbing fern (*Lygodium microphyllum*) and Japanese climbing fern (*L. japonicum*) are currently major threats to forests and other natural communities in Florida. Japanese climbing fern (JCF) is more prevalent in north FL, and Old World climbing fern (OWCF) is widespread in south Florida, although in recent years there has been increasing overlap of these ranges. Both species prefer moist soils and are spread mainly by microscopic spores, which can be carried on clothing, equipment, and vehicles, as well as in contaminated fill dirt. Both also spread aggressively, excluding other plants and reducing the diversity and productivity of the site, and both can affect fire behavior, acting as a "ladder" fuel which spreads understory fires into the canopy. OWCF can form massive monocultures over large areas of cypress swamps and other wet areas. JCF is of major economic concern for the pine straw industry, because it is against Florida regulations to transport the plant in infested material.

As part of our management strategy to reduce the spread of *Lygodium* species in Florida, the Florida Forest Service has contributed along with eleven other public and private agencies to Central Florida Lygodium Strategy (CFLS), a program administered by The Nature Conservancy with the goal of limiting the northward spread of OWCF through early detection and rapid response, monitoring, education, and assistance. However, this program's activities have been reduced due to reductions in funding. The effort to survey for outlier populations and implement rapid control efforts has primarily been carried on by regional

Cooperative Invasive Species Management Areas (CISMAs) with local partners in FFS and other public land management agencies.

NATIVE/INDEGENOUS INSECTS AND DISEASES

Southern Pine Beetle (SPB)

The southern pine beetle (*Dendroctonus frontalis*, or SPB) is a periodically destructive pest of pines in Florida. Damaging outbreaks are typically cyclical, can be separated by several years of minimal activity, and are driven by forest or environmental conditions. Such conditions include an abundance of forest acreage in loblolly pine (the most susceptible host to SPB), prevalence of pine stands that are overstocked and/or overmature, and weather stressors such as drought. Impacts of southern pine beetle outbreaks include loss of timber, premature salvaging of stands, flooded wood markets, associated reductions in timber values, and extremely complex management and social issues in wildland-urban interface environments where trees are being killed and harvested around residences, roads, power lines, and other structures.

Several Florida counties experienced outbreak conditions through the 1990s and early 2000s, but from 2003 to the present statewide SPB activity has been minimal (Figure 4). To reduce the susceptibility of pine forests to SPB infestations, the Florida Forest Service has actively participated in the Southern Pine Beetle Prevention and Restoration Program administered by the USDA Forest Service and facilitated more than 183,000 acres of preventive silvicultural practices from 2005-2019 through its cost- share program for private landowners.

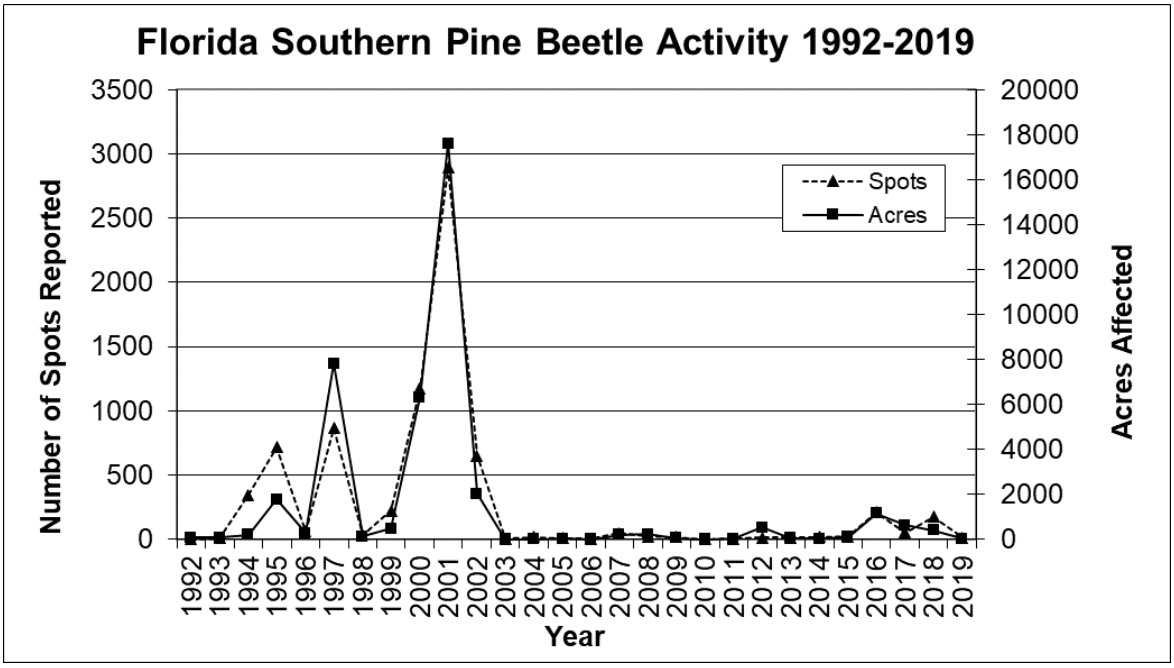


Figure 4. Historical SPB activity in Florida since 1992, showing the long period of low activity since the last major outbreaks in 2000-2002.

Fusiform Rust and Other Issues Affecting Longleaf Pine

Longleaf pine (*Pinus palustris*) is the focus of a regionwide conservation and restoration effort, with longleaf pine forest currently covering less than 3% of its historical range. As both public land managers and private landowners have recently been establishing longleaf pine plantations on more and larger areas, some pest and disease issues have been reported which were not historically considered to be major concerns for that species. Most notably, longleaf pine was long considered to be highly resistant to fusiform rust (caused by the fungus *Cronartium quercuum* f. sp. *fusiforme*), one of the most damaging diseases of southern yellow pines. In recent years, evidence has accumulated showing that fusiform rust can be seriously damaging to longleaf plantations, with effects ranging from seedling mortality to reduction in timber quality at time of harvest. Unlike other commonly planted pine species such as loblolly or slash, very little work has gone into screening longleaf pine seed sources for fusiform rust susceptibility, developing genetically improved rust-resistant varieties, or determining the best management practices for pine nurseries to prevent infection in longleaf seedlings.

Other problems which have been commonly reported on longleaf pine include: pitch canker disease (caused by the fungus *Fusarium circinatum*), particularly in young (3-7 year old) plantations on sites with a history of nitrogen fertilization; redheaded pine sawfly (*Neodiprion lecontei*) outbreaks, occasionally severe and widespread; and apparent failure of the root systems causing mortality on sites with sandy, normally well-drained soils where the water table has been elevated due to periods of extreme or prolonged heavy rainfall (such as from hurricanes). Although these problems are not new to Florida's pine forest managers, there is a need for greater understanding and awareness of how they pertain to longleaf pine in particular.

Diplodia Pine Tip Blight

Diplodia tip blight is a fungal disease (caused by *Diplodia pinea* and a complex of related fungi) that causes cankers and dieback of shoots and branches, sometimes progressing to the death of the tree. It has long been a concern with 2-needled pines (particularly Austrian pine) in the northern U.S. but had not been known to cause significant problems in Florida until 2012 when it was found causing widespread mortality in slash pines planted along highways in the Orlando area. Since then, this disease has been found damaging slash pines in a variety of settings through much of peninsular Florida, and much is still unknown about why this is occurring, and how to manage it.

Other Native/Indigenous Insects and Diseases

Florida's forests are affected by a wide array of other native pests and pathogens, which in a typical year account for most of the pest incidents observed around the state. Most of these do not represent serious ecological threats to Florida's forest resources; rather they are sporadic, management-related issues with impacts ranging from short-term nuisances to significant economic damages. Among the more important of these problems are *Ips* engraver beetles, black turpentine beetle, pine sawflies, various hardwood defoliators, cypress looper, *Heterobasidion* root disease, pine pitch canker, *Armillaria* and *Ganoderma* root rots of oaks and other species, miscellaneous *Phytophthora* root and/or basal canker infections, various pine needlecasts, and bacterial leaf scorch (BLS) of various hardwood species.

Of concern with respect to the entire subject of threatening (native or non-native) insects and pathogens is the diminishing number of disciplinary experts (entomologists and pathologists) being trained and employed to deal with these organisms in a forest context. While the number of biologists and ecologists

with expertise in the area of non- native invasive pest plants are increasing, there is a critical need to assess Florida's capacity to deal with the magnitude of the issue statewide.

Post-Hurricane Forest Health Issues

Florida is routinely impacted by hurricanes and tropical storms, and the example of Hurricane Michael in October 2018 demonstrates the devastating impact that these events can have on trees and forests. The immediate and direct damage to trees caused by wind and rain is well known, but less well studied are their longer-term effects on the incidence of stress-responding insects and diseases, what factors influence the risk of such issues, and how best to manage or prevent them. Widespread outbreaks of *Ips* pine engraver beetles in the region affected by Hurricane Michael have demonstrated that these effects can continue for years after the event.

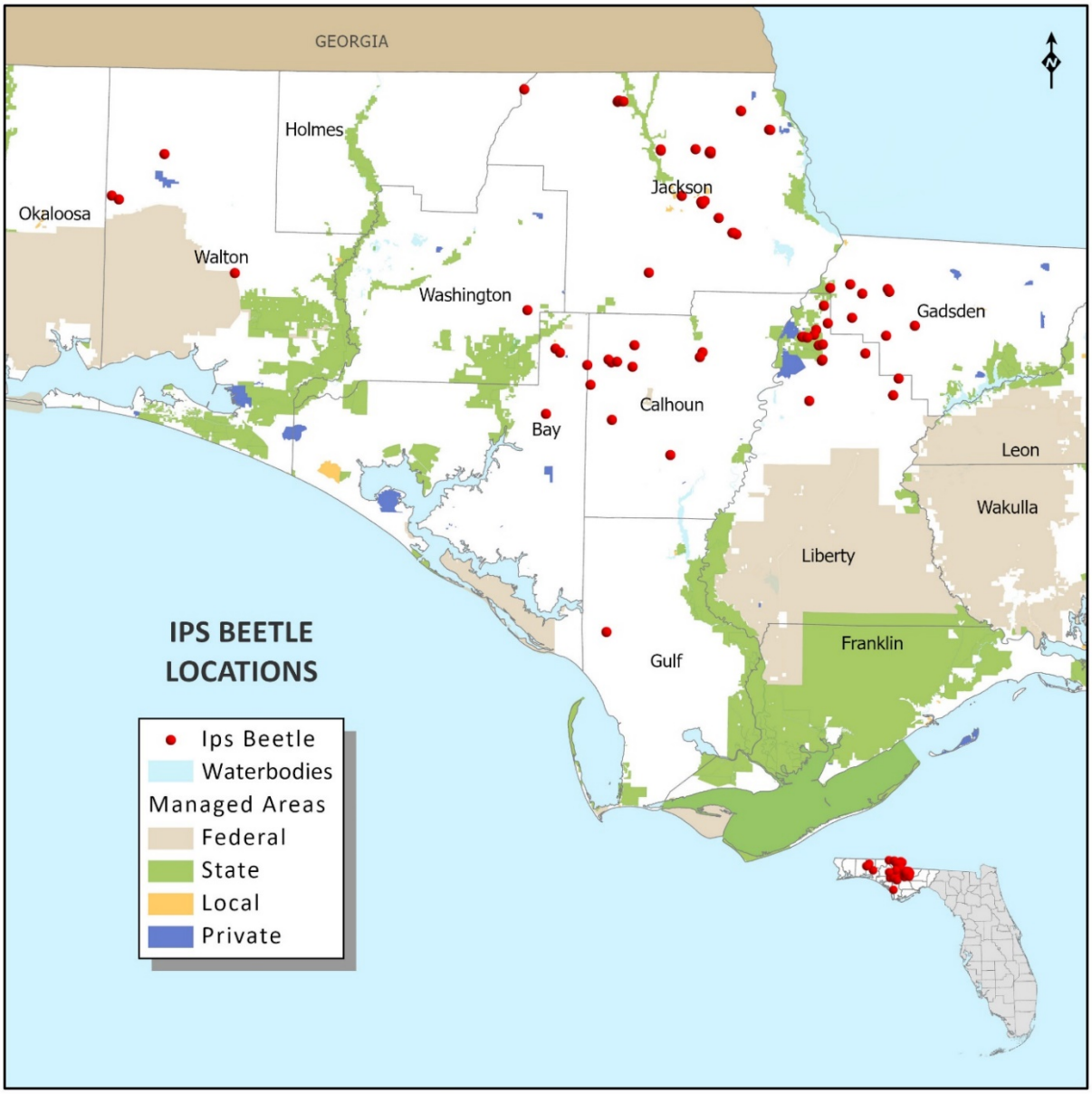


Figure 5. Locations of Ips infestations detected in aerial and ground surveys following Hurricane Michael.

Hurricanes also may affect the spread of invasive plant species. Winds and water movement from the storms themselves can move propagules (seeds, spores, and plant parts) to new sites, and the site disturbance caused both directly and indirectly (from salvage and clearance of storm-damaged trees) can provide many opportunities for weeds to establish and spread. For this reason, post-hurricane disaster relief funding has often been requested to assist public and private landowners with survey and control of invasive plant infestations in the affected regions.

5) Opportunities

With funding support from the USDA Forest Service, the Florida Forest Service has conducted many routine and special projects to address these threats in the past decades, including annual trapping and aerial survey programs for pests such as the southern pine beetle, survey and monitoring programs for new and emerging pests and diseases, landowner assistance programs to prevent and control forest health problems such as southern pine beetle or cogongrass, and efforts to inform public and private stakeholders about the most current, science-based information regarding the biology and management of pests and diseases. These approaches have a long and successful track record and will be continued to the extent allowed by available resources.

New methods and technologies show great promise in enhancing and expanding the ability of the Florida Forest Service to prevent and respond to forest health issues in the coming years. For example, unmanned aerial vehicles (drones) could prove to be a cost-effective tool for survey and evaluation of pest and disease outbreaks. New remote sensing products such as light detection and ranging (LIDAR) imagery and hyperspectral imaging analysis could prove to be valuable in early and efficient detection of forest health problems. Additionally, the increasing accessibility and decreasing cost of advanced molecular diagnostic tools (such as PCR and DNA sequencing) may greatly expand the ability of the Florida Forest Service to identify and diagnose pests and diseases.

In addition to developing the agency's internal capabilities, the Florida Forest Service has long recognized the importance of developing partnerships with other agencies, universities, and organizations. A new opportunity for such collaboration is ProForest (Proactive Forest Health and Resilience), a group consisting of researchers and specialists from a wide range of institutions and disciplines that is focused on working proactively to protect forests ecosystems and the services they provide. This includes projects to predict and manage invasive pests and diseases, develop and improve new management methods, and improve communication between researchers, forest managers, and landowners.

6) Agency and Organization Roles

With the diverse issues affecting forests and shade trees in Florida and the wide variety of stakeholders affected, developing and maintaining active partnerships is essential. Important partners with the Florida Forest Service have included the USDA Forest Service (USDA-FS), the USDA Animal and Plant Health Inspection Service (USDA-APHIS), the FDACS Division of Plant Industry (FDACS-DPI), the University of Florida School of Natural Resources and Conservation (UF-SFRC), the UF Institute of Food and Agricultural Sciences (UF-IFAS), the FDACS-DPI Cooperative Agricultural Pest Survey Program (CAPS), Water Management Districts (WMDs), the Society of American Foresters (SAF), the International Society of Arboriculture (ISA), the Florida Department of Environmental Protection (DEP), the Florida Fish and Wildlife Conservation Commission (FWCC), Cooperative Invasive Species Management Areas (CISMAs), the Florida Invasive Species Partnership (FISP), and The Nature Conservancy (TNC).

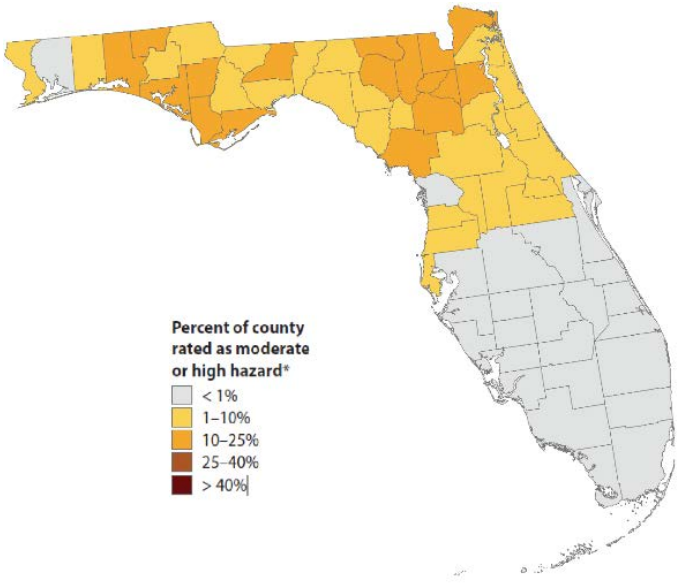
Partnership Roles

Partner	Regulatory	Survey/ Evaluation	Education/ Training	Outreach	Project Coordination	Funding
USDA-FS		**x**	**x**	**x**	**x**	**x**
USDA-APHIS	x					
FDACS-DPI	x	x			x	
UF-SFRC			x	x	x	
UF-IFAS		x		x		
CAPS		x				
WMDs		x				
SAF			x	x		
ISA			x	x		
DEP/FWCC		x	x	x	x	x
CISMAs		x	x	x		
FISP					x	
TNC		x		x	x	

7) Priority Areas

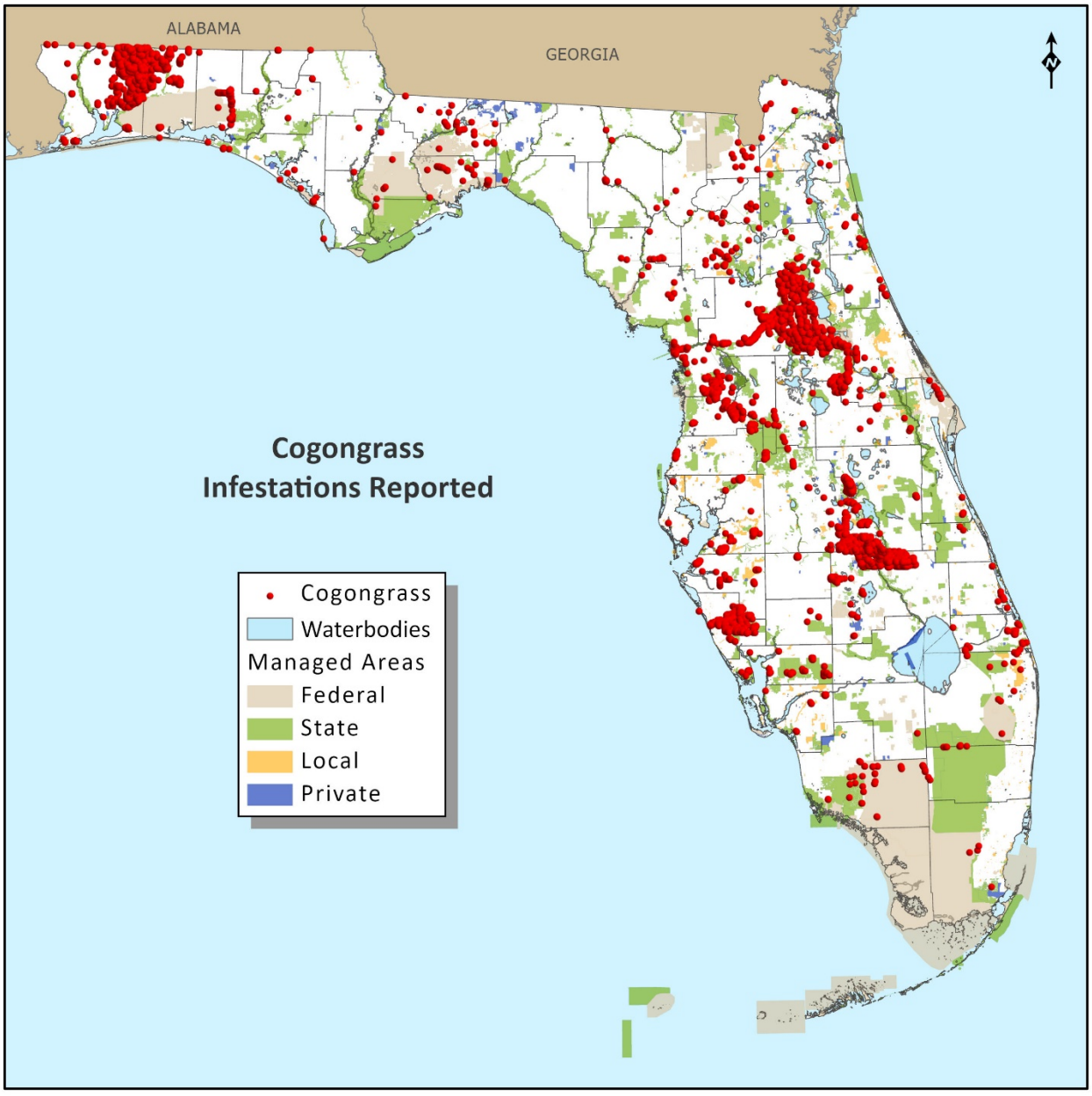
Southern Pine Beetle

The USDA Forest Service's Forest Health Assessment & Applied Sciences Team (FHAAST) has developed the following map, showing the area of each county that is considered at high hazard for developing southern pine beetle activity, based on factors such as the prevalence and density of loblolly pine (the preferred host of SPB). Southern pine beetle infestations have never been recorded in South Florida, where loblolly pine does not naturally occur.



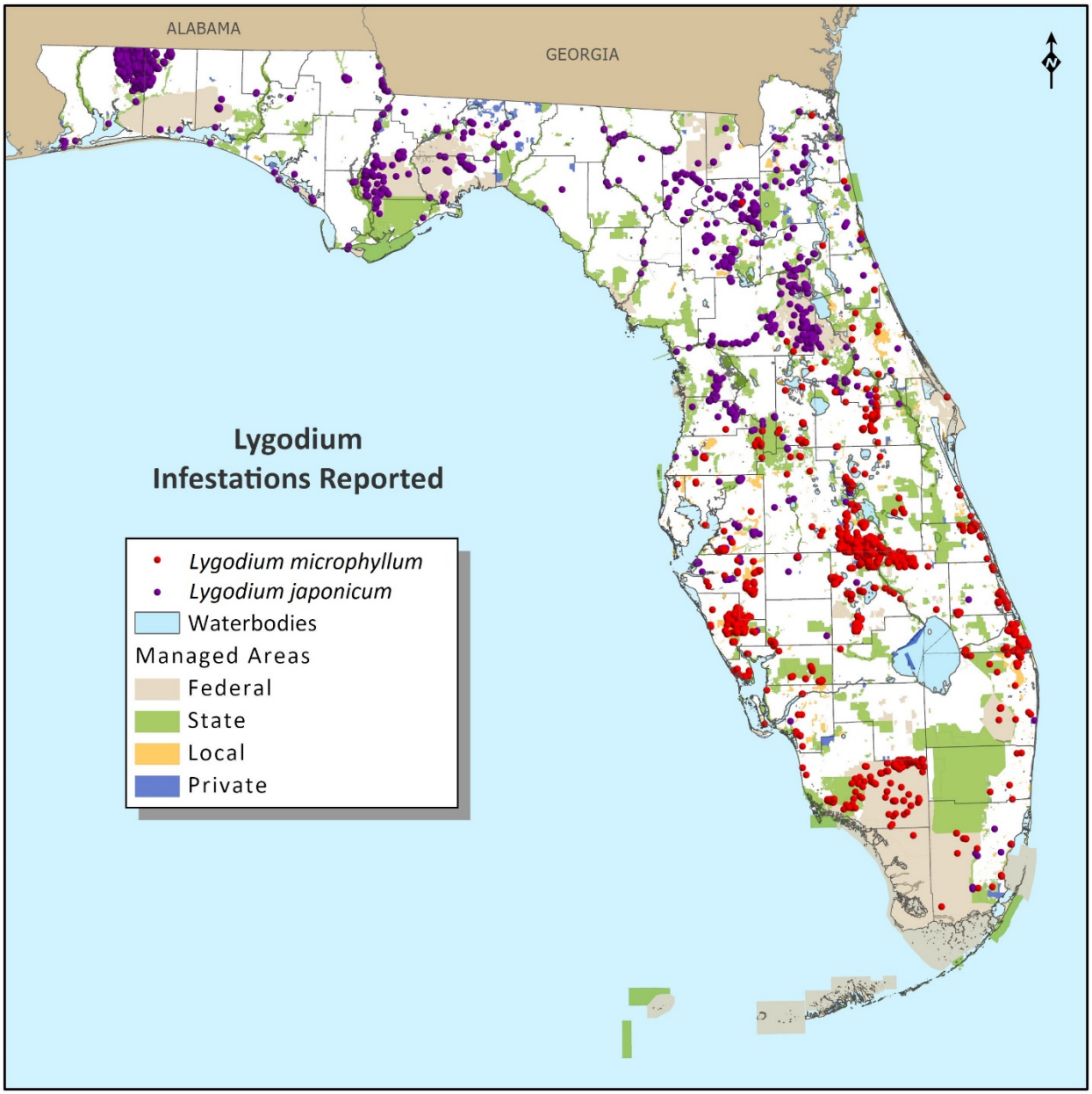
Cogongrass

This map shows locations of cogongrass (*Imperata cylindrica*) infestations as recorded from the past 5 years in the Florida Natural Areas inventory and EDDMaps databases. As many infestations are not reported (particularly on private land), this only gives a very conservative sense of the distribution of this high-priority invasive pest plant in Florida.



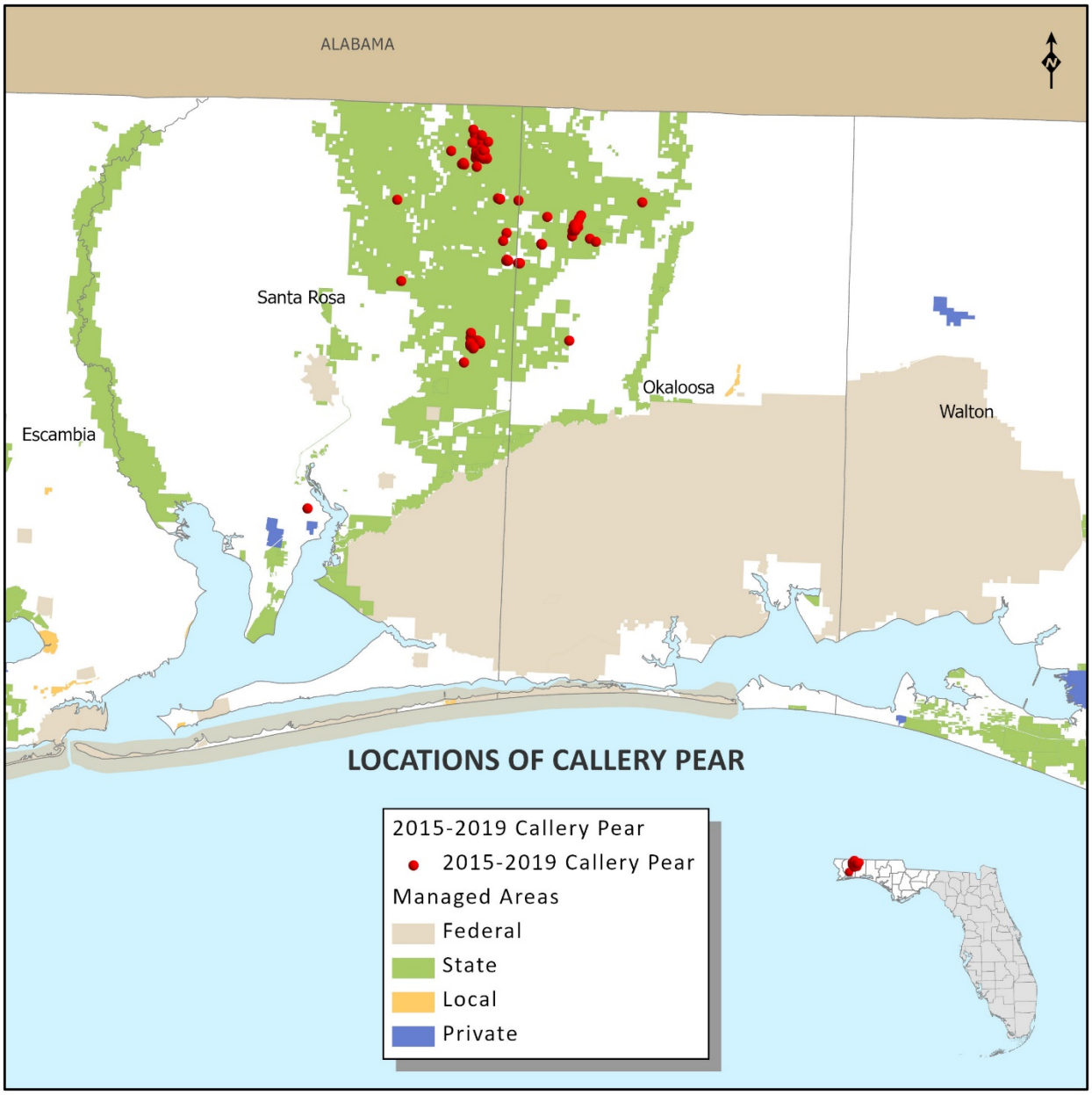
Climbing Ferns

This map shows the locations of infestations of Old World climbing fern (*Lygodium microphyllum*, or OWCF) and Japanese climbing fern (*L. japonicum*, or JCF) in Florida, as reported from the past 5 years by FNAI and EDDMaps. Previously, JCF was restricted to North Florida while OWCF was found only in the southern part of the Peninsula. However, these ranges have increasingly overlapped, and the priority now is to restrict the continued expansion of OWCF to the north, through early detection and aggressive eradication of outlier infestations.



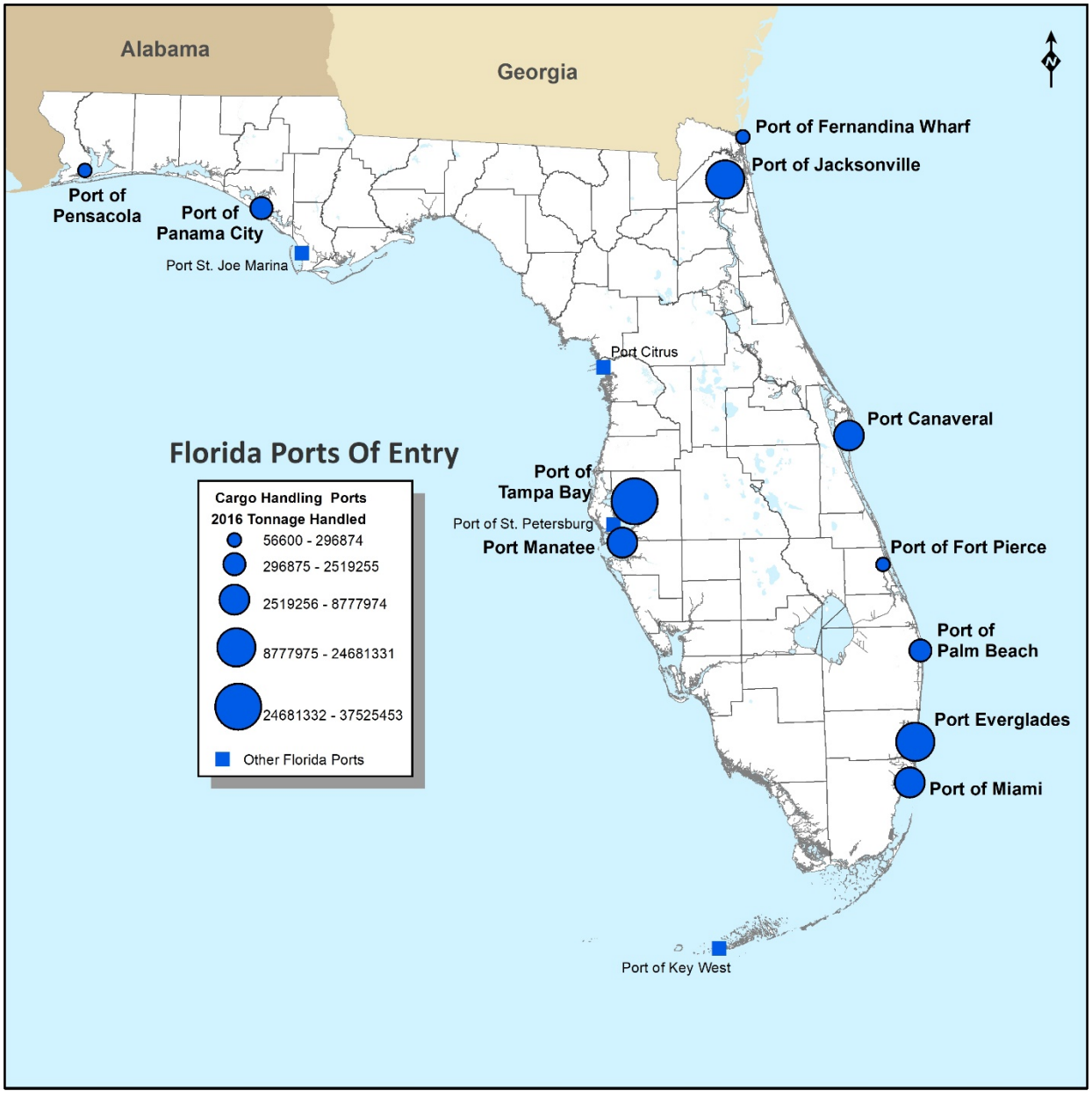
Callery Pear

Callery pear (*Pyrus calleryana*) is quickly becoming recognized as a high-priority invasive plant species across the southeast, as cultivated ornamental varieties have increasingly cross-pollinated and established aggressive feral populations. In Florida, this species has only begun to invade natural areas in a restricted region of the western Panhandle. Infestations in this area will be targeted for treatment before they can establish further.



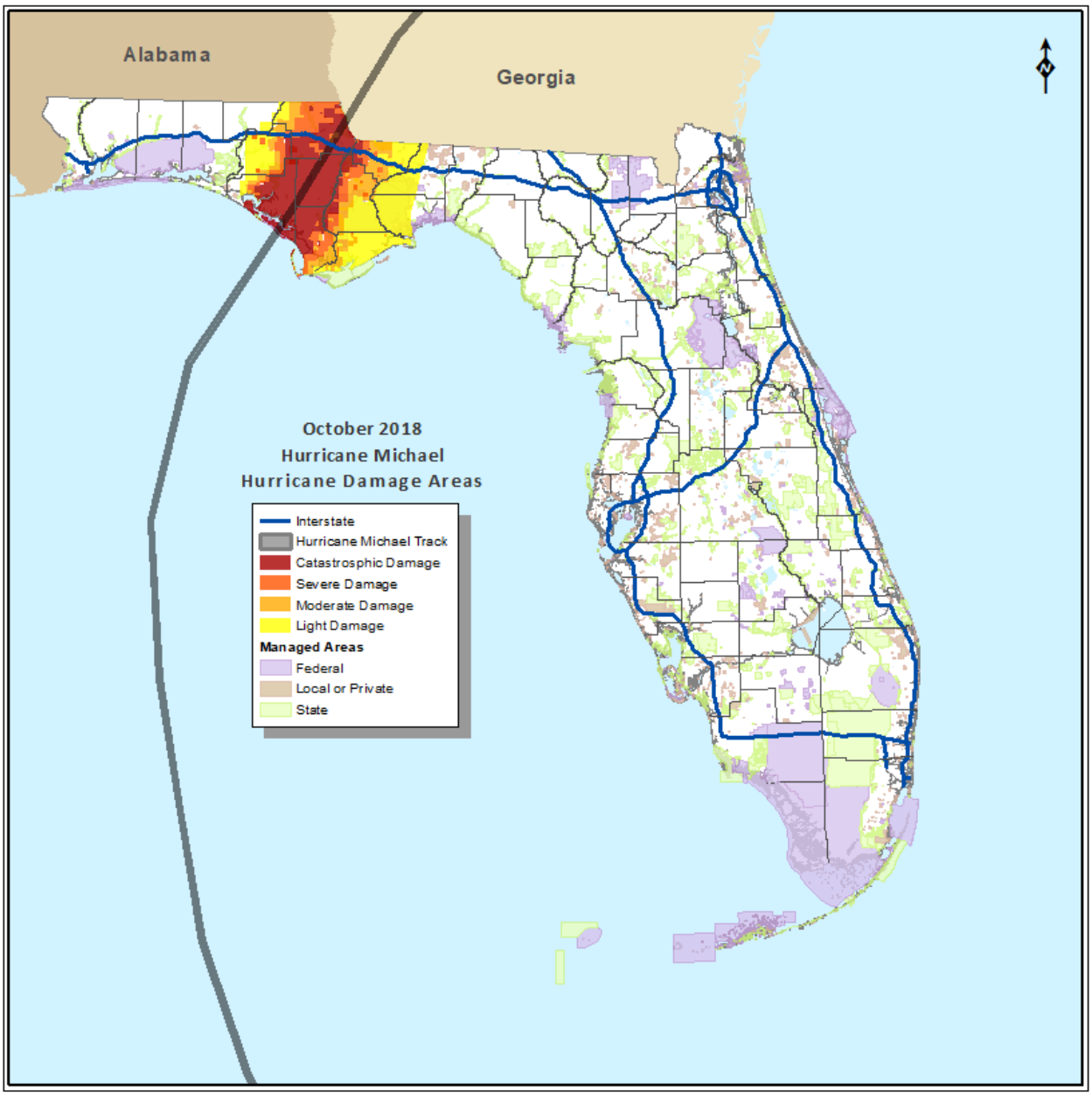
Ports of Entry

Florida's many ports of entry potentially provide many opportunities for the introduction of new pest and disease species. These ports and the areas around them are high-priority targets to monitor and survey for exotic organisms that are not yet established in the state, and which may threaten our native forests and shade trees.



Hurricane Michael

The area of the state damaged by Hurricane Michael in 2018 will remain a high priority for survey, monitoring, and management of insects, diseases, and invasive plants that tend to become more prevalent after large-scale disturbances.



8) References

Hughes, M.A., J.A.Smith, R. Ploetz, P.E. Kendra, A.E. Mayfield, J.L. Hanula, J. Hulcr, L. Stelinski, S. Cameron, J.J. Riggins, D. Carillo, R.J. Rabaglia, J. Eickwort, and A. Pernas. 2015. Recovery plan for laurel wilt on redbay and other forest species caused by *Raffaelea lauricola* and disseminated by *Xyleborus glabratus*. *Plant Health Progress*. 16(4): 173-210.

Manion, P.D. 2003. Evolution of concepts in forest pathology. *Phytopathology*. 93(8): 1052-5.

9) Goals, Objectives and Strategies

The goals and objectives of Florida's Forest Health Program are to protect the State's vast and diverse forest resources from serious and/or damaging impacts of forests pests (insects, pathogens, and NNIPPs) and to provide Florida forest resource owners and managers with information and resources to facilitate forest resource management in such a way as to minimize the harmful effects of such pests. All of these program goals and objectives are compatible with and supportive of the three broad national goals of 1) conserving working forests, 2) protecting forests from harm, and 3) enhancing public benefits. Our overall approach is to maintain and implement a comprehensive program emphasizing prevention of, early detection of and rapid response to, and management/control of damaging agents (both native and non-native) as dictated by circumstances and associated economic and/or environmental threats. To accomplish specific goals and objectives, the Forest Health Program Staff will continue to implement a variety of strategies targeting priority pests and needs as they arise and change over time.

Goal 1: Maintenance and enhancement of staff capacity and capabilities.

Objective 1.1: Maintain current Section staff positions to deal with forest health issues ("tri-disciplinary" to cover insects, diseases, and NNIPs).

Strategy 1.1.1: Define and staff a Forest Pathologist position.

Strategy 1.1.2: Define two regional (West Florida and South Florida) Forest Health Program Coordinators.

Objective 1.2: Develop and improve the Section staff's technical expertise, to enhance its capability with diagnostics, detection, and monitoring of forest pests and diseases.

Strategy 1.2.1: Pursue training and obtain equipment for independent molecular diagnostic tools and methods such as PCR and DNA sequencing.

Strategy 1.2.2: Pursue training and obtain equipment/software to utilize new technologies for detection and mapping of forest pests and diseases, such as unmanned aerial vehicles (drones) and other sources of remote imaging data.

Goal 2: Continuation of comprehensive FFS staff training and public education efforts regarding native and non-native biotic threats to forest health in Florida.

Objective 2.1: Continue educational venues for forest health issues across the state.

Strategy 2.1.1: Work with existing partners to efficiently maximize public awareness of forest health issues via workshops, printed materials, PSA's, etc.

Strategy 2.1.2: Provide regular update training to Florida Forest Service staff statewide.

Strategy 2.1.3: Identify and contract translation of appropriate forest health circulars/leaflets etc. into Spanish to communicate to the State's growing Latino population.

Goal 3: Continuation and expansion of meaningful assistance programs for private forest landowners and other appropriate publics to promote risk reduction for and/or management of threatening forest pests.

Objective 3.1: Continue to collaborate with existing organizations, municipal and county governments, and forest landowners, to minimize the spread and proliferation of cogongrass within Florida.

Strategy 3.1.1: Conduct necessary training workshops to ensure appropriate recognition and management of target pests.

Strategy 3.1.2: Pursue funding to support further landowner assistance programs for prevention and control of infestations and outbreaks.

Objective 3.2: Review and continue current SPB prevention program.

a. Conduct annual SPB trapping
b. Conduct annual SPB aerial detection survey flights, utilizing new GIS technologies as they become available.
c. Provide landowner assistance and incentive funding to qualifying forest landowners for preventive silvicultural practices

Goal 4: Minimize impacts of non-native invasive pest plants (and other pests) on State Forests and other public and private lands.

Objective 4.1: Facilitate management of NNIPS on State Forests.

Strategy 4.1.1: *Prevention*: Assist Florida State Forest personnel with procedures/practices to reduce the threat of invasive non-native species by promoting and implementing decontamination procedures to prevent spread of new and established infestations.

Strategy 4.1.2: *Control*: Develop maintenance/suppression programs for priority NNIPPs on State Forests as need dictates and within feasibility and budgetary realities.

Strategy 4.1.3: Continue supporting NNIPP survey/management crews on State Forests with technical expertise, as well as funding for salary and equipment (when available).

Objective 4.2: Minimize risk of introduction and spread of unwanted non-native insects and pathogens via indiscriminate movement of firewood.

Strategy 4.2.1: Inventory state forests and parks for status of publicity/awareness.

Strategy 4.2.2: Prepare and distribute posters and brochures for highlighting issues as warranted.

Objective 4.3: Continue provision of technical assistance regarding forest health issues to public personnel, private forest landowners, and citizens throughout the State of Florida.

Goal 5: Early Detection and Rapid Response (EDRR) for Invasive Species.

Objective 5.1: Provide continued support to Florida's natural resource managers with respect to identifying, locating, and responding to new and damaging non-native biotic threats to forest health.

Strategy 5.1.2: Work with partners (USFS, APHIS, Division of Plant Industry, CAPS, CISMAs, etc.) to quickly detect threatening invasive pests (insects, pathogens, NNIPPs, etc.)

a. continue to distribute funding (when available) to the FL Division of Plant Industry's Cooperative Agricultural Pest Survey program, to support EDRR survey trapping activities.
b. continue participation in Sudden Oak Death (S.O.D.) stream baiting surveys as requested and within capabilities of time/personnel limits.

Strategy 5.1.3: Work with state foresters to create early detection lists for invasive non-native species for each District. These lists will include invasive species that have not yet been detected in the District but are nearby and/or likely to arrive there, and those that are present at an early or incipient level. Assist with the development of eradication programs for early detection species as need dictates and within feasibility and budgetary realities.

Strategy 5.1.4: Provide funding (when available) and technical support for efforts to identify, study, and prepare for non-native pests and diseases that are not yet present in the state, but that pose a potential threat to Florida's tree species if they were to be introduced.

Objective 5.2: Continue and enhance participation in national Forest Health Monitoring program.

Strategy 5.2.1: Maintain DMSM (Digital Mobile Sketch Mapping) hardware and software for each of the FFS's four Regions.

Strategy 5.2.2: Acquire one GPS-enabled tablet device for each of FFS's fifteen Districts/Forestry Centers.

Strategy 5.2.3: Develop and implement applications for field staff to use with mobile devices for recording and submitting data for pest and disease incidents.

Strategy 5.2.4: Provide technical training (initial and update) for utilization of digital equipment for use in geo-referencing, recording and reporting of forest pest data for submission to the national programs

Strategy 5.2.5: Provide support to appropriate aerial survey programs to estimate the range and extent of insects, diseases, and NNIPs throughout the state.

Strategy 5.2.6: Design and conduct additional appropriate surveys, monitoring, and evaluations of forest/shade tree pests and their impacts statewide (native and non-native pests).

Goal 6: Regional Ranking of Longleaf Pine Seed Sources for resistance/susceptibility to Fusiform Rust (and possibly pitch canker disease).

Objective 6.1: Provision of support to regional initiative(s) to screen longleaf pine seed sources for resistance to fusiform rust (and possibly pitch canker disease).

Strategy 6.1.1: Provide technical advice and communication regionally.

Strategy 6.1.2: Continue to collect and supply longleaf pine seeds and fusiform rust aeciospores to the U.S. Forest Service's Resistance Screening Center in Asheville, NC,

10) Performance Measures

Goal 1: Maintenance and enhancement of staff capacity and capabilities.

- Enhanced program delivery enabled by employing regional forest health program coordinators.

Goal 2: Continuation of comprehensive FFS staff training and public education efforts regarding native and non-native biotic threats to forest health in Florida.

- Number of workshops, publications, PSAs completed/developed with partners to promote forest health awareness by the public.
- Update trainings provided to Florida Forest Service Foresters in each of four regions annually
- 3-day workshops held for new foresters regularly.
- Number of publications translated into Spanish
- Number of billboards, internet articles, PSAs developed to enhance public awareness of threats to forest resources.

Goal 3: Continuation and expansion of meaningful cost-share programs for private forest landowners and other appropriate publics to promote risk reduction for and/or management of

threatening forest pests (e.g., Southern Pine Beetle, NNIPPs such as cogongrass, etc.)

- Acres of land surveyed and treated for invasive plant infestations.
- Number of program participants and number of acres treated in landowner assistance programs.
- Number of insect traps deployed/serviced, and acres surveyed for SPB or other target pests, diseases, and other issues.
- Development of additional pest specific cost-share programs as dictated by circumstances.

Goal 4: Minimize impacts of non-native invasive pest plants (and other pests) on State Forests and other public and private properties.

- Number of state forests, etc. with decontamination plans and programs.
- Number of NNIPP programs and acres treated, number of acres under maintenance-level control.
- Number of NNIPP personnel hired/retained, number of acres surveyed and treated.
- Completed inventory of awareness of indiscriminate movement of firewood, number of posters or brochures printed/distributed.
- Numbers of assists to public regarding forest health issues.

Goal 5: Early Detection of and Rapid Response to Invasive (and other pest) Species.

- Number of traps or sentinel sites deployed/serviced for exotic bark beetles, Sudden Oak Death, or other pests and pathogens.
- Number of regions with early detection/rapid response programs, number of acres or invasion sites eradicated - if new species are found.

Goal 6: Regional Ranking of Longleaf Pine Seed Sources for resistance/susceptibility to Fusiform Rust (and possibly pitch canker disease).

- Technical advice provided and communicated regionally.
- Local seed source samples provided to the USDA Forest Service's Resistance Screening Center in Asheville, NC.
- Aeciospores from longleaf pine infections collected and supplied to U.S. Forest Service Screening Center.

Issue 4: Forest Resiliency

1) Current Issue Description

Forest resiliency is a key issue that affects all components of Florida's forest ecosystems. The value of some ecosystem services is obvious, such as the value of timber or the monetary value of a recreational lease. Other services provide benefits that require scientific quantification to evaluate because they are not visually obvious. These benefits include carbon sequestration, storm water mitigation, soil stabilization, the promotion of human health and the remediation of water and air pollution. Additionally, there are some ecosystem services which are unique and vary from person to person, such as the value of an aesthetically pleasing vista or a population of rare flowering plants. Though all vegetation in the forest ecosystem assists with these essential services, the larger trees provide the most impact over time. All ecosystem functions thrive when the trees remain healthy and conversely suffer when external forces impede the trees' ability to do so. There are many of these external forces that pose active and potential challenges to Florida's forests including: climate change, invasive species, storms, commercial development, insects, and diseases. As nearly 11 million acres or 65 percent of Florida's forest lands belong to private non-industrial forest landowners, the Florida Forest Service can make use of both state and federal resources to help these landowners manage their forests in a manner that optimizes the ecosystem benefits and adapts to the ever-changing challenges of forest management. In addition, state and federal resources can assist local entities to encourage the growth of healthy trees in urban areas of the state, where over 90% of Floridians live. There are 15.2 million publicly-owned, urban trees in Florida and these trees provide numerous human health, economic, environmental and infrastructural benefits to Florida's communities and residents (Hodges et al 2019).

2) Key Attributes

Florida forests will face several challenges and many stressors over the next ten years. Hopefully, this next decade will bless our state with continued economic prosperity. However, with a bustling economy comes an increasing population and expanding cities. Both of these attributes lead to increased development which continues to be a concern for retaining healthy forest ecosystems. In addition to the removal of trees and forest vegetation to make way for a construction site, the remaining forest surrounding a developing area is often left damaged, degraded, or stressed. Degraded or stressed forests are more vulnerable to storms, invasive species and environmental shifts caused by climate change. Another issue exacerbated by increased development is the heat island effect. This phenomenon occurs in the interior sections of cities where large, continuous expanses of impervious surfaces absorb, retain and slowly emit heat which causes an increase in the ambient temperature. The increased temperature and microclimates caused by the heat island effect lead to a number of problems that impact human health, infrastructure and forest communities (https://www.epa.gov/heatislands/heat-island-impacts). Some of these problems include: increased peak energy usage in the community, higher air conditioning costs for residences and businesses, increased air pollution levels, increased heat-related illness or death, shortened service life of asphalt, and water stress and sunscald on urban trees. Any change to our climate that results in more days of extreme temperatures will only increase costs and risks to human health. Promoting healthy urban forests and planting more urban trees will help to mitigate the heat island effect, particularly when these trees are located near buildings and along streets. Trees help to lower the temperature in cities by shading impervious surfaces such as roads and building and cool the air through the process of transpiration. Studies have shown the cooling benefits of trees are most significant when strategically placed on the east-, south-, or west-facing sides of one- and two-story buildings (Sacramento Municipal Utility District:

http://www.smud.org/residential/trees/index.html). Shade from trees over public spaces like sidewalks, streets, and parks makes a city more tolerable for outdoor activities during summer months, which is a significant indicator of quality of life for urban residents. Additionally, there is growing evidence that accessibility to publicly owned greenspaces is correlated with improved cardiovascular and mental health.

3) Public Benefits

Forests play a significant role in human health, ecosystem services, and wildlife habitat. Maintaining a healthy and resilient forest is essential in maximizing these public services. Using all available resources to promote forest health in both rural and urban settings is vital to retaining the benefits these trees and forests provide to Floridians. Trees provide services necessary for human life such as clean air and clean water, but also benefit the public by reducing the impacts of the heat island effect, providing recreational opportunities, slowing storm water runoff, and mitigating some effects of climate change. One of the primary ways trees and forests mitigate climate change is through the absorption of atmospheric carbon. Forests and long-lived wood products currently offset 310 million metric tons of U.S. fossil fuel emissions of carbon—20 percent of the overall total (Pacala et al. 2007). Atmospheric carbon is captured and stored in trees by taking in carbon dioxide and transforming it into above and below ground biomass. This carbon conversion and storage process is called carbon sequestration. Though trees can hold the captured carbon for a long time, this storage is not permanent. Once trees die or are cut down, the stored carbon is released into the atmosphere as the wood decomposes. However, this rate of decomposition differs widely depending on how the wood is used or processed. Urban and exurban forest cover improve air quality by removing pollutants, but also provide a number of other human health benefits including stress reduction and shorter hospital stays (Donovan et al 2013). Tree shade reduces summer air conditioning demand but can increase heating energy use by intercepting winter sunshine. The energy saving benefits are maximized when a deciduous tree is located on the southwestern side of the home or building. Lowered air temperatures and wind speeds from increased tree cover can decrease both cooling and heating demand. As urbanization continues and now that over 90% of Floridians live in areas classified as urban, it is more important than ever to fully integrate urban forestry into State Implementation Plans for air quality, water quality, invasive species mitigation and human health. For many residents, the urban forest may be their only exposure to forests and natural resources. This makes it critical to fully integrate urban forests into statewide management plans and outreach materials. Additionally, there are opportunities to increase urban wood utilization for unique wood markets and for biomass energy production. Assessments should identify areas where management or restoration of the urban or exurban forest canopy will have significantly positive and measurable impact on air quality, energy savings and forest resiliency.

4) Threats

The important benefits that both rural and urban forests provide can be disrupted or adversely impacted by natural disasters, invasive species, development and climate change. The loss of biodiversity, wildlife habitat, water storage and quality, timber growth, and ecological community stability could all result from disruptions to Florida's forest ecosystems. Tree species' ranges and vegetation community composition are projected to change significantly due to climate change. Additionally, unique ecosystems or forest types can be lost to development, overrun with invasive plant or pest communities, or damaged beyond repair during a natural disaster. These challenges often come together to the detriment of the forest. For example, a storm may leave an opening that could be colonized by an invasive species or climate change may cause an increased temperature that will disproportionately impact trees in urban settings. Fragmented ecosystems may also exacerbate the problem by separating native plant communities and making them more vulnerable to forest disturbances. On the whole, climate change lurks as a force that

will worsen all these forest resiliency issues. Additionally, climate change will affect the frequency of storms and wildfires, so the "usual" patterns of forest response and behavior are likely to change over time. If natural resource managers can identify changing conditions early enough, adjustments to land-use plans and practices can be made to take the new conditions into account. In any case, natural resource managers face increased uncertainty concerning the environmental outcomes of forest activities whether due to man-made causes such as development or natural causes such as storms or climate change. The Intergovernmental Panel on Climate Change (IPCC) has concluded that global concentrations of carbon dioxide, methane, and nitrous oxide (the primary greenhouse gases) have increased as a result of human activities since 1750 and now far exceed pre-industrial levels. The IPCC surmises that the burning of fossil fuels and land-use changes are the primary reasons for these increasing levels. This panel representing the scientific community predicts rising sea levels, loss of sea ice, and increased frequency of drought, heat waves, and heavy precipitation events over the next century. These predicted changes will inevitably impact forest attributes and force a shift in local, state, and national forest management strategies. (IPCC, 2007*: Summary for Policymakers. In: Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*). http://ipccwg1.ucar.edu/wg1/Report/AR4WG1_Print_SPM.pdf.

Water Supply and Quality: Climate change and an increasing population will both be significant factors in determining the future supply and quality of water. A warming planet and changing climate can alter the distribution, volume, timing, and type of precipitation, and will also indirectly modify the distribution and timing of water needs. The water supply and storage network designed for pre-change conditions may become less suitable for the new conditions. Meanwhile, increasing populations and a warmer climate will increase the demand for water. Climate change could also alter water quality. Lessened water quality could negatively impact some industries and limit the ability of water supplies to be used for human consumption. Watershed-based adaptations may be needed if the flow of watershed derived goods and services is to be maintained in the face of changing conditions. General patterns of climate change emerge from all predictive models: some areas are likely to receive more precipitation and some less. Warming temperatures may result in reduced dry-season stream flows, greater moisture stress on vegetation, and increased stress on aquatic ecosystems. Areas subject to increased climatic extremes may experience more frequent and larger floods and more frequent and longer droughts. Warming conditions may trigger more extensive and severe insect outbreaks and more frequent, larger, and more severe wildfires, contributing to reduced water quality through increased erosion. All of these factors will contribute to a scarcer supply of clean water, causing greater stresses and risks to be placed on water-related ecosystem services. Aquatic habitats that are in marginal condition may be rendered unusable for some species and uses by warming temperatures and reduced flows. Increased impervious surface area due to development and loss of tree canopy during storms may also impact water supply and quality. Reduced tree canopy cover and increased impervious surface area will greatly increase the amount of storm water that must be slowed, detained and treated by local governments. This increased runoff can be a vector for more water-based pollution that is picked up from roadways and parking lots and released into streams, lakes, or other aquatic systems. Trees lost during storms can leave local areas more prone to erosion control and storm water issues, leading to degraded water quality. Some municipalities are utilizing trees and phytoremediation to remove heavy metals, inks and other chemicals from ground water sources. Additionally, some cities have incorporated trees into storm water management plans and recognize the value of trees in slowing and avoiding storm water runoff.

Biological Diversity: Climate change, invasive species, storms, insects, development and disease could all pose a significant threat to biological diversity. Though storm or insect damage may appear readily to the

casual observer, climate change and development could prove to be the most damaging forces facing biological diversity (Roe et al 2019). While all of these issues can significantly change the ecosystem to the detriment of biological diversity, climate change represents an especially large threat due to shifting weather patterns that are leading to more precipitation coming in heavier, more infrequent storm events and seasonal shifts that will alter the length of the growing season. These changes can lead to other forest resiliency issues such as invasive species. As the climate continues to change, invasive or aggressive native species may be able to outcompete other desirable species leading to a loss of biological diversity. Storms also pose a threat to diversity, especially in coastal regions. The forest disturbances caused by storms could cause the loss of forest structure necessary for some unique species and leave areas of the canopy open for colonization of invasive species. Commercial development continues to be a threat to biological diversity at a regional and global scale. Expanding cities, land use changes for agriculture, solar farms, and industrial forestry have all lead to an unprecedented loss of biological diversity over the past 100 years. Species respond to environmental change based on their habitat needs, competitive abilities, and physiological tolerances. Although increases in richness can be predicted in some areas (Curie 2001), overall biological diversity is expected to decline as time elapses. Cumulative effects of climate change and land use are difficult to assess, but it seems that these changes disproportionately impact poorer and developing regions of the world (Roe et al 2019).

Forest Pests: Bark beetle, sawfly, and several rust disease infestations are a regular force of natural change in forested ecosystems. However, these outbreaks can be difficult to control, costly and extremely detrimental to the overall health of the forest. Although outbreak dynamics differ from species to species and from forest to forest, storms, development, and climate change can place added stress on forests and lead to the initiation or exacerbation of forest pest infestations. Additionally, invasive plants, diseases or insects can decimate native forest communities and completely change the forest structure in impacted areas. Elevated temperatures associated with climate change, particularly when there are consecutive warm years, can speed up the reproductive cycles of damaging insects and reduce cold-induced mortality. Shifts in precipitation patterns and associated drought can also influence bark beetle outbreak dynamics by weakening trees and making them more susceptible to bark beetle infestations. Forest plant diseases are strongly influenced by weather and climate. For forest pathogenic fungi, bacteria, viruses, and other microorganisms, the temperature and moisture conditions interacting with seasonal phenology and stress on the host determine infection severity and distribution. Extreme weather such as drought or hurricanes can kill large expanses of trees directly by overwhelming the physiological capabilities and structural strength of trees. Expected changes in climate coupled with the increasing stresses of invasive species and the absence of a fire regimen will create conditions conducive for many forest plant diseases. Patterns and rates of wood decay, caused by forest fungi, are also expected to change, which will influence forest carbon cycles. Increased commercial development will leave remaining forests more vulnerable to forest pests. Much like how extreme weather can weaken trees and allow pests to overwhelm the trees' physiological response to infestations, development or construction can cause root damage or leave scrapes that weaken the tree and leave it open for infestation or decay. The damaged trees can serve as a host or starting point for pest or disease outbreaks. These negative effects of development can be lessened by following best management practices for trees and construction, but this is an often-overlooked source of forest pest infestation.

Invasive Species: Storms, commercial development and climate change all will play a role in the spread of invasive species. Storms and development will both cause forest disturbances that will leave canopy gaps open for opportunistic invasive species to establish populations in new areas, while climate change will change precipitation and temperature patterns that will disadvantage native plant communities further. Heavy equipment used for cleaning up debris or land clearing could also be a vector for invasive species by

carrying seeds or spores from site to site. Because of the rapidity of expected changes in climate, individuals of a native plant species may be lost from their current habitats faster than they will be able to migrate and re-establish in more suitable locations. This will result in stressed communities more vulnerable to the invasion and establishment of invasive plant species. These invasive species may be better adapted than native species to the new environmental conditions resulting from climate change, storms or development, although native species of plants that can migrate from adjacent areas or regions into locations where they previously were excluded by climate as the new locations become more suitable.

Fire Management: Theoretically, a warmer climate can lead to more frequent and possibly more severe fires, with a longer fire season. Storms and invasive species may also impact fuel levels and fire behavior. McKenzie et al. (2004) built statistical models of the associations between seasonal and annual precipitation and temperature and fire extent for 1916-2002 for the 11 contiguous Western States. They found that relatively modest changes in mean climate will lead to substantial increases in area burned, particularly in crown-fire ecosystems in which distinct thresholds of fuel moisture and fire weather exist. For a mean temperature increase of 4 °F (predicted by the mid-21st century), annual area burned by wildfire is expected to increase by a factor of one and one half to five times the current annual average. Where increasing temperatures and decreasing fuel moistures are expected to occur in the long term, more active fuels and overstory management will be necessary to mitigate the situation. Whether due to climate change, an increased fuel load due to storms, or an increase in ladder fuels due to the presence of invasive species, active forest management practices, fuel reduction through mechanical and chemical means, and increased citizen awareness will be necessary to mitigating the increased wildfire risk.

Wildlife Habitat: All organisms depend on their habitats for food, water, shelter, and opportunities to breed and raise young. Some organisms have more specific habitat requirements than others, making them less adaptable to alterations in their immediate environment. Climate change can affect organisms and their habitats on an individual, species, population, community, and ecosystem level. Development and storms also destroy wildlife habitat and lead to the loss of native flora and fauna at a more localized level. Invasive species may out compete these local communities or disrupt their food chains and habitat. These changes may also alter behavior, population size, species distributions, plant and animal community composition, and ecosystem function and stability. How strongly different species will be affected differs, depending on differences in their ecology and life history. Species with small population sizes, restricted ranges, specialized habitat requirements and limited ability to move to different habitat will be most at risk.

Silviculture: Current seed zones and seed transfer guidelines that specify using relatively local seed sources for reforestation assume that climates are static over the long term. As ecosystem changes and other forest stressors occur, genetic variants that were once an optimal choice for a specific site may change. Moving seed sources to match future climates requires both knowledge of existing climates and knowledge of the climatic parameters under which particular species can thrive. Considerable uncertainty currently exists, however, about future climates. Until more information about future climates is known, the use of local seed sources may mean that the health and productivity of both planted and native forests will likely decline as climates change.

Being relatively long-lived, the forest trees living today will probably compose much of the forests of the next century. Long-term adaptation to climate changes, however, will require healthy and productive forests in the short term. Dense forests are more prone to decline in tree vigor, especially when vital environmental resources such as water, nutrients, or light become limited. Additionally, dense forests contain less understory vegetation and the understory that does grow represents only a few species. These conditions provide quality habitat for fewer organisms than more structurally and compositionally diverse

forests (Wilson and Puettmann 2007). Likely effects of more frequent and longer-term moisture stresses on forests include slower growth, reduced productivity and decreased vigor. Declines in vigor may also make forests more susceptible to large-scale pest attacks, more frequent or severe fires and more vulnerable to storm damage. Projections for increased ambient air temperatures as well as increased frequency of seasonal drought may have substantial consequences for instream and riparian microclimates and habitats and the unique ecosystem functions provided by these water-based systems (Anderson et al. 2007, Olson et al. 2007). It is important to determine what management actions can be undertaken to enhance forest ecosystem health and productivity in a changing climate. Trees planted in the **urban environment** are challenged from the moment they are installed in the ground. Frequently, they are subjected to radiant heat from the surrounding pavement and the intense air temperatures of a typical Florida summer day. Their root growth is limited by compacted soils and the lack of oxygen resulting from the impermeable pavement covering the soil. They are also subjected to higher than normal levels of pollutants in the air and water they absorb. For these reasons, mortality tends to be higher and the growth rate lower than in an undeveloped environment. Also, insect and disease problems tend to be more acute as a result of the trees' weakened state. These weakened trees will be less resilient to stressors such as storms, pests, climate change and development. The stresses of city life on a tree also take their toll as urban trees are often hit with vehicles, damaged by passing pedestrians or severely pruned. Urban trees can be served better by local governments and private consultants by adopting policies to increase the minimum soil volume for new tree plantings and utilizing best management practices for planting, establishment, care and pruning. The benefits of urban trees are maximized when protected and allowed to grow longer and to a larger size.

5) Opportunities

The **urban forest's** contributions to forest resiliency can be classified in terms of providing ecosystem services that serve to reduce energy consumption and increase human health in and around these communities. Increasing tree canopy and enhancing the health of existing urban trees would improve the livability of Florida's communities and offer valuable ecosystem services to mitigate the effects of climate change, natural disasters and increased impervious surfaces due to development. In the past, some sources recommended communities maintain an average tree canopy of 30-40% in urban or developing communities to reap the maximum benefit. However, more recent research suggests that it is not the percentage of canopy but rather how it is distributed and arranged. Connectivity between parks and areas of higher canopy coverage are vitally important. Additionally, in many communities the tree canopy is not equitably distributed. Low-income neighborhoods and inner cities tend to have less tree canopy coverage than their middle-upper class and suburban counterparts. It will take a joint effort to move our communities forward and to maximize tree canopy in a way that best serves Florida cities. Our agency aims to promote tree planting and increasing canopy cover in a way that is culturally sensitive, inclusive and accessible by all Floridians. Residential and park or natural areas afford the greatest potential for increasing overall tree canopy to a desirable level. Encouraging communities to adopt *form-based codes* could also help to increase tree canopy in commercial areas and transportation corridors. Utilizing native species with lower water requirements, employing the principles of *Right Tree/Right Place,* following the principles of Best Management Practices during site location and installation will increase the likelihood of tree planting success. Properly pruned healthy trees will live longer and provide increased amenities to the urban environment. Active management of forest vegetation may mitigate some negative effects and increase forest resilience to storms, development, invasive species and climate changes. **Silvicultural practices** can be applied and modified adaptively as disturbance regimes change over time. Practices that improve forest health, encourage longer rotations in most instances, encourage retention of larger forested tracts, and produce more durable solid wood products are especially valuable. Reforesting cutover areas and

afforesting areas where forests have historically occurred will increase canopy and further mitigate areas deforested for development and lost to other issues. Higher planting densities will increase future opportunities for thinning but may hamper efforts to enhance the migration of understory species and cause a disturbance that could introduce invasive species. Additionally, recently thinned stands may be more vulnerable to storm damage or pest infestation. However, thinning stands will improve individual tree vigor and will lead to a healthier and overall more resilient stand of timber. Wood from these thinning operations can be utilized for biomass energy production or other forest products, which can help offset the cost of management. Prescribed burning reduces understory density and the potential release of carbon through a catastrophic wildfire. Enhancing forest heterogeneity at the landscape scale with a variety of size classes and species will facilitate desirable species migration as climate change or ecosystem-wide changes occurs. This could include underplanting thinned stands with adapted species or genotypes when advanced regeneration is unacceptable for future conditions or deploying a mixture of seedlings including some provenances adapted to more stressful environments. In some cases, shorter rotations will create opportunities for species migration. Cooperating with private entities to help landowners sell carbon credits or non-traditional forest products could generate periodic income for private non-industrial landowners and encourage them to retain their land in forested ownership. Management strategies to enhance **biodiversity** need to address the risk of losing key species that are required to maintain important ecosystems and the services they provide (Neilson et al. 2005). They also need to address the increased risk of catastrophic disturbance resulting from temperature-induced drought stress, which could rapidly reduce the carrying capacity of the ecosystem. Managers could develop strategies both for responding to disturbances after the fact and for increasing ecosystem resilience (Millar et al. 2007). Managers might enhance diversity of all sorts, from genetic (Wang et al. 2006) to structural, so that the ecosystem can find its own route into the future. Silvicultural practices listed above could accomplish the desired results. However, some prior planning and information gathering would be required. Climate change, storms and development are going to alter ecosystems and their susceptibility to **invasive species**, our ability to recognize susceptible ecosystems and potential invasive plant species beforehand will be crucial to limiting the scale of infestation and eradicating these species when possible. Prevention first requires an awareness of invasive species that pose a threat. These are not the same as native plant species that need to migrate to new locations to survive. The next step is to actively prevent the spread of invasive plant species into ecosystems recognized as being more susceptible. The most important option for management is early detection of invasive species and constantly monitoring for ecosystem changes that may lead to a more suitable environment for these species. This requires detailed, regularly scheduled monitoring, followed by a rapid response to eradicate these initial infestations. Established principles of **watershed management** will remain a primary response to the increased demands and risks imposed by a warming planet. Watershed managers will need to carefully consider the many potential interactions between altered physical, biological, and social environments to ensure that management decisions are appropriate for likely future conditions. An effective adaptation strategy would focus on maintaining and restoring watershed health and resiliency, because such systems are more likely to provide a sustained flow of ecological services in face of ongoing and future disturbances, including those associated with climate change (Baron 2002). The types of actions that might be implemented will differ dramatically in different landscapes–they will depend on dominant watershed processes, key watershed services, and principal threats to those services. They could include protecting and restoring riparian forests, improving or decommissioning roads within or adjacent to riparian areas, restoring degraded wetlands and flood plains, maintaining and restoring environmental flows, removing migration barriers and reestablishing habitat connectivity to help species adapt to changing conditions. Fuel modification can reduce the severity of **wildfires**. Treatments could include prescribed burning, mechanical, and chemical treatments, as well as thinning of the overstory and enhancement of access to critical areas. Priority should be given to creating resilience specific landscapes with high resource, economic, and political values, the wildland-urban

interface for example. Additional measures could include maintaining biological diversity as previously described, with emphasis on plant communities that are sensitive to increased fire. Monitoring postfire conditions to control new threats such as exotic species or eroded soil is essential, as is developing restoration plans based upon anticipated conditions resulting from a warmer, drier climate. Once again, uncertainty will exist because of unknown vegetation and fire behavior responses to increased temperatures, drier weather and a potentially increased fuel load.

6) Agency and Organization Roles

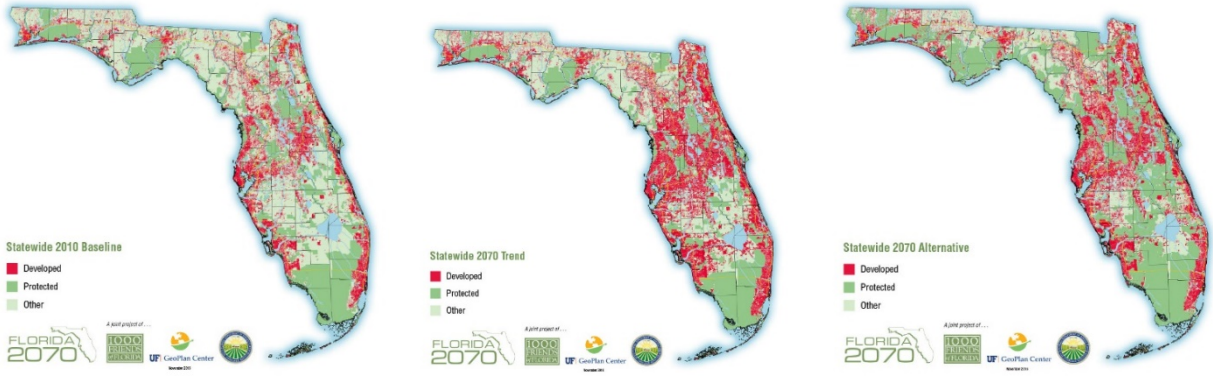
Improving the health and extent of rural and urban forests will promote overall forest resiliency and mitigate some of the challenges related to storm damage, invasive species, commercial development and climate change. Resource strategies should attempt to maintain and enhance resilient and connected forest ecosystems that will continue to provide public benefits in an ever-shifting series of regional circumstances. The current federal state and private forestry programs provide opportunities to strengthen the role that both private non-industrial forestlands and urban or community forests play in enhancing forest diversity and promoting forest resiliency. However, these programs have room to grow and can utilize additional management practices or new cost-sharing programs to achieve these goals. Our agency can also support the development of markets for urban wood utilization, carbon offsets, woody biomass, wood product substitution. The Florida Forest Service and partnering organizations can additionally encourage the retention of PNIF forest ownership and promote the retention and planting of trees in urban and rapidly developing areas. Incorporating opportunities to promote carbon emissions offsets, human health benefits and sustainable development through forestry into assessments and inventories will spotlight the contributions that trees make to Florida's residents, economy and quality of life.

Partnerships to provide technical and financial assistance, as well as research and innovative strategies, are an essential component of how to address threats to forest resiliency. All state and federal resource management agencies who provide information and assistance should cooperate with one another and share resources that may be beneficial to the success of initiatives and efforts related to forest resiliency. However, each organization is different, and some agencies may be more prepared to handle certain requests than others. All involved entities should refer those seeking assistance to the most applicable organization to ensure the public is receiving the best service possible. Federal agencies and universities who have the resources to conduct and compile research findings should make this information easily accessible to state agencies and the general public. Private sector entities are also an important partner because they provide assistance and profit-motivated strategies to address forest resiliency on private properties and to stakeholders not always reached by government-based initiatives.

7) Priority Areas

Though the challenges associated with forest resiliency will impact forests statewide, some areas will be disproportionately affected. According to Census data, Florida's estimated population in 2020 is just shy of 22 million and the annual growth rate is 1.6 percent. If the current growth rate were to continue through 2030, then over the next ten years Florida's population will increase by four million people. Those four million new Floridians will need places to live, places to work and places to play and roads to get them there. All of those needs will stress existing infrastructures and necessitate additional development that will impact forests and forest resources. As Florida's cities continue to grow, resources should be used to help these areas develop responsibly, retain ecosystem connectivity, care for existing trees, increase usage of pervious pavement and plant more urban trees where possible. Fragile forest ecosystems most at risk

for loss due to development, climate change, invasive species, storms, insects and diseases should be prioritized.



Florida 2070 project maps indicating 2010 baseline, 2070 trend and 2070 alternative development scenarios (1000 Friends of Florida).

As shown in the above maps, forests located on the outskirts of existing cities and along major transportation corridors are most at risk to loss due to development. These areas are a priority because they can be used to promote responsible development that incorporates healthy and resilient forests into city planning. These forests will in turn serve to make more resilient, livable cities with a healthier population. Additionally, forest ecosystems that include rare plants or provide habitat for threatened and endangered should also be a priority for receiving resources.

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9) Goals, Objectives and Strategies

Goal 1: Develop storms, invasive species, development and climate change adaptation strategies for Florida forests.

Objective 1.1: Develop or compile climate change models specifically for Florida.

> **Strategy 1.1.1:** Sponsor research to more accurately predict the impacts of climate change on Florida forests.

Objective 1.2: Identify key regions that are most desirable and conducive for implementing forestry adaptation strategies.

> **Strategy 1.2.1:** Identify scenarios and models that can predict areas and vegetation communities that are most susceptible to loss or spatial displacement due to storms, invasive species, development and climate change.
>
> **Strategy 1.2.2:** Provide resources to actively manage these areas to facilitate forest conservation and migration.

Objective 1.3: Develop effective strategies involving scientists, public entities and private landowners that promote forest adaptation to storms, invasive species, development and climate change, as well as strategies that encourage public education and recognition of the importance of these ecosystems.

Strategy 1.3.1: Cooperate with other scientific and land management entities to compile the most accurate information on storms, invasive species, development and climate change impacts to Florida forests and make it available to all concerned entities through various venues.

Strategy 1.3.2: Help sponsor conferences to achieve Strategy 1.3.1.

Goal 2: Maintain the current level of forested acreage statewide in Florida.

Objective 2.1: Continue support for programs that encourage private non-industrial forest landowners to retain ownership of their properties and continue land uses that prioritize native forest ecosystems and promote forest resiliency.

Strategy 2.1.1: Advocate for new and continued funding of state and federal programs that encourage the retention of forest lands through either fee simple purchase or less than fee arrangement.

Strategy 2.1.2: Prioritize conservation of forested areas adjacent to identified susceptible communities, using the programs described in the above strategy.

Strategy 2.1.3: Prioritize conservation of forested areas in a manner that maintains the continuity of contiguous forested and riparian areas and provides for the adaptation and migration of communities in response to storms, invasive species, development and climate change.

Strategy 2.1.4: Provide landowners with information about conservation easements, land trusts, estate planning strategies, and ways to ensure agricultural assessment for property taxes.

Strategy 2.1.5: Provide landowners with information about various alternative means of deriving income from their forested properties.

Strategy 2.1.6: Participate in efforts to develop carbon credit programs for public and private forest landowners and educate landowners about the benefits of participating in these programs. Advocate that forested lands be a component of such programs on the state level.

Objective 2.2: Continue to provide information to local governments about the value of trees and canopy cover in urban areas.

Strategy 2.2.1: Encourage local governments to conduct and maintain inventories of publicly owned trees within their incorporated limits.

Strategy 2.2.2: Encourage local governments to conduct and maintain canopy assessments that determine overall canopy cover for their incorporated limits and identify potential planting spaces.

Strategy 2.2.3: Encourage local governments to use those inventories to determine the value of ecosystem services currently provided by forests, especially carbon sequestration and avoided storm water runoff.

Strategy 2.2.4: Encourage local governments to adopt and enforce "tree friendly" development ordinances and land-use codes.

Strategy 2.2.5: Encourage local governments to maintain greenspace and riparian buffers within their incorporated areas.

Strategy 2.2.6: Encourage local governments to develop a management plan for their urban forest that includes sections about storm response, species selection, and planting specifications.

Strategy 2.2.7: Continue to provide technical assistance to local governments and non-profit groups that will encourage them to establish or maintain active local urban forestry programs.

Goal 3: Take advantage of all available opportunities to increase tree canopy cover.

Objective 3.1: Provide financial incentives for private non-industrial forest landowners to reforest cutover areas and plant trees on other idle lands.

Strategy 3.1.1: Advocate that federally sponsored conservation programs contain funding for tree planting practices.

Strategy 3.1.2: Continue to provide technical assistance to private non-industrial forest landowners to help them establish tree plantings for various uses including carbon storage.

Objective 3.2: Encourage local governments to responsibly and equitably increase tree canopy coverage throughout their jurisdictions.

Strategy 3.2.1: Create urban greenspaces where none currently exist or enhance existing greenspaces with additional trees.

Strategy 3.2.2: Plant trees in strategic locations around buildings to reduce energy consumption and slow storm water runoff.

Strategy 3.2.3: Encourage principles that help to keep urban trees healthy, such as proper site selection and preparation, right tree/right place, and the use of drought-tolerant species and landscaping regimes (xeriscaping).

Strategy 3.2.4: Establish a fund to provide cost-shares to landowners and communities to replant trees following a natural disaster such as wildfire or hurricane. Funds can come from a combination of public and private sources.

Strategy 3.2.5: Promote environmental equity and provide resources to local governments to make sure trees and greenspaces are readily accessible to all Floridians.

Strategy 3.2.6: Work with local governments and minority groups to develop culturally appropriate planting plans and species lists.

Strategy 3.2.7: Encourage the development of urban food forests, especially in areas classified as a food desert.

Goal 4: Encourage forest management activities on public and private lands that optimize forest health and tree growth to mitigate environmental stresses.

Objective 4.1: Continue to improve wildland fire management.

Strategy 4.1.1: Encourage increased prescribed burning under favorable weather conditions in forest stands that would benefit from this practice.

Strategy 4.1.2: Develop wildfire management strategies for areas with significant storm damage, forests with an abnormal abundance of ladder fuels and invasive species, new developments on the wildland urban interface and predicted climate change conditions.

Strategy 4.1.3: Maintain increased fire readiness with adequate personnel and equipment to account for hotter and drier conditions.

Objective 4.2: Continue to protect riparian and coastal forested areas.

Strategy 4.2.1: Maintain adequate ground cover, shading, and erosion protection within watersheds surrounding key riparian areas.

Strategy 4.2.2: Maintain and actively manage forests and trees within developed areas in proximity to the Atlantic Ocean and Gulf of Mexico coastlines.

Strategy 4.2.3: Be prepared to alter water control structures to account for altered water regimes.

Strategy 4.2.4: Maintain forested linkages between riparian areas.

Objective 4.3: Protect trees from pest infestations.

Strategy 4.3.1: Continue to conduct aerial and ground monitoring of various insect and disease pest populations.

Strategy 4.3.2: Either treat the pest infestation aggressively or establish alternative tree or vegetative cover that is less susceptible to pest infestation.

Strategy 4.3.3: Conduct thinning operations to remove unhealthy trees and give the surrounding healthy trees room to grow.

Objective 4.4: Manage timber stands for a variety of forest products.

Strategy 4.4.1: Manage stands at various densities and thinning regimes that include large, long rotation trees to store carbon.

Strategy 4.4.2: Establish trees initially at a high enough density to encourage desirable stem form and allow for commercial thinnings, but not so high as to detract from wildlife habitat and other ecosystem services on more than a temporary basis. Higher densities will be emphasized in particular on previously disturbed sites with low vegetational diversity.

Objective 4.5: Provide recognition to landowners and cities that actively manage their rural and urban forests, respectively.

Strategy 4.5.1: Continue to provide recognition to worthy entities and individuals through the Forest Stewardship and Arbor Day Foundation recognition programs, including Tree City USA.

Goal 5: Protect the integrity of Florida's indigenous forested communities, particularly those that are the most unique and vulnerable to storms, invasive species and climate change.

Objective 5.1: Control the spread of invasive exotic vegetation.

Strategy 5.1.1: Identify and monitor known areas of invasive exotic vegetation. Continue to conduct surveys and participate in those conducted by other entities.

Strategy 5.1.2: Conduct eradication measures on state forest properties and support eradication measures on public properties owned by local governments.

Strategy 5.1.3: Secure cost-share funds for private non-industrial forest landowners to control invasive exotic infestations.

Objective 5.2: Monitor biodiversity and supplement vegetation community components as they begin to disappear.

Strategy 5.2.1: Obligate state lands management funds to replace vegetation community components, or to relocate them to a more adaptable location.

Objective 5.3: Monitor the reaction of native plant communities to environmental stressors such as storms, development, and climate change.

Strategy 5.3.1: Utilize reference plots on state forests to make note of trends and develop strategies as the need arises.

Strategy 5.3.2: Develop and implement adaptive management strategies to allow forest communities to shift spatially in response to a large-scale environmental stressor.

Strategy 5.3.3: Enter into cooperative agreements with private landowners adjacent to potential transitional areas to where their properties can be used to facilitate vegetation community migration.

Goal 6: Increase the use of non-timber forest products from public and private forests to create marked-based incentives for biodiversity and to keep forests as forests.

Objective 6.1: Set reasonable and attainable statewide goals for woody biomass production.

Strategy 6.1.1: Set a goal for the percentage of Renewable Portfolio Standard (RPS) that is desirable and obtainable for woody biomass production. This goal will be based upon the current estimated statewide supply of woody biomass, the production capability of existing forest lands or available non-forest lands to produce additional biomass volume, and the compatibility of various biomass production and harvesting practices with other landowner management objectives.

Strategy 6.1.2: Improve current forest inventory procedures by developing a method to assess the available volume of woody shrubs that are desirable for biomass harvesting and are found in the forest mid-story and understory. These procedures should be applicable on both the statewide level and for individual tracts.

Strategy 6.1.3: Improve current forest inventory procedures by developing a method to assess the available volume of invasive exotic overstory species that could be used for biomass production, such as Melaleuca and Brazilian Pepper, or to incorporate this information from other sources.

Strategy 6.1.4: Incorporate the growth and harvest of woody biomass into forest management programs for both private and publicly owned forests.

Strategy 6.1.5: Provide technical assistance to private non-industrial forest landowners, other public agencies who manage forest land, and companies who may be involved in either harvest or utilization of forest biomass.

Objective 6.2: Increase the available supply and demand for urban wood utilization.

Strategy 6.2.1: Encourage the increased use of urban wood waste from routine arboricultural operations . Involve the Florida Urban Forestry Council and the Florida chapter of the International Society of Arboriculture (ISA) member companies and local government entities in strategy development.

Strategy 6.3.2: Encourage local governments to partner with regionally based artisans that can utilize recycled wood waste.

Strategy 6.3.3: Provide financial assistance to local governments and non-profit organizations to either establish urban wood mills or implement practices to improve the marketability of recycled wood.

Strategy 6.3.4: Develop a strategy for utilizing both forest and urban woody storm debris for biomass production.

Objective 6.4: Encourage and participate in research to promote the use of biomass from forests as a source of feedstock for electricity generation and transportation fuel manufacturing.

Strategy 6.4.1: Develop methods and equipment to expedite the harvest, transportation, and storage of forest biomass to improve the economic viability of biomass operations for landowners and producers.

Strategy 6.4.2: Enter into research partnerships with the University of Florida, Florida Forestry Association member companies, Florida Farm Bureau, power producers, waste management companies, and other entities involved with encouraging biomass harvest.

10) Performance Measures

Goal 1: Develop storms, invasive species, development and climate change adaptation strategies for Florida forests.

•Florida Forest Service and other natural resource entities have the capability to identify changes to forested communities, as well as the most likely places where these changes will occur.

•Adequate funding is available to implement forest management practices in response to storms, invasive species, development and climate change.

Goal 2: Maintain the current level of forested acreage statewide in Florida.

- Forested acreage levels in Florida maintained as the result of incentive programs.
- Local governments have tools in place to evaluate their urban forests and enhance their ability to mitigate local impacts of environmental stressors.

Goal 3: Take advantage of all available opportunities to increase tree canopy cover statewide.

- Tree canopy cover increases to a measurable extent in both rural and urban forests.
- Adequate technical and financial assistance is available to rural and urban forestry entities to help them increase tree canopy cover.

Goal 4: Encourage forest management activities on public and private lands that optimize forest health and tree growth to mitigate environmental stresses.

- Statewide acreage lost to wildfire annually does not exceed previous 30-year averages.
- Statewide acreage prescribe burned annually increases by five percent over previous ten year average.
- Water quality and quantity in riparian and coastal areas remains consistent with standard metrics commonly used for evaluation in Florida.
- Extent of pest infestations do not exceed previous 30-year averages.
- Reforestation acreages, particularly those of longleaf pine, remain consistent with previous 10-year averages.
- Exceptional forest management practices continue to be recognized through the Forest Stewardship and Tree City USA programs.

Goal 5: Protect the integrity of Florida's indigenous forested communities, particularly those that are the most unique and vulnerable to storms, invasive species and climate change.

- Infestations of invasive exotic vegetation do not exceed 2020 baseline averages.
- Acreages of ecologically significant forest vegetation communities remain at a level above where their extinction does not become a concern.

Goal 6: Increase the use of non-timber forest products from public and private forests to create marked-based incentives for biodiversity and to keep forests as forests.

- Accepted agency goals are adopted for statewide woody biomass production.
- Accepted statewide inventory procedure for assessing available woody biomass for harvest is adopted.
- Harvest of woody biomass is incorporated into public and private forest management plans as a viable strategy, where applicable.

•Adequate markets for woody biomass and urban wood products are identified, as well as primary vendors available to perform harvesting.

•Power and transportation fuel producers recognize the potential for using woody biomass and are working to incorporate them into their processes.

•An increased amount of urban wood waste is utilized.

Issue 5: Economic Viability of Forests

1) Current Issue Description

For decades Florida's forests provided timber resources for forest products industry, a place for hunters to pursue game, and campers, hikers, and bird watchers to enjoy nature. While these activities are vital to many, new opportunities for forest resources are emerging, and the economic importance of forest-based industries is still of paramount importance to the State of Florida. Thus, as Florida's forests continue to meet traditional and emerging new needs, the land itself has become increasingly valuable for many other uses.

According to the US Forest Service's Forest Inventory and Analysis (FIA) program, in 2017 Florida had 16.97 million acres of forest land, representing nearly 50 percent of the state's total land area. Most of Florida's forests are located north of Orlando (Figure 1, Page 90). A significant share, 14.99 million acres, of all forests were classified as timberland, i.e., capable and not withdrawn from timber production. A majority, 78%, of Florida's timberlands are in the Northeast and the Northwest (panhandle) regions of the state. At the time of the first Florida FIA inventory in 1934-36, forests covered 23.5 million acres. Since then the FIA data shows decline in area of forest land until 1995, with an uptick recorded for the more recent inventories in 2007 and 2012 (Figure 2, Page 91). Most of the forest land acreage decline occurred prior to the 1980s in the form of conversion to agricultural uses. Since the 1980s, forests have replaced some agricultural lands, but at a slower rate than forest conversion to urban development. Growth of metropolitan areas has consumed increasingly larger acreages of forests and other lands, as well as fragmented forest lands and parceled it into smaller ownerships. This trend will only continue as the population of the state increases. After rapid divestiture of forest products industry lands in the late 1980s and 1990s, Florida's forest ownership pattern stabilized by 2007, and fluctuated only a little in the last decade for which data is available (Figure 3, Page 91). Currently, Florida's forest land ownership is 65% private and 35% public. Within private sector, corporate ownerships (formerly forest product industry, and now mostly investment timberlands owned by REITs and TIMOs) are 39% of all forest lands. Family and individually owned forests are 26%. Together these two ownership groups are known as Non-Industrial Private Forests (NIPF). Among public sector, federally-owned forests are at 14%, state-owned forests, including 38 state forests, 5 water management districts' lands, wildlife management areas, state parks, and alike comprise 18%, and municipal / county forests round up major ownership categories at 3% (www.FDACS.gov/Forest_Inventory, 2015).

The reasons for owning and managing private family forests have been evolving for a few decades, with timber production not a top priority for many family forest owners. In 2006, the top three reasons for owning a family forest in Florida were: (1) privacy, (2) to enjoy beauty or scenery, and (3) to protect the nature and biologic diversity (Butler et al. 2008). In the same study "timber product production" ranked #9 with 2.3% respondents expressing its importance to them. The newer results based on data collected by the same researchers between 2011 and 2013 indicate that the three top "very important" or "important" reasons for owning a family forest in Florida were: (1) to protect wildlife, (2) to enjoy beauty or scenery, and (3) to pass land on to children or other heirs (Table 1, Page 92). In this second study, "timber products" ranked #8, with 6.7% respondents professing its importance. So, although top reasons for owning private family forest changed somewhat over the few years separating the studies, the importance of timber production ranked toward the bottom of the top ten surveyed ownership objectives in both studies.

Forest product industry enjoys a relatively robust presence in Florida despite slowly shrinking timberland base, forest fragmentation, and evolving forest landowner objectives. That fact is remarkable also in the

context of Florida's diversified economy in which tourism is the number one "money maker", and agriculture famously boasts about 300 different crops besides timber. In 2019, Florida had 69 primary wood-using mills, which purchased roundwood, or in-woods chips for further processing. This is the same number of mills reported in 2007 (Table 2, Page 95). Among the mills currently operating in the state, 26 sawmills and 19 mulch producing facilities are the most numerous. Nevertheless, forest products manufacturing has changed over the last decade. A number of less efficient facilities, especially smaller sawmills, and two veneer mills have closed. The six remaining pulp mills, the staple on Florida's forest products landscape for decades, have been joined by one of the world's largest wood pellet mills, and a 100 MW biomass-fired power plant in more recent years. Florida also has four post mills, which support the livestock production and other sectors in their fencing needs. The three chip mills work in concert with pulp mills providing them with extra chipping capacity, when needed. The two pole plants have recently been consolidated under one ownership. The Ocala region famed for horse breeding features two animal bedding mills supporting that industry. Florida also produces firewood in two facilities. And, last but not least, the state also has one each of composite panel (OSB), plywood, and veneer mills, which are of significant economic importance in their respective locations.

Perhaps more surprisingly Florida is also home to 342 secondary wood-using facilities. These, often smaller establishments manufacture secondary wood products from the output of the primary wood-using mills. Among those, Florida features 205 cabinet makers, 50 millwork shops, 42 furniture manufacturers and a myriad of other facilities (Table 3, Page 95).

Economic viability of Florida's forest in Northwest Florida has been severely impacted by Hurricane Michael, a category 5 storm, which cut an 80 mile wide swath of destruction through 10 counties in the Florida panhandle on October 10, 2018, before moving on to Georgia (Figure 6, Page 96). The storm affected 2.81 million acres of forest land, damaging some 72 million tons of timber worth estimated $1.3 billion. The tonnage of damaged timber is equivalent of 4.4 annual harvests in Florida. This level of destruction will require massive cleanup, recovery, and reforestation efforts, which are currently ongoing, but will take many years, if not decades to accomplish.

The 2020 corona virus pandemic will no doubt have adverse effect on the state economy including the forestry sector. Although the forest product industry is of vital importance to keep the flow of paper and other wood-based products, the general economic slowdown due to wide spread shutdowns will ripple through the entire economy including our sector.

Even in the best of times, the challenge to Florida's forest landowners and managers, as well as forest-based industries is how to keep economic viability of Florida's forests in the face of continually shrinking and increasingly fragmented timberlands, without depleting the resource. This also includes assuring forest sustainability, while accommodating uncertainties around forest landowner values and ownership management objectives. One could assume that for the 39% of corporate NIPF landowners, timber production is one of their top management objectives. For the next 26% of NIPF landowners in the family / individual category, timber production ranks toward the bottom of the top ten most important management objectives and is one of many reasons they own the forest to begin with. With the 35% of forests being in public ownerships, where timber production is one of many objectives as well, the challenge of supplying timber to Florida's forest product industry is only more obvious. Additional aspects of maintaining economic viability of Florida's forests are discussed in more detail in the following sections.

2) Key Attributes

In 2016, Florida forest lands supported more harvestable wood volume than at the previous assessment a decade ago. Net merchantable bole volume of live trees at least 5 inches DBH increased from 20.3 to 24.5 billion cubic feet, a 20.4% increase since 2007. This is a result of increased net annual growth of merchantable wood volume from 709.5 to 814.2 million cubic feet, and gradually decreasing annual removals from 477.1 to 448.9 million cubic feet per year between 2010 to 2016. At 437.5 million cubic feet, average annual harvest removals of merchantable volume of growing stock trees accounted for 87% of all timber removals on forest lands in 2016. Close to 90% of merchantable timber is supplied by 65% of forest lands in private ownerships, while the remaining 10% originates from the 35% of publicly owned forests. State-owned forests supply 6% of harvested timber, while federal and municipal/county forests provide 2% each.

In the last decade, state-wide statistics looked favorable, and the 2015 CSFIAS study concluded that Florida's forests were sustainable overall across species and timber products, with a statewide sustainability index of 2.03. This means that on average state-wide, twice as much timber was grown as was harvested. The same study pointed to some areas of concern, where more pine timber had been harvested exceeding timber growth locally in some of the Northwest and Northeast Florida counties (www.FDACS.gov/Forest_Inventory, 2015). With an additional 72 million tons of timber on the ground in the Hurricane Michael impacted Northwest Florida counties, it will take massive cleanup and reforestation efforts to restore sustainable timber supply in that area, and throughout the state.

3) Public Benefits

Since the 1800s, the forests of Florida have provided immeasurable opportunities for the people of this state. Employment, financial return, cultural stability, recreational opportunities, economic growth, and environmental sustainability are just a few of the benefits from forest lands. The pressures and demands on this resource have grown commensurate with increases in the state's population and the rapidly urbanizing landscape. The challenge is to conserve the working forests while at the same time maintain or even enhance the benefits derived from them.

Timber remains a major part of Florida's economy. This is reflected in the previously discussed timber resource base, and in the products harvested from Florida forests. The Southeastern U.S. leads the nation in timber production and is one of the most important timber producing regions worldwide. Florida is a significant contributor to those regional outputs. The annual harvest and processing of 16.3 million tons of timber into forest products has an employment impact of 124,104 jobs (Hodges et al., 2017). Most of the timber is harvested in the northern part of the state, and naturally that is where majority of primary wood-using mills are located (Figure 4, Page 93). Secondary manufacturing facilities are scattered throughout the state with very significant presence in coastal regions including Miami-Dade County (Figure 5, Page 94).

The annual market value of harvested wood, mostly pulpwood and sawtimber, is approximately $315 million, but as value is added through processing and manufacturing, total value approaches $25.1 billion in output (revenue) impacts. This corresponds to nearly $11.0 billion in value added, $6.6 billion in labor income, $880 million in state and local government tax revenues, and $1.7 billion in federal government tax (Hodges et al. 2017). In addition, total economic contributions of recreational spending by nonresident visitors to Florida's publicly owned forest lands were nearly 8 thousand jobs, $851 million in output impacts, $505 million in value added, and $48 million in state and local tax revenues (Hodges et al. 2017). These estimates do not include economic contributions of urban forest, nor the value of Florida forests

ecological services. The latter vary wildly depending on valuation methods employed but are in the range of additional billions of dollars (Hodges et al. 2017).

4) Threats

Conversion of forest land to urban uses is the ultimate threat to forest land resources in Florida and elsewhere. Such conversions are rarely reversible. On the other hand, conversions to agricultural uses, while decreasing the forest land acreage for the time being, are readily reversible when landowner's management objectives change. Another major threat is forest fragmentation, which impedes effective forest management for a variety of objectives. This threat is discussed in greater detail in Issue 2: *Forest Fragmentation*.

Besides forest land conversion or fragmentation, wildfire and pests pose the biggest threats to the long-term health and productivity, and therefore economic viability of Florida's forest lands. Both of these threats have been exacerbated by the impacts of Hurricane Michael in the 10 affected counties in the panhandle region of Florida. The amount of fuel on the ground is at least ten times of what is usually associated with Florida's forests in that region. The same downed timber also provides fertile breeding grounds for many insect pests, especially *Ips* beetles. Historically, southern pine beetle (SPB) has been the pest to watch for, with occasional outbreaks threatening pine forests of mostly North Florida where the loblolly pine (the preferred host) is more prevalent. Across the state, collaborative work with local, state, and federal entities is crucial for implementation of mitigation and prevention measures including prescribed fire, as well as effective and efficient fire and pest suppression programs.

Invasive non-native plants are problematic to the health and productivity of forest ecosystems as well. Many invasive species such as cogongrass, Chinese tallow and Chinese privet have been around for many decades, while others like Japanese climbing fern, and old world climbing fern have only begun to encroach on the Florida landscape more recently.

Maintaining logging capacity is also a difficult challenge. Logging has a proud history in Florida, and for many in this occupation the business cycle alternates between "feast" and "famine". Nowadays, a logging operation depends on significant capital investment. As a number of mills decrease overtime, roundwood markets become more competitive, which makes it more difficult for too many logging outfits to stay in business.

As the current trends described in this section continue, additional challenges will surface for non-industrial private forest landowners who wish to maintain the economic viability of their working forests. A foreseeable challenge may be dealing with new neighbors in the Wildland Urban Interface who have no or at best limited knowledge of the benefits of traditional forest management practices such as prescribed burning, chemical timber stand improvement or timber harvesting. They tend to view these practices as detrimental to the environment. New rural neighbors often enter local political arena to advocate for the passage of laws restricting forest management practices. Also, trespass and vandalism tend to become more common in the wake of urban expansion into previously rural areas.

Another threat is a loss of professional forestry expertise in some areas of the state. This is exacerbated by the current "retirement boom" of foresters from private, government and academic institutions. Furthermore, enrollment in Forestry bachelor's degree programs is declining South-wide and is not likely to provide adequate numbers of graduates to fill future needs.

5) Opportunities

The growing demand on Florida's timber and biomass resources, including the growth of energy generation and wood pellet production, has potential for helping Florida's economy. This growth has to be balanced against current harvest of timber products to supply established forest industry, and the ability of local ecosystems to sustainably support the increased demands on the timber resource. This risk has been identified by the state of Florida resulting in the mandate to conduct Comprehensive Statewide Forest Inventory Analysis and Study (CSFIAS). This study ended in 2016 with its results available at www.FDACS.gov/Forest_Inventory. Timber resources are not static due to land cover changes, harvests, fires, hurricanes, pest outbreaks and other disturbances. Therefore, continued assessment of the spatial distribution and availability of the resource is needed. This is accomplished to a large degree by the Florida Forest Service's implementation of the USFS Forest Inventory and Analysis (FIA) program in our forests. The FIA results are complemented with additional studies such as those obtained by CSFIAS.

Commercial interest in non-timber forest products, most notably pine straw collection for landscaping has been popular new economic pursuit in North Florida in the last couple of decades. Slash pine and longleaf pine are preferred species for pine straw raking in plantation settings. Although firm data is lacking, according to available information, economic impact from pine straw raking may rival that of pulpwood production.

Woody biomass is another non-traditional market that has shown economic potential for Florida landowners in certain locations. For decades, wood waste has been used to generate process steam and electricity at pulp mills and other wood processing facilities. A few years ago, woody biomass was considered a viable alternative to natural gas and coal in electricity generation. However, the abundance of cheap natural gas from fracking has again dampened the widespread adoption of woody biomass as the fuel of choice. Florida has managed to build a 100 MW biomass-fueled power plant located near Gainesville.

Wood pellet production for electricity generation in Europe remains a lucrative business proposition, and Florida is contributing to that market via its pellet production in one of the world's largest facilities near Cottondale. That facility is using pulp grade material for pellet production and had been welcomed and embraced by local timber markets since it opened in 2008. Unfortunately, Cottondale was also in the path of Hurricane Michael in October 2018, which complicates the sourcing of suitable material for continued pellet production in this facility in the near future.

Florida now boasts more than 500,000 forest land owners. While many still invest in property for traditional, commercial forestry reasons, there seems to be more individuals who own property for other reasons than timber production, such as protection of wildlife, water, biological diversity, enjoyment of scenery or just as land investment (Table 1, Page 92). Historically, state agency and university extension forestry programs for landowners have been geared toward traditional timber management. While the economic opportunity should never be discounted or neglected, service and consulting foresters must embrace changing landowner objectives. To ensure the relevance of forestry programs, resource professionals and programs must be re-tooled to meet the new needs of landowners.

To improve the financial return on timberland investments, landowners are beginning to look at other opportunities, such as markets for ecosystem services. Trade in carbon credits is one such opportunity for forest land owners who wish to be carbon credit suppliers, and those in various industries who wish to become carbon credit buyers. While still far from mature, it appears that the carbon market is here to stay.

Trading in carbon credits has a broad appeal to forest landowners and those entities who want to reduce impact on climate change by offsetting carbon emissions elsewhere via forest carbon credits. Therefore, trading in carbon credits has potential to grow into a profitable addition to traditional income streams from timber harvests and non-timber forests products. Other new opportunities on the horizon include monetizing other ecosystem services in addition to carbon credits. Direct payments to landowners for ecosystem services related to water supply and purification by forest lands seem to be the most likely. In many cases forest landowners are already being compensated by utilities for locating water wells or intakes on their properties. Air purification, noise reduction, supply of wildlife habitat, and protection of biological diversity are also being considered and studied.

Traditional opportunities in forest economic development still exist in Florida, especially in North Florida, with its abundant working forests, despite the impact of Hurricane Michael in 2018. Changes in timberland ownership, mill closures, fluctuating logging capacity, wildfire and pests, occasional natural disasters, all pose significant challenges to forest management in Florida. Fortunately, many still engage in traditional forestry and new economic ventures, including managing for timber, wildlife, pine straw, woody biomass, and carbon credits. These opportunities may soon be enhanced by direct payments to forest landowners for other ecosystem services.

6) Agency and Organization Roles

The following organizations have been identified as likely partners having significant roles in sustaining economic viability of Florida's forests:

Research
USDA Forest Service
Universities, especially University of Florida
Forest Industry Groups, such as NCASI

Education
Universities/Extension Service
Florida Forest Service
Florida Forestry Association
Florida Fish and Wildlife Conservation Commission
Florida Department of Environmental Protection
USDA Forest Service, NRCS and FSA

Outreach
Florida Forest Service
Universities/Extension Service
Local Governments/Chamber of Commerce/Department of Community Affairs
USDA Forest Service, NRCS and FSA
Non-Profit Conservation Organizations

Development and Promotion of Sustainable Markets
Florida Forestry Association
Local Governments/Chamber of Commerce
Forest Landowners
Forest Industry Groups

7) Priority Areas

The Southern Forest Land Assessment (SFLA) provides an overall analysis of 13 data layers weighted according to each state's priorities. The priority areas analysis for Florida based on SFLA data is provided elsewhere in this document. For the Issue 5 – Economic Viability of Forests in Florida, the priority areas correspond to FIA Unit 1 (Northeast), and FIA Unit 2 (Northwest). These two areas encompass 78% of working forests in Florida, which makes them more important than the rest of the state from the standpoint of economic contributions of forestry to overall economy. Additional reasons for prioritizing Unit 1 include low timber growth to removal ratios in some counties for pine timber, which has an effect of overall sustainability index for pine pulpwood of just 1.13 (Figure 7, page 96). Prioritizing this area for increased efforts in pine reforestation, and intensive forest management is needed to prevent sustainability ratios for pulpwood and sawtimber decreasing below 1.00, which would mean that harvest and other timber removals exceed timber growth. Prioritizing forests in Unit 2 for reforestation and management have an added urgency created by Hurricane Michael destruction to timber resources in the 10 affected counties (Figure 6, page 96). Large swaths of timberland in these counties obviously need a lot of extra attention and resources to rebound from the hurricane impact and become productive again. Long term economic well-being of wood-using mills located in the area depend on the restoration of these forests as well.

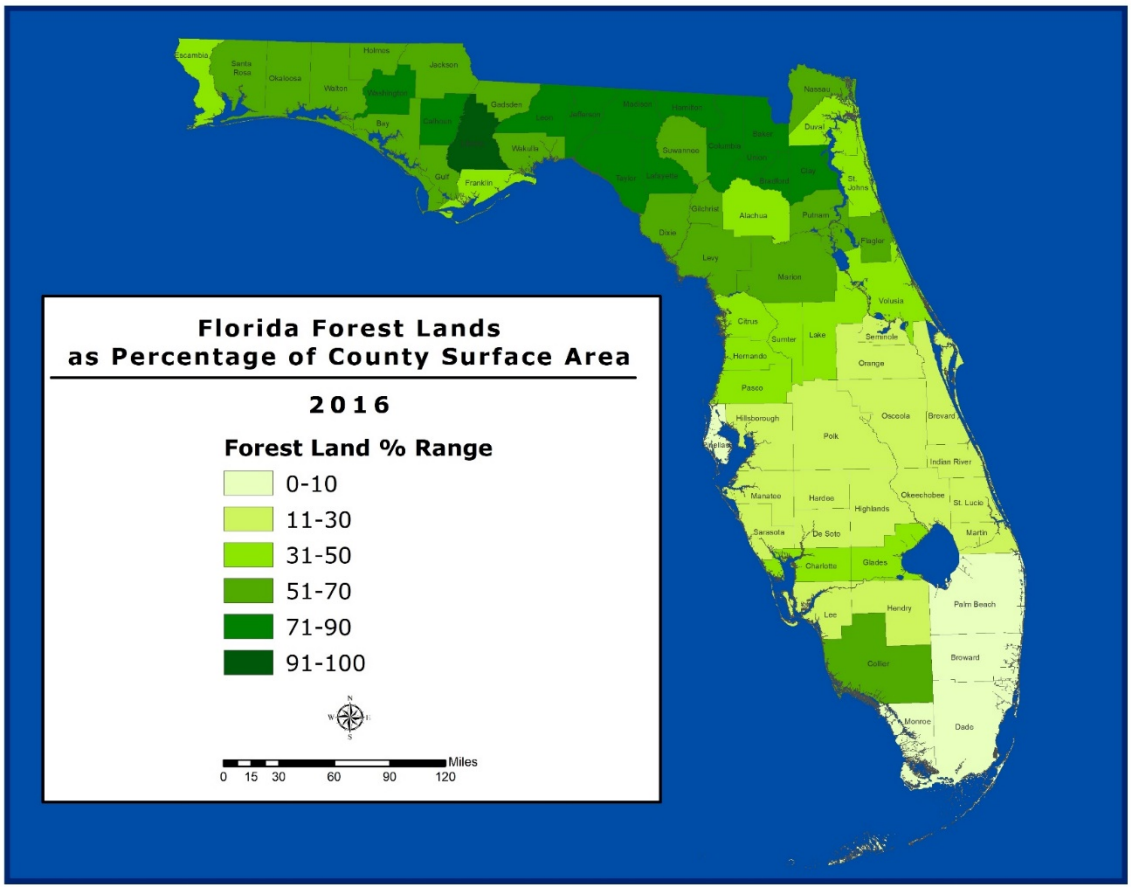

Figure 1. Florida's forest lands as percentage of county surface area, 2016. Source: US Forest Service FIA online tools EVALIDator https://apps.fs.usda.gov/Evalidator/evalidator.jsp

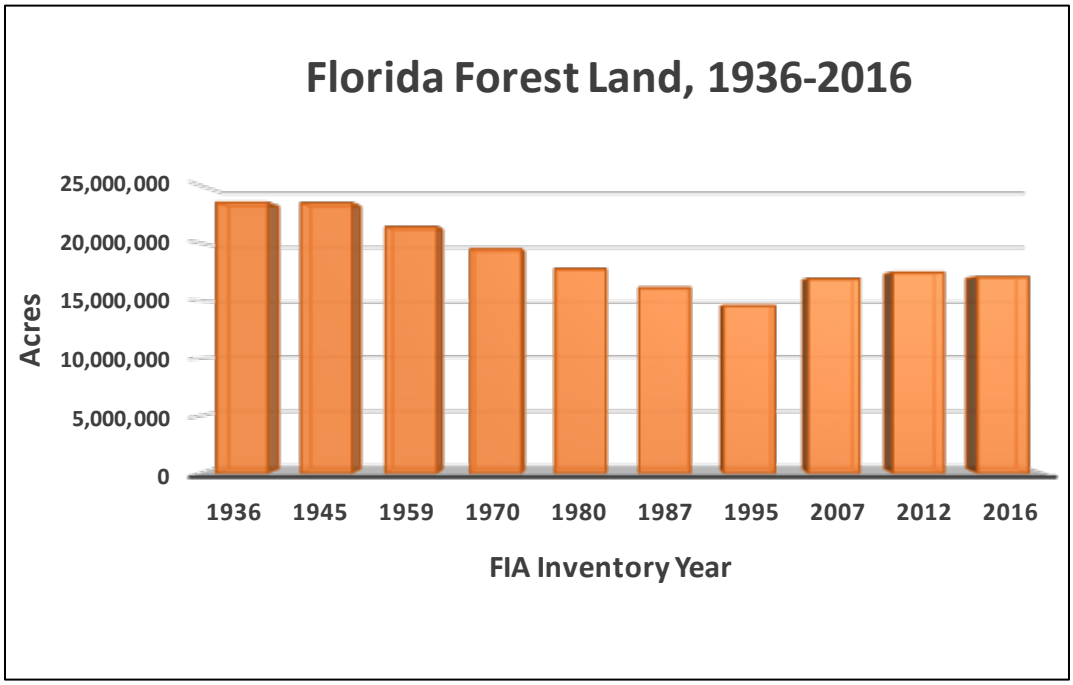

Figure 2. Florida's forest land acreage between 1936 and 2016. Source: US Forest Service's Florida FIA reports.

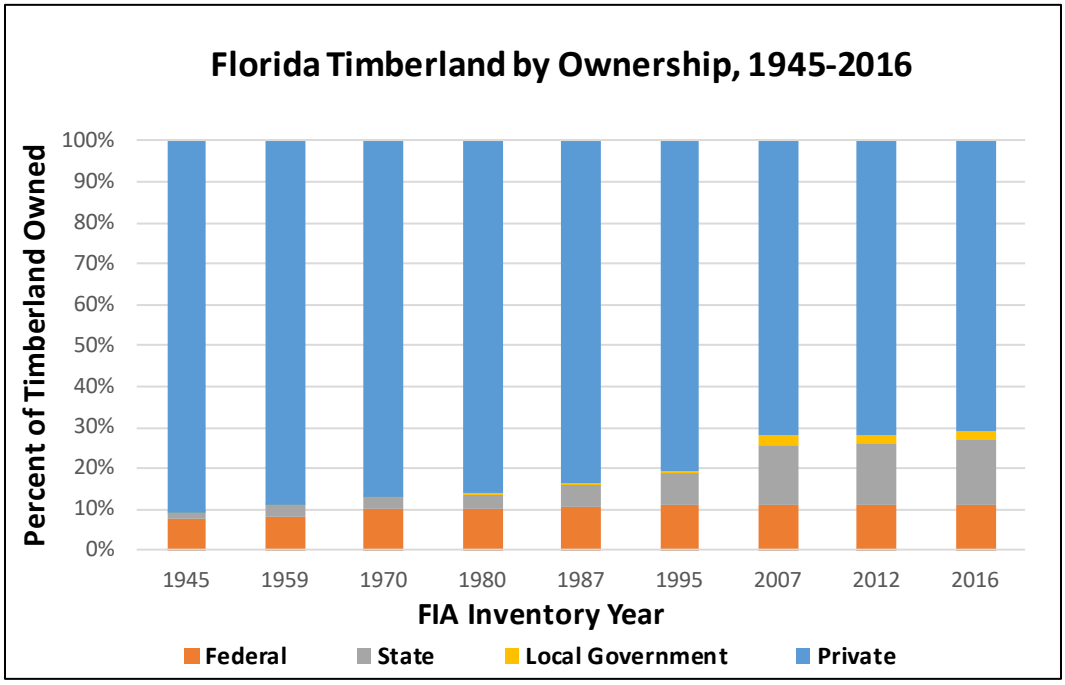

Figure 3. Florida's timberland ownership by sector between 1945 and 2016, Source: US Forest Service's Florida FIA reports.

Florida Private Forest Land ≥10 acres, NWOS, 2011-2013			
Rank	**Reasons for owning private forest land rated "very important" or "important" by respondents**	**Number of Responses**	**Percent of Responses**
1	To Protect Wildlife	2,735	9.4
2	To Enjoy Beauty of Scenery	2,640	9.0
3	To Pass Land on to Children or Other Heirs	2,521	8.6
4	To Protect Nature and Biologic Diversity	2,498	8.5
5	To Protect Water	2,402	8.2
6	For Land Investment	2,188	7.5
7	Privacy	2,069	7.1
8	For Timber Products	1,950	6.7
9	Hunting or Fishing	1,927	6.6
10	Part of Home	1,784	6.1
11	Part of Farm or Ranch	1,570	5.4
11	Other For Recreation	1,570	5.4
12	To Raise My Family	1,475	5.0
13	Part of Cabin or Vacation Home	714	2.4
14	For Non-timber Forest Products	547	1.9
15	For Firewood	476	1.6
16	Other	167	0.6
	Total Number of Responses	29,233	100.0

Table 1. Reasons for owning private forest land in Florida, 2011-2013. Source: US Forest Service, National Woodland Owner Survey, https://www.fia.fs.fed.us/nwos/results/

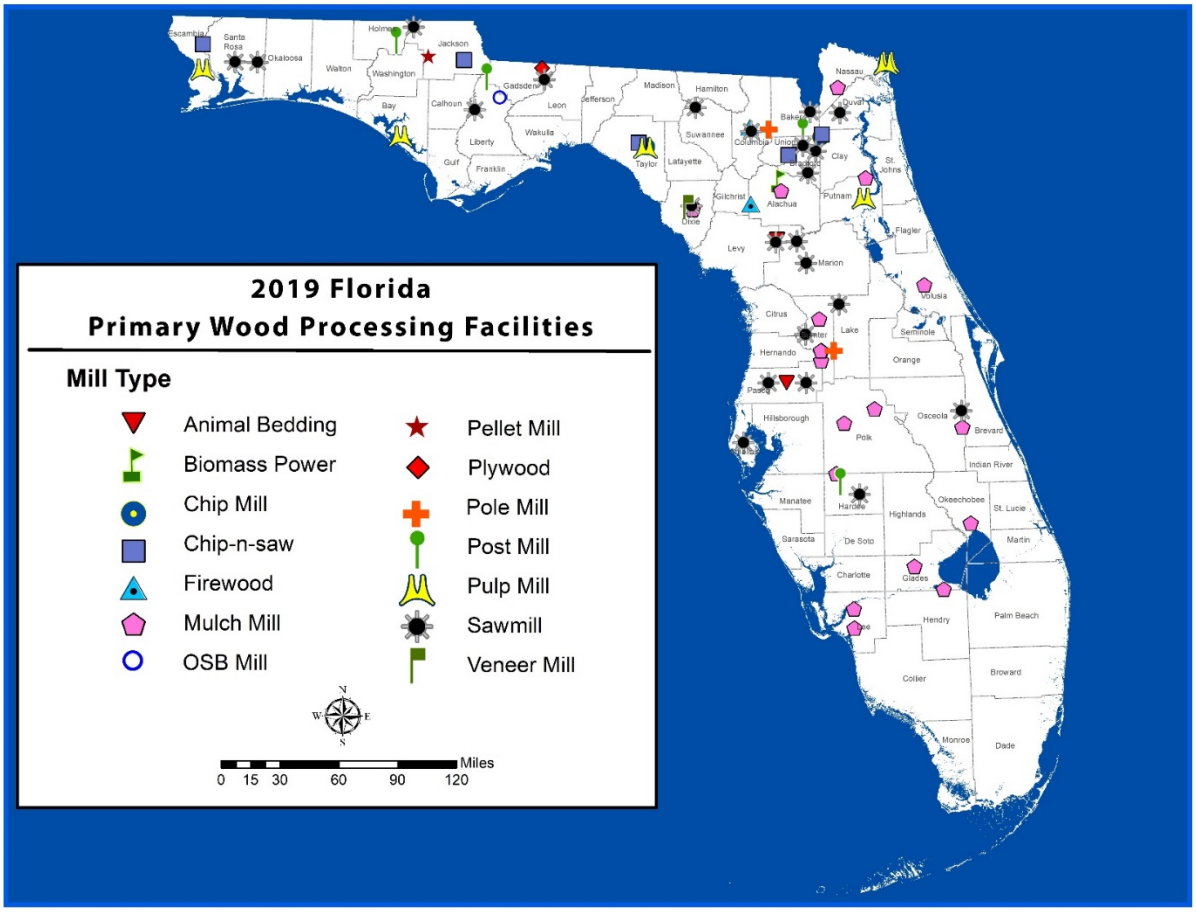

Figure 4. Florida primary wood-using mills, 2019.

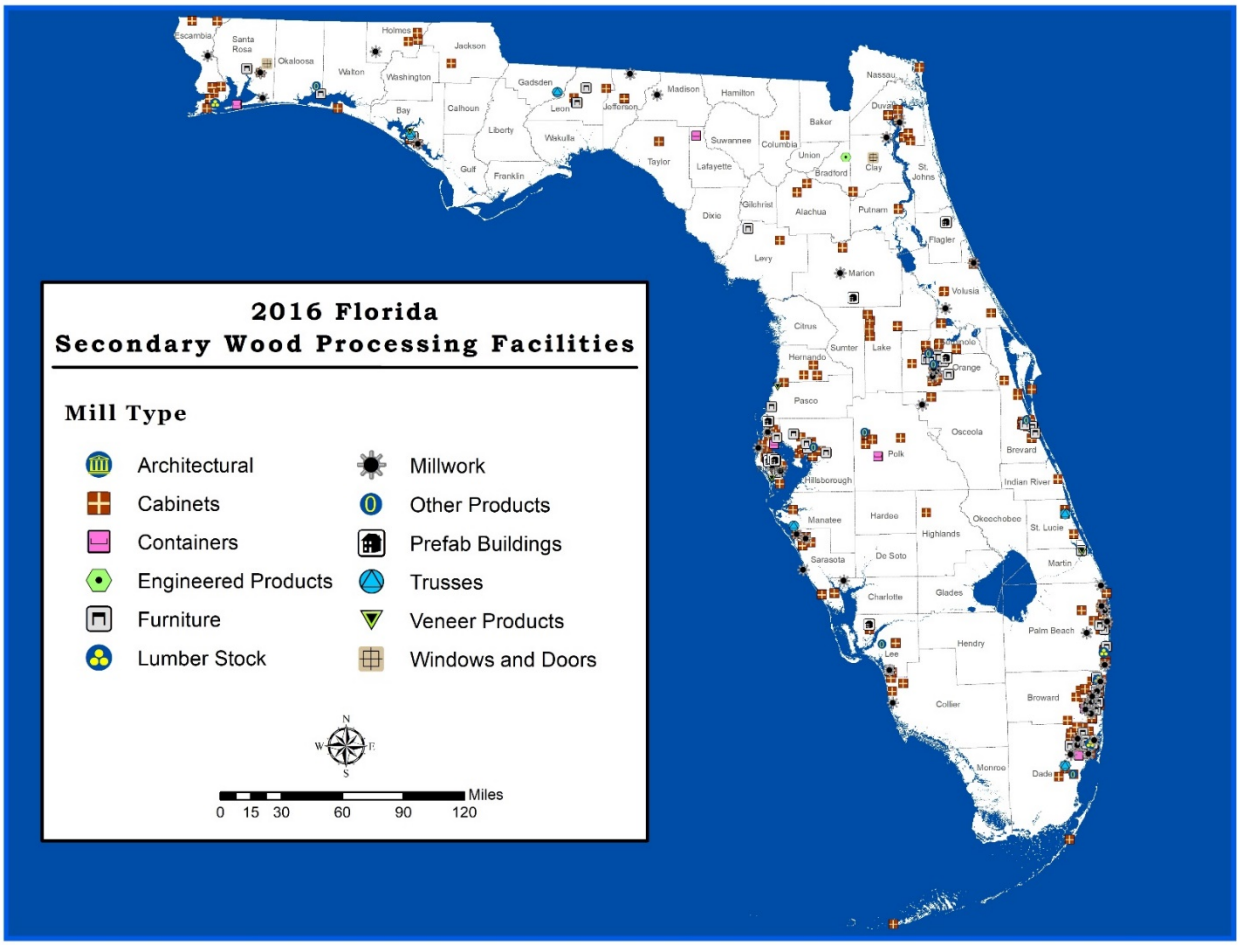

Figure 5. Florida secondary wood-processing facilities, 2014.

Florida Primay Wood-Using Mills, 1987-2019				
Mill Type	**1987**	**1997**	**2007**	**2019**
Saw	97	58	37	26
Pulp and Paper	10	8	6	6
Veneer	5	5	3	1
Pole	2	2	2	2
Plywood	2	2	2	1
Composite Panel	0	0	1	1
Pellet	0	0	0	1
Biomass Power Plant	0	0	0	1
Other	27	26	18	30
Total	143	101	69	69

Table 2. Florida primary wood-using mills by type 1987-2019. Source: US Forest Service's Florida FIA reports and Florida Forest Service data.

Florida Wood-Using Secondary Manufacturing Facilities, 2014			
Type	**Count**	**Type**	**Count**
Cabinets	205	Lumber Stock	5
Millwork	50	Trusses	5
Furniture	42	Veneer Products	4
Containers	10	Architectural	2
Prefab Buildings	8	Windows and Doors	2
Other	8	Engineered Products	1
		Total	342

Table 3. Florida wood-using secondary manufacturing facilities. Source: Florida Forest Service data.

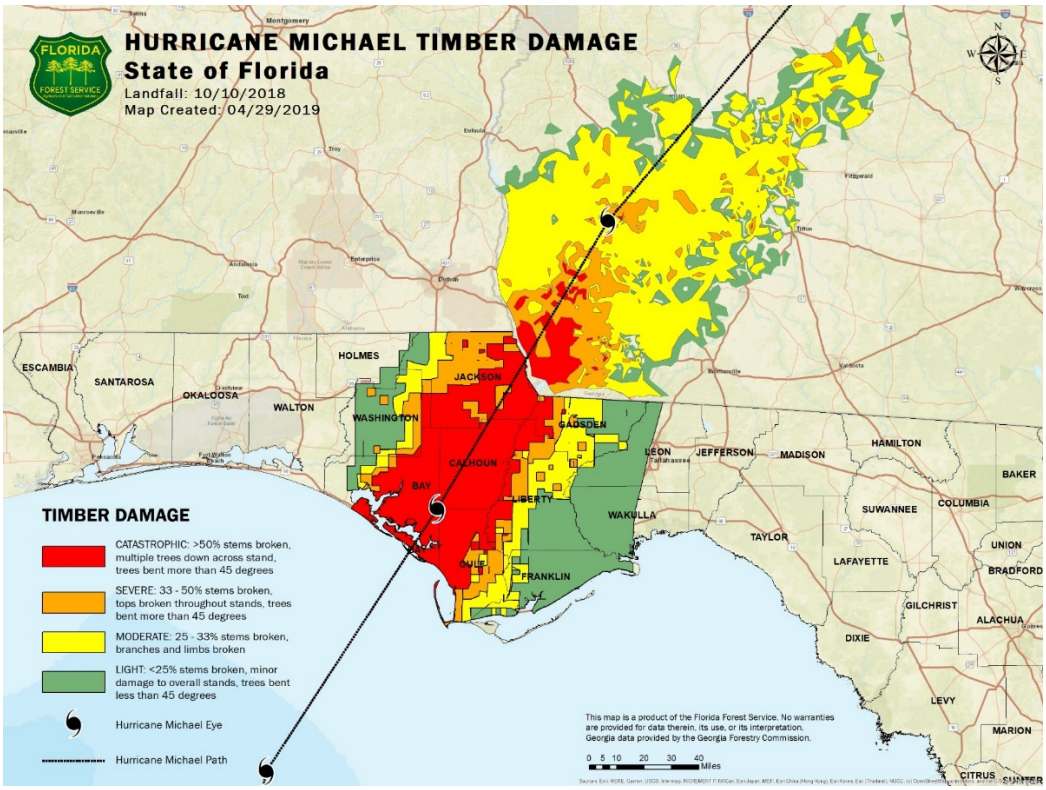

Figure 6. Timber damage zones after Hurricane Michael landing in Florida panhandle on October 10, 2018.

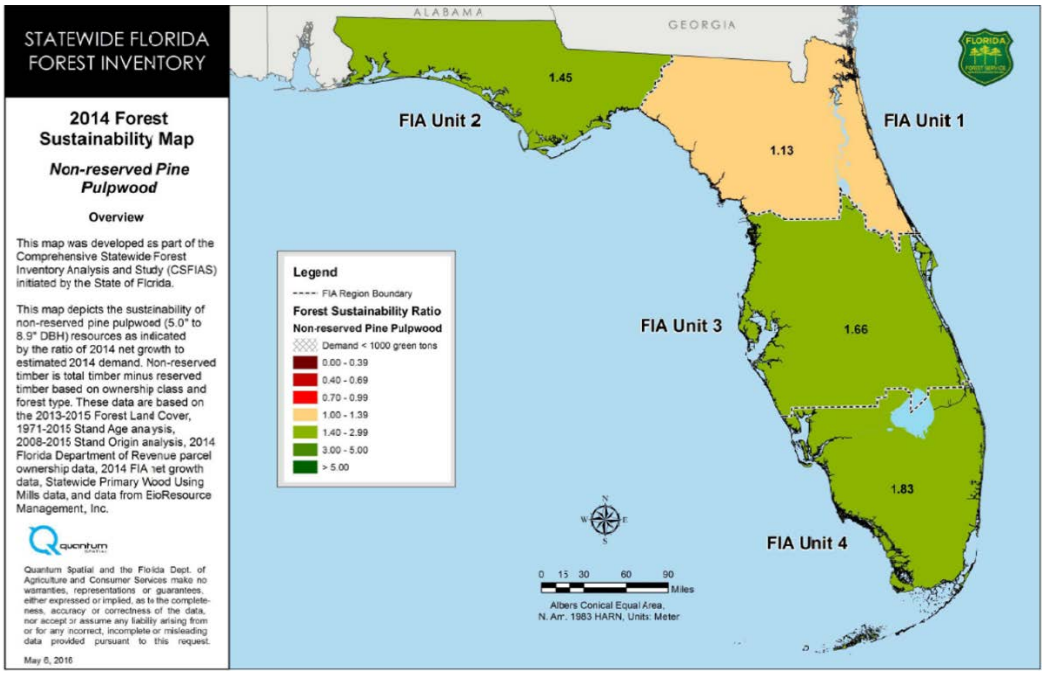

Figure 7. Pine pulpwood sustainability map based on Florida Forest Service CSFIAS study available at www.FDACS.gov/Forest_Inventory

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9) Goals, Objectives and Strategies

Goal 1: Ensure forestry continues to be economically viable land management option in Florida.

Objective 1.1: Protect valuable working forests from conversion to other land uses by providing proper legal framework at the state and local level.

Strategy 1.1.1: Prioritize forests based on economic productivity and unique ecosystem services values.

Strategy 1.1.2: Develop incentives to protect high priority working forests from development.

Strategy 1.1.3: Work with state and local governments, and other stakeholders to protect working forests from development through proper zonation and other means.

Objective 1.2: Provide financial incentives to encourage forest ownership and management.

Strategy 1.2.1: Support increased funding for conservation easement programs.

Strategy 1.2.2: Increase financial assistance programs for forest landowners practicing sustainable forest management.

Strategy 1.2.3: Continue support for property tax relief for timber growers based on agricultural use exemption.

Strategy 1.2.4: Support improvements to federal income tax structure to encourage forestry practices.

Strategy 1.2.5: Seek elimination or deferral of estate taxes on forests.

Strategy 1.2.6: Quantify and promote the economic value of social and ecological benefits of forests as justification for incentive programs.

Objective 1.3: Provide technical assistance to forest landowners to enhance their forest management knowledge and capabilities.

Strategy 1.3.1: Collaborate with universities, non-governmental organizations, and other natural resources agencies to provide streamlined forest land management recommendations and assistance.

Strategy 1.3.2: Provide on the ground technical assistance to forest landowners as appropriate or needed.

Objective 1.4: Continue educating policymakers and public at large on the importance of forestry's economic contributions to society.

Strategy 1.4.1: Actively manage and promote state and federal forests as outdoor demonstration areas.

Strategy 1.4.2: Engage policymakers, forest landowners, and the public at large in educational programs highlighting the economic contributions of forestry to society.

Strategy 1.4.3: Partner with other state and federal natural resource / environmental agencies to celebrate forest specific recognition days.

Goal 2: Monitor and work toward enhancing sustainability of Florida forests.

Objective 2.1: Monitor forest sustainability by conducting appropriate forest inventories, including standing timber volume, timber growth, mortality, removals, and timber drain by county.

Strategy 2.1.1: Continue state's agency participation in the US Forest Service Forest Inventory and Analysis (FIA) program throughout the entire state, including forest plot measurements, timber drain, and utilization studies.

Strategy 2.1.2: Continue detailed tree stand inventories on state forests managed by the Florida Forest Service.

Strategy 2.1.3: Engage in innovative approaches in quantifying timber and other forest resources / attributes using remote sensing and other emerging, innovative technologies.

Strategy 2.1.4: Conduct periodical forest sustainability assessments, and studies, by compiling information from forest inventories and other sources.

Objective 2.2: Work toward reforestation goals which exceed annual timber harvest acreage in the state.

Strategy 2.2.1: Develop long-term projections of forest regeneration scenarios and wood supply in Florida.

Strategy 2.2.2: Conduct surveys of landowners, agencies and seedling nurseries within Florida and neighboring states to assess annual regeneration acreage and species composition in Florida.

Strategy 2.2.3: Communicate knowledge on advancements in regeneration practices to forest landowners to enhance reforestation success and long-term timber yields.

Objective 2.3: Work with major forest certification programs on implementing their protocols to enhance forest sustainability in Florida.

Strategy 2.3.1: Conduct analyses on participation rates and economic impacts of certification programs in timber and biomass markets.

Strategy 2.3.2: Work with forest landowners to further their understating of forest certification programs, so they can be better informed regarding their potential participation in these programs.

Goal 3: Work to enhance markets for non-timber forest products, biomass, and other non-traditional revenue opportunities.

Objective 3.1: Provide framework for improving landowner understanding and utilization of non-timber forest products and markets.

Strategy 3.1.1: Educate forest landowners on options with regard to non-timber forest product harvesting and marketing depending on their particular location in the state.

Strategy 3.1.2: Work with interested parties on non-timber forest products research, marketing and utilization options.

Strategy 3.1.3: Target regionally important non-timber products for additional research and market development, e.g. pine straw in the North, and palmetto berries in the South of the state.

Objective 3.2: Continue exploring alternative fuel production from woody biomass.

Strategy 3.2.1: Continue exploring woody biomass market potential for electricity generation.

Strategy 3.2.2: Continue working with universities and other interested parties on liquid fuel production from woody biomass.

Goal 4: Explore potential for quantification and monetization of ecosystem services provided by forests: carbon sequestration, water supply and purification, wildlife habitat and biodiversity protection.

Objective 4.1: Work on better understanding of existing forest carbon markets, and their potential for enhancement of forest-derived revenue streams.

Strategy 4.1.1: Educate forest landowners on the availability forest carbon credits and participation options in the carbon markets.

Objective 4.2: Work toward monetization of forest ecosystem services associated with water supply and purification.

Strategy 4.2.1: Work with interested parties on developing and participating in markets for water ecosystem services.

Objective 4.3: Help investigate and develop markets for other forest ecosystem services, such as air purification, wildlife habitat and biodiversity protection, other.

Strategy 4.3.1: Participate in any new research, education, marketing or monetizing initiatives concerned with a number of other forest ecosystem services.

Goal 5: Monitor the demographic characteristics of Florida's forest landowners, their management objective preferences and underlying values.

Objective 5.1: Understand standard demographic characteristics of Florida forest landowners (age, income levels, property size, management objectives, etc.) through appropriate surveys.

Strategy 5.1.1: Utilize existing data to better target forest landowners with economic and other information relevant to their demographic characteristics and interests.

Strategy 5.1.2: Continue exploring options to reach unengaged landowners through new technology.

Goal 6: Determine impacts on long-term timber supply of additional wood drains / withdrawals either through proposed new processing facilities, or hurricanes and other natural disasters.

Objective 6.1: Evaluate how new mills would impact long-term timber supply depending proposed mill size and location.

Strategy 6.1.1: Prepare wood basket analyses and long-term timber supply projections based on FIA and other data, and likely wood utilization rates of proposed or considered new mills.

Objective 6.2: Evaluate how a natural disaster would impact long-term timber supply depending on the size and severity of impact area.

Strategy 6.2.1: Conduct analyses and report on long-term timber supply projections based on FIA and other data in the event of a hurricane or other natural disaster affecting timber in multi-county area.

Goal 7: Promote Florida's forests, forestry and forest-based industries within the state, the Nation and internationally.

Objective 7.1: Promote Florida's forest resources products and productivity.

Strategy 7.1.1: Maintain vigorous forest timber inventory to identify new business opportunities.

Strategy 7.1.2: Utilize FDACS marketing specialists to enhance marketing of all Florida forest products.

Strategy 7.1.3: Partner with industry, universities and others to educate the public about economic and other benefits of forest utilization.

Objective 7.2: Seek additional wood industries to locate in Florida if new opportunities or resources are identified and are available.

Strategy 7.2.1: Collaborate with academia, forest product industry, and/or other forestry stakeholders to identify new opportunities for innovative forest-based business ventures

Strategy 7.2.2: Identify economically viable sources of timber and/or woody biomass in urban forests.

Goal 8: Promote Florida's forest economic and forest sustainability research efforts.

Objective 8.1: Maintain and enhance Florida's forest economics research efforts

Strategy 8.1.1: Identify forestry research needs related to forest economic viability and sustainability.

Strategy 8.1.2: Identify ways to facilitate and fund research in forest economics and sustainability.

The goals, objectives, and strategies given above help to accomplish the S&PF National Priorities. First, strategies to address this issue help to conserve working forest landscapes since the strategies identify how manipulations of the existing forest resource (such as changes in reforestation efforts or the establishment of additional wood-processing facilities) can impact long-term sustainability. Second, strategies to address this issue help to protect the forest from harm via work on forest sustainability. Third, strategies to address this issue enhance public benefits from trees and forests because the strategies identify those practices resulting in economic development, increases in return on investments by investors and landowners. Additionally, working toward the long-term forest sustainability ultimately provides better recreational opportunities, enhances habitat for both terrestrial and aquatic wildlife, and provides a myriad of other ecosystem benefits.

10) Performance Measures

Goal 1: Ensure forestry continues to be economically viable land management option in Florida.

- Valuable working forests are protected from conversion to other land uses by providing proper legal framework at the state and local level.
- Financial incentives are available to encourage forest ownership and management.
- Technical assistance to forest landowners is routinely provided to enhance their forest management knowledge and capabilities.
- Policymakers and public at large are increasingly more aware of the importance of forestry's economic contributions to society.

Goal 2: Monitor and work toward enhancing sustainability of Florida forests.

- Forest sustainability is properly monitored by conducting appropriate forest inventories, including standing timber volume, timber growth, mortality, removals, and timber drain by county.
- Reforestation exceeds annual timber harvest and other timber removals acreage in the state.
- Acreage of certified forests increases enhancing forest sustainability in Florida.

Goal 3: Work to enhance markets for non-timber forest products, biomass, and other non-traditional revenue opportunities.

- Utilization of non-timber forest product such as pine straw, palmetto berries, and other, increases appreciably in ecologically sustainable ways.
- Woody biomass finds new applications as fuel or otherwise.

Goal 4: Explore potential for quantification and monetization of ecosystem services provided by forests: carbon sequestration, water supply and purification, wildlife habitat and biodiversity protection.

- Forest carbon markets are being used to enhance forest-derived revenue streams.
- Water ecosystem services have become or are closer to becoming a source of revenue for forest landowners.
- Markets for other forest ecosystem services, such as air purification, wildlife habitat, and biodiversity protection (or other) are closer to becoming a source of revenue for forest landowners.

Goal 5: Monitor the demographic characteristics of Florida's forest landowners, their management objective preferences and underlying values.

- Understanding of standard demographic characteristics of Florida forest landowners (age, income levels, property size, management objectives, etc.) has increased and is being used for better targeting in programming.

Goal 6: Determine impacts on long-term timber supply of additional wood drains / withdrawals either through proposed new processing facilities, or hurricanes and other natural disasters.

- Impact of any new mills in the state on long-term timber supply is better understood.
- Impact of natural disasters on long-term timber supply in Florida is better understood.

Goal 7: Promote Florida's forests, forestry and forest-based industries within the state, the Nation and internationally.

- Florida's forest resources, and forest-based economic opportunities are better understood throughout Florida, the Nation and internationally.
- Additional wood industries were successfully located in Florida based on available resources.

Goal 8: Promote Florida's forest economic and forest sustainability research efforts.

- New forest economic or sustainability knowledge was gained and is being applied to Florida's forests and/or forest-based enterprises.

ISSUE 6: Water Quality and Quantity

1) Current Issue Description

It is well established that forest cover has many positive effects regulating surface and groundwater quality, quantity and hydrological processes. However, forestry operations, if not properly executed, can impact water resources. To prevent the negative impacts of forestry and other agricultural activities, Florida developed and implemented Best Management Practices (BMPs), which each commodity group is subject to when carrying out its management activities. Florida Forest Service administers Silviculture BMPs (FDACS, 2008), which are part of a larger effort by the state of Florida to protect water quality and quantity in response to the federal Clean Water Act (CWA) of 1972. A fundamental purpose of the CWA is to ensure the nation's water resources maintain "chemical, physical, and biological integrity". The Florida Forest Service's Silviculture BMP program standards aim at meeting this overall purpose for the state's forestry operations. Currently in Florida, 5.6 million acres of forest lands are enrolled in Silviculture BMP Notice of Intent (NOI) program. However, all forestry operations on all 17.1 million acres of forest land are subject to BMP implementation and monitoring. Florida's Silviculture BMP compliance is surveyed every other year since 1981. Since the last Florida Forest Action Plan (2010), silviculture BMP compliance has consistently been above 99 percent, and in the last published survey for 2017 it reached 99.6 percent (BMP Implementation Report, 2017). In 2018, Florida Department of Environmental Protection provided Florida Forest Service with a follow up verification letter attesting to effectiveness of Florida Silviculture BMPs in protecting groundwater from excessive nitrate-N concentrations. The first such letter issued in 2007, provided initial verification of Florida Silviculture BMPs, except for fertilization practices. Florida Forest Service is working with multiple partners, including Florida Department of Environmental Protection, Florida Department of Agriculture and Consumer Services' Office of Agricultural Water Policy, five regional Water Management Districts covering the entire state, forestry researchers at the University of Florida, members of Florida Forestry Association, other forestry stakeholders, forest land owners and loggers, to ensure the forestry community adheres to Silviculture BMPs to avoid negative impacts forestry operations can have on water quality and quantity, now and into foreseeable future.

2) Key Attributes

Florida's freshwater resources are dominated by several prolific groundwater aquifers, which yield large quantities of water into streams, rivers, lakes, springs, and wells tapped for human consumption and use (Borisova and Wade 2017). For most of the state, the source of groundwater is the Floridan Aquifer, supplying the municipal water in north and central Florida. It also yields water to thousands of domestic, industrial and irrigation wells throughout the state. In parts of the state where the Floridan Aquifer is not available, shallow, non-artesian surficial aquifers are being tapped for water supplies. Water in all of these aquifers is replenished by rainfall either indirectly percolating through the permeable surfaces, or directly where the confining material is broken up, through sinkholes, and where aquifers come up to the surface. This is why it is so important to exercise appropriate practices when managing forests in aquifer recharge areas, or when growing agricultural crops, managing septic systems or even gardening. The quality and quantity of that ground water is significantly influenced by the type and condition of the ground cover encountered by precipitation at the land surface. Currently, Florida is nearly 50 percent forested, but the amount of forest land has diminished by over 6.4 million acres between 1936 and 2016 – an average of 80,000 acres per year. Significantly, large forested areas of the state generally coincide with higher groundwater recharge areas (Figure 2, Page 109). Consequently, forest land losses, especially those lost to urbanization, have resulted in a disproportionately significant need to maintain, or even increase, the acres

of forest land cover in the state, in order to protect groundwater recharge areas and provide a sustainable quantity of high-quality water.

Surface runoff and groundwater discharge feed more than 1,700 streams and rivers spanning 25,949 miles of waterways and smaller watercourses. Florida also features 7,700 lakes covering 2,143,698 acres with the largest, Lake Okeechobee (467,200 acres), being among the top ten largest lakes in the U.S. Florida also has many types of wetlands, including world-renowned and unique Everglades in the southern tip of Florida, and Green Swamp in the central part of the state. Together, the big, well-known and smaller wetlands scattered throughout the state cover 10,887,987 acres. These wetlands provide habitats for a variety of flora and fauna and serve as major groundwater recharge areas. Among Florida's five largest rivers, four are draining basins in north Florida. These are: the Apalachicola, Suwannee, Choctawhatchee, and Escambia Rivers. The first two originate in Georgia, and the latter two in Alabama. Only the last one of Florida's five largest rivers, the St. Johns River, flows entirely within the borders of the state, from the marshes west of Vero Beach to its mouth at the Atlantic Ocean in Jacksonville. Therefore, managing the flow and quality of water in the other four largest rivers in Florida requires coordination of efforts with the states of Alabama and Georgia.

3) Public Benefits

Few would argue that the most critical single resource for sustaining all life forms on the earth is water. Likewise, few would argue that one of the most critical single resources for protecting and producing water – especially high-quality water is forest land. The quality of water from forest lands is significantly better than from other land uses (Sun et al. 2017). The positive influence of forest cover in watersheds and the negative impacts of its removal on water quality have long been acknowledged and supported by research (Packer 1953, Tebo 1955, Bormann and Likens 1967, Allan 2004, Ouyang et al. 2014). Forest removal and associated land use alterations can negatively influence the overall quality of aquatic resources by directly altering hydrology, geomorphology, and water chemistry, which in turn influence biotic composition and overall ecosystem health (Tebo 1955, Bormann et al. 1999, Peterson and Kwak 1999, Clements et al. 2000, Bledsoe and Watson 2001, Sheldon et al. 2012).

Forest cover can also have a significant influence on water quantity and water supply. The water budget of any given watershed is a function of (1) precipitation, (2) condensation, (3) evapotranspiration, (4) infiltration (groundwater recharge), and (5) runoff (surface water recharge). All five of these basic hydrologic cycle processes are heavily influenced by land use and land cover (LU/LC). A key to protecting and sustaining water resources is the presence of forests and the maintenance of forest health across large forested landscapes. Commensurate with the state's forest cover approaching 50 percent, nearly 44 percent of Florida's surface water yield originates from forests of various ownerships located within the state (nearly 37% comes from state and private forest, and another 7 percent from federally-owned forests). Florida's state and private forests alone contribute water supply to 3.28 million people in 50 communities via 736 surface water intakes (Liu et al. 2020).

4) Threats

Studies have shown that loss of forest cover and conversion to non-forest use can drastically affect the individual components of the water budget. Although 'water supply and demand' is a function of many environmental and socioeconomic factors, including land use, climate, population, economics, and infrastructure, the effect of forest land conversion to urban/suburban is most significant for Florida. According to the U.S Census Bureau estimates at the end of 2019, Florida was the third most populous

state in the Union with 21.5 million inhabitants. Only California (39.5 million) and Texas (29.0 million) had larger populations in 2019. By 2070, Florida's population is projected to be 33.7 million (about a 50% increase), and it is estimated that an additional 3.5 to 5.4 million acres of land will be developed (1000 Friends of Florida 2016). In the medium range forecasts until 2035, Florida's population is projected to reach 25.0 million people with corresponding water demand increasing by 1.1 billion gallons per day (bgd) to 7.5 bgd. To meet the ever-rising water demands, Florida's water management districts are increasingly relying on Alternative Water Supplies (AWS) instead of tapping into more groundwater sources. Between 2005 and 2018, there were 924 AWS projects developed, providing 0.976 bgd. Plans are in place to develop another 280 AWS projects capable of providing additional 1.5 bgd when fully implemented (Florida Department of Environmental Protection 2018).

Most problematic for Florida's future groundwater supply is that population growth and urbanization lead to an increase in impervious surface area, which decreases the amount of water that infiltrates into the soil. Impervious surfaces such as paved roads, parking lots, roof tops, etc. also have much less resistance to flow and therefore lead to increased runoff velocity. A natural consequence of urbanization is more rapid and larger pulses in storm flow (Dunne and Leopold 1978, Neller 1988, Beighley et al. 2003), which typically results in more frequent and intense flooding. Also, urbanization diminishes infiltration rates and base-flow contribution to stream flow and reduces flows during prolonged inter-storm periods (Rose and Peters 2001, Wang et al. 2001). In addition, increases in urban land use within watersheds often represent a significantly higher risk to human health, due to the introduction of contaminants such as fecal coliform bacteria (e.g., *E. coli*), pesticides, pharmaceuticals, household and industrial chemicals, and heavy metals. Some of these contaminants do not yet have regulatory limits and may not be removed during water treatment operations. Exposure to these contaminants can result from consumption of contaminated fish, and/or drinking water, and various forms of body contact recreation

5) Opportunities

Since the late 1980s, Florida has maintained an aggressive land acquisition program directed at conserving natural landscapes including forested and agricultural lands. The result is that over 2 million acres (about 5%) have been acquired for conservation purposes, and hence protected from future development and consequent impacts to water resources. These new acquisitions bring the total acres of conserved land (including state, federal and other public lands) to about 9 million – approximately 25 percent of the state's land base.

While land acquisition programs have been instrumental in maintaining forested landscapes and protecting water resources, the threat of forest land loss remains high – hence, the threat to state's water supply remains high as well. Key strategies for lessening the threat include education of landowners and policy makers on the value of forest land cover for protecting and sustaining water resources, development of water resource-based protection incentives for forest landowners, redesigning land use regulations to better protect forests, and providing for additional forest land acquisition. Implementation of these strategies will necessarily involve stakeholders at local, state and federal levels, and include both public and private sector entities. The Florida Forest Service along with the state water quality agencies (Florida Department of Environmental Protection plus Water Management Districts) will have key roles, but the involvement of local governments and private forest landowners will be critical for success.

Active management of the urban forest will also help to mitigate the negative impacts of development on water quality. Trees reduce the volume of stormwater runoff through the processes of interception in the canopy, infiltration through the soil, and absorption through the roots. Modifications of site development

plans to accommodate trees will improve tree growth and consequently increase the amount of stormwater runoff that trees can sequester. They will also reduce the volume of sheet flow that needs to be retained and treated. These practices include the retention of streamside buffer zones, the creation or retention of adequately sized tree islands within the developed area, and the use of pervious paving that allows rainwater to be available in the tree root zone and permeate into the subsoil instead of into storm drains.

Many areas of high groundwater recharge are relatively nutrient poor, and generally less productive in terms of forest growth and yield. Fertilization operations that may be conducted to improve forest productivity may also represent a disproportionately higher threat to groundwater, because of the high infiltration rates on these sites. Florida's Silviculture BMPs address forest fertilization, and compliance with these BMPs has been excellent (BMP Implementation Survey Report, 2017). In 2018, Florida Department of Environmental Protection issued a verification letter to Florida Forest Service attesting to the effectiveness of Silviculture BMPs in protecting groundwater from excessive nitrate-N concentrations, whenever fertilization BMPs are followed, based on the recent University of Florida studies (Cohen 2016).

An opportunity yet to be explored is development and verification of Silviculture BMPs effectiveness for groundwater protection from nutrient enrichment in pine straw production operations. Pine straw collection is a significant Florida (and regional Southeast) industry, especially on sandy, or more permeable sites, due to their relative lack of understory vegetation. Like timber production, pine straw production can be enhanced by adding soil amendments such as nitrogen and phosphorous. Anecdotal evidence suggests that fertilization for pine straw production may be problematic in some areas and could be contributing to nutrient enrichment of groundwater. Regardless, a strategy for maintaining or increasing pine straw production on these higher groundwater recharge sites may include fertilization activities. This necessitates development and verification of forest fertilization BMPs for pine straw production to ensure protection of groundwater quality.

6) Agency and Organization Roles

Partners for this issue include:
Florida Department of Agriculture and Consumer Services, Office of Agricultural Water Policy
Florida Department of Environmental Protection
Florida Water Management Districts
Florida Fish and Wildlife Conservation Commission
Florida Department of Health
USDA Forest Service
USDA Natural Resources Conservation Service
US Environmental Protection Agency
The Nature Conservancy
University of Florida, School of Forest Resources and Conservation

7) Priority Areas

For groundwater resources the more vulnerable, and vulnerable areas cover most of the state, except for the Everglades region in south Florida (Figure 2, Page 109). Conversely, for surface waters, the highest priority areas are in south Florida, coastal regions of the Gulf of Mexico, and the Atlantic coast (Figure 3, Page 110). This information was derived from Critical Lands and Waters Identification Project (CLIP)

Database, Version 4.0. The CLIP Version 4.0 was completed in August 2016. Many of the natural resource data layers included in CLIP were derived from the Florida Forever Conservation Needs Assessment developed by Florida Natural Areas Inventory (FNAI) at Florida State University to support the Florida Forever program.

From the forest and water nexus standpoint, the most critical areas in the state are central and north Florida, where most of the state's forest land and principal water recharge areas are located, and where forest loss is likely to be the highest (Figure 4, Page 111). Considering the location of existing forests, the potential for development pressure and the recharge potential Figure 3, page 110 shows the specific priority areas where the key strategies will provide the greatest public benefit.

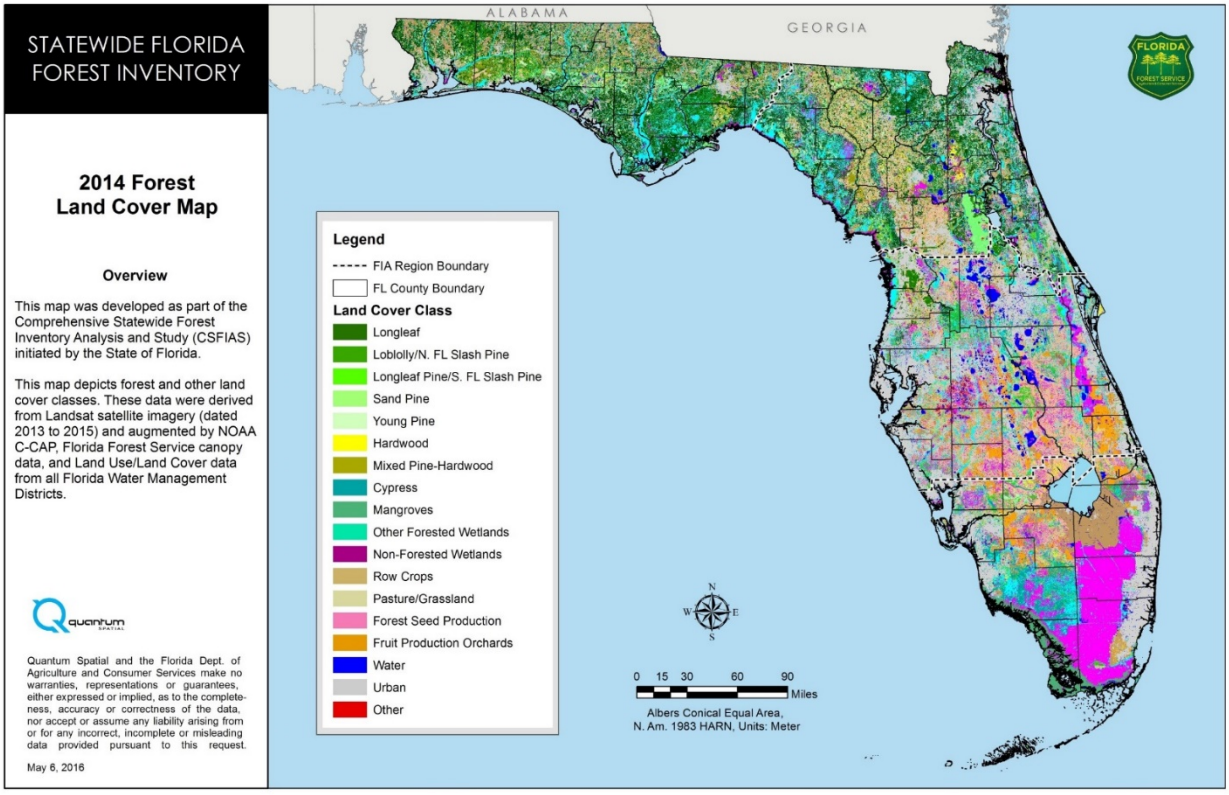

Figure 1. Current forest and other land cover distribution.

Source: Comprehensive Statewide Forest Inventory and Analysis Study, 2015
www.FDACS.gov/Forest_Inventory

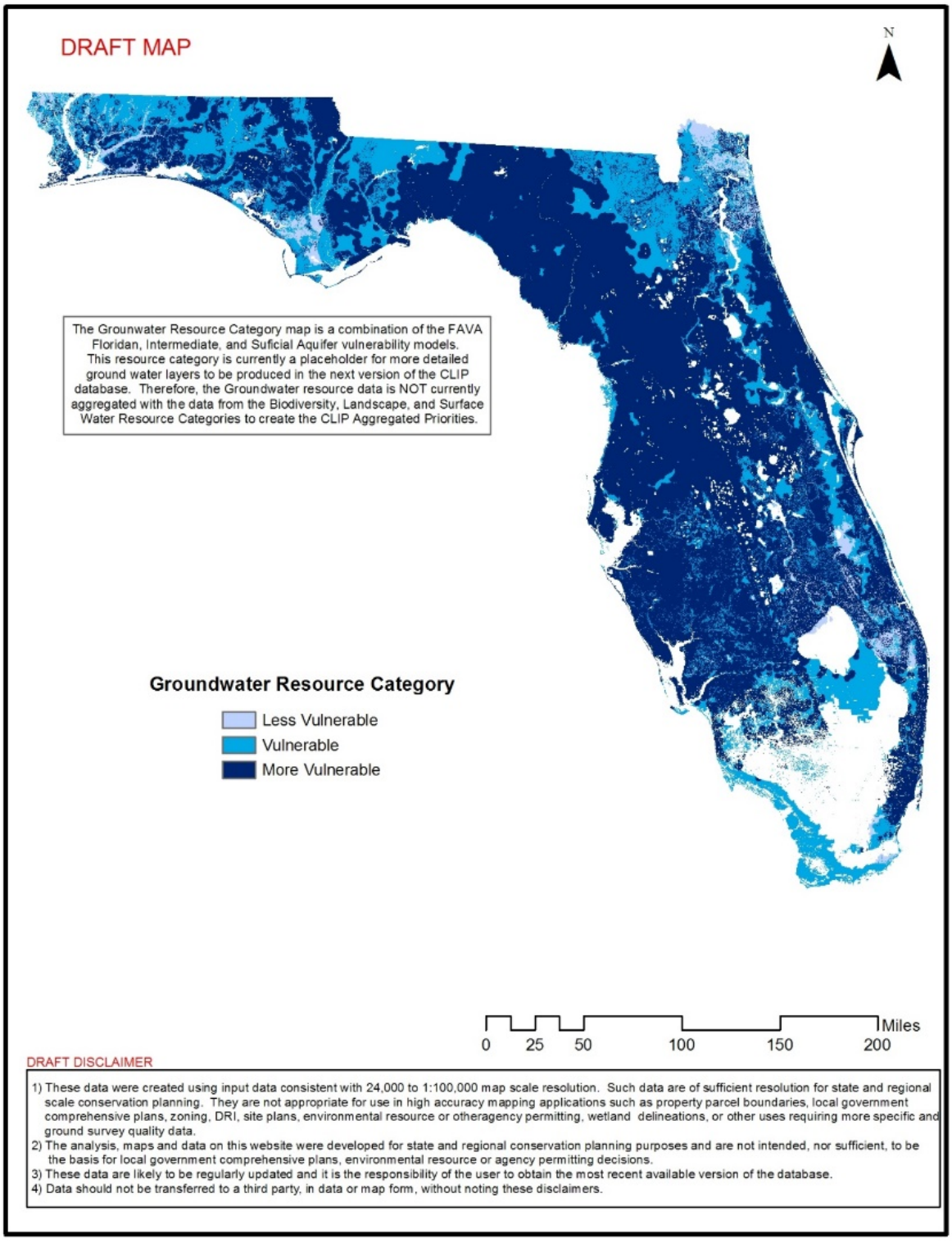

Figure 2. Florida groundwater resource categories: more vulnerable, vulnerable, and less vulnerable. Source: Critical Lands and Waters Identification Project. Database Version 4.0.

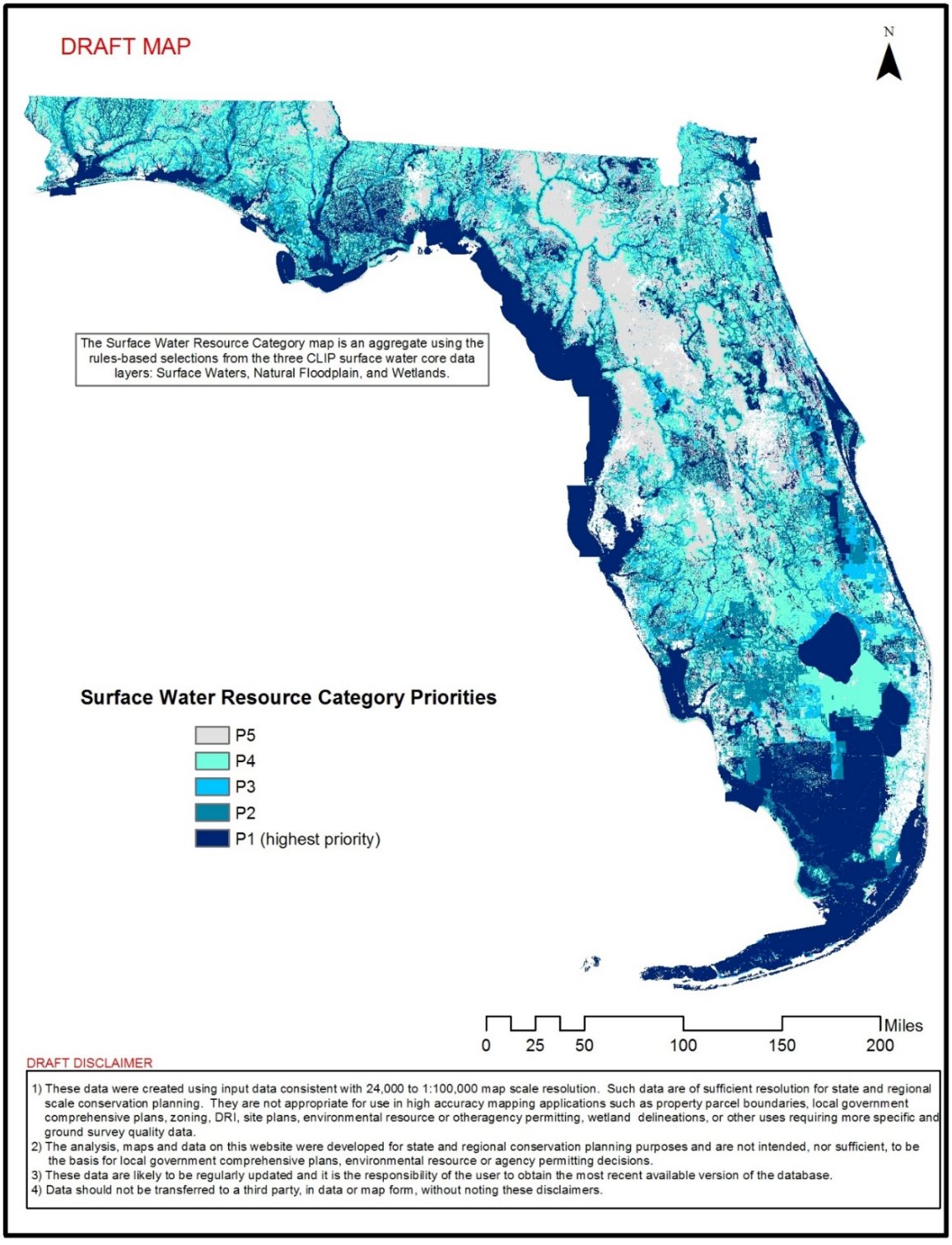

Figure 3. Florida's surface water resource category priority areas.

Source: Critical Lands and Waters Identification Project. Database Version 4.0.

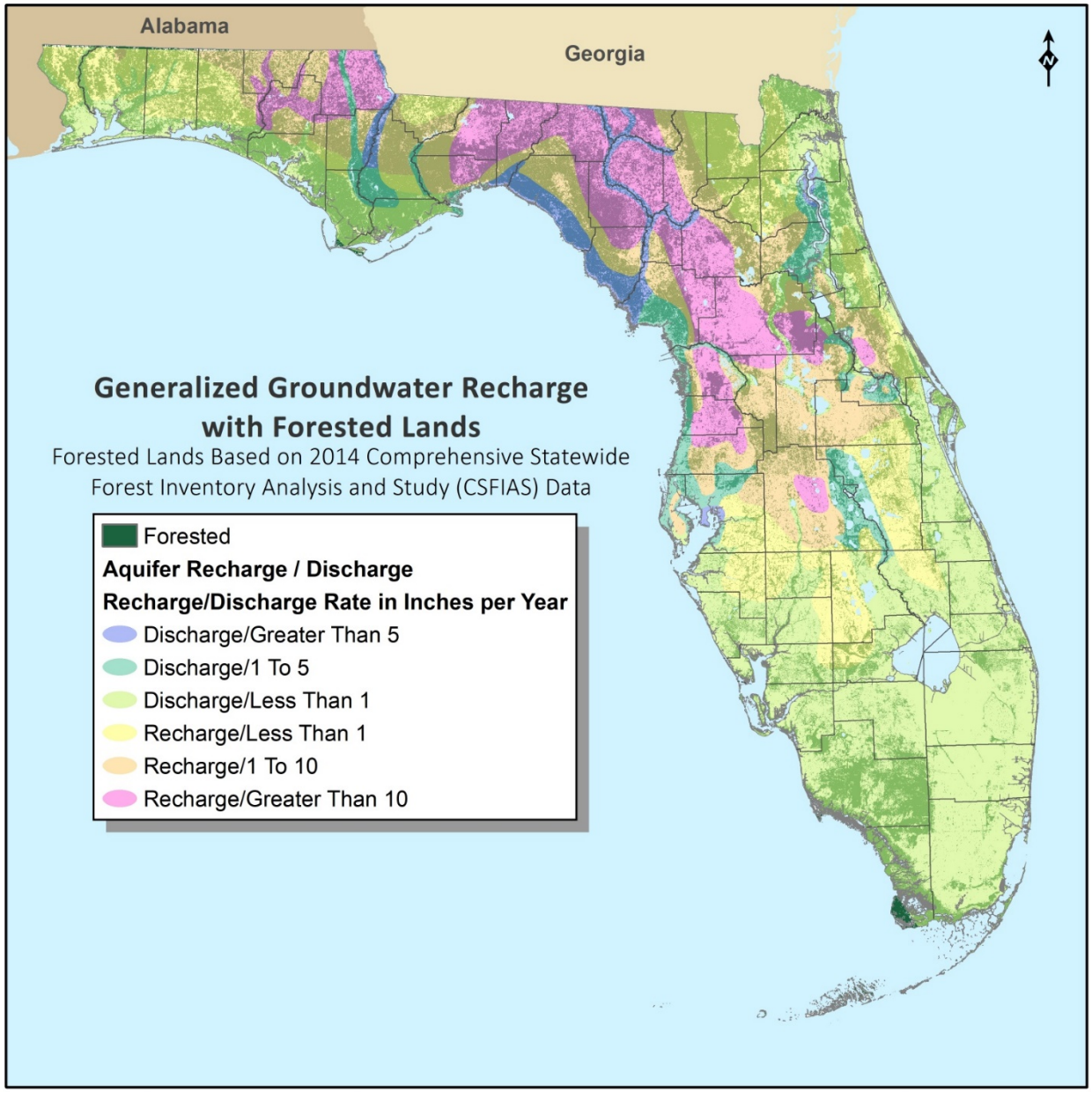

Figure 4. Forested lands, water recharge areas and developed lands.

Sources: Comprehensive Statewide Forest Inventory and Analysis Study, 2015 www.FDACS.gov/Forest_Inventory. Aquifer recharge/discharge information from Florida Department of Environmental Protection.

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9) Goals, Objectives and Strategies

Goal 1: Protect water quality through research, education and outreach.

Objective 1.1: Expand and extend current efforts to verify the effectiveness of silviculture Best Management Practices (BMP) related to forest fertilization and nutrient management.

Strategy 1.1.1: Extend the time frame for the current research and monitoring project involving forest fertilization, to better characterize nutrient input and export scenarios.

Strategy 1.1.2: Develop outreach and training programs for professional forestry fertilizer applicators.

Strategy 1.1.3: Develop outreach and training programs for pine straw producers and landowners. And, if feasible, publish pine straw standards based on research.

Strategy 1.1.4: Review current BMP standards for areas that could be problematic and may potentially need additional research to answer water quality questions.

Objective 1.2: Target TMDL watersheds for increased landowner and logger educational efforts.

Strategy 1.2.1: Conduct targeted BMP implementation monitoring within watersheds where impaired waters have been identified and forestry is a significant land use.

Strategy 1.2.2: Develop and deliver landowner and logger workshops to address deficiencies identified through watershed monitoring, as well as the importance of BMP adherence to ensure forestry activities do not contribute to lower water quality in the Target TMDL watersheds.

Goal 2: Protect water quantity through information dissemination and land acquisition.

Objective 2.1: Reduce forest land conversion by developing information for distribution and presentation to policy makers on the value of forest land cover for protecting and sustaining water resources.

Strategy 2.1.1: Customize information from the Regional Investment Project to Florida specific conditions – create educational and outreach materials and/or campaigns.

Strategy 2.1.2: Organize and conduct presentations to policy makers at the local, state and federal level, emphasizing the value of forests as well as trees in developed areas for water resource protection.

Strategy 2.1.3: Emphasize (through partners such as Florida Forestry Association) the need for and the contributions a robust forest industry has on water quantity and quality.

Strategy 2.1.4: Explore and use media that can be readily available and enhances landowners, loggers, and policy makers understanding for the need to protect forest lands for water quantity.

Objective 2.2: Develop water resource-based protection incentives for forest landowners and urban developers.

Strategy 2.2.1: Work with state and federal partners to develop incentives for forest landowners to maintain forested watersheds – target high groundwater recharge areas.

Strategy 2.2.2: Work with local governments to redesign land use regulations to better protect and promote the forestry land use.

Strategy 2.2.3: During the development process, ensure that site plans provide adequate protection for existing trees and provisions to create a favorable environment for retained and planted trees.

Objective 2.3: Provide for additional public forest land acquisition and management.

Strategy 2.3.1: Give high priority to forested, high groundwater recharge areas for acquisition.

Strategy 2.3.2: Support forest land management activities resulting in water resources protection and enhancement.

10) Performance Measures

Goal 1: Protect water quality through research, education and outreach.

- Verify BMP effectiveness for forest fertilization practices for pine straw production
- Conduct training for fertilizer applicators, landowners and pine straw producers

- Conduct special BMP implementation monitoring within certain TMDL basins
- Conduct BMP training on implementation deficiencies identified during monitoring of TMDL basins – follow up with additional implementation monitoring

Goal 2: Protect water quantity through information dissemination and land acquisition.

- Produce customized information on the forest-water relationship
- Conduct presentations to key policy makers
- Establish forestry incentives in high groundwater recharge areas of the state
- Propose site development and land use (zoning) changes to key local governments
- Propose reprioritization of land acquisition efforts

Issue 7: Longleaf Pine Ecosystems

1) Current Issue Description

Forest Resource

Longleaf Pine Ecosystems, which once covered approximately 60% of the Southeastern Coastal Plain, are now among the most imperiled ecosystems in the United States, occupying less than 6% of their original extent (Kirkman and Jack 2018). Longleaf Pine Ecosystems (LPEs) are some of the most biologically diverse ecosystems outside of the tropics due to their diverse understories composed of native grasses, sedges, and forbs (Jose *et al*. 2006). Functionally important grass species include wiregrass (*Aristida beyrichiana* and *A. stricta*) and bluestems (*Andropogon* and *Schizachyrium* spp.). Longleaf Pine Ecosystems are further characterized by an open overstory dominated by longleaf pine (*Pinus palustris*) and a sparse or absent midstory. The most important functional attribute of these systems is the occurrence of low intensity, frequent fire. Naturally occurring longleaf pine forests typically occur as uneven-aged mosaics of even-aged patches distributed across the landscape. These patches vary in size, shape, structure and density (Brockway *et al*. 2005), with individual trees capable of living for over 500 years. The landscape is also characterized by scattered individuals, small clumps or small stands of hardwoods dominated by fire-resistant oaks.

Longleaf Pine Ecosystems support a significant number of diverse faunal species, many of which are now considered threatened or endangered. The Southeastern Coastal Plain contains the highest species richness of herpetofauna in the United States and Canada (see Jose *et al.* 2006 and references therein). While the number of bird and mammal species in Longleaf Pine Ecosystems is relatively low, many of those species that are associated with these systems are specialists, particularly vulnerable to habitat loss and degradation. There are 212 resident vertebrate species in longleaf pine savannas, of which 38 are specialists, occurring exclusively or primarily in longleaf pine savannas (Jose *et al.* 2006). Longleaf Pine Ecosystems are highly valued for the large number of endemic species and hyperdiversity they support.

As mentioned above, Longleaf Pine Ecosystems are among the most imperiled ecosystems in the United States. Longleaf Pine Ecosystems once occupied an estimated 92 million acres in the southeastern United States prior to European settlement, but now occupy less than 4.8 million acres (Kirkman and Jack 2018). Of the original range, only about 0.2% is being managed with fire sufficient to perpetuate the open structure and species diversity characteristic of this ecosystem (Jose *et al.* 2006). The loss of longleaf pine ecosystems from all causes continues.

A variety of causes contributed to the decline of Longleaf Pine Ecosystems over the last three centuries. Prior to 1800, the initial decline of longleaf pine was gradual and attributable to small-scale logging and land clearing. However, by the latter half of the 19th Century, improvements in technologies in both the naval stores and logging industries resulted in a significant increase in the rate of longleaf pine deforestation (Jose *et al*. 2006). By the mid-1900s, longleaf pine occupied less than 2% of its original range. Additional observations suggest that the decline of longleaf pine was furthered by management considerations and market activities that decreased the incentive for planting additional longleaf acres. These included the relatively poor seedling survival rates of longleaf compared to other pine species and the increased demand for faster growing tree species for various wood products. Loss of Longleaf Pine Ecosystems has continued with much of the more recent declines attributable to fire suppression,

fragmentation and conversion to other land uses, including off-site pine plantations, agriculture, and development (Jose *et al*. 2006; Costanza *et al*. 2015).

2) Key Attributes

Historical

Frost (2006) estimates that of the more than 92 million acres in the pre-settlement range of longleaf pine, about 56 million acres (61%) were dominated by longleaf pine and about 36 million acres (38%) had longleaf in mixed stands with other pines and hardwoods. These estimates were developed using a wide range of historical information discussed in Frost (2006) and referenced therein. Detailed analysis such as that conducted by Frost (2006) have not been attempted to our knowledge for Florida.

Estimates for the extent of "Natural Vegetation in Florida" have been based on the map developed by Davis (1967). Longleaf pine occurred as a dominant or codominant in three vegetation types that were mapped in this effort:

1. *Mixed Hardwood and Pine* (Figure 1, Page 136) was mapped by Davis and his students from field visits that occurred after a long period marked by unsustainable longleaf pine removals, conversion to plantations of off-site species, and lack of fire management.
2. *Pine Flatwoods* have long been the subject of debate concerning their composition. Perhaps the simplest interpretation is that these forests were of mixed pines (longleaf, slash, loblolly, and pond) with longleaf pine in pure stands toward the drier end of the gradient, as a dominant or codominant over the broad middle of the gradient, and in stands dominated by the other pines toward the wetterend.
3. *Sandhill* ecosystems (mapped as Longleaf Pine and Xerophytic Oaks by Davis, 1967) were dominated by longleaf pine in varying mixtures with hardwoods.

Using the digital version of the Davis (1967) map, an estimated 21,850,000 acres were in Mixed Hardwood and Pine, Pine Flatwoods, and Sandhill in Florida (Table 1, Page 136). This would represent 24% of the pre-settlement range provided by Frost (2006).

Box *et al*. (1999) developed a climatic-envelope model to assess the potential effects of several climate change scenarios on the distribution of important tree species in Florida. This climate-based model estimated that the original extent of longleaf pine in Florida covered more than 29,715,000 acres. This extent included many other ecosystem types, such as wetlands, that did not contain longleaf pine.

Forest Inventory and Analysis Data

Forest Inventory and Analysis (FIA) data for the State of Florida are available on the U.S. Forest Service Southern Research Station website in reports dating from 1987 through 2016. Historical changes in longleaf pine acreage from forest survey data are shown in Figure 2, Page 137. In the first Forest Survey in 1936, longleaf pine was the leading forest type and occupied about 45%, or 8,865,000 acres, of the total commercial forest land (Knight and McClure 1970). By 1970, commercial longleaf pine forests occupied less than 10% of total commercial forest land due to conversion to slash pine, which represented more than 1/3rd of total commercial forest land. This change was accompanied by an increase in the ownership of forest land by forest industry, from 23% of the commercial forest land in 1959 increasing to about 1/3rd by 1970.

Between 1970 and 1980, conversion of forests to slash pine continued to increase (34%) while remaining longleaf pine acreage continued to decline (17%) (Bechtold and Knight 1982). By 1980, longleaf pine forests made up only 8% of Florida's timberland.

The rate of decline in longleaf pine acreage continued with a reduction in remaining acres by 23% between 1980 and 1987 (Bechtold *et al*. 1990). By 1987, longleaf pine occupied only 6% of the timberland area. These authors reported a growing interest in planting longleaf pine but noted that not much progress was being made – only 2% of all plantations, or 90,000 acres, were in longleaf pine at that time.

Brown (2007) reported an overall decline in all forested acreage between 1936 and 1995 from 23.5 million acres to 16.9 million acres. Although a decline occurred in each year of the surveys, the highest rate was in the 1950s with the rate slowing between 1987 and 1995. Declines persisted in the peninsula and northeastern Florida, while acreage in timberland increased slightly in the northwestern portion of the state. Sandhills made up 17%, rolling uplands (upland pine) 10%, and flatwoods 45% of the timberlands in Florida in 1995. Longleaf pine continued to decline by 22% in that period to only 740,500 acres. The continued decline in longleaf pine resulted from land conversion to agriculture and development, and replacement with other pine species including slash, loblolly, and sand pine (Outcalt 1997).

Using FIA data from 1995, Outcalt (1997) described a rate of decline of 11,400 acres per year between 1987 and 1995 in plots where longleaf comprised more than 50% of the trees. In this analysis, Florida had the most longleaf forest type with 741,000 acres out of the 2,965,000 acres remaining throughout the range.

Between 1987 and 1995, approximately 65% and 22% of the conversions from longleaf were to urban and agricultural uses, respectively. About 90% of these land use conversions occurred on private lands. Losses were greater on xeric sandhill sites than on more mesic upland and flatwoods sites. Much of this was the result of scrub oaks capturing dry sites, suggesting a lack of fire management, a lack of longleaf recruitment, or both. Restoration of

these sites on both public and private lands was occurring during the period, but not at rates that abated the continuing decline. Outcalt (1997) noted that there were substantial opportunities for restoration on both public and private lands.

FIA data from 2007 (Miles 2009) suggest some changing trends for longleaf pine in the state (Figure 2, Page 137). For the first time since 1936, the number of acres of Longleaf Pine forest type appears to have increased 15.4% from a low of 740,755 acres in 1995 to 855,139 acres in 2007. There is no overlap in the sampling error percentage around these two figures. Although the cause of this apparent increase in longleaf forest acreage is unclear, it is coincident with increased efforts on both public and private land to reforest former longleaf sites that had been converted to other forest species or other uses, such as pasture. This trend continued in the following decade, with Longleaf Pine Forest increasing 17% over 2007 estimates to 1,000,538 acres in 2016 (USDA Forest Service 2020).

The Longleaf Pine/Oak forest type acreage has been steadily declining since 1995, when data collection for this forest type began, from a high of 390,407 acres to 280,940 acres in 2016. Possible explanations for this change include increased longleaf pine community restoration, increased degradation of disturbed longleaf pine communities, and less likely, loss of xeric sandhill acreage.

The shift in ownership of longleaf pine forests is also apparent in Figure 3, Page 138. The number of acres in longleaf pine forests is defined in this data as acres capable of producing timber crops and not withdrawn from utilization. While acreage on public land remained relatively steady from the 1970 to 1995 surveys, the acreage in private ownership declined during this period. Data from 1995 FIA surveys reported 394,209 acres of longleaf pine on public land, a figure that exceeded the private land acreage of 321,423 by 72,786 acres. This trend was also observed in 2007; public land longleaf pine acreage totaled 487,241, with private land acreage estimated at 348,269. The 2007 data shows an increase of nearly 24% over 1995 in the acreage on public land, and, for the first time, there is no decline in acreage on private land, with total acres increasing by 8.4%. The increase in acreage on public land is due to an active program for acquisition of conservation lands in Florida and longleaf pine restoration. Data from 2016 FIA surveys show a smaller increase for public land longleaf pine acreage over the previous 10-year period, while the opposite is true for private land acreage. Public land acreage increased by 12.6% to 548,581 acres, while private land acreage saw a similar increase of 12.2%, bringing the total to 390,931 acres (USDA Forest Service 2020).

Landsat Imagery

Kautz et al. (2007) used Landsat imagery to determine changes in vegetation between 1985-1989 and 2003. The researchers found that sandhills experienced a relatively high degree of loss with 15.5% of those present in 1985-1989 converted to other uses by 2003. Of this conversion, 72% was to urban or other development. Other LPE types were grouped with other forest types to the extent that additional longleaf losses could not be assessed. The

general category of “Pinelands” experienced a 9.2% conversion to other uses over the same period.

The Florida Fish and Wildlife Conservation Commission (FWC) (2005) provided an assessment of “habitats” in Florida based on the same 2003 Landsat imagery analyzed by Kautz *et al*. (2005). Their assessment included three habitats in which longleaf pine is either a dominant or codominant species. The FWC’s ranking system identified “interior scrub and sandhill habitats” as one of five geographic regions or discrete habitat types that is a “Critical Area for Terrestrial Conservation”. According to the FWC (2005):

- Mixed Hardwood-Pine Forest included associations that are dominated by longleaf pine.
  - 879,766 acres
  - 16% designated as Strategic Habitat Conservation Areas
  - 74% on private lands

- Natural Pineland included associations dominated by longleaf pine.
  - 3,095,165 acres
  - 30% on conservation or managed areas, 7% on private lands on the state’s acquisition list, and 8% designated as Strategic Habitat Conservation Areas
  - 56% on other private lands

Mapping, assessment, and management efforts for Mixed Hardwood-Pine Forest and Natural Pineland are confounded by the fact that the types are artifacts of previous and somewhat out-of- date vegetation classification efforts in Florida that confused ecological processes such as the role of fire and the stability of longleaf pine forests. These classifications were also based on the use of Landsat imagery that could not distinguish well among conifer and mixed conifer-hardwood forests.

- Sandhill ecosystems were more easily and clearly mapped.
  - 753,547 acres
  - 45% on conservation or managed areas
  - 5% on private lands on the state’s acquisition list, and 5% designated as Strategic Habitat Conservation Areas
  - 45% on other private lands

In an effort to develop a common habitat classification system that could be used by FWC and its partners, the agency developed the Florida Land Cover Classification System in 2009 (FWC 2009). Soon thereafter, FWC partnered with FNAI to create the Cooperative Land Cover (CLC) Map utilizing the Land Cover Classification System. The CLC was produced using existing data

sources, including aerial imagery, to identify and locate recognized habitat types throughout the state. Habitat data obtained from the CLC was incorporated into FWC's Florida's State Wildlife Action Plan 2019. These data include the following longleaf pine community acreages:

- Sandhill (775,755 ac.)
- Upland Coniferous (444,728 ac.)
- Upland Mixed Woodland (10,939 ac.)
- Dry flatwoods (1,526,927 ac.) (includes wet, mesic and scrubby flatwoods)

The Florida Natural Areas Inventory (FNAI 2009, 2018) recently conducted an analysis of inadequately or under-represented natural community types (ecosystems), defined as those communities of which less than 15% of their original extent currently exists, on conservation lands. The analysis evaluated Sandhill and Pine Flatwoods and used the Davis (1967) map to define original extent. The current acreage for each of these natural communities was estimated using 2003 Florida Fish and Wildlife Conservation Commission Landsat imagery and Florida Water Management District land cover classifications. Acreages were further adjusted based on data for potential natural areas from the Florida Natural Areas Inventory database.

The original extent for Sandhill was estimated at 6,943,000 acres, while just 773,050 acres, or 11%, of the original extent remain. Only 484,570 acres, or 7% of the original extent, is protected on public conservation lands.

The original extent of Pine Flatwoods was estimated at 12,558,000 acres. Currently, only 2,331,680 acres, or 19% of the original acreage, remain, and only 1,236,190 of these acres are on public lands (10% of the original acreage.)

The most current inventory and analysis is from the Florida Longleaf Pine Ecosystem Geodatabase (LPEGDB). From 2012-2018, the Florida Forest Service (FFS), FNAI, and partners developed a spatial database that serves as the central repository for data on the distribution and condition of Longleaf Pine Ecosystems in Florida. A major accomplishment of the project was the collection of new data for previously unknown longleaf pine sites resulting from FFS County Forester surveys. The database currently shows approximately 2.36 million acres of confirmed longleaf pine in Florida (Table 2, Page 137). This database is a major step toward fulfilling the inventory and assessment objectives of the 2010 Florida's Forest Action Plan and the America's Longleaf 2009 Range-wide Conservation Plan for Longleaf Pine, as well as serving as a template for the larger Longleaf Element Occurrence project in the southeastern United States.

Public Lands

The estimates below are from recent inventory and mapping efforts or from the Cooperative Land Cover Map (v3.4) and were obtained directly from the agencies or FNAI. Based on these

data, current public land longleaf pine community acreage in Florida totals approximately 1,447,320 (Figure 4, Page 138). An additional 102,707 acres of longleaf pine communities occur on private conservation lands and conservation easements (all types).

State Forests

The historical natural communities of most of the state forests have been mapped using the Florida Natural Areas Inventory natural community classification and the earliest available aerial imagery with ground-truthing by ecologists. The data suggests that, historically, more than 625,000 acres of state forest land may have been dominated or co-dominated by longleaf pine. Current natural community acreage presented in the table below is from a combination of FNAI maps developed for the agency (59%) and the Cooperative Land Cover Map (CLC) v3.4 in areas without FNAI agency maps (41%). Between 1991 and 2020, FFS reforested 91,344 acres with longleaf pine, averaging 3,045 acres per year.

State Forest Longleaf Pine Acres by Community Type		
Natural Community	**Acres**	
	Historical	**Current**
Sandhill	135,338	107,340
Upland Pine	150,707	123,804
Mesic Flatwoods	229,810	131,149
Scrubby Flatwoods	9,277	7,071
Wet Flatwoods	97,985	2,012
Upland Mixed Woodland	1,992	3,690
Total	**625,109**	**375,065**

State Wildlife Management Areas

Historical natural communities have been mapped for most of the Wildlife Management and Wildlife and Environmental Areas managed by the Florida Fish and Wildlife Conservation Commission. These areas were mapped by the Florida Natural Areas Inventory using remote sensing and ground-truthing techniques. Current natural community acreage presented in the table below is from the Cooperative Land Cover (CLC) Map v3.4.

Wildlife Management/Wildlife and Environmental Area Longleaf Pine Acres by Community Type		
Natural Community	**Acres**	
	Historical	**Current**
Sandhill	10,013	10,267
Upland Pine	5,324	3,536
Mesic Flatwoods	121,932	89,086
Scrubby Flatwoods	4,551	7,634
Wet Flatwoods	40,657	29,655
Upland Mixed Woodland	-	518
Total	**182,477**	**140,696**

State Parks

Florida State Parks and Recreation Areas are managed by the Florida Department of Environmental Protection (DEP). The agency manages an additional 5,548 acres of longleaf pine on land outside of the state park system, the majority of which are mesic flatwoods. Current natural community acreage presented in the table below is from the Cooperative Land Cover (CLC) Map v3.4.

State Park Longleaf Pine Acres by Community Type		
Natural Community	**Acres**	
	Historical*	**Current**
Sandhill		19,207
Upland Pine		10,064
Mesic Flatwoods		54,410
Scrubby Flatwoods		11,490
Wet Flatwoods		14,110
Upland Mixed Woodland		6,141
Total		**132,571**

*No data available

Water Management Districts

Florida's five water management districts protect and manage land through acquisition or easements for the purpose of protecting water quality and quantity. Current natural community acreage presented in the table below is from the Cooperative Land Cover (CLC) Map v3.4.

Water Management District Longleaf Pine Acres by Community Type		
Natural Community	**Acres**	
	Historical*	**Current**
Sandhill		11,606
Upland Pine		1,383
		91,484
Scrubby Flatwoods		6,544
Wet Flatwoods		27,917
Upland Mixed Woodland		23
Total		**138,957**

*No data available

National Forests in Florida

The USDA Forest Service manages almost 1.2 million acres of land in three national forests, the Apalachicola, Ocala, and Osceola National Forests. Data collected from 2017 and 2018 reported in the *National Forests in Florida Longleaf pine restoration strategy v. 2 September 2018* shows longleaf pine communities occurring on a total of 217,834 acres across all three forests. The greatest acreage occurs in the Apalachicola National Forest with 137,113 acres, followed by 52,339 acres in the Ocala and 28,382 acres in the Osceola. Stand analyses indicate an additional 545,144 acres of national forest land with potential for longleaf restoration. Data in the RWCP show that National Forests in Florida have 206,413 acres of existing longleaf pine ecosystems, with a goal of 220,548 acres (ALRI 2009).

National Wildlife Refuges

Current natural community acreage presented in the table below is from the Cooperative Land Cover (CLC) Map v3.4.

National Wildlife Refuge Longleaf Pine Acres by Community Type		
Natural Community	**Acres**	
	Historical*	**Current**
Sandhill		5,540
Upland Pine		0
Mesic Flatwoods		19,507
Scrubby Flatwoods		1,952
Wet Flatwoods		11,253
Upland Mixed Woodland		0
Total		**38,252**

*No data available

Department of Defense

Current natural community acreage presented in the table below is from the Cooperative Land Cover (CLC) Map v3.4.

U.S. Department of Defense Longleaf Pine Acres by Community Type		
Natural Community	**Acres**	
	Historical*	**Current**
Sandhill		227,148
Upland Pine		11,325
Mesic Flatwoods		37,149

Scrubby Flatwoods		5,106
Wet Flatwoods		34,320
Upland Mixed Woodland		0
Total		**315,048**

*No data available

County and Municipal Governments

Current natural community acreage presented in the table below is from the Cooperative Land Cover (CLC) Map v3.4.

Local Governments **Longleaf Pine Acres by Community Type**		
Natural Community	**Acres**	
	Historical*	**Current**
Sandhill		2,923
Upland Pine		6
Mesic Flatwoods		68,463
Scrubby Flatwoods		4,643
Wet Flatwoods		9,377
Upland Mixed Woodland		235
Total		**85,647**

*No data available

Private Conservation Land

Current natural community acreage presented in the table on following page is from the Cooperative Land Cover (CLC) Map v3.4.

Private Conservation Lands Longleaf Pine Acres by Community Type		
Natural Community	**Acres**	
	Historical*	**Current**
Sandhill		6,324
Upland Pine		29
Mesic Flatwoods		13,578
Scrubby Flatwoods		4,344
Wet Flatwoods		5,642
Upland Mixed Woodland		0
Total		**29,917**

*No data available

Conservation Easements

Current natural community acreage presented in the table below is from the Cooperative Land Cover (CLC) Map v3.4.

Conservation Easements Longleaf Pine Acres by Community Type		
Natural Community	**Acres**	
	Historical*	**Current**
Sandhill		6,193
Upland Pine		9,840
Mesic Flatwoods		45,233
Scrubby Flatwoods		2,978
Wet Flatwoods		8,531
Upland Mixed Woodland		15
Total		**72,790**

*No data available

Private Land

FIA survey data from 2016 show 396,767 acres of Longleaf Pine forest type and 169,270 acres of Longleaf Pine Oak forest type currently exist on private land in Florida.

3) Public Benefits

Longleaf Pine Ecosystems provide a variety of economic, cultural, ecological, and recreational benefits to the public. Historically, longleaf pine forests were harvested for a variety of products including lumber, pulp, and naval stores. Because of its tall, straight form, longleaf pine was used to produce masts for sailing ships and exported to other countries (Hughes 2007). Longleaf pine has been called the "tree that built the south" (Summerford 2000) because it was the source of most of the "heart pine" (resin-soaked heartwood) that was used to construct southern homes.

Longleaf Pine Ecosystems are highly valued for their aesthetic quality and recreational opportunities, both of which have become major components of southern culture. Longleaf pine forests are internationally known for their value as hunting reserves, especially for southern bobwhite quail. The aesthetic value of the open-grown longleaf pine forests with their majestic trees, understory grasses, and displays of wildflowers and butterflies has been noted by countless authors, foresters and biologists.

Biodiversity may be the most important public benefit provided by Longleaf Pine Ecosystems. The complex, natural vegetative pattern and disturbance-mediated processes that characterize Longleaf Pine Ecosystems promote high levels of biodiversity. The number of plant species per unit area qualifies these terrestrial ecosystems as among the most species-rich in the temperate zone (Brockway *et al*. 2005).

In addition to biodiversity, LPEs have also proven to be essential for some cultural applications. Currently, timber extracted from old-growth forests of longleaf pine are being used to help restore Notre Dame cathedral, as well as historic battleships. Niche markets for old-growth longleaf pine timber have continued to expand in recent decades. In a recent assessment of LPE restoration needs, Smith et al. (2018) conclude that the "… value of restoring and establishing old-growth stands needs to be in discussion about the longleaf pine ecosystem. To our knowledge, there is not a comprehensive effort to establish a series of representative old-growth sites on the few public lands that currently support mature LPE forests" (Smith *et al*. 2017).

Some research suggests that Longleaf Pine Ecosystems may be resilient to climate change (Costanza *et al*. 2015). Longleaf pines are relatively tolerant of climate-related stressors, such as drought (Samuelson *et al*. 2012), and wind damage (several references reviewed in Zamperi 2019). A significant research gap exists in light of the complex interactions that occur with prescribed fire, the potential changes in range given there is a possible affirmative role of longleaf pine in climate change mitigation, and the suggestion that longleaf pine could play a role in mitigating climate change and in carbon storage. Thus, a strategy to manage this ecosystem can meet both native biodiversity and climate adaptation goals.

4) Threats

In an assessment of risk to ecosystems in the United States (Noss and Peters 1995, cited in FWC 2005), seven southeastern states (Florida, Georgia, North Carolina, South Carolina, Virginia, Alabama, and Tennessee) were rated in the "extreme risk" category based on number of endangered ecosystems, percentage of imperiled species by state, and development pressures. The longleaf pine and savanna ecosystem was ranked as the third most endangered ecosystem according to this assessment.

In Florida's Wildlife Action Plan 2019, FWC utilized the Conservation Measures Partnership's Direct Threats Classification system to identify threats to wildlife habitat and biodiversity in Florida's ecosystems. The agency's adoption of this hierarchical classification system followed recommendations of the Association of Fish and Wildlife Agencies aimed at creating consistency among state wildlife action plans (FWC 2019). The original classification developed by Salafsky *et al*. (2008) "is designed to provide a simple, hierarchical, comprehensive, consistent, expandable, exclusive and scalable classification of all direct threats to biodiversity" (FWC 2019).

Four habitat types identified by FWC (2019) account for a large percentage of Longleaf Pine Ecosystems in Florida: Sandhill, Upland Coniferous, Upland Mixed Woodland, and Pine Flatwoods (includes scrubby, mesic and wet flatwoods). Threats to these habitats include development, agriculture, linear facilities, anthropogenic disturbances, including modification of natural processes, such as fire regimes, nuisance and non-native invasive species and pathogens, and climate change. The severity and extent to which these threats impact each habitat type is variable and likely to change through time. The mechanisms by which these threats are most likely to alter longleaf pine habitats are presented below.

<u>Lack of Fire Management</u>

The primary threat to the remaining longleaf pine ecosystem is the absence of frequent fire. Currently, fire management in longleaf pine communities is achieved almost exclusively with prescribed fire as the landscape of Florida is no longer conducive to management with naturally occurring fire or unregulated fire caused by human activities. Therefore, any impediment to the application of prescribed fire has the potential to result in an absence of fire or reduction in fire frequency in longleaf pine communities. Most impediments to the application of prescribed fire are directly or indirectly tied to development and changes in land use. For example, fragmentation caused by development and changes in land use contributes to decreased fire frequency in many areas by increasing the cost and complexity associated with conducting prescribed burns and narrowing the conditions under which they can be conducted safely. The presence of infrastructure, particularly in the Wildland Urban Interface, increases the risks associated with the application of prescribed fire, such as the potential for property damage and smoke-impacts to human health. Furthermore, the misapplication of prescribed fire that results in damage to natural resources, property, and/or human health could result in the inability or restricted ability to conduct burns in the future. Challenges to effectively managing longleaf pine communities in Florida with fire are likely to increase as population growth results in additional development and land use changes (Brockway *et al*. 2005).

Lack of frequent fire in longleaf pine communities increases the risk of catastrophic wildfire caused by excessive vegetative fuel loads in these areas. In addition to their negative ecological impacts, catastrophic wildfires jeopardize human health and safety. Increased wildfire risk due to excessive fuel loading can be mitigated through the development and implementation of fire management programs that yield effective prescribed burning and wildfire contingency plans.

A fire regime consisting of frequent, low-intensity fire is integral to maintaining the health and ecological value of LPEs. Prescribed fire management informed by historic fire frequency, seasonality, intensity, and extent is necessary to maintain biodiversity and preserve vegetative community composition and structure. Atypical fire behavior and qualities caused by altered fuel structures, such as high intensity levels, ground fires and long surface residence time near tree boles, resulting from disturbed fire regimes often result in overstory tree mortality, sterilization of soils, and compromised seed bank viability, among other negative ecological impacts.

Conversion to Other Uses

Florida's significant population growth over the past 70 years has resulted in increased development and the loss and fragmentation of natural areas throughout the state. The state's population grew from less than three million people in 1950 to nearly 21.5 million by 2019 (Bureau of the Census 1950 and 2020). Recent projections predict Florida's population may increase by nearly 27%, to just below 27.3 million people, by 2045 (Rayer and Wang 2020). These figures are based on 2010 census figures and thus do not account for recent economic developments.

Conversion to other uses and the construction of linear facilities, such as roads and powerlines, to accommodate Florida's population growth, has affected LPEs. FWC (2019) identified conversion to residential, commercial, and industrial development and recreation areas as threats to all longleaf pine forest types. Aside from the direct loss of LPE acreage, conversions to other uses increases ecosystem fragmentation, which in turn negatively impacts many aspects of the remaining natural community. Fragmentation alters community composition, structure, and functions, such as fire regimes and hydroperiods, soil structure, and chemistry. Fragmentation also promotes the proliferation of non-native invasive plants and animals.

Silvicultural Practices

Land management practices, including silviculture, if not planned and implemented appropriately, can alter the composition, structure, and function of LPEs such that their inherent values are decreased. In Florida's State Wildlife Action Plan (FWC 2019), FWC identifies intensive silviculture as incompatible with the needs of many wildlife species. However, silviculture and other land management activities are compatible with the needs of many wildlife species through the application of Silviculture and Wildlife Best Management Practices that effectively protect and preserve water quality and wildlife habitat. While voluntary, compliance with Silviculture BMPs is consistently high as confirmed by monitoring conducted by the FFS. Silvicultural practices are essential for restoration, management, and the generation of revenue vital to achieving the long-term mutual goal of sustaining and perpetuating LPEs.

Non-native Invasive Plants and Animals

Due to its climate, Florida provides an ideal habitat for invasive species from both the tropical and temperate zones. Non-native invasive plants and animals directly and indirectly threaten wildlife through competition, predation, habitat alteration, and the introduction of pathogens (FWC 2019). In addition to the ecological impacts of non-native invasive species, management of these plants and animals comes at a significant cost. Recent estimates show that state and federal agencies spend nearly $45 million dollars annually to treat non-native invasive plants on conservation lands alone (Hiatt et al. 2019). Treatment costs associated with severe non-native invasive species infestations in degraded longleaf pine communities may be prohibitive to restoration in some cases.

Threats specific to Natural Pinelands were identified (FWC 2005), such as the construction and maintenance of utility corridors through this habitat particularly on public lands, conversion to more intensive land uses, and insufficient management of invasive plant species. Threats specific to Sandhill were identified as the pathogen-causing Upper Respiratory Tract Disease in gopher tortoises, movement of parasites and pathogens from pets to native wildlife, siting of utility corridors through this habitat, military base closures, and insufficient management of invasive species (FWC 2005).

Climate Change

Much more research is needed to understand how longleaf pine communities in Florida will be affected by climate change. Range migration and changes to community composition, structure, function, and disturbance regimes will occur in response to shifting climatic variables, but the extent to which such changes will occur is less clear. Another unknown is the effect that population movement resulting from climate change impacts will have on longleaf pine communities. Given the implications for prescribed fire, the impact of shifting populations is likely to be significant, especially when coupled with current population growth predictions for Florida.

A primary threat from climate change facing the longleaf pine ecosystem lies in the potential for it to disrupt the delicate balance between precipitation, temperature, and disturbance (fire, tropical storms and anthropogenic). Studies into climate-growth relationships find that high summer temperatures and low precipitation (drought), which are likely to occur more frequently due to climate change, negatively impact growth of longleaf pine (Devall & Parresol, 1998; Foster & Brooks, 2001; Henderson & Grissino-Mayer, 2009; Meldahl, et al., 1999; Patterson et al., 2016). These effects may be stronger at the southern limit of the species range in central Florida. In addition, the effects of increased CO_2 on longleaf pine tree growth are poorly understood.

Hurricanes and tropical storms are also important components of the disturbance regime in LPEs. Historically, these storms played a significant role in regulating tree density throughout the coastal plain by regularly creating mortality events. Frequent, low-intensity hurricanes helped to maintain open canopy dynamics by removing trees from the overstory. However, data from numerous climatic models suggest an increase in the frequency of more severe storms in the North Atlantic, which could lead to more mass mortality events (Elsner et al. 2008, FWC 2016).

The threats posed by climate change may also impede natural regeneration, alter fire regimes, increase opportunities for invasive species establishment, and provide favorable conditions for the spread of pests and other pathogens in longleaf pine communities (Dale et al., 2001; Everham & Brokaw, 1996; Holzmueller & Jose, 2012; Lake & Leishman, 2004; Mitchell et al., 2009; Platt et al., 2009; Seidl et al., 2017). It is important to consider that even protected, high-quality stands of longleaf pine are at risk from the broader impacts of climate change and associated extreme stochastic events.

5) Opportunities

Significance of Florida to the Conservation of Longleaf Pine Ecosystems

Two of the six longleaf pine vegetation ecoregions described by Peet (2006) occur in Florida. The majority of the Southern Coastal Plain type occurs in the peninsula and the southern panhandle and a portion of the Eastern Gulf Coastal Plain occurs in the northern portion of the panhandle.

More longleaf pine forest occurs in Florida than in any other state. FIA data shows the state contains 29% of all of longleaf forest types by acreage, approximately 10% more than Alabama, which contains the second largest acreage (Kirkman and Jack 2018). The largest concentrations of longleaf pine forests within the range are in Okaloosa (175,479 ac.) and Santa Rosa (147,575 ac.) Counties, which combined comprise just over 25% of the total longleaf forest acreage in Florida, which as of 2016, totaled 1,281,478 acres (FIA 2016). Florida is unique in that it is the only state where the majority of longleaf pine forest is under public ownership (Outcalt and Sheffield 1996).

Six of the eleven longleaf pine ecoregions identified by RWCP (2009) occur in Florida. The Florida Longleaf Pine Sandhill type occurs only in Florida. Two additional upland ecosystems, the East Gulf Coastal Plan Interior Upland Longleaf Pine Woodland and the Atlantic Coastal Plain Upland Longleaf Pine Woodland, also occur in Florida. One of the flatwoods ecosystems, Central Florida Pine Flatwoods, occurs only in Florida, while two additional flatwoods systems, East Gulf Coastal Plain Near-coast Pine Flatwoods, and Southern Atlantic Coastal Plain Wet Pine Savanna and Flatwoods, also occur in Florida.

Significant Landscapes for Longleaf Conservation, defined as regions where there is the potential to restore connected landscapes of over 100,000 acres of longleaf pine communities, are identified in eight southern states from Texas to North Carolina (RWCP 2009). Four of these Significant Landscapes occur at least partially in Florida. The largest of the Landscapes is the Eglin Air Force Base/Blackwater River State Forest/Conecuh National Forest, which occurs in Alabama and Florida. The Osceola National Forest/J.M. Bethea State Forest/Okefenokee National Wildlife Refuge occurs in Florida and Georgia. Two additional Significant Landscapes, the Apalachicola National Forest/St. Marks National Wildlife Refuge and the Ocala National Forest, occur entirely in Florida.

Restoration

A combination of recent developments provides hope that the negative trend for longleaf pine forests can be reversed. Reforestation with longleaf pine and restoration of degraded longleaf pine sites have slowed the conversion of longleaf pine to other tree species on public lands (Brockway *et al*. 2005). Incentives from federal and state governments for reforestation of longleaf pine have resulted in a recent surge on private lands; between 1998 to 2000, longleaf pine was planted on more than 168,000 acres across the region. State and federal land management agencies are making a concerted effort to restore longleaf pine ecosystems within the state. Between 1991 and 2020, the Florida Forest Service has planted 91,344 acres of longleaf pine, averaging 3,045 acres per year. Efforts to restore longleaf pine ecosystems by The Nature Conservancy and Nokuse Plantation are notable examples of successful restoration efforts on private lands. Restoration and reforestation of longleaf pine has also benefited from the concerted efforts of such groups as the Longleaf Alliance, whose mission is "… the restoration of the longleaf pine forest ecosystem across its range, emphasizing its economic and ecological values through research, education, and outreach" (http://www.longleafalliance.org/).

The need for ecological restoration of longleaf pine ecosystems is clear, but the choice and the extent to which it should and can be pursued are less clear (Brockway et al. 2005). Restoration decisions, including both whether to restore and how to do so, require an integrated, multi-disciplinary approach that incorporates ecological, land use, social and economic considerations (Kirkman and Jack 2018). While restoration occurs at a local level (site-specific), it must be planned and implemented within the context of achieving large-scale ecosystem goals and objectives, such as biodiversity, population viability and ecosystem services (RWCP 2009).

A significant amount of research and land management experience over the last several decades have provided important information on the effectiveness of longleaf pine restoration and land management practices that can be used to guide on-the-ground restoration efforts going forward. Management goals and objectives determine the desired restoration condition of a given site, whereas the site conditions will determine the course of management actions needed to achieve the desired condition. While the specific structural and compositional attributes of the possible desired conditions may be variable, it is generally accepted that successful longleaf pine restoration requires three primary components: overstory reestablishment, implementation of a frequent fire regime, and restoration of native groundcover (Kirkman and Jack 2018).

5) Agency and Organizational Roles

The following agencies and organizations have been identified as integral to longleaf pine ecosystem management and restoration efforts in Florida.

Private

Longleaf Alliance, Tall Timbers Research Station & Land Conservancy, Archbold Biological Station, Joseph W. Jones Ecological Research Center, Nokuse Plantation, Florida Forestry Association, The Nature Conservancy, Florida Audubon Society, Coastal Headwaters.

Local

County Environmental Management Departments

State

Florida Forest Service, Florida Fish & Wildlife Conservation Commission, Florida Department of Environmental Protection, Northwest Florida Water Management District, Suwannee River Water Management District, St. Johns River Water Management District, South Florida Water Management District, Southwest Florida Water Management District, Florida National Guard.

Federal

USDA Forest Service, US Fish & Wildlife Service, US Department of Defense, US Environmental Protection Agency.

Universities

University of Florida IFAS, Florida State University, Florida Natural Areas Inventory, University of West Florida, Auburn University.

Multi-Agency Organizations

Gulf Coastal Plain Ecosystem Partnership, Apalachicola Regional Stewardship Alliance, Upland Ecosystem Restoration Project.

7) Priority Areas

Prioritization of areas for longleaf pine restoration is a complex endeavor that should be guided by both regional and local restoration goals and objectives. A multitude of ecological, land use, and economic factors contribute to successful longleaf pine management and restoration and any prioritization of areas for restoration must assess all of these. Once restoration criteria have been determined, they can be used to systematically evaluate disturbed longleaf pine communities to determine restoration feasibility and priorities.

To assist in the development of restoration priorities, the map in Figure 5, Page 139 was created using data from the Range-wide Conservation Plan for Longleaf Pine, the Landowner Survey Focus Areas map provided by FWC, and managed areas mapped by the Florida Natural Areas Inventory. The boundaries should be interpreted as general guidelines that can be expanded or contracted as needed to facilitate management and restoration of LPEs at the parcel and landscape scale. The majority of areas in Figure 5 are now part of America's Longleaf Restoration Initiative Significant Geographic Areas (ALRI SGAs), for which interagency Longleaf Implementation Teams (LITs) have been established by the ALRI. These LITs are focused on longleaf pine restoration, management, and conservation.

The Goals, Objectives, and Strategies listed below and in the Performance Measures that follow include ongoing, short-term (2 – 3 years) near-term (5 years), and long-term implementation timeframes. The timeframe within which a Strategy is expected to be implemented is broadly indicated in the Performance Measures, and the order in which they are listed is meant to suggest priority among the Objectives and Strategies. The first two Goals should be considered the highest priority because of the need to identify where and how LPE exist and are currently being managed in Florida and the absolute imperative to apply frequent prescribed fire wherever safety and logistical concerns can be met.

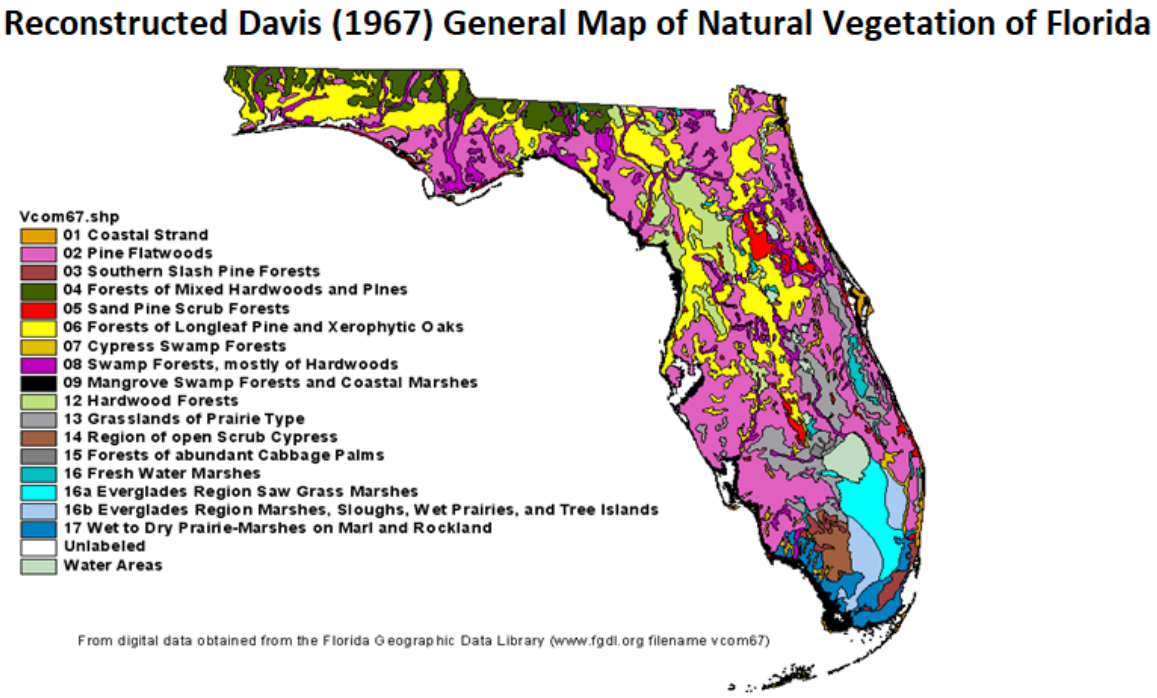

Figure 1. Reconstructed Davis (1967) general map of natural vegetation of Florida.

Source: Florida GeoPlan Center, University of Florida

	Sandhill	Pine Flatwoods	Mixed Hardwood and Pine	Florida Total	Range-wide
Pre-settlement [3]					91,000,000
Historical [1]	7,161,445	12,566,263	2,123,358	21,851,066	
Historical [2]	6,943,000	12,558,000			
1985-89 [8]	851,315	6,538,048		7,389,363	
2003 [10]	753,547	3,095,000	979,766	4,828,313	
2003 [11]	762,085	6,544,440	893,545	8,200,070	
2003 [12]	768,100	2,928,200		3,696,300	

Table 1. Historical acreages of pine ecosystems in Florida.

Sources: [1] based on Davis (1967); [2] FNAI (2009) based on Davis (1967); [3] Frost (2006); [4] Brown (1999); [5] Knight and McClure (1971); [6] Bechtold and Knight (1982); [7] Bechtold *et al*. (1987); [8] Kautz *et al.* (2007); [9] Outcalt and Sheffield (1996); [10] FWC (2005); [11] Kautz *et al.* (2007); [12] FNAI (2009); [13] Brown (1999); Miles (2009); [14] RWCP (2009); [15] Miles (2009), [16] Larson and Goforth (1961).

Manager Type	Acres	
Federal Conservation Lands		**629,459**
US Dept. of Defense	342,033	
US Fish and Wildlife Service	20,758	
US Forest Service	265,795	
Federal Conservation Lands- Other	873	
State Conservation Lands		**711,723**
FL DEP, Florida Coastal Office	1,166	
FL Fish and Wildlife Conservation Commission	80,331	
Florida Forest Service	392,842	
Florida Park Service	74,368	
Northwest Florida Water Management District	24,725	
South Florida Water Management District	1,599	
Southwest Florida Water Management District	56,817	
St. Johns River Water Management District	23,873	
Suwannee River Water Management District	17,404	
State Conservation Lands- Other	38,598	
Local Conservation Lands		**41,414**
Private Conservation Lands		**15,616**
Conservation Easements & Mitigation Banks		**71,503**
Other Private Lands		**894,757**
Total		**2,364,472**

Table 2. Acres of confirmed longleaf pine ecosystems by manager type for the Longleaf Pine Ecosystem Geodatabase project.

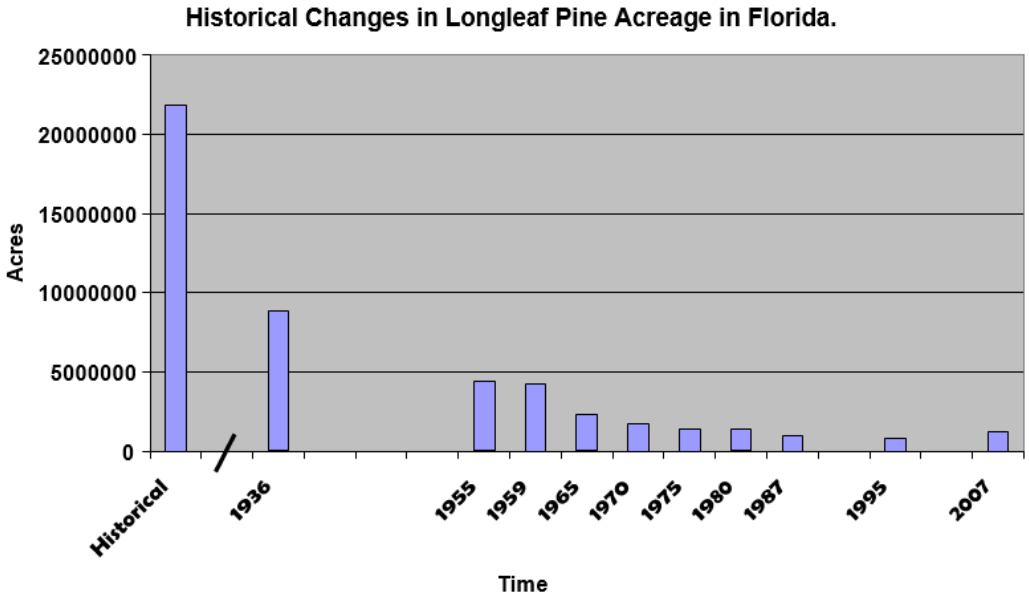

Figure 2. Historical longleaf pine acreages over time.

Sources: Forest survey data reported in Brown (1995) and Miles (2009), and historical data calculated from Davis (1967).

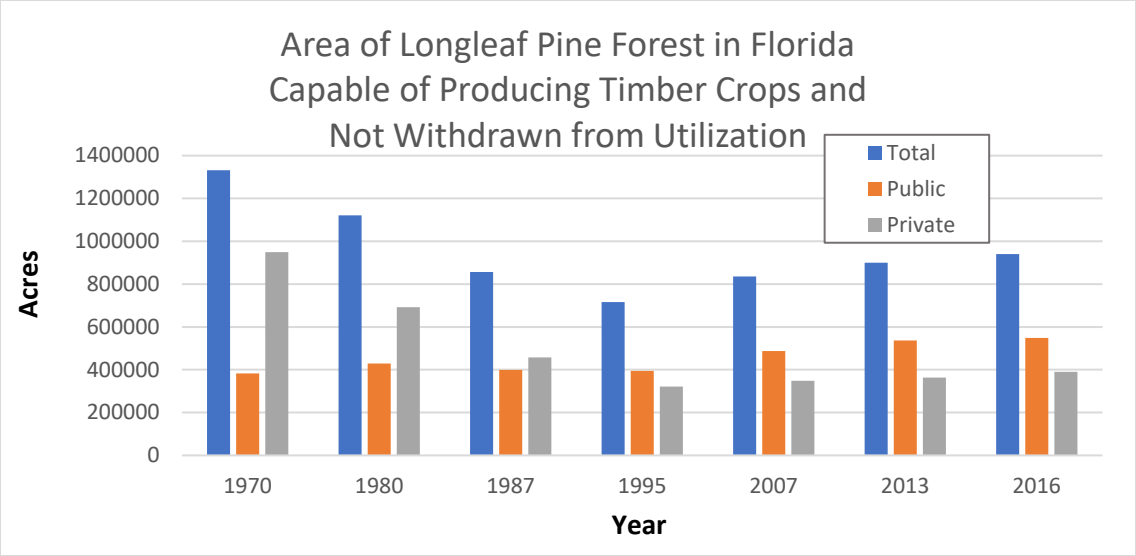

Figure 3. Area of longleaf pine forest in Florida capable of producing timber crops and not withdrawn from utilization.

Source: USDA Forest Service 2020

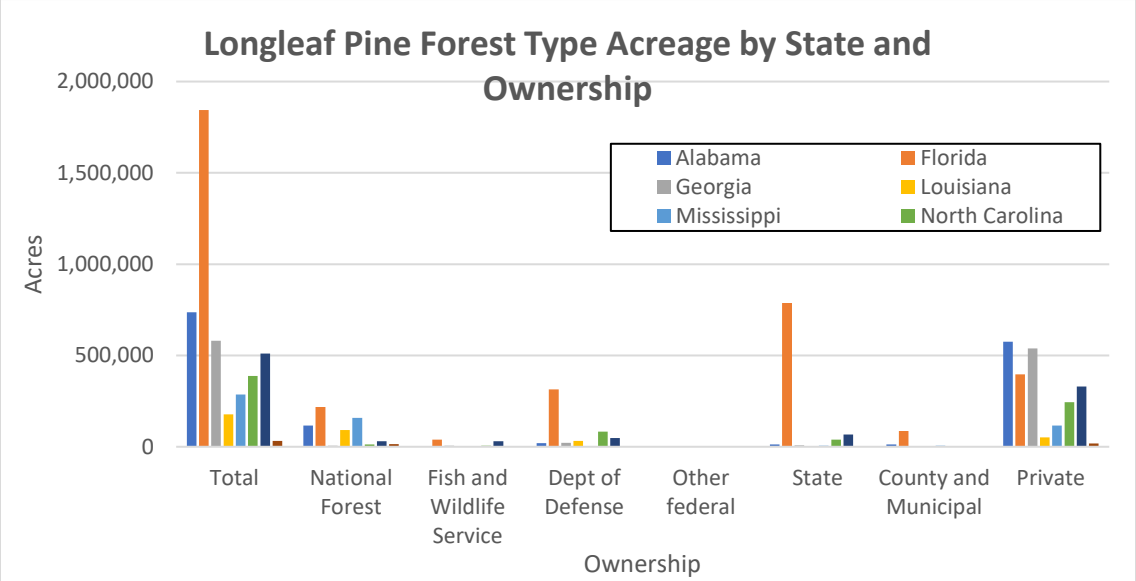

Figure 4. Longleaf pine forest type acreage by state and ownership type.

Sources: Data for all states excluding Florida sourced from the most current FIA data available (USDA Forest Service 2020)

Florida data sourced from the Cooperative Land Cover Map, v3.4 (Florida Fish and Wildlife Conservation Commission and Florida Natural Areas Inventory 2020), except for National Forest data (USDA Forest Service 2018)

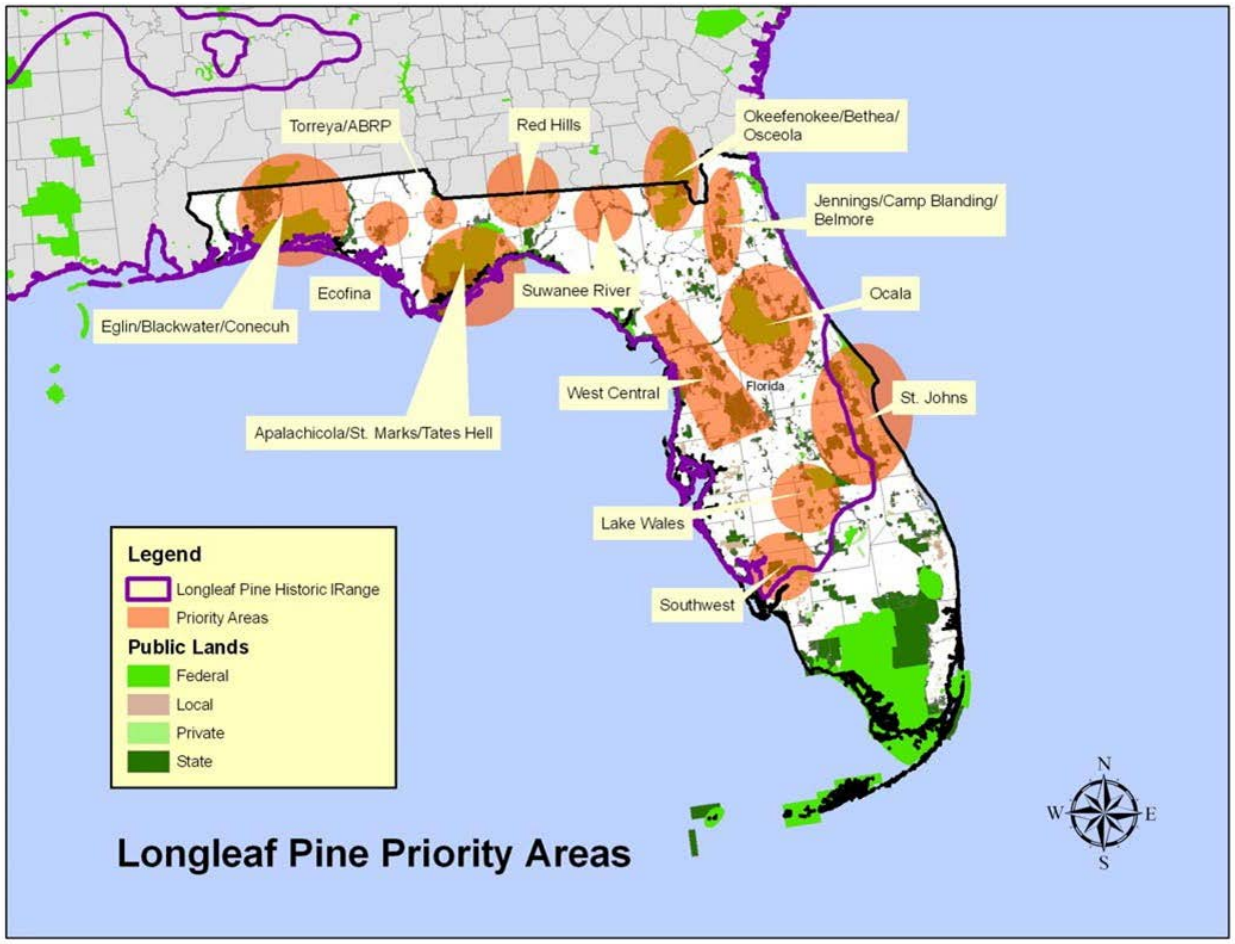

Figure 5. Longleaf pine priority areas.

Sources: Florida Forest Service, Florida Natural Areas Inventory

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9) Goals, Objectives and Strategies

Goal 1: Continue to assemble data from inventories and assessments of Longleaf Pine Ecosystems (LPEs) on public and private land and compile in accessible databases.

Objective 1.1: Use and update the LPE geodatabase completed in 2018 as part of the Florida Longleaf Pine Ecosystem Geodatabase project (FLPEGDB) to identify sites where land managers and landowners can observe restoration projects at various stages and interact with practitioners to develop realistic expectations for restoration efforts and site potential.

Strategy 1.1.1: Continue to survey public land management agencies in Florida to determine:

- whether LPEs have been identified and inventoried;
- if and how condition class is measured;
- if and how fire frequency and intensity are measured;
- planned and actual fire frequency in LPE units;

and, to identify:

- ongoing LPE restoration projects for reforestation, groundcover, and wildlife;
- LPE restoration plans;
- sites suitable for restoration;
- LPE restoration and management demonstration projects;
- LPE ecological reference sites.

Strategy 1.1.2: Conduct a meeting of agencies and partners (as needed) to evaluate project outcomes and determine the frequency at which the geodatabase should be updated, by way of voluntary data submission or contracted work, and how to best integrate Florida's project with the range-wide Longleaf Ecosystem Occurrence (LEO) project.

Strategy 1.1.3: Work with the Longleaf Alliance, Florida Natural Areas Inventory, and partners to ensure the continued flow of existing information on LPE occurrences.

Strategy 1.1.4: Develop a longleaf pine occurrence and condition model to address gaps in the database, utilizing environmental data, LIDAR, USGS/Tall Timbers burn history database, and other data sources as appropriate.

Strategy 1.1.5: Survey public land management agencies in Florida to determine whether a program for public land manager incentives for protection and restoration of LPEs is needed.

Strategy 1.1.6: Designate longleaf pine reference sites in appropriate, accessible habitat on public conservation land, specifically where stands are permitted to attain old-growth characteristics and fire is applied at a regular, appropriate interval.

Goal 2: Fire-return intervals in LPE range from 1 to 5 years (depending on the ecosystem type) and prescribed fires are conducted in all months of the year when feasible and based on condition and location in the landscape.

Objective 2.1: Accomplish fire-return intervals in LPE burn units on public lands in Florida that range from 1 to 5 years (depending on the ecosystem type) within the next 10 years.

Strategy 2.1.1: Expand prescribed burning in fire-dependent ecosystems across all public land management agencies using internal funding, external assistance (e.g., FFS Prescribed Fire Assistance Program), grants, and available burn teams.

Strategy 2.1.2: Increase and maintain prescribed fire plans and acreage accomplishments on state forests to between 200,000 and 300,000 acres, based on a 5-year average, within the next 5 years.

Strategy 2.1.3: Support the development of prescribed fire planning and management tools using Geographic Information Systems (GIS) mapping and their integration with the collection and verification of other types of field data.

Strategy 2.1.4: Manage all longleaf pine stands on state forests with a fire-return interval of 1 to 5 years (depending on the ecosystem type), with a focus on maintaining the fire frequency in stands routinely burned on a ≤ 3-year interval.

Strategy 2.1.5: Within the next 10 years, identify, prioritize and harvest timber in stands that need thinning to promote burn frequency on public lands in Florida, where consistent with approved management plans.

Strategy 2.1.6.: Within the next 5 years, identify an area within each LPE region where a focus on restoring old-growth conditions could be a priority. Attempt to encompass ≥ 2 burn blocks that are each ≥ 200 acres to provide alternating fire applications within the region.

Strategy 2.1.7: Using historic aerials from University of Florida archives, Civilian Conservation Corp timber type county maps, Florida Natural Areas Inventory historical condition and current condition maps, and timber inventory data, identify stands that will be restored or managed as LPE with prescribed fire.

Strategy 2.1.8: Determine what programs and assistance from the FFS are needed and desired by other public land managing agencies in the inventory, thinning, restoration, and prescribed burning of LPE units.

Strategy 2.1.9: Develop and distribute informational materials that demonstrate the value of a comprehensive fire management program, including protection from wildfire and value of frequent fire in LPE (e.g., FIREWISE or SouthWRAP).

Objective 2.2: Increase fire management on private lands by providing the training, services, and financial incentives to facilitate the ability of landowners to conduct prescribed burns.

Strategy 2.2.1: Develop and maintain online databases of certified burn managers in Florida.

Strategy 2.2.2: Continue development of FFS-led prescribed fire strike teams and to support development and utilization of additional prescribed fire strike teams to achieve public and private prescribed fire management objectives.

Strategy 2.2.3: Address capacity for prescribed burning and fuels management, particularly in the wildland-urban interface within Priority Areas for LPEs.

Strategy 2.2.4: Expand and leverage wildland fire control resources to expand planning and application of fire management.

Strategy 2.2.5: Provide information, training, experiential opportunities, and financial assistance to private landowners about the techniques and advantages to managing with a 1 to 5-year fire-return interval.

Goal 3: <u>Reforestation of longleaf pine</u> is planned or in progress on all sites that have been identified as suitable.

Objective 3.1: Establish longleaf pine on LPE sites where it is historically or functionally appropriate over the next 10 years.

Strategy 3.1.1: Reforest longleaf pine on appropriate sites within state forests, with priority given to sites where LPE restoration can be achieved at a lower cost or with less intensity.

Strategy 3.1.2: Assist Division of Recreation and Parks and the Florida Fish and Wildlife Conservation Commission with reforestation on state parks and wildlife management areas with longleaf pine as requested.

Strategy 3.1.3: Develop guidance with partners for area-specific, feasible LPE restoration goals defined relative to area and spatial context for landowners and resource managers.

Strategy 3.1.4: Use mechanical and chemical methods to control competing and encroaching vegetation and promote prescribed fire where fire-return intervals are out of rotation in longleaf pine stands, while minimizing damage to individual old growth trees and remnant groundcover. The purpose should be to promote native groundcover and to facilitate future management with prescribed fire.

Strategy 3.1.5: In areas lacking adequate native groundcover, encourage groundcover restoration prior to pine planting to increase fine fuel availability for fire management and to improve wildlife habitat. In instances where groundcover cannot be established prior to reforestation, encourage establishment of wiregrass (and other native grasses) in the harvest rows of planted longleaf pine stands after the first harvest occurs.

Strategy 3.1.6: Convert LPE sites currently forested with off-site species to longleaf pine and begin implementing prescribed fire management. These sites have existing nearly mature or productive forests of pines other than longleaf but can provide fuel for prescribed fire and timber for economic return. Encourage selection harvests of off-site species and favor longleaf pine regeneration or plant longleaf pines while causing as little damage as possible to remnant groundcover.

Strategy 3.1.7: Use mechanical and chemical methods to control non-native, invasive, and/or encroaching midstory vegetation and reduce accumulations of fuels in stands that cannot be maintained with prescribed fire because of safety, management effectiveness, or logistical concerns.

Strategy 3.1.8: Identify old-old growth longleaf legacy forests and develop long-term management plans for them.

Objective 3.2: Develop a plan that adequately funds management programs over the long-term subsequent to restoration.

Strategy 3.2.1: Develop an assessment of funding levels necessary for restoration and long-term maintenance based on a prioritization of LPE stands, units, and landscapes that can be managed over the long-term with frequent fire.

Strategy 3.2.2: Develop an assessment of funding levels necessary to manage stands in a manner that reduces wildfire risk based on a prioritization of stands that will be managed with mechanical and chemical methods in place of fire over the long-term because of safety, management effectiveness, or logistical concerns.

Strategy 3.2.3: Include dedicated and potential funding sources to control non-native invasive plants and animals in all LPE management plans.

Objective 3.3: Increase longleaf pine seed and seedling production in the public and private sectors.

Strategy 3.3.1: Increase and maintain the number of longleaf pine cone collection sites; improve access for collection by prescribed fire and mechanical means on appropriate state forests; and continue to increase genetic diversity of seed sources by 2030, yielding an average of 2,000 pounds of seed annually.

Strategy 3.3.2: Increase Andrews Nursery capacity for producing containerized seedlings by constructing a new suspension field to produce 1,000,000 additional seedlings by 2030 using federal and state funding.

Strategy 3.3.3: Continue to support existing public and private nurseries that supply longleaf pine seed and seedlings and expand the capacity of existing or new public and private nurseries.

Strategy 3.3.4: Encourage seedling producers to advertise seed origin by ecosystem type (e.g., sandhill or flatwoods) and geographic area.

Strategy 3.3.5: Develop a long-term plan for providing niche longleaf products that focus on the value of the dense heartwood associated with old-growth trees.

Strategy 3.3.6: Coordinate seed collection, related seed collection work, and exploration of new technologies in seedling production by public and private nurseries.

Goal 4: Functional and native, diverse herbaceous groundcover exists or is being restored in stands that can be maintained with prescribed fire.

Objective 4.1: Place a priority on identifying, inventorying, and maintaining those forests with intact groundcover.

Strategy 4.1.1: Develop a spatial database of groundcover conditions in LPE on public lands using a consistent methodology across jurisdictional lines; this should begin with the existing groundcover data assembled in the LPEGDB, and a solicitation for agency review and updates to ensure all existing and available groundcover metric data are incorporated into the LPEGDB.

Strategy 4.1.2: Develop standard LPE groundcover condition metrics and field data collection methods to refine levels of groundcover condition within the existing FLPEGDB "Maintenance" categories. At a minimum, these refined metrics and data collection methods should provide guidance identification of "high quality" or "reference" condition for LPE groundcover on public lands.

Strategy 4.1.3: Integrate collection of relevant groundcover condition data in ongoing forest and wildlife inventories and provide mechanism for updates to the map database of groundcover condition.

Strategy 4.1.4: Prioritize among groundcover condition classes to determine which can be managed with prescribed fire over the long-term, which can be restored with fire management, and which can be managed by other means.

Objective 4.2: Together with partners, develop the seed and plant production technologies, standards, and guidance needed to produce understory plant materials.

Strategy 4.2.1: Designate and maintain an appropriate number of groundcover seed collection areas across state forests to collect an average of 100 pounds of seed per year.

Strategy 4.2.2: Utilize available capacity of Andrews Nursery to produce an average of 500,000 containerized wiregrass and groundcover species per year.

Strategy 4.2.3: Work with other land management agencies, both public and private, to create groundcover seed collection areas; coordinate seed collection, related seed

collection work, and explore new technologies in seedling production by public and private nurseries.

Strategy 4.2.4: Continue to support existing and encourage new public and private nurseries producing groundcover seed and seedlings.

Strategy 4.2.5: Work with partners to implement accreditation standards for producers of seed and seedlings to assure genetic and physiological quality of seeds and plants used in restoration. Encourage seedling producers to advertise seed origin by ecosystem type (e.g., sandhill or flatwoods) and geographic area.

Strategy 4.2.6: Work with partners to develop guidelines for collection methods and frequency in LPE with high quality groundcover for use by public and private sectors.

Strategy 4.2.7: Work with utility companies, as well as conservation partners, to provide seed and plant material from and on linear facilities rights-of-ways.

Strategy 4.2.8: Participate in the development of a native seed market in the longleaf pine range.

Strategy 4.2.9: Encourage private landowners to identify incentives that will promote management and improvement of groundcover in LPE and identify potential barriers to these efforts.

Strategy 4.2.10: Develop programs and materials through the FFS Plant Conservation Program that support conservation of listed plant species in LPE.

Strategy 4.2.11: Work with both public and private land managers to develop standard practices and/or methods to allow for pine straw harvests in LPEs while either maintaining or improving groundcover conditions on a site.

Objective 4.3: Control non-native invasive species in LPE.

Strategy 4.3.1: Treat an average of 6,000 acres of longleaf pine stands for non-native invasive plant species across all state forests per year, depending on available funding.

Strategy 4.3.2: Work with partners to compile and distribute sources of information for the identification, potential threat, control, and removal of non-native invasive plants and animals.

Strategy 4.3.3: Continue to engage with non-native invasive species programs (e.g., cogongrass taskforces, Florida Exotic Pest Plant Council, and Cooperative Invasive Species Management Areas) within the longleaf pine range to identify areas of mutual interest.

Objective 4.4: Work with partners to update information related to groundcover restoration research and implementation and build on information compiled in Trusty and Ober (2009).

Strategy 4.4.1: Continue to update contact list identifying resources for groundcover restoration. Include Native Plant Societies, Botanical Gardens, Garden Clubs, other

NGOs, water management districts, state and federal land managing agencies, and university-based resources.

Strategy 4.4.2: Continue to catalog existing demonstration projects and ecological reference sites where landowners and managers can observe a variety of site conditions and restoration projects at various stages and discuss restoration with other land managers. Such opportunities will help landowners and managers develop realistic expectations for restoration efforts and site potential.

Goal 5: <u>Restoration of wildlife species</u> characteristic of or dependent or partially dependent upon LPE is occurring. Existing populations are managed for long-term viability and are appropriately monitored.

Objective 5.1: Participate in efforts to coordinate LPE restoration and management with wildlife restoration and management in consultation with public and private partners.

Strategy 5.1.1: Continue to increase existing red-cockaded woodpecker populations and enhance foraging habitat on Blackwater River, Goethe, Tate's Hell and Withlacoochee State Forests while maintaining multiple-use management values.

Strategy 5.1.2: Coordinate with FWC to implement surveys of selected state forests for gopher tortoises and sandhill herpetofauna.

Strategy 5.1.3: Continue to work with FWC, FNAI, and other partners to develop and enhance Guidelines for Restocking Gopher Tortoises on Public Lands and to identify priority restoration areas for gopher tortoise mitigation.

Strategy 5.1.4: Coordinate with Southern Range Translocation Cooperative to restore red-cockaded woodpeckers on state forests to reach or exceed planning goals.

Strategy 5.1.5: Coordinate LPE restoration and management with augmentation, reintroduction, and introduction efforts, where appropriate, for wildlife and plants.

Strategy 5.1.6: Encourage fire management that increases edge and ecotone burning and utilizes the smallest practical burn unit size to benefit wildlife.

Strategy 5.1.7: Encourage strict law enforcement protections for sandhill reptiles, particularly regarding gopher tortoise burrow gassing.

Strategy 5.1.8: Encourage nuisance and invasive predator reductions to facilitate gopher tortoise, RCW, and other listed species restoration, specifically focusing on efforts to reduce coyotes and feral hogs.

Strategy 5.1.9: Develop programs that support rare and imperiled amphibians that are associated with or dependent on LPE during their life cycles, which should include methods to burn and manage embedded ephemeral wetlands many upland amphibians depend upon to breed.

Strategy 5.1.10: Encourage enrollment in the Florida Forestry Wildlife Best Management Practices for State Imperiled Species program and adherence to Wildlife BMPs when conducting longleaf pine management and restoration activities

Goal 6: Fragmentation of LPE by linear facilities and development is being avoided on public lands. Existing fragmentation is being addressed through restoration and acquisition.

Refer to Issue 2, Forest Fragmentation Goal 4, for the Goals, Objectives and Strategies relevant to Longleaf Pine Ecosystems.

Goal 7: Seek better understanding of the likely effects of climate change on LPEs as well as the role LPE management and restoration could possibly play in mitigating or adapting to climate change.

Objective 7.1: Encourage more extensive scientific study of the potential effects of climate change on LPEs, including effects on tree species, plants, animals, ecosystem functions and fire management.

Strategy 7.1.1: Engage with partners conducting climate change research on the need to better understand the potential effects of climate change on plants, animals, and ecosystem functions in LPEs, especially with respect to southern range contraction and non-native invasive exotics.

Strategy 7.1.2: Engage with partners conducting climate change research regarding the need to better understand the potential effects of climate change on wildland fire management in general, as well as effects of fire management with frequent, low-intensity prescribed fires versus catastrophic wildfires in terms of carbon storage and sequestration.

Objective 7.2: Encourage more extensive scientific study on the potential role that LPEs, both at the level of ecosystem function and at the level of silvicultural management of the species, could play in mitigating or adapting to climate change.

Strategy 7.2.1: Engage with partners conducting climate change research on the need for determining the contributions that LPE restoration and management could play in carbon sequestration and adaptation to climate change.

Strategy 7.2.2: Engage with partners conducting climate change research on the need for determining impacts from the increased level of prescribed burning conducted to restore and maintain healthy LPE.

Strategy 7.2.3: Monitor state and federal climate change legislative proposals to assess potential opportunities or challenges presented to private landowners and to the landscape-level initiative to restore LPEs.

Strategy 7.2.4: Promote and demonstrate range-wide and site-based conservation planning for LPE restoration to support ecosystem adaptation (resilience and resistance) and integrate the results with other climate change planning efforts.

Goal 8: <u>Economic opportunities</u> for longleaf forest products and ecosystem services are enhanced for landowners, local communities, and society.

Objective 8.1: Identify and promulgate with partner agencies appropriate silvicultural techniques and tools to provide a sustainable supply of products while maintaining ecosystem values and services.

Strategy 8.1.1: Continue to work with the Florida Forestry Association to determine whether the Master Logger Program needs to be expanded to smaller timber companies that work in LPEs.

Strategy 8.1.2: Continue to work with partners to determine whether LPE management and restoration can be integrated into the Master Tree Farmer Program.

Strategy 8.1.3: Continue to refine research, development, and communication efforts concerning uneven-aged management so these techniques become applicable and efficient in public and private LPE management.

Strategy 8.1.4: Continue to coordinate with federal, state, and private research organizations to develop long-term funding for research and application development.

Strategy 8.1.5: Develop additional demonstration sites on public and private land that show uneven-aged silvicultural systems, as well as innovative thinning and stand conversion techniques.

Strategy 8.1.6: Continue to meet with USFS, academic and institute forestry researchers, and other partners to review and update existing growth and yield models for longleaf pine forests or develop new ones, if necessary.

Strategy 8.1.7: Continue to meet with USFS, academic and institute forestry researchers, and other partners to review existing actuarial analysis tools and to develop new ones, if necessary.

Objective 8.2: Continue to develop and implement Private Landowner Incentive Program for protection, management, and restoration of LPEs.

Strategy 8.2.1: Continue utilizing and updating the LPEGDB for private lands within Significant/Priority Landscapes using multiple funding sources.

Strategy 8.2.2: Develop an outreach program by 2012 using NFWF funding for private landowners interested in longleaf pine reforestation and/or LPE restoration.

Strategy 8.2.3: Encourage private landowners to assist in developing additional incentives for other landowners to manage and restore LPE.

Strategy 8.2.4: Support local communities and communities of interest in determining economic and related objectives, and where compatible, assist in the development of new markets, to produce premium longleaf products.

Strategy 8.2.5: Support and supplement studies of landowners (non-industrial, investment and industrial owners) that are integral to longleaf restoration including demographic characteristics and values, as well as investment and other objectives.

Strategy 8.2.6: Develop public and private land demonstration areas for LPE conservation and to showcase opportunities for private land managers.

Strategy 8.2.7: Promote development, acceptance, and use of various and/or "stacked" ecosystem market payments, for example, hunting leases, mitigation banks, and watershed quality trading credits for longleaf forests and their values. Provide relevant information to service foresters, consulting foresters, and other resource service providers.

Strategy 8.2.8: Promote and encourage landowner participation in federal and state conservation and agriculture financial and technical assistance programs, such as EQIP and CSP, when applicable.

Strategy 8.2.9: Coordinate with appropriate federal and state agencies to add longleaf pine management and restoration practices to existing conservation and agriculture financial and technical assistance program eligibility lists.

Strategy 8.2.10: Coordinate with appropriate state agencies to develop additional landowner financial and technical assistance programs to support longleaf pine establishment, management and restoration activities to include grant, cost-share and opportunity offset payment programs.

Strategy 8.2.11: Promote development of conservation banking instruments for longleaf forests, for example, gopher tortoises and wetlands. Provide outreach to landowners to develop and clearly communicate these incentives.

Strategy 8.2.12: Promote development, application, and acceptance of new economic models that incentivize longleaf restoration at landscape scales, models that can capture public/private ventures, cross multiple ownerships and provide longer-term stability to restoration efforts.

Strategy 8.2.13: Assess development of wood-to-energy industries, their potential effects on longleaf restoration efforts, and opportunities to make them more compatible and/or less competitive.

Objective 8.3: Develop a pine straw market that is compatible with LPE management approaches on public and private land.

Strategy 8.3.1: Educate the forest management consulting community about the illegality of selling pine straw bales contaminated with Japanese climbing fern, and appropriate control methods.

Strategy 8.3.2: Create a system where landowners can voluntarily have their plantations certified as non-native invasive species-free. Provide incentive programs so that landowners increase profits by having certified pine straw.

Goal 9: <u>Partnerships</u> among public agencies and non-governmental organizations, including state and regional fire councils, state and federal fire and resource management agencies and other natural resource conservation and management organizations, support LPE conservation and achieve fire management goals on public and private land for LPE.

Objective 9.1: Integrate public lands programs to prioritize and support LPE conservation in the areas of fire management, smoke management, silviculture, nursery operations, non-native invasive species control, wildlife management and restoration.

> **Strategy 9.1.1:** Work with public land management agencies and private land management organizations to support increased land management cooperation and coordination.
>
> **Strategy 9.1.2:** Identify and work to amend policies that restrict management activities across jurisdictional and ownership boundaries.

Objective 9.2: Continue to advance awareness of the influence of fire in shaping and sustaining native ecosystems in Florida and the benefits of frequent prescribed fire as a means to reduce wildfire hazard risk through education and outreach.

> **Strategy 9.2.1:** Reevaluate existing educational and training materials and distribute in relevant venues.
>
> **Strategy 9.2.2:** Work cooperatively with the U.S. EPA and the Florida Department of Environmental Protection to address smoke management for fire management and to facilitate increased burning while complying with state air quality laws.
>
> **Strategy 9.2.3:** Assure that the positive aspects of fire management on air quality are recognized in plans of other state agencies and local governments.
>
> **Strategy 9.2.4:** Participate in the development and/or updating of Smoke Management Programs prepared by state air quality and land management agencies.

Objective 9.3: Develop and facilitate new partnerships, alliances, and networks of organizations and landowners willing to research, conserve and manage LPE.

> **Strategy 9.3.1:** Work to develop partnerships to encourage conservation of significant LPE on lands encompassed by federal/state base closures.
>
> **Strategy 9.3.2:** Work to develop partnerships to encourage implementation of comprehensive management and mitigation plans that protect high quality LPE and natural resources.
>
> **Strategy 9.3.3:** Work with America's Longleaf Restoration Initiative (ALRI) as a potential structure and mechanism to guide restoration through public and private coordination within LPE Priority Areas.
>
> **Strategy 9.3.4:** Work with single-issue advocacy groups (National Wild Turkey Federation, Quail Forever, NBCI) to accomplish broad ranging LPE management.

Goal 10: The <u>public and policy makers are informed</u> about economic and ecological values of LPE and support budgets and management structures that accomplish LPE conservation and restoration. State and federal air quality regulators, key policy makers and planners at state and local government levels understand the importance and support the use of frequent prescribed fire in LPE.

Objective 10.1: Inform policy makers and legislative leaders concerning LPE management and restoration on public and private lands.

Strategy 10.1.1: Involve partners from public land managing agencies, universities and the environmental, research and forestry communities CFEOR in developing communication and educational strategies and materials concerning the economic and ecological values of LPE management and restoration for policy makers and legislative leaders.

Strategy 10.1.2: Continue to educate landowners, the public, policy makers and legislative leaders about the proper use and values of Silviculture Best Management Practices (BMPs) and Wildlife Best Management Practices.

Strategy 10.1.3: Evaluate and communicate the values added by restoring native groundcover in LPE to landowners and policy makers.

Strategy 10.1.4: Continue to hold groundcover workshops and field days for private landowners and public land managers.

Strategy 10.1.5: Continue to fund County Foresters in landowner assistance programs.

Objective 10.2: Work with partners to guide the maintenance of existing high quality groundcover communities, avoid continued loss, raise awareness of significance of existing habitats, and influence management policy development.

Strategy 10.2.1: Develop educational and training materials to communicate the effects of common management practices on native groundcover. Emphasize the importance of retaining horizontal continuity of groundcover as fuel for fire and the effects of various silvicultural treatments on soil disturbance and fuels continuity.

Strategy 10.2.2: Develop training and informational materials regarding silvicultural systems, groundcover management, wildlife management, and non-native invasive species control appropriate to LPE restoration and management.

Strategy 10.2.3: Develop informational materials that describe the economics of uneven-aged silvicultural systems.

10) Performance Measures

Goal 1. *<u>Inventories and assessments</u>*

Survey of public land managers in Florida of LPE and partner agencies (Florida Natural Areas Inventory, University of Florida, Auburn University, Longleaf Alliance) has been conducted and analyzed.

Follow-up meeting held with public land managers and partner agencies to determine how to facilitate information flow and develop common definitions and metrics concerning Longleaf Pine Ecosystems (LPE).

Goal 2. ***Fire return intervals***

A total of 5,000 acres are burned at Blackwater River and Goethe state forests using.

Monthly and annual collection of data on prescribed burning in state forests is maintained in a database.

Stands whose Desired Future Condition is restoration to and long-term management for LPE and desired fire frequency in stands and burn units on state forests are being determined and identified in geodatabases used by FFS for forest management.

Harvesting plan that supports increased fire frequencies in LPE has been developed and is being implemented.

Best available data shows that prescribed burning trends are approaching a 1-5 year fire-return interval with a mode of 3 years on state forests with LPE by 2014.

Online database of certified prescribed burners in Florida is maintained and available.

Fire frequency and burn unit condition classification on other public lands have been accessed and evaluated; programs to offer assistance from FFS have been implemented.

Best available data shows that prescribed burning trends are approaching a 1-5 year fire return interval with a mode of 3 years on public lands with LPE where this interval is the objective by 2014.

Interagency training in prescribed burning is ongoing, of high quality, and sufficient to meet demands.

Goal 3. ***Reforestation of longleaf pine***

Reforestation of 1,000 acres of LPE has been accomplished with longleaf pine at Indian Lakes, Withlacoochee, Blackwater River, Pine Log, Big Shoals and J.M. Bethea state forests.

Reforestation of 100 acres of LPE has been accomplished on State Parks managed by the Division of Recreation and Parks. Encourage additional planting.

Reforestation of 100 acres of LPE has been accomplished on Wildlife Management Areas managed by the Florida Fish and Wildlife Conservation Commission. Encourage additional planting.

Restoration priorities have been developed among agencies managing LPE, including stands that will be restored and managed with prescribed fire and with mechanical and chemical means, including control of non-native invasive flora and fauna, and a realistic funding plan has been developed.

Full-cost accounting for restoration and management of LPE on state forests has been determined and funding plan has been developed. Prescribed burning, reforestation, groundcover restoration, and non-native invasive species control cost estimates are included.

The number of longleaf pine cone collection sites has been increased; access for collection has been improved on three State Forests for a total of about 1,500 acres; and genetic diversity of seed sources has been increased using ARRA funding. Five thousand pounds of additional longleaf pine seed has been produced.

The capacity of Andrews Nursery and other public and private nurseries to produce longleaf pine seedlings has been expanded and is adequate to meet the demand. Longleaf pine seedling producers are able to identify seedlings based on origin by ecosystem type.

Goal 4. *Groundcover*

Survey has been conducted and analyzed of public land managing agencies and partners in Florida to determine whether groundcover in LPE has been identified and inventoried and how condition class is measured. If feasible, a map of conditions is being created.

Relevant groundcover data is being collected in forest and wildlife inventories.

Groundcover restoration priorities have been identified by partner agencies. Plans for restoration have been developed by condition class and the necessary funding amounts have been identified.

At six state forests, 120 acres of groundcover seed collection areas were created, and 1,200 pounds of seed collected using ARRA funding.

The capacity of Andrews Nursery was increased by 400,000 containerized seedlings of wiregrass and groundcover species using ARRA funding.

Groundcover restoration is considered in oil, gas, and powerline easements across public land.

Surveys of private landowners to determine incentives and barriers for groundcover restoration and management has been implemented and analyzed.

An outreach program for private landowners interested in restoration of longleaf pine or LPE has been implemented with incentives developed in consultation with the landowners.

Surveys of nurseries and groundcover restoration companies to discuss and review seed collection, accreditation and marketing have been implemented and analyzed.

Groundcover seed and seedling availability is sufficient to meet demand. Suppliers are able to identify materials based on origin by ecosystem type.

Groundcover restoration is included in workshops and field days, with brochures and training materials available.

Pine straw harvest is a viable industry, is used in LPE restoration on suitable sites, and is conducted in a manner that does not damage native groundcover or spread non-native invasive species.

A total of 200 acres of LPE has been treated for non-native invasive plants using ARRA funding.

Goal 5. *Restoration of wildlife*

Red-cockaded woodpecker populations and habitat have been enhanced at Blackwater River, Tate's Hell and Goethe State Forests using ARRA funding.

Selected state forests have been surveyed for gopher tortoises and sandhill reptiles using ARRA funding; ongoing surveys are planned and funded.

Information and assistance are available for private land owners and public land managers to restore and manage LPE for the benefit of wildlife.

The Southern Range Translocation Cooperative continues to coordinate donors and recipients in the translocation of red-cockaded woodpeckers.

Guidelines for the Restocking of Gopher Tortoises have been developed and implemented; restocking of public lands is occurring.

Goal 6. *Fragmentation*

Refer to Issue 2, Forest Fragmentation, for the Performance Measures relevant to Longleaf Pine Ecosystems.

Goal 7. *Climate change*

Research on the relationship between climate change and restoration and management of LPE is being conducted and supported by CFEOR, SERRPAS and USFS SRS, based on input from partners in public and private land management of LPE. Research includes potential effects on LPE species, ecosystem functions, carbon sequestration, and prescribed burning.

Goal 8. *Economic opportunities*

The Master Logger Program and Master Tree Farmer Program have been reviewed and updated as necessary to address LPE restoration and management.

Needs for research and application techniques and for training and information materials in silvicultural methods compatible with efficient LPE management and restoration on public and private land have been identified by Conserved Forest Ecosystems: Outreach and Research (CFEOR), SERRPAS, USFS SRS and others.

Demonstration sites on public and private land show uneven-aged management and other silvicultural systems compatible with LPE.

Growth and yield models and actuarial analysis tools have been identified for LPE and are being updated as appropriate by CFEOR, SERRPAS, USFS SRS and other partners.

An ongoing LPE Incentive Program has been developed and implemented using NFWF funding. The first two years of the program have resulted in 100 acres of groundcover restoration; prescribe burning of 3,000 acres; reduction of midstory on 500 acres; and treatment of 200 acres for non-native invasive plants.

Training and informational materials have been developed for private landowners with their input that describe stacked ecosystem market payments, promote conservation banking instruments and economic models that create incentives for LPE restoration and management.

Assessments have been made of wood-to-energy industries, their potential effects on longleaf restoration efforts, and opportunities to make them more compatible and/or less competitive.

Pine straw harvest is a viable industry, is used in LPE restoration on suitable sites, and is conducted in a manner that does not damage native groundcover or spread non-native invasive species.

Goal 9. *Partnerships*

Strong partnerships are maintained with state and regional fire councils, state and federal fire and resource management agencies, and other natural resource conservation and management organizations to achieve cooperatively and across jurisdictional boundaries agency objectives for prescribed fire, management and restoration goals for LPE.

Educational materials that describe the influence of fire in shaping and sustaining native ecosystems in Florida and the benefits of frequent fire as a means to reduce wildfire and pollution are updated and available in all relevant venues.

State and federal air quality regulators, key policy makers and planners at state and local government levels understand the importance of and support the use of frequent prescribed fire in LPE.

Federal and state air quality regulations and plans recognize and account for the difference between frequent prescribed fire and wildfire in their effects on air quality, pollution and global climate change.

Active participation is occurring in the Gulf Coastal Plain Ecosystem Partnership, Apalachicola Regional Stewardship Alliance, Lake Wales Ridge Ecosystem Working Group, Sandhill Working Group, Gopher Tortoise Restocking of Public Lands Working Group, Southern Region Translocation Cooperative, Longleaf Alliance, etc. Development of new partnerships is occurring where appropriate.

Working groups centered on LPE restoration and management have been developed, where appropriate, in northeast Florida (Okefenokee/Bethea/Osceola and Jennings/Blanding/Belmore Longleaf Pine Priority Areas), west central Florida and other Longleaf Pine Priority Areas.

Meeting held with America's Longleaf staff to discuss strategies for LPE conservation and restoration in Florida.

Cooperative work continues with the National Wild Turkey Federation, Quail Forever, and other single issue groups on projects that can integrate with LPE.

Goal 10. *Public and policy makers are informed*

Brochures and educational materials concerning prescribed fire, LPE restoration and management, non-native invasive species control and Silvicultural BMPs are endorsed by multiple partners and are regularly distributed to policy makers and legislators in appropriate venues.

Training and workshops in LPE restoration and management, prescribed fire, and groundcover restoration and management are ongoing, updated, high quality and adequate to meet demands. Updated LPE training materials are distributed in workshops, training courses and field days.

III. Forest Legacy Program

Program Description

The Forest Legacy Program (FLP), a Federal program in partnership with States, supports State efforts to acquire and protect forest lands with natural resource values. Designed to encourage the protection of privately-owned forest lands, FLP is an entirely voluntary land acquisition program. The U.S. Forest Service administers the Forest Legacy Program in cooperation with State partners as nationally competitive grants. To maximize the public benefits it achieves, the program focuses on the acquisition of fee simple or partial interests in privately-owned forest lands. Conservation easements, legally binding agreements transferring a negotiated set of property rights from one party to another, while allowing for continued private management and ownership of the remaining interests in the property. Most FLP conservation easements restrict certain types of development, require sustainable forestry practices, and protect other natural resource values.

The federal government may fund up to 75% of project costs, with at least 25% coming in the form of a match for the federal funds. The match can come from a wide variety of sources that includes private, State, or local sources. The Forest Legacy Program complements private, Federal, and State programs focusing on conservation. In Florida there are a wide range of partnerships across the over $6 billion collective of funded acquisition programs in the state, including what has evolved into Florida Forever. The consortium of conservation acquisition programs may focus on supporting efforts to acquire working forests in fee simple or conservation easements, depending on several variables including what the participating agency providing the match can allow.

On February 10, 2003, Florida Governor Jeb Bush petitioned U.S. Department of Agriculture Secretary Ann M. Veneman to allow Florida to participate in the Forest Legacy Program with the Florida Division of Forestry, now renamed and referred to as the Florida Forest Service (FFS), in the state Department of Agriculture and Consumer Services as the State Lead Agency. The Forest Service approved the request pending the development of an Assessment of Needs document and its approval.

Statewide Resource Strategy

Following a meeting with the State Forest Stewardship Coordinating Committee (SFSCC), a working group was formed consisting of members and representatives of the SFSCC and the Florida Natural Areas Inventory to discuss and layout the direction of the Forest Legacy Program in Florida. Utilizing data developed for the new agricultural land conservation initiative and other successful conservation programs in Florida, the working group recommended a set of measurable criteria to be used as a basis for establishing Forest Legacy Areas.

In an effort to secure broad support for the Forest Legacy Program in Florida and to seek further input into potential criteria and focus areas, the Lead Agency held a series of eight Public Participation Workshops around the state. A comprehensive plan was developed to allow

maximum participation by Florida citizens and potential stakeholders, including nearly 900 letters to potential stakeholders; news releases; public notices; and, a website to provide program updates and a response form for providing input on-line.

Input from the Public Participation Process supported the recommendations of the SFSCC Working Group with respect to the natural resource-based criteria and urged a broad approach when considering Forest Legacy Area (FLA) boundaries. Based on the recommendations of the SFSCC Working Group and public input, Florida has established two Forest Legacy Areas (North Florida and South Florida).

The Forest Legacy Program in Florida follows the National Forest Legacy Program guidelines. The Florida Forest Legacy Program will help to support the national mission while providing an incentive to partners to direct limited resources to the conservation of forest resources under threat of conversion through the acquisition of voluntary easements and outright purchases, focusing solely on forested lands that might not be otherwise conserved without Forest Legacy.

Florida's Forest Legacy Goals are to:

1. Conserve important forested communities to enhance the environmental, social, and economic health of the state.
2. Seek established public conservation partners to leverage federal funding.
3. Pursue high quality forest lands that support statewide strategic conservation efforts.
4. Mitigate the state's rapid loss of environmentally important forests, focusing on those which are threatened by conversion from all sources.
5. Respect the property rights of private landowners by limiting participation to willing sellers.

"Environmentally important forests" will be defined by the eligibility criteria selected for identifying Forest Legacy Areas through the public participation process.
"Threatened" is defined as those forested areas that have development potential between 2005- 2030 based on the Geoplan Growth Allocation Model, and forest resources under threat of conversion from parcelization and fragmentation.

Florida's Assessment of Need (AON) which contains an assessment of the forests and forest uses, a description of forces that are converting forests to non-forest uses, describes Eligibility Criteria developed by the State to identify important forest areas to be proposed as Forest Legacy Areas (FLA), and acts as a guide to implementation of FLP in the State was approved by the US Department of Agriculture Secretary Mike Johanns on April 11, 2005.
More about Florida's AON can be found at:
https://www.fdacs.gov/Divisions-Offices/Florida-Forest-Service/Our-Forests/Land-Planning-and-Administration-Section/Florida-Forest-Legacy-Program

2. Program Priority Areas

North Florida

FLA General

Description:

This 42-county area contains some of the most productive commercial forestland in the state. Sustainable forestry is the key to much of the region's economic stability. Dozens of processing mills provide jobs to thousands in local communities.

Most of the land conservation is undertaken by the State and the state's five water management districts (only small areas in the southern ends of this FLA fall within the boundaries of the Southwest and South Florida Water Management Districts). County land conservation programs are also very active in the eastern portion of the area, with several counties expressing strong support for the Forest Legacy Program.

North Florida FLA Goals

1. Support sustainable forestry practices important to the area's economic viability.
2. Focus on riverine systems, aquifer recharge, and natural spring protection.
3. Conserve critical fish and wildlife habitat including threatened and endangered species such as the black bear and red cockaded woodpecker.
4. Outreach to private, non-industrial forest landowners to participate in FLP, where practical.

South Florida

FLA General

Description:

There are only 8 counties in this Forest Legacy Area. The counties in this region lie mostly south of the prime, forested areas of the state, but contain unusual natural communities critical to the state's ecosystems. It is an area characterized by heavy development along the Gulf coast from Tampa - St. Petersburg to Naples, with large tracts of undeveloped farmland, citrus groves, sugar cane, wetlands, and large private ranches. Florida's National Scenic Trail Corridor passes through most of this area. While the area still supports a viable commercial forest industry, forest vegetation is generally non-commercial, but contains pockets (some quite large) of critical forest habitat.

At the southern end of the area are the famous Everglades National Park and Big Cypress Swamp. Many of the waterways in the northern part of this area feed these great ecosystems and are vital to their health.

Although commercial forestland is not a prominent feature of the landscape, there is still an interesting mix of forested natural communities. In general, wetlands, canals, citrus groves, agriculture, and pockets of forest characterize the landscape.

South Florida FLA Goals

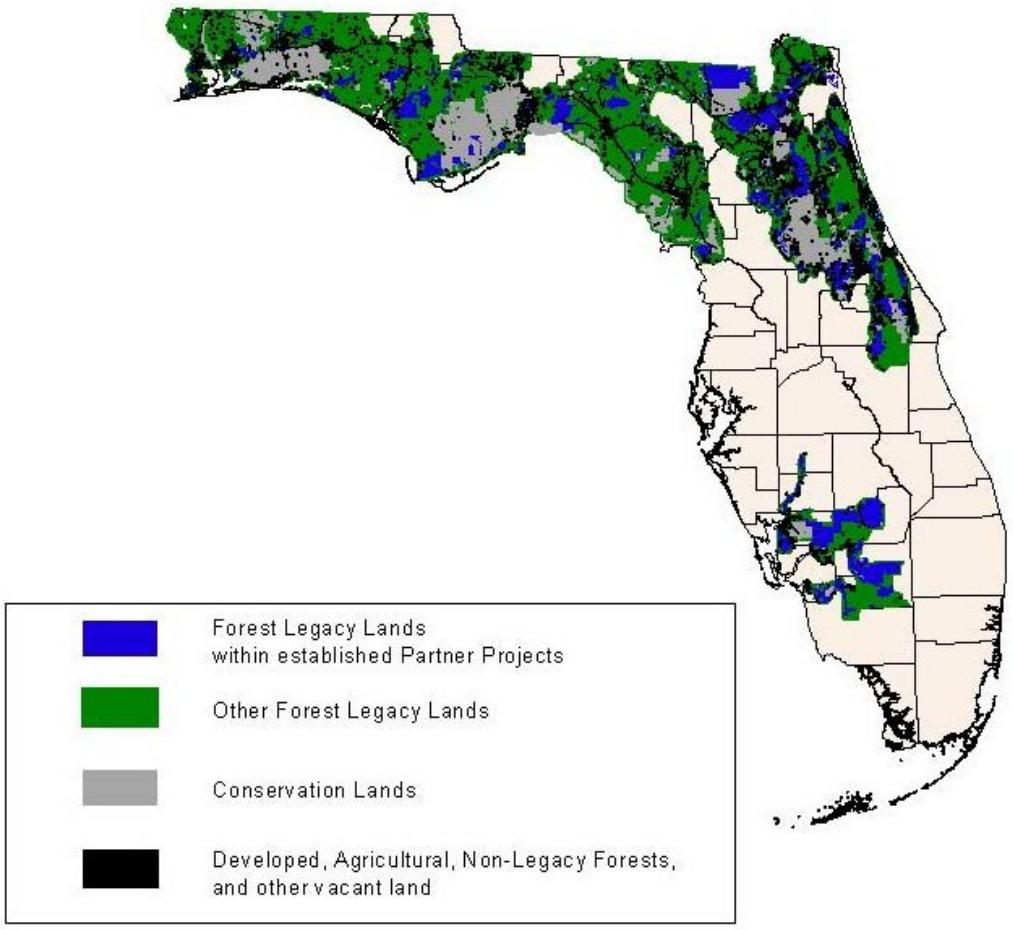
1. Maintain a healthy flow of clean water vital to rapidly expanding coastal communities and the Everglades Natural Communities, flora and fauna.
2. Conserve critical fish and wildlife habitat including threatened and endangered species such as the Florida Panther, black bear, and whooping crane.

Forest Legacy Area Acreage Breakdown Chart by Region

	A	B	C	D	E	F	G	H
FLA	FLA Acres	Already Conserved Forest with Resources	% of FLA (1)	Private Forest with Resources	% of FLA (2)	Private Forest in Partner Projects	% of FLA (3)	% of Column D (4)
North Florida	15,004,270	3,820,291	25%	9,352,156	62%	1,591,164	11%	17%
South Florida	1,580,977	266,935	17%	554,774	35%	282,115	18%	51%
Total	16,585,247	4,087,226	25%	9,906,930	60%	1,873,279	11%	19%

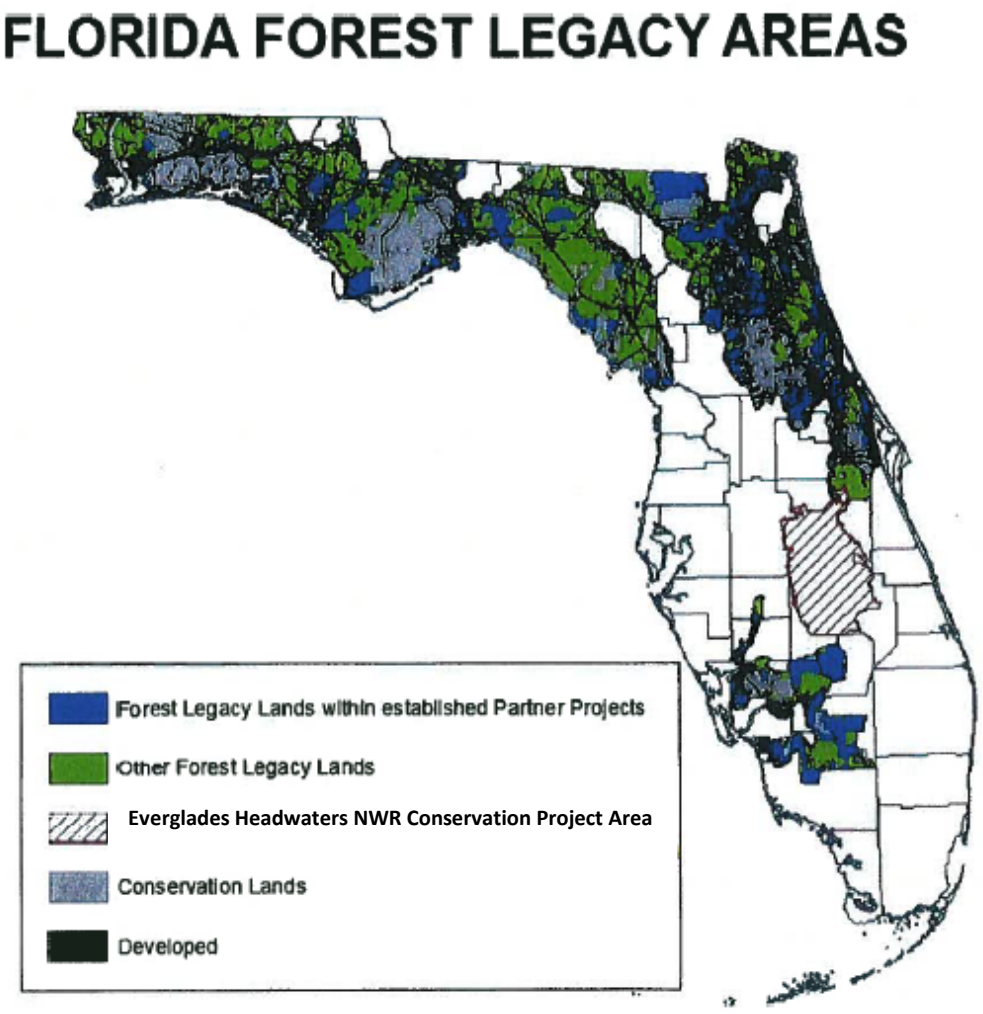
(1) Percent of FLA with forest cover already conserved. [B/A]
(2) Percent of FLA with forest land with resources not already conserved [D/A]
(3) Percent of FLA with forest land with resources in Partner Projects [F/A]
(4) Percent of remaining private forest lands in Partner Projects [F/A]

FLORIDA FOREST LEGACY AREAS



NOTE: The first Florida Forest Legacy Program Assessment of Need (AON) was approved by USDA in 2005. With changes in national guidance and the 2008 Farm Bill, it was determined that states may include the Forest Legacy Program in their State Assessments and State Strategies in lieu of completing new or revised AONs. It is intended that this section meet the review component. Each year, the Florida SFSCC members are presented with informative FLP materials as well as project proposals for potential FLP National Panel submittal. During this time, members are given the opportunity to discuss FLP-related topics including FLAs. As review of Florida's FLAs every 5 years for possible update or modification is to occur, it has been determined no revision to the FLAs are needed at this time. In 2013 FFS together with SFSCC input determined appropriate FLA minor amendment to incorporate portions of the Everglades landscape in to what had already been established as FLP-qualifying areas, communicated by letter to Regional Program Manager November 2013. A modified FLA map as attachment to the letter is indicated on the next page as amended. FFS as state Lead Agency together with SFSCC may or may not amend or update the FLA's resulting from future review.

Amended FLA Map:



IV. Agency and Organization Roles/Needed Resources

Needed Resources: Agency & Organizational Roles Matrix, Correlation to Programs, and Correlation to National Priorities

	State & Private Forestry Programs						Contributing Resources Organizations																		National Priorities		
Goals by Issue	Forest Protection Program	Forest Health Program	Forest Stewardship Program	Urban & Community Forestry Program	Forest Legacy Program	Outreach Program	USFS National Forest System	USFS Research and Other USFS	NRCS/FSA & Other USDA	U.S. Fish & Wildlife Service	Other Federal Agencies	Florida Fish & Wildlife Conservation Commission	Florida Department of Environmental Protection	Florida Water Management Districts	Other Florida State Agencies	The Nature Conservancy	Tall Timbers	Other Land Trusts, Wildlife, & Conservation Orgs.	Universities and Schools	Florida Forestry Association	Forestry Consultants, Forest Industry	Florida Urban Forestry Council	Municipalities & Cities	Local Fire Departments & VFDs	Protect	Conserve	Enhance
Issue 1	**Use of Prescribed Fire/Wildfire Threat**																										
Goal 1	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X		X	X	X
Goal 2	X		X	X		X	X		X	X	X	X	X	X	X	X	X						X	X	X	X	
Goal 3	X						X			X	X	X	X											X	X		
Goal 4	X						X			X	X	X	X			X	X		X		X			X	X	X	X
Goal 5	X						X			X	X													X	X		
Goal 6	X						X																	X	X	X	X
Issue 2	**Forest Fragmentation**																										
Goal 1			X		X	X	X		X	X	X	X		X	X				X	X	X				X	X	X
Goal 2		X	X			X	X		X			X			X			X	X	X	X					X	X
Goal 3			X	X		X						X	X					X	X	X	X	X	X		X		X
Goal 4		X	X		X	X	X		X	X	X	X	X	X	X	X		X	X	X	X				X	X	X
Goal 5		X	X		X	X	X		X	X		X	X			X	X	X	X	X			X		X	X	X
Issue 3	**Forest Health: Insects, Diseases and Non-Native Pest Plants**																										
Goal 1		X																								X	X
Goal 2		X	X	X			X	X	X			X	X	X	X	X	X		X			X	X		X	X	X
Goal 3		X	X				X	X	X			X	X	X	X	X			X	X						X	X
Goal 4		X					X	X	X		X	X	X	X	X	X		X	X				X		X	X	
Goal 5		X					X	X		X		X	X	X	X	X		X	X						X		
Goal 6		X						X											X								X
Issue 4	**Forest Resiliency**																										
Goal 1	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X
Goal 2			X		X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X		X		X	X	X
Goal 3			X	X	X				X	X	X				X				X				X				X
Goal 4	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X
Goal 5		X	X	X	X	X	X		X	X	X	X	X	X	X	X		X	X	X	X		X		X	X	
Goal 6			X	X		X	X	X											X	X	X	X	X				X

*Performance measures are outlined in number 10 "Performance Measures" for each issue, by goal, in body of document.

Agency and Organization Roles/Needed Resources (Continued)

Needed Resources: Agency & Organizational Roles Matrix, Correlation to Programs, and Correlation to National Priorities

	State & Private Forestry Programs						Contributing Resources Organizations																		National Priorities		
Goals by Issue	Forest Protection Program	Forest Health Program	Forest Stewardship Program	Urban & Community Forestry Program	Forest Legacy Program	Outreach Program	USFS National Forest System	USFS Research and Other USFS	NRCS/FSA & Other USDA	U.S. Fish & Wildlife Service	Other Federal Agencies	Florida Fish & Wildlife Conservation Commission	Florida Department of Environmental Protection	Florida Water Management Districts	Other Florida State Agencies	The Nature Conservancy	Tall Timbers	Other Land Trusts, Wildlife, & Conservation Orgs.	Universities and Schools	Florida Forestry Association	Forestry Consultants, Forest Industry	Florida Urban Forestry Council	Municipalities & Cities	Local Fire Departments & VFDs	Protect	Conserve	Enhance
Issue 5	**Economic Viablity of Forests**																										
Goal 1		X	X					X	X			X	X	X					X	X	X				X	X	X
Goal 2		X	X			X	X	X	X						X	X	X		X	X	X					X	
Goal 3			X	X				X											X	X	X						X
Goal 4			X			X		X				X	X	X					X	X	X				X	X	X
Goal 5			X					X		X	X								X	X	X				X		
Goal 6			X					X	X	X	X								X		X				X		X
Goal 7			X					X			X	X							X	X	X				X		X
Goal 8			X					X				X							X						X		X
Issue 6	**Water Quality and Quantity**																										
Goal 1			X					X	X	X		X	X	X	X				X	X	X		X		X	X	X
Goal 2			X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X
Issue 7	**Longleaf Pine Ecosystems**																										
Goal 1	X		X				X	X	X			X	X	X	X	X	X	X	X	X	X		X		X	X	
Goal 2	X	X	X				X		X	X	X	X	X	X	X	X	X				X				X	X	X
Goal 3		X	X				X			X	X	X	X	X	X	X		X	X		X		X				X
Goal 4		X	X				X			X	X	X	X	X	X	X	X	X					X				X
Goal 5			X				X			X	X	X	X	X	X	X	X	X	X				X			X	X
Goal 6					X		X			X	X	X	X	X	X	X		X					X		X	X	X
Goal 7		X	X					X		X	X	X	X	X	X	X	X		X						X		
Goal 8			X			X			X		X	X							X	X	X				X		X
Goal 9	X	X	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X
Goal 10		X	X	X		X			X	X	X	X	X	X		X	X		X	X	X	X	X		X	X	X

*Performance measures are outlined in number 10 "Performance Measures" for each issue, by goal, in body of document.

Appendix A: Strategy Process

Process Overview

This document has been developed through direct support from stakeholder and partner organizations and others. An original team of stakeholders were requested to participate as members of Florida's Forest Stewardship Committee in August of 2019. Issue writers requested additional input from organizations with particular expertise/interest by Issue. The State Technical Committee of the Natural Resources Conservation Service was presented this information through the Forest Stewardship Committee and encouraged to provide input. Florida Forest Service staff developed draft language for the document with input from stakeholders and others familiar with the specific issue. A final draft was provided to the entire group for requested final input before the document was submitted in December 2020. Final stakeholder comments and request for strategy assistance by agencies/organizations under section "IV. Agency and Organization Roles/Needed Resources" in the matrix were solicited to complete this document.

Public and Partner Involvement

As previously indicated, Florida's Forest Stewardship Coordinating Committee membership created the majority of the roster of original stakeholders for the assessment process. Plan update information was provided to the Committee at the annual meeting held on October 9, 2019. Additional stakeholders were included starting with the issue refinement stage of development of the 2010 strategy document as well as this update. Input was provided by representation from the following organizations:

American Forest Foundation
Association of Consulting Foresters
Defenders of the Environment
Department of Environmental Protection
Department of Defense/Air Force
Enviva Pellets Cottondale, LLC
F&W Forestry Services, Inc.
Florida Fish and Wildlife Conservation Commission
Florida Association of Conservation Districts
Florida Audubon Society
Florida Chapter International Society of Arboriculture Florida Farm Bureau
Florida Forestry Association Florida Forestry Council
Florida Natural Areas Inventory
Florida Urban Forestry Council
Georgia-Pacific Corporation
International Paper Company
Longleaf Alliance
National Wild Turkey Federation
Natural Resource Planning Services, Inc.
NOAA Coastal Services
NW Florida Water Management District
ProForest
Rayonier Advanced Materials

Rayonier Inc.
Southern Forestry Consultants, Inc.
St. Johns River Water Management District
Suwannee River Water Management District
Tall Timbers Research Station
The Nature Conservancy
University of Florida School of Forest Resources & Conservation
US Fish and Wildlife Service USDA Farm Service Agency
USDA Forest Service
USDA Natural Resources Conservation Service
Weyerhaeuser Company
West Rock Company

Primary Data Sources

1. Sustainable Forestry
Comprehensive Statewide Forest Inventory Analysis and Study (CSFIAS) 2016. Florida Forest Service.
www.FDACS.gov/Forest_Inventory

2. Forest Patch Size
The Forest Patches layer is intended to emphasize forest patches of ecologically and/or economically-viable size.
Source: Southern Forest Land Assessment
A cooperative project of the Southern Group of State Foresters created using 2015 USGS Cropland Data Layer. Produced by Texas A&M University System, Spatial Sciences Laboratory Texas Forest Service.

https://www.nass.usda.gov/Research_and_Science/Cropland/SARS1a.php

3. Development Risk
Development level Emphasizes areas that are projected to experience increased housing development in the next 10 years.
Source: Derived from a more recent version of the integrated Climate and Land Use (ICLUS) version 1 model – ICLUS V2

4. Forest Ownership

Forest Ownership by Categories data provides a breakdown of forests owned by private non-industrial landowners, private industrial or corporate landowners and publicly owned forestland. This data is presented to display the occurrence of private forest ownership across the state and landowners who may be benefit from FFS programs and assistance.

Source: FFS Comprehensive Statewide Forest Inventory Analysis
and Study (CSFIAS) — 2014

5. Wildfire Risk (Levels of Concern)

Source: Southern Group of State Foresters Wildfire Risk Assessment Portal

6. Wildland Urban Interface

Low, Medium, and High Interface and Intermix Areas

Source: *Southern Group of State Foresters Wildfire Risk Assessment Portal*

7. Florida Open Burning Authorizations

Source: Florida Fire Management Information Systems

8. Wildfire Fire Occurrence

Source: Florida Fire Management Information System

9. Forest Distribution

Source: USDA Forest Service FIA online tools; EVALIDator
https://apps.fs.usda.gov/Evalidator/evalidator.jsp

10. Longleaf Pine Priority Areas

Sources: America's Longleaf Conservation Plan
http://www.americaslongleaf.org/media/fqipycuc/conservation_plan.pdf
Florida Forest Service Florida's Forest Resource Strategy 2010
https://www.fdacs.gov/content/download/81380/file/Florida_Forest_Resource_Strategy_6-18-10.pdf
Florida's Longleaf Pine Ecosystem Geodatabase
https://www.fdacs.gov/Divisions-Offices/Florida-Forest-Service/Our-Forests/The-Florida-Longleaf-Pine-Ecosystem-Geodatabase

11. Forest Type History Map 1934

Source: USDA Forest Service (1934)
http://www.fgdl.org/metadata/metadata_archive/fgdc_html/fortype1934.fgdc.htm

12. Aquifer Recharge Areas

Sources:
Florida Natural Areas Inventory; Critical Lands and Waters Identification Project. Database Version 4.0.
https://www.fnai.org/clip.cfm
Florida Department of Environmental Protection
https://fdep.maps.arcgis.com/apps/Cascade/index.html?appid=473b768b4af049bf91b2879b83ea961c

13. Forest Resource Priority

Source: Southern Forest Land Assessment 2019 State Breaks

14. Forest Resource Richness

Source: Southern Forest Land Assessment 2019 State Breaks

15. Forest Resource Threat
Source: Southern Forest Land Assessment 2019 State Breaks

16. Critical Lands and Waters Inventory Project (CLIP)
Source: Critical Lands and Waters Identification Project. Database Version 4.0.

CLIP Version 4.0 was completed in August 2016. Many of the natural resource data layers included in CLIP were derived from the Florida Forever Conservation Needs Assessment developed by FNAI to support the Florida Forever program.

17. National Woodland Owner Survey

The National Woodland Owner Survey (NWOS) is aimed at increasing understanding of private forest landowners, including: the number of forest landowners; acreage of privately owned forests and woodlands; forest management history and future management plans; and landowner motivations for ownership and decision-making.

Source: Butler, B.J.; Hewes, J.H.; Dickinson, B. 2016. USDA Forest Service National Woodland Owner Survey: National, regional, and State statistics for family forest and woodland ownerships with 10+ acres, 2011–2013. Res. Bull. NRS-99. Newtown Square, PA: U.S. Department of Agriculture, Forest Service, Northern Research Station. 39 p.

https://www.fia.fs.fed.us/nwos/

18. USDA Forest Service Forest Service Forest Inventory and Analysis data

Source: USDA Forest Service. The USFS collects data on the status and trends in forest area and location; in the species, size, and health of trees; in total tree growth, mortality, and removals by harvest; in wood production and utilization rates by various products; and in forest land ownership through the Forest Inventory and Analysis program.

https://www.fia.fs.fed.us/

Integration of Other Plans and Assessments

A major informational piece for the development of this document was "Florida's Statewide Assessment of Forest Resources – 2010", which was the basis for Florida's 2010 Resource Strategy (Forest Action Plan) . Additionally, Florida's Community Wildfire Protection Plan, the current Florida State Wildlife Action Plan, the Critical Lands and Waters Inventory Project, Southern Forest Futures Project as well as preliminary information from the Southern Forest Outlook project, were utilized in the development of resource strategies in this document.

List of Preparers

The Florida Forest Service utilized in-house staff to prepare this document. The primary authors included, John Saddler, Jennifer Tucker-Jenks, Jeff Eickwort, Will Liner, Jarek Nowak and Brian Camposano. Additionally, mapping support was directed by Karen Cummins. Input from the partners listed in the public and partner involvement section provided guidance and recommendations in the development of the plan's strategic actions.

Appendix B: National Program Guidance

Forest Stewardship Program
https://www.fs.fed.us/spf/coop/library/fsp_standards_guidelines.pdf

Forest Legacy Program
https://www.fs.usda.gov/sites/default/files/fs_media/fs_document/15541-forest-service-legacy-program-508.pdf

Urban & Community Forestry Program

https://www.fs.usda.gov/managing-land/urban-forests/ucf/program

State and Private Forestry Program Laws

http://www.fs.fed.us/spf/coop/library/SPF-CF%20handbook.pdf