



Population Surveys of Rare Lauraceae Species to Assess the Effect of Laurel Wilt Disease in Florida

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Cover Photographs

- Top: Pondspice (*Litsea aestivalis*) fruits Pumpkin Hill Creek Preserve State Park, Duval County 8/04/10 (Jim Surdick).
- Middle: Bog spicebush (*Lindera subcoriacea*) Metts Creek, Eglin Air Force Base, Okaloosa County 10/06/10 (Jim Surdick).
- Bottom: Gulf licaria (*Licaria triandra*) Simpson Park, Dade County 7/03/10 (Pete Diamond).

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ABSTRACT

Population status surveys were conducted for rare species in the Lauraceae (Laurel Family) throughout Florida to help gauge the response to Laurel Wilt Disease (LWD). As of October 2010 evidence of LWD has been observed in 26 of the 67 Florida counties. Several members of the Lauraceae have been found to be susceptible to the lethal effects of LWD. However, little is known as to how wild populations will respond to the disease. In an effort to document the effect of LWD on rare species within the Lauraceae Florida Natural Areas Inventory (FNAI) updated the status of accessible populations of Gulf licaria (*Licaria triandra*), northern spicebush (*Lindera benzoin*), and bog spicebush (*Lindera subcoriacea*) throughout Florida and all accessible known pondspice (*Litsea aestivalis*) populations not updated during a 2008-09 survey of northeastern Florida. *Litsea aestivalis*, *Lindera subcoriacea*, and *Licaria triandra* are listed as Endangered by the State of Florida, FNAI ranks them as G3/S2, G2/S1, G4/S1, respectively. Currently LWD is not found in the counties where the two known occurrences (i.e., FNAI database Element Occurrence) of *Lindera subcoriacea*, one known occurrence of *Licaria triandra*, or eight of the ten *Litsea aestivalis* populations recently discovered or updated element occurrences. There was evidence of LWD symptoms at four sites where *Litsea aestivalis* seeds were collected. Three of the five University of South Florida herbarium collection sites for *Lindera benzoin* were also visited. The two *Lindera benzoin* populations visited outside of the current range of LWD in Florida were relocated and updated while the Putnam County occurrence which is within the LWD range was not relocated. The Florida border is 17km south of the only known occurrence of the federally endangered pondberry (*Lindera melissifolia*) in Alabama. A cursory search within the adjacent Florida counties failed to document an occurrence of *Lindera melissifolia*. Approximately 1400 *Litsea aestivalis* seeds from four separate populations in northeast Florida were collected and placed in long-term cold storage at Bok Tower Gardens Center for Plant Conservation and the National Center for Genetic Resources Preservation in Fort Collins, Colorado.

INTRODUCTION

Laurel Wilt Disease (LWD) is believed to have originated near Port Wentworth, GA in 2002 and has rapidly spread into Florida decimating populations of red bay (*Persea borbonia*) and swamp bay (*Persea palustris*) (USDA Forest Service 2010). Laurel Wilt Disease is carried by an introduced Ambrosia beetle (*Xyleborus glabratus*) from Asia that carries *Raffaelea lauricola* fungus which is the agent responsible for the observed bay die-offs in the affected areas (Harrington et al. 2008). However, the disease is not limited to bay trees and has been found in and lethal to several other members of the Lauraceae including pondspice, northern spicebush, and pondberry (*Lindera melissifolia*) (Fraedrich et al. 2008).

Gulf licaria (*Licaria triandra*) is a small tropical evergreen tree of rockland hammocks that reaches a height of 9m and a diameter at breast height (dbh) of 20cm. Small flowers appear in June and the blue berries with a bright red cup are distinctive all year. Gulf Licaria is currently considered a G4/S1 species (See Appendix A for Global and State Rank explanations). It is found in Florida, the West Indies, Central America, and South America (Natureserve 2010).

There is only one known occurrence of Gulf licaria in south Florida, within the 8 acre Simpson Park in the city of Miami.

Northern spicebush (*Lindera benzoin*) is a shrub or small tree that grows to 5m typically in woodlands near streams or rich uplands with exposed limestone. Flowers appear prior to the alternate leaves in late winter to early spring and red drupes persist well into fall. It occurs in the eastern portion of the United States from Ontario south to Texas. Currently northern spicebush is not ranked in Florida G5/SNR however there are a total of only seven counties where this species has been collected in Florida (Wunderlin and Hansen 2008). Although more common in northern portions of its range northern spicebush is rare in Florida and given the threat of LWD it was included in the current survey.

Pondberry (*Lindera melissifolia*) is a short dioecious shrub that rarely grows taller than 1.5m and often grows in large clonal groups. The leaves are fragrant, alternate, and droop. Flowers occur before the leaves emerge in spring and the red fruits persist on the plants after the leaves drop in fall. It occurs in seasonally flooded wetlands. There are less than 100 known populations from Louisiana north to Missouri and east to North Carolina (Natureserve 2010). It is federally and state listed as Endangered, ranked G1/SX, and has not been observed in Florida since 1860 (McCartney et al. 1989).

Bog spicebush (*Lindera subcoriacea*) was first described in 1983 (Wofford 1983). It is a clonal shrub that grows to 4m and has simple, alternate leaves. Male and female flowers occur on separate shrubs in early spring and the bright red drupes persist into fall. It typically occurs in boggy areas along streams with sphagnum moss, bay trees, and titi. It is sporadically distributed from Virginia to Louisiana and east to northern Florida (Natureserve 2010). There are less than 100 occurrences most of which consist of only a few genetic individuals (Natureserve 2010). Currently bog spicebush is ranked G2/S1 with only two known Florida occurrences, one on Eglin Air Force Base in Okaloosa County and the other on the campus of the University of West Florida in Escambia County.

Pondspice (*Litsea aestivalis*) is an obligate wetland shrub that grows to 2-5m high and has alternate 1 to 3cm long deciduous leaves held on “zig-zag” reddish brown branches. The yellow unisexual flowers occur in late winter before the leaves appear. Female individuals produce a 4 to 6mm bright red fruit in late summer. The typical habitats in Florida are edges of depression marshes and dome swamps embedded in natural communities that receive frequent fire such as sandhill and flatwoods. In Florida *Litsea aestivalis* is currently considered a G3/S2 species. It occurs from Louisiana to Maryland and despite being widespread is rarely encountered throughout its range with approximately 50-100 known locations (NatureServe 2010).

The objectives of this project were to relocate the existing known populations of *Licaria triandra*, *Lindera benzoin*, *Lindera subcoriacea*, and *Litsea aestivalis* in Florida, assess population sizes of all new and relocated occurrences, determine the health of individual specimens encountered (experiencing mortality or wilt), and report on the status of these occurrences and findings. In addition, collect seed from pondspice in four to six locations affected by LWD for long-term cold storage in genetic seed banks.

METHODS

Licaria triandra, *Lindera subcoriacea*, and *Litsea aestivalis* records in the FNAI database were queried to help direct site visits. Private landowners and public land managers with extant Element Occurrence (EO) records were contacted to request access to the locations. The University of South Florida Herbarium Specimen Database was utilized to search for *Lindera benzoin* at three of the five historic collection locations. There were 12 EOs for *Litsea aestivalis* in northeastern Florida that were updated in 2008-09 and were not visited during the current survey (Surdick and Jenkins 2009). All population updates during the current survey were conducted between 02/02/2009 and 10/07/2010. Trimble Recon GPS/dataloggers (3m accuracy) were used to record GPS points and gather data where rare Lauraceae species populations were encountered. The data recorded included location (latitude, longitude), site name, survey date, surveyor, population size, phenology, evidence of LWD within the focal species, evidence of LWD in *Persea* sp., natural community setting, vegetative associates, and evidence of disturbance. Plants exhibiting signs of LWD had one or more of the following symptoms; stems with small (<2mm) ambrosia beetle entrance holes, one or more stems with nearly all brown leaves during the growing season, and sapwood with a purple to black stain. In addition, an attempt to locate *Lindera melissifolia* in the northern portion of the panhandle was conducted by surveying areas of appropriate habitat along publicly accessible rights-of-ways.

In an effort to conserve genetic material from *Litsea aestivalis* populations in areas of Florida affected by LWD seeds were collected from four separate populations. A site visit to a fifth location, Mill Creek Preserve in Alachua County, was canceled after learning the Alachua County Environmental Protection Agency staff had previously collected *Litsea aestivalis* seed for long-term cold storage at Bok Tower Gardens. A permit was granted to collect regulated plant material from the Florida Department of Agriculture and Consumer Services, Division of Plant Industry (Permit #929) and to access and collect *Litsea aestivalis* seeds from Price's Scrub from the Florida Department of Environmental Protection, Special Use Permit. *Litsea aestivalis* populations located on the Rodman Naval Bomb Target and Price's Scrub were visited on 7/28/10 and on private property in Clay County and Pumpkin Hill Creek Preserve State Park on 8/04/10. Fruits were collected from bushes throughout each population and did not exceed 10 percent of the available ripe fruits from any individual plant. Fruits were placed in paper bags with locality data and shipped to Cindy Campbell the Rare Native Plant Curator of Bok Tower Gardens.

RESULTS

The only known *Licaria triandra* population in Florida was visited on 7/3/10 (Figure 1). The original canopy tree present at Simpson Park fell after Hurricane Katrina and currently there are many seedlings and young saplings to 5m tall within the rockland hammock natural community. There was no evidence of LWD observed.

Three *Lindera benzoin* populations were assessed (Figure 1). The first was at Florida Caverns State Park where more than 18 individuals of approximately an equal number of male and female flowering bushes were observed on 3/08/10 in upland hardwood forest. Common associates included pignut hickory (*Carya glabra*), sugarberry (*Celtis laevigata*), red bay (*Persea borbonia*), eastern hophornbeam (*Ostrya virginiana*), needle palm (*Rhapidophyllum hystrix*), coralberry (*Symphoricarpos orbiculatus*), false rue anemone (*Enemion biternatum*), and wild columbine (*Aquilegia canadensis*). The invasive exotic species Japanese honeysuckle (*Lonicera*

japonica) was common along the trail system throughout the population. All observed *Lindera benzoin* specimens were in areas of exposed limestone within 60m of the Chipola River. There was no evidence of LWD on the *Lindera benzoin* or associated bay trees. A second population was visited on 5/06/10 on the west bank of the Apalachicola River near the town of Chattahoochee. Only one approximately 4m high bush was observed. However, five to seven individuals were observed flowering in the vicinity earlier in the season (pers. comm. Gil Nelson). Common associates in this upland hardwood forest included sugarberry, water oak (*Quercus nigra*), buckthorn bully (*Sideroxylon lyciodes*), dwarf palmetto (*Sabal minor*), and poison ivy (*Toxicodendron radicans*). Several invasive exotic species were observed in the area such as coral ardisia (*Ardisia crenata*), small leaf spiderwort (*Tradescantia fluminensis*), Japanese honeysuckle, and Japanese climbing fern (*Lygodium japonicum*). Finally, a third population along Deep Creek in Putnam County on the Marjorie Harris Carr Cross Florida Greenway State Recreation and Conservation Area was not relocated. The herbarium collection notes indicated the population was along the creek where a utility corridor crosses. A search along the utility corridor and more than 80m southeast into the hydric hammock natural community along Deep Creek failed to produce any *Lindera benzoin* observations. The utility corridor was treated with herbicide a few months prior to the site visit and most of the vegetation was dead and leafless. Furthermore, there was extensive evidence of LWD on the swamp bay trees (*Persea palustris*) persisting in the adjacent hydric hammock.

On 10/07/10 a large population of greater than 1000 *Lindera melissifolia* plants near Opp, Alabama was visited to acquire a search image for the species and assess the natural community in which it occurs. There was no evidence of LWD on the surrounding bay trees (*Persea* sp.), however, there were several *Lindera melissifolia* resprouting from dead stems that had ambrosia beetle sized holes. No additional populations of *Lindera melissifolia* were observed in Florida during a search of wetlands accessible from right-of-ways in northern Walton, Holmes and Jackson Counties.

The two known *Lindera subcoriacea* populations in Florida, EO records #1 and #2, were visited on 10/06/10 (Figure 1). There were six individuals observed along the east bank of Metts Creek 350m south of Range Road 236 on Eglin Air Force Base. The original 1994 EO record reports a total of 12 individuals some of which were observed along Metts Creek, near the Range Road 211 and 236 bridges however, thorough searches failed to find any in these areas during the current survey. Dominant species within the baygall where *Lindera subcoriacea* was observed included slash pine (*Pinus elliottii*), blackgum (*Nyssa sylvatica* var. *biflora*), black titi (*Cliftonia monophylla*), sweetbay (*Magnolia virginiana*), fetterbush (*Lyonia lucida*), large gallberry (*Ilex coriacea*), climbing heath (*Pieris phyllyreifolia*), *Sphagnum* sp., red pitcher plant (*Sarracenia rubra*), and white arrow arum (*Peltandra sagittifolia*). There were four 2m high *Lindera subcoriacea* and two shorter 0.5m high bushes observed. Also present were 4m high, 5cm (dbh) dead stems associated with some of the bushes that appeared to have died during a fire that passed through the community three to five years prior. Digging from feral hogs (*Sus scrofa*) was not extensive through the baygall community but appeared to be concentrated within the vicinity of the population with some rooting observed at the base of the *Lindera subcoriacea* bushes. The second *Lindera subcoriacea* element occurrence on the University of West Florida campus was not relocated despite receiving detailed directions from the original observer (pers. comm. James Burkhalter). During a 1996 FNAI survey nine bushes were reported, and relocated again and reported to be in good condition in 2001. There are now currently dense stands of blackberry (*Rubus argutus*) and the invasive exotic plant Chinese privet (*Ligustrum sinense*)

making visibility and mobility within the reported population location difficult. Several of the large canopy trees had fallen within the last five years likely due to hurricanes, however many of the original vegetation associates still persist in the area.

There were six *Litsea aestivalis* locations visited for population updates and four new occurrences recorded (EOs #23, #32 #34 and #35) during the current survey (Table 1). However, EO record #35 is likely already extirpated. This location was traditionally known to have two individuals in recent years (pers. comm. Mike Cambell). On 2/18/10 only one dead 4m tall pondspice bush was observed with brown wilted fruits and leaves, ambrosia beetle sized holes, and dark stained sapwood. It appeared the bay trees (*Persea* sp.) also in the vicinity of Palatka Pond within Lochloosa Wildlife Conservation Area had LWD symptoms. Element Occurrence record #3 in Taylor County may also be extirpated. Approximately 15-20 *Litsea aestivalis* bushes were originally reported but during the current survey it appeared the adjacent pine plantation had recently been clear-cut and debris plowed into the area where the bushes likely occurred.

There were approximately 872 to 1172 individuals recorded from eight different populations during the current survey. With the estimated number from a survey conducted in northeastern Florida in 2008-09 (Surdick and Jenkins 2009) the total population of *Litsea aestivalis* bushes among all 25 of the updated EOs in Florida is between 1822 and 2272 individuals. Laurel Wilt Disease was only suspected from two populations updated during the current study (EOs #10 and #35). The largest population encountered during the two studies was the 700-1000 observed at Cascade Lake in Leon County (EO #18).

The natural communities where *Litsea aestivalis* populations were documented during the current survey included six depression marshes, four dome swamps, a shrub bog, the edge of a sandhill upland lake, and two hydric hammocks. Common canopy species included slash pine, pond cypress (*Taxodium ascendens*), swamp tupelo (*Nyssa biflora*), laurel oak (*Quercus laurifolia*), and red maple (*Acer rubrum*). Shrubs often associated with *Litsea aestivalis* included fetterbush (*Lyonia lucida*), common buttonbush (*Cephalanthus occidentalis*), and swamp bay. The majority of the wetlands where pondspice was documented were generally small (<0.5ha) and embedded in several different types of natural communities that would have traditionally received fire such as sandhill, scrubby flatwoods, mesic flatwoods, wet flatwoods, and scrub.

Litsea aestivalis seeds were collected from four populations (EOs #2, #10, #28, and #36) within counties where LWD is currently present (Figure 2). Table 2 shows how many seeds were collected from each population, the temperature they are stored, and the facility they were deposited.

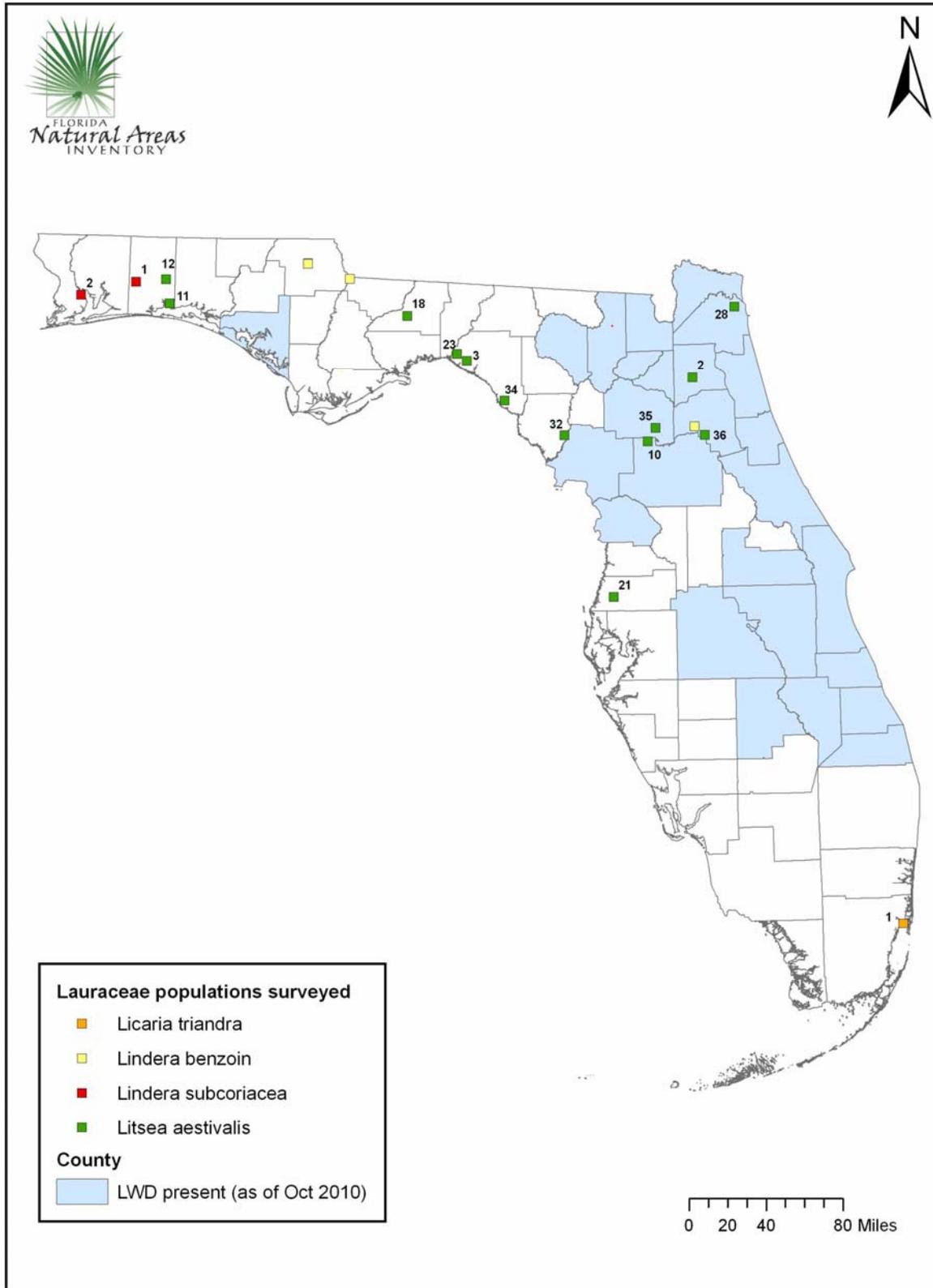


Figure 1. Locations of the rare Lauraceae species populations visited during the 2009-10 Florida Natural Areas Inventory survey. The blue shading represents counties where Laurel Wilt Disease (LWD) has been observed (USDA Forest Service 2010). The numbers represent Element Occurrence records.

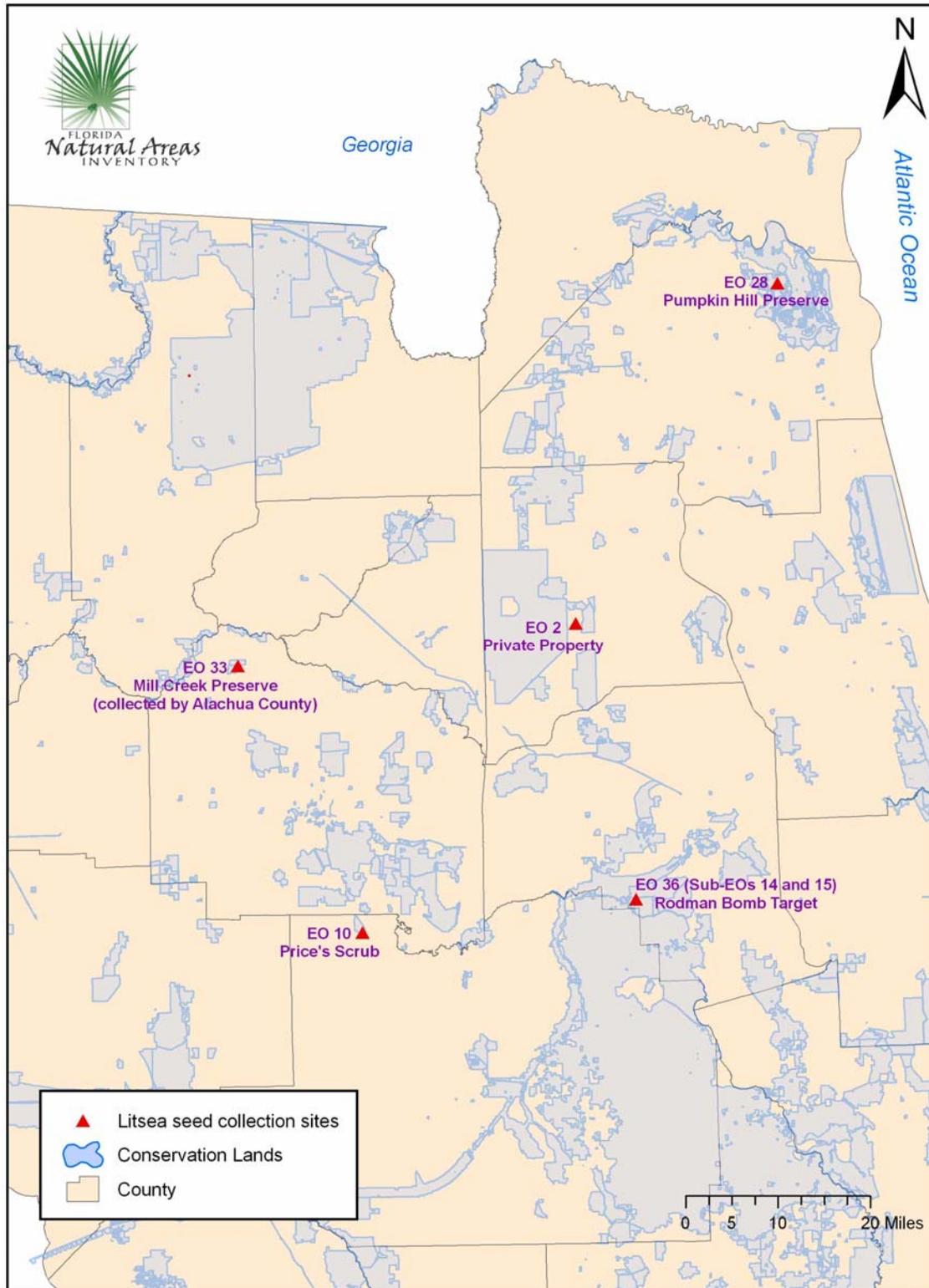


Figure 2. Locations where pondspice (*Litsea aestivalis*) seeds were collected during the 2009-10 Florida Natural Areas Inventory survey. The numbers represent element occurrence records.

Table 1. Documented wetlands (FNAI Element Occurrences) with pondspice (*Litsea aestivalis*) in Florida not visited during the 2008-09 survey (Surdick and Jenkins 2009), the initial estimated population size, the 2009-2010 estimated population size, and the ratio of bushes exhibiting symptoms of Laurel Wilt Disease.

Site	County	Element Occurrence (EO)	Initial Observation Population Size	Current Population Size	Percent With LWD Symptoms
private	Taylor	update EO #3	15-20	extirpated?	0
private	Taylor	EO #8	NE (1956)	NV	NV
Rocky Bayou State Park	Okaloosa	update EO #11	NE (1996)	27	0
Eglin Air Force Base	Okaloosa	update EO #12	25 (1995)	5	0
private	Pasco	EO #16	NE (1990)	NV	NV
private	Madison	EO #17	NE (1992)	NV	NV
private	Leon	update EO #18	10 (2002)	700-1000	0
Starkey Wilderness Preserve	Pasco	update EO #21	45 (2004)	66	0
Snipe Island, Big Bend WMA	Taylor	new EO #23	NV	50	0
Yellow Jacket Conservation Area	Dixie	new EO #32	5 (2006)	4	0
private	Taylor	new EO #34	NV	3	0
Lochloosa Wildlife Conservation Area	Alachua	new EO #35	2	1 dead	100
Rodman Bomb Target	Putnam	update EO #36	NE (1997)	17	0
NE= not estimated, NV= not visited					

Table 2. The number of pondspice (*Litsea aestivalis*) seeds collected from each Element Occurrence record (EO), where they were stored, and at what temperature. Element occurrence locations are shown in Figure 2.

	EO # 2	EO # 10	EO # 28	EO # 36
Bok Tower Gardens -7C	46	0	49	37
Bok Tower Gardens -20C	50	0	50	37
NCGRP cryogenic storage	400	87	400	270

NCGRP = National Center for Genetic Resources Preservation, Fort Collins, Colorado

DISCUSSION

Laurel Wilt Disease symptoms were not suspected in the *Licaria triandra*, *Lindera benzoin*, and *Lindera subcoriacea* populations observed during the current study. Only one population of *Lindera benzoin* was visited within a county that is known to currently have LWD, and the disease may have been a factor in not being able to relocate the population along Deep Creek in Putnam County. A thorough search of the area should be conducted to determine if LWD is having an effect on the Deep Creek *Lindera benzoin* population. Five of the thirteen *Litsea aestivalis* populations visited were located in counties currently known to have LWD present. However, symptoms of LWD were not suspected on *Litsea aestivalis* at two of these populations (EOs #2 and #36) despite being prevalent in the surrounding bay trees. The population found at Pumpkin Hill Creek Preserve State Park (EO #28) continues to exhibit a small ratio of *Litsea aestivalis* with symptoms of LWD and large fruiting specimens are common even after more than four years of the epidemic being present in the county. This evidence suggests that the more shrubby members of the Lauraceae may be less susceptible to LWD in the

field than the larger members of the family (e.g., *Persea spp.*). At the same time, it appeared the only *Litsea aestivalis* shrub at EO #35 was dead from what appeared to be symptoms of LWD.

There remain several other threats to many of the observed rare Lauraceae populations such as feral hogs, fire suppression, and invasive exotic plant species. There is only one known population of *Licaria triandra* in the United States and it persists in a small isolated rockland hammock on the Miami Rock Ridge surrounded by urban development. Stochastic events such as hurricanes or canopy fire have the potential to eliminate this localized population. Given that many of the rare Lauraceae species occur in very low numbers amongst widely scattered populations lends them particularly susceptible to a variety of disturbances that larger populations may more effectively resist (e.g., drought events).

Disturbance to the natural community and/or direct mortality from feral hogs was observed in several of the populations of rare Lauraceae visited (e.g., *Litsea aestivalis* EOs #12, #28, #34, #36 and *Lindera subcoriacea* EO #1). On Eglin Air Force Base there was extensive hog rooting observed in the shrub bog where *Litsea aestivalis* (EO #12) occurs and the population has decreased from approximately 25 shrubs to five in less than 15 years. Also on Eglin Air Force Base hog rooting within the *Lindera subcoriacea* (EO #1) was prevalent around some of the six shrubs observed and was noted as a disturbance when first discovered in 1994.

The baygall where *Lindera subcoriacea* EO #1 was found had received fire three to five years before the current survey yet dense shade remained and competition from other shrub species was apparent. It is not clear why the remaining individuals of *Lindera subcoriacea* originally documented along Mett's Creek could not be relocated but shading and competition may have been factors. Anderson (1999) reported one of the bushes was brush-cut shortly after he collected the original herbarium specimen. *Lindera subcoriacea* EO #2 was not relocated during the current study and was in an area with thick shrubs that may have formerly been reduced by periodic fire. At this time it is not known if the *Lindera subcoriacea* population has been extirpated from this location or if the habitat did not allow for a thorough survey. Throughout the range of *Lindera subcoriacea* fire suppression may be responsible for the low numbers observed and restoring periodic fire to the wetland habitats it occurs in may reverse this trend (Natureserve 2010).

Habitat Management

The use of prescribed fire may be an important management technique benefiting the remaining *Litsea aestivalis* and *Lindera subcoriacea* populations. Initially winter, fuel reduction burns may be necessary in populations that have been severely fire suppressed (Sorrie 1993). Allowing prescribed fire from the adjacent uplands to naturally enter wetlands may be beneficial to these species. The location within the surveyed wetlands of many of the *Litsea aestivalis* shrubs suggested they were in an area that received fire when water levels were low and may not receive fire when water levels are high. The natural periodicity of fire for *Litsea aestivalis* may be slightly longer than what was typical for the surrounding landscape (e.g., mesic flatwoods, sandhill). Restoring natural hydrological regimes to landscapes altered by ditches/canals or other factors, may also help to improve wetland habitat condition for many of these species. Control invasive exotic plant species when observed near rare Lauraceae populations.

RECOMMENDATIONS

A thorough survey should be conducted for the *Lindera benzoin* populations mentioned in McCartney et al. (1989) along Mormon Branch in Ocala National Forest, Deep Creek in Putnam County, Rock Springs Run in Orange County, a hammock in Brevard County, and for potentially extirpated populations in Manatee and Highlands Counties. These locations may be the only known occurrences of *Lindera benzoin* in peninsular Florida and are in counties experiencing LWD. Surveys in northern Florida where other rare Lauraceae species might be found, particularly *Lindera melissifolia* and *Lindera subcoriacea*, may aid in finding new populations that soon may be extirpated due to LWD. In south Florida the remaining rockland hammock communities near Simpson Park should be searched for undocumented *Licaria triandra* populations. Discovering the locations where these rare Lauraceae species are found is valuable if any future restoration efforts are attempted to reestablish extirpated populations.

Continue to monitor the remaining known rare Lauraceae populations and their response to LWD. At this time it is difficult to determine if LWD will have long term deleterious effects on the shrubby species of Lauraceae in Florida. Thoroughly searching all similar natural communities in the vicinity of known populations may result in the discovery of new rare Lauraceae locations. In combination with monitoring efforts it may prove beneficial to collect seeds of rare Lauraceae species for long term storage to help conserve their genetic information in case LWD does extirpate populations in Florida. Unfortunately, Lauraceae seeds tend to have high lipid counts potentially reducing their viability in long term cold storage (Mayfield 2009). Stored Lauraceae seeds may need to be periodically tested for viability and more collected to replenish unviable stocks.

To reduce the dispersal rate of ambrosia beetles avoid transporting LWD infected wood and mulch. The spread of LWD is believed to have been enhanced by human transport of infected wood to areas that had not previously been exposed to LWD. Educate the public about the problems of transporting LWD infected wood.

Maintain natural landscape processes. Allow prescribed and wild fire in the surrounding landscape to enter wetlands. Monitor the response of rare Lauraceae populations to periodic prescribed fire in combination with the affects of LWD. Study the response of rare Lauraceae to different fire periodicities. Refrain from any activities that alter the hydrology of wetlands where wetland dependent rare Lauraceae persist. The practice of putting firebreaks around wetlands should be avoided as it prevents fire from entering wetlands and can alter hydrology. Avoid using heavy machinery and applying foliar herbicides within or close proximity to rare plant populations. Control feral hog numbers on properties where rare Lauraceae natural communities are being disturbed.

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Appendix A

GLOBAL AND STATE RANKS

Florida Natural Areas Inventory (FNAI) defines an **element** as any rare or exemplary component of the natural environment, such as a species, natural community, bird rookery, spring, sinkhole, cave, or other ecological feature. FNAI assigns two ranks to each element found in Florida: the **global rank**, which is based on an element's worldwide status, and the **state rank**, which is based on the status of the element within Florida. Element ranks are based on many factors, including estimated number of occurrences, estimated abundance (for species and populations) or area (for natural communities), estimated number of adequately protected occurrences, range, threats, and ecological fragility.

GLOBAL RANK DEFINITIONS

- G1 Critically imperiled globally because of extreme rarity (5 or fewer occurrences or less than 1000 individuals) or because of extreme vulnerability to extinction due to some natural or human factor.
- G2 Imperiled globally because of rarity (6 to 20 occurrences or less than 3000 individuals) or because of vulnerability to extinction due to some natural or human factor.
- G3 Either very rare and local throughout its range (21-100 occurrences or less than 10,000 individuals), or found locally in a restricted range, or vulnerable to extinction from other factors.
- G4 Apparently secure globally (may be rare in parts of range).
- G5 Demonstrably secure globally.
- GH Occurred historically throughout its range, but has not been observed for many years.
- GX Believed to be extinct throughout range.
- GXC Extirpated from the wild but still known from captivity or cultivation.
- G#? Rank uncertain (e.g., G2?).
- G#G# Range of rank; insufficient data to assign specific global rank (e.g., G2G3)
- G#T# Rank of a taxonomic subgroup such as a subspecies or variety; the G portion of the rank refers to the entire species, and the T portion refers to the subgroup; T# has same definition as G#.
- G#Q Ranked as species but there is some question as to whether it is a valid species.
- G#T#Q Same as above, but validity as subspecies or variety is questioned.
- GU Global rank unknown; due to lack of information, no rank or range can be assigned.
- G? Temporarily not ranked.

STATE RANK DEFINITIONS

State ranks (S#) follow the same system and have the same definitions as global ranks, except they apply only to Florida, with the following additions:

- SA Accidental in Florida and not part of the established biota.
- SE Exotic species established in Florida (may be native elsewhere in North America).
- SX Believed to be extirpated from state.

FEDERAL AND STATE LEGAL STATUSES

Provided by FNAI for information only.

For official definitions and lists of protected species, consult the relevant state or federal agency.

FEDERAL LEGAL STATUS

Definitions derived from U.S. Endangered Species Act of 1973, Sec. 3. Note that the federal status given by FNAI refers only to Florida populations and that federal status may differ elsewhere.

LE Endangered: species in danger of extinction throughout all or a significant portion of its range. LT Threatened: species likely to become Endangered within the foreseeable future throughout all or a significant portion of its range.

E(S/A) Endangered due to similarity of appearance to a species which is federally listed such that enforcement personnel have difficulty in attempting to differentiate between the listed and unlisted species.

T(S/A) Threatened due to similarity of appearance (see above).

PE Proposed for listing as Endangered species.

PT Proposed for listing as Threatened species.

C Candidate species for which federal listing agencies have sufficient information on

biological vulnerability and threats to support proposing to list the species as Endangered or Threatened. XN Non-essential experimental population. MC Not currently listed, but of management concern to USFWS. N Not currently listed, nor currently being considered for listing as Endangered or Threatened.

FLORIDA LEGAL STATUSES

Plants: Definitions derived from Sections 581.011 and 581.185(2), Florida Statutes, and the Preservation of Native Flora of Florida Act, 5B-40.001. FNAI does not track all state-regulated plant species; for a complete list of state-regulated plant species, call Florida Division of Plant Industry, 352-372-3505.

LE Endangered: species of plants native to Florida that are in imminent danger of extinction within the state, the survival of which is unlikely if the causes of a decline in the number of plants continue; includes all species determined to be endangered or threatened pursuant to the U.S. Endangered Species Act.

LT Threatened: species native to the state that are in rapid decline in the number of plants within the state, but which have not so decreased in number as to cause them to be Endangered.

PE Proposed for listing as Endangered.

PT Proposed for listing as Threatened.

N Not currently listed, nor currently being considered for listing.