

# Redbay (*Persea borbonia*): Drifting Toward Oblivion

by Dr. Kim D. Coder, Professor of Tree Biology & Health Care

At the edge of streams, springs, and swamps hides the redbay tree. Redbay (*Persea borbonia*), with its evergreen aromatic leathery leaves, dark blue fruit hanging on into winter, and reddish bark, is a jewel among trees. The Native Americans found a host of medicinal uses for this medium sized tree. Early European Americans found the fine grained, highly polished wood to be perfect trim for bay boats and sailing ships. Southern gumbos require redbay leaf flavoring to be authentic.

Now exotic pests threaten this unique American tree. This publication is designed to assist people understand the great variability and confusion regarding redbay taxonomy, its lineage, where it grows, its identifying characteristics, and stress problems.

## Scientific Choices

The scientific name today for redbay is *Persea borbonia*, but that was not always the case. Redbay was first clearly identified in 1739 and taken for plant collections. Redbay has had a number of different scientific names. The genus and this species have many overlapping descriptions with various other species, varieties and forms, leading to taxonomic confusion. The genus name *Persea* was first used in 1601 and is a Greek derived name for a middle-Eastern or Persian tree with fruit growing from its stem. Over the years, this genus has been called many things including *Persea* (1601), *Laurus* (1731), *Borbonia* (1760), *Farnesia* (1763), *Menestrata* (1835), *Tamala* (1838), and *Nothaphoebe* (1898).

Other early scientific names for redbay included *Laurus caroliniensis* (1731), *Laurus borbonia* (1753), *Laurus axillaris* (1789), *Laurus elongata* (1796), *Borbonia caroliniensis* (1825), *Persea caroliniensis* (1836), *Tamala borbonia* (1838), *Tamala caroliniensis* (1838), *Nothaphoebe borbonica* (1898), *Persea littoralis* (1903), *Tamala littoralis* (1913), *Borbonia borbonia* (1922), and *Borbonia littoralis* (1922). All of these scientific names were describing the same tree species we now call *Persea borbonia*.

## Lumping or Splitting?

Because of variability in tree characteristics over its range, a number of varieties and forms have been identified. Some experts have described this variability as multiple species, and some have de-

scribed this variability as varieties of a single species. It is clear there are a number of types of redbay in the Southern and Southeastern United States. The easiest way in the field to differentiate the types of redbay is either through the flower / fruit stem length, or through hairs (tricombes) on leaf undersides. Five unique variations have been described.

The first type of redbay variation was first identified in 1814 (smoothbay -- *Laurus caroliniensis* var. *glabra* (1814), *Persea caroliniensis* var. *glabriuscula* (1864), *Persea caroliniensis* for. *glabriuscula* (1889)). This was a slight variation of redbay which was found in isolated pockets at the Northeastern portion of the species range and had leaf undersides with few or no tricombes.

#### Swampy

The second type of redbay variation was widespread and also first identified in 1814 (swampbay -- *Laurus caroliniensis* var. *pubescens* (1814), *Tamala palustris* (1838), *Persea caroliniensis* var. *palustris* (1860), *Persea caroliniensis* var. *pubescens* (1864), *Persea caroliniensis* for. *pubescens* (1889), *Persea palustris* (1895), *Persea pubescens* (1895), *Tamala pubescens* (1913), *Persea borbonia* for. *pubescens* (1945), and *Persea borbonia* var. *pubescens* (1979). This variation of redbay was significantly different than standard redbay by having dense, long, kinked leaf tricombes and very long flower / fruit stems. This variation grew in more poorly drained swampy areas across the general range of redbay, but tended to be concentrated in more Northern or cooler portions of the redbay range.

#### Silky

The third type of redbay variation was first identified in 1895 (silkbay -- *Persea humilis* (1895) and *Borbonia humilis* (1922)). This variation was found in Florida and its Texas scrub lands with dense, silky tricombes on leaf backsides. The fourth type of redbay variation was first identified in 1903 (*Persea littoralis* (1903), *Tamala littoralis* (1913), and *Borbonia littoralis* (1922)). This was a slight variation or ecotype of redbay found on coastal dunes in Florida. The fifth type of redbay variation was identified in 1942 (*Persea palustris* var. *laevifolia*) as a slightly different Virginia type of swampbay with few tricombes on leaves.

#### Summing Variations

The standard type of redbay is sometimes called *Persea borbonia* var. *borbonia* to differentiate the main species description from later described species, varieties, and forms. In most modern texts they will list either three separate varieties or three species for *Persea* in the South and Southeastern United States. The varieties are listed as: the medium sized standard tree *Persea borbonia* var. *borbonia* (1753) -- redbay; the dwarf tree or shrub *Persea borbonia* var. *humilis* (1895) -- silkbay; or, the small tree *Persea borbonia* var. *pubescens* (1814) – swamp bay. Some experts accept the varieties as separate species: *Persea borbonia* -- redbay; *Persea humilis* -- silkbay; and, *Persea palustris* – swampbay. Here I will accept these three variations as separate species, and the rest of this publication will concentrate on the standard redbay. Note Figure 1 for differentiating these three *Persea* species.

#### Common Names

The common names of redbay are many and as varied as the different places its grows. Redbay has been called bullbay, red bay, redbay, redbay persea, scrubbay, shorebay, swamp bay, swampbay persea, swampbay, sweet bay, sweetbay, and tisswood. Because of the variation in redbay's appearance, many names have been applied to the variations in this species. The term "bay" attached at the end of any name can be included as a one word name or separated out in two words (i.e. redbay = red bay). For common names, local preference determines which one is used and how it is spelled.

## The Genus

The genus for redbay is *Persea*. *Persea* species occur in the Western Hemisphere, plus one species in the Canary Islands. The total count of *Persea* in the Western hemisphere is approximately 81 species and 18 varieties for a total of 99 types. Most of these types are tropical and sub-tropical trees primarily in South and Central America. *Persea* is divided into two groups (or sub-genera). One group is the (*Persea*) *Eriodaphne* or redbay group containing most of the species. The second group is the (*Persea*) *Persea* or avocado group which includes six species or varieties. There is a great deal of overlap in all the species concepts for *Persea*.

Probably the most recognizable member of the *Persea* genus is *Persea americana* the avocado from Central America. *Persea americana* var. *americana* is the avocado in grocery stores and *Persea americana* var. *drymifolia* is the Mexican avocado of ethnic cuisine.

## Scented Family

Redbay belongs to the plant order *Ranales*, one of the most primitive groups of angiosperms (historically called Magnoliids). This ancient group includes the magnolias, yellow poplars, pawpaws, anise tree, wild cinnamon, and the laurels, along with a few others.

Redbay is in the laurel family (*Lauraceae*, sub-family *Lauroideae*, tribe *Perseeae*). The laurel family contains about 46 genera and about 2,500 species, mostly concentrated in tropical and subtropical parts of Central America, South America, and East Asia. Laurel family trees contain many commercial aromatic oils like anise, linaloa, sassafras, cinnamon, and camphor. A number of these tree have dark or unique heartwood and are used in cabinetry.

## US Relatives

Redbay's laurel family relatives include about 29 genera just in the Western hemisphere. The United States has roughly five native trees, two naturalized trees, four native shrubs, and one native herbaceous vine in the laurel family. These United States laurel family genera include: *Cassyth*, *Cinnamomum*, *Laurus*, *Licaria*, *Lindera*, *Litsea*, *Misanteca*, *Nectandra*, *Ocotea*, *Sassafras*, and *Umbellularia* (Western US). Of laurel family trees, four are native to the Southern and Southeastern United States.

Critical to health concerns in this family are the five Southern and Southeastern species closely related to *Persea* which could harbor, or be susceptible, to similar pest problems. These local close relatives are: *Sassafras albidum* of the central and Southern hardwoods; *Lindera benzoin* the Northern spicebush; *Lindera melissaefolium* an endangered species of the Coastal Plain; *Litsea aestivalis* from the Coastal Plain; and, *Persea americana* the commercially cultivated avocado which has escaped cultivation in places.

## Confusion Ranges

Because of the confusion of species and varieties within native *Persia* in the Southern and Southeastern United States (especially between redbay and swampbay), identifying a species range can be a problem. Redbay is a tree of the Coastal Plain growing roughly from the mouth of the Chesapeake Bay area South to the Florida Keys and West to the Eastern Gulf area of Texas with a gap within its range in Louisiana across the Mississippi River valley. Redbay is at the Northern edge of this large tropical / subtropical genus. Genetically redbay's closest relative is the Cuban shrub *Persea hypoleuca*.

The range of redbay is also confused due to differences among several taxonomic authors, with some sources being used for regulatory ranges. The literature lists five variations for the range of redbay, variously listing redbay growing in 8, 9, 11, 12, or 14 different states plus the Bahamas. Some suggest the Bahamas population is actually swampbay, not redbay. In addition, redbay is cultivated and has poten-

tially escaped in Hawaii, Puerto Rico, and the Virgin Islands. Historically, it is believed redbay barely survived being driven into the Gulf and extinction during glacial periods, while it colonized farther north in-between ice periods.

### Geographic Range

The core range for redbay always listed by all sources include Alabama, Florida, Georgia, Louisiana, Mississippi, North Carolina, South Carolina, and Texas. Far southeast Virginia is usually listed as having a significant area of redbay. The Arkansas, New Jersey, and Oklahoma outlying populations are now extinct. A small area in far Southern Delaware is identified, as are several small pockets in Southeastern Maryland, as having redbay. Maryland lists redbay as a state endangered species. Figure 2. Two redbay ranges in Georgia, derived from different sources, are shown in Figure 3. At the state level scale, where redbay grows has significant variation among sources.

Redbay can be found along the Coastal Plain of the Atlantic and Gulf coasts. Redbay grows to about 400 feet altitude above sea level. Redbay grows in heat zones 9 to 12 along the Southern Gulf coast and 7 to 11 along the Southeastern Atlantic coast. Hardiness zones of minimum cold temperature are between 8 and 11. Hardiness zone 7B is sometimes listed, but represents a hardiness zone range expansion placed for ornamental purposes. Redbay does not have a strong cold resistance process and requires winter temperatures to stay above 29°F / -2°C.

### Locations

Redbay grows as single stems or in thickets along streams and high spots along swamp edges and hammocks. The further upslope from wet, non-flooded conditions, the less chance of redbay growing and surviving. Redbay survives and thrives in a variety of wet and well-drained conditions, as well as a wide range of light conditions. Generally, redbay requires partial sun to full sun with plenty of water and root oxygen for best growth. One of myth surrounding redbay is it grows in “swamps.” Actually redbays grow in bayheads where fresh water flows out of a spring or seep, but flows or drains away. Redbays require plenty of water and plenty of root oxygen, which makes limited drainage and anaerobic soil conditions damaging.

### Requirements

Compared with other native trees, redbay has a medium growth rate and a medium life span. Redbay seeds germinate and redbay seedlings grow well in mucky acidic soils, and it transplants and grows well in upland areas, including urban sites which are more moist and well-drained than most. As general rules: 1) the richer and more well protected the site, the taller the redbay; 2) the more water available and the more well-drained the site, the taller the redbay; 3) the farther inland and the higher altitude above sea level, the shorter the redbay; and, 4) the more droughty and well-drained the site, the shorter the redbay. Redbay is moderately tolerant of salt and intolerant of fire. Redbay, and associated species, have many highly variable characteristics which have caused some major historical and modern misidentifications.

### Tree Size

Redbay can be expected to reach approximately 45 feet in height on average sites. A maximum of 75 feet in height is possible. An average stem diameter (dbh) is considered 1 to 2.5 feet, with 4 feet in diameter maximum. Crown width is wildly variable due to site and light interference. An average crown width gathered from multiple sources is 32 feet in diameter with a maximum of 70 feet in diameter. One of the largest redbays ever measured is in Florida and has reached 77 feet tall, 48 inches in stem diameter, and 52 feet in crown diameter.

## Natural Form

The natural form of redbay is noticeably different than many other trees. The crown is oval to round shaped with densely packed single layers of foliage held on slender but stiff twigs. Redbay holds branches low to the ground and does not self-prune lower limbs well. In the understory of a forest it tends to form a crooked, multi-stem shrub. With small gaps in the canopy from overstory tree failures, redbay can slowly attain single stem tree form.

Training redbay for shade and street tree use should begin early and will require more effort than with many young native trees. Redbay should be trained quickly into a single dominant stem. Branch subordination throughout the crown will be required. Raising the crown of redbay should be attempted only if essential, and then slowly over many years to assure a strong tapered stem. Crown raising should at least keep branches from reclining on the soil surface. Maintaining a natural appearance would conserve the crown close to the ground (skirted). Training is needed to develop twig and branch structure because redbay is prone to wind and ice damage.

## Leaves

Redbay leaves are simple with an entire, smooth margin which is slightly curled under. Leaves are thick, leathery, evergreen, and fall from the tree after 1.5 to 2 years, usually in early Summer. When crushed, leaves have a aromatic spicy fragrance (like a kitchen "bay" leaf). The leaves are elongated-elliptical to wide-oval in shape, tapered at each end. On average, leaves measure 3 to 6 inches long and 1 to 2 inches wide.

Redbay leaves are bright, smooth, shiny and a medium green color on top. The leaf underside is paler due to a scattered covering of minute golden to brown colored shiny hairs (tricombes) and a pale grayish-white surface coating. Leaf tricombes lay flat along the leaf surface, and are straight and un-branched. The leaf mid-rib on the underside is reddish-orange in color. Leaves tend to develop a more yellowish tint in the cooler and more Northern portions of its range. Redbay leaves are held on 0.5 to 1.0 inch long petioles. Petioles are stiff with a v-shaped groove running along the upper side. Petioles are reddish-brown in color and covered with minute tricombes.

## Flowers

Redbay is monoecious with perfect flowers (both male and female parts in the same flower). Redbay is usually not self-fertile, requiring cross-pollination for viable seeds. Flowers are small, about 1/8 to 1/4 inch long. They are not showy, nor usually noticeable, among leaves. Flowers are a pale creamy white to pale yellow in color, and are tiny and bell-shaped with no petals. They are held on short flower stalks which are about the same length or shorter than the leaf stalks (petioles). Flowers grow from leaf bases (axils) in loose groups of several flowers. Redbay flowers in mid-May to June. Bees and wind are cited as the primary pollinators for redbay.

## Fruit

Redbay fruiting occurs every year in October. Fruit are small, round to oval, single seeded, shiny, dark blue to very deep purple colored drupes. Average fruit size is 0.5 to 0.9 inches long. Fruit has a thin, bitter tasting flesh which hangs onto the tree into winter. Fused flower parts are visible at the base of the fruit as a six-lobed, green colored, persistent receptacle. The fruit stem is no longer than the leaf petioles and is reddish to orange-yellow in color.

The single seed inside a fruit is round with a slight point. Inside the seed are red cotyledons. Seeds should be sown as soon as gathered after the first of October. Germination occurs under wet (not flooded), mucky or wet organic litter conditions. Seed passage through animals (small birds, quail, turkey, bear and deer) stimulates germination. The tree is considered messy from fruit fall -- as well as from evergreen leaf fall and twig drop. Fruit can stain porous materials and damage painted surfaces if not promptly removed.



## Twigs & Buds

Redbay has slender, somewhat looping, stiff twigs. Twigs densely fill-in gaps within the leaf canopy. Twigs are green when young, aging to a light brown color. Lateral buds are small and round with two outer bud scales densely covered with tricombes. The twig has elliptical leaf scars, a single linear bundle scar, and no stipule scars. Tricombes on twigs are sparse. Twigs have a terminal bud about 0.25 inches long which is densely covered with red tricombes. Twig pith is large -- about 1/2 twig diameter -- white colored, square to round in cross section, and solid -- not diaphragmed or chambered.

## Branches

Redbay branches droop with age. They are poor self-pruners even when hanging dead on the tree stem. Branches are stiff, stout, and wide spreading. Branch unions are notoriously weak and fail easily in wind storms when a tree is in an exposed location. Proper training and mature tree pruning helps control some storm branch damage. The branch order number is controlled by active twig shedding. Twig shedding, along with shedding of fruits and evergreen leaves, make redbay messy from a litter standpoint.

## Roots

Little has been examined on redbay roots. Redbay roots have a high oxygen demand and are stressed by approaching anaerobic soil conditions. They contain an antibiotic compound (borbonol) which acts as an anti-root pathogen material to protect roots. Borbonol has been shown to be a defense against *Phytophthora* root rots. The roots have a yellowish tint and are thick. They can be found growing far from the main stem near the soil surface under the litter layer. Moving young understory redbay wildlings can be difficult unless they are root-pruned first.

## Bark

Redbay periderm in its native form can be showy. Periderm color can range from dark reddish brown to grayish brown. Periderm texture is furrowed with shallow, irregular ridges expanding into scales with old age. Periderm thickness is relatively thin (0.5 inches thick). On the younger periderm of twigs there are scattered, golden-reddish colored, fine hairs (tricombes) laying against the surface which fall off with age. A number of other organisms growing on periderm can discolor or darken the surface. Sooty molds can make the periderm black colored.

## Wood

Redbay wood is difficult to find in the commercial lumber or hobbyist marketplace, and then only in small pieces. As such, redbay has only limited local use as a wood material. Heartwood is red-colored, fine-grained, brittle, water resistant, works moderately well and polishes very well. It was traditionally used for tableware (like spoons), furniture pieces, boat and interior trim, and cabinets. It was gathered for boat trim in the live oak maritime forests during the live oak gathering days of early sailing vessels.

## Wildlife Uses

Redbay fruit is consumed by many birds, including quail and turkey. Birds cited for eating and distributing redbay include bluebirds, mockingbirds, brown thrashers, fish crows, robins, and other seed-eating generalist songbirds. Because the fruit is held on a tree well into Winter, it is a good winter food source. Rodents, like squirrels, also make use of the fruit. The tree as a whole is considered intermediate in palatability for browse, especially for deer and bear. New growth is especially susceptible to deer browse when other browse is limited. Redbay can periodically (every couple of years) be heavily grazed for short times with little long-term damage. Constant heavy grazing will kill redbay. The foliage is potentially poisonous to

domestic grazing animals. Other animal users of note are three butterflies. Redbay is the host for the larvae of the palamedes (sometimes called laurel), Schaus' and spicebush swallowtail butterflies.

### Food & Drug

Dried redbay leaves have been used for generations as the "real" Southern bay leaf for flavoring savory foods and considered essential for gumbo. Before European Americans, the Native Americans found great medicinal value in redbay. The Seminole and Creek nations used redbay for a number of purposes including treatment for: insanity (craziness), stiff neck, deep cough, drooling, numbness in limbs, arthritis, loss of appetite, nausea and vomiting, to cause vomiting, stomachache, dizziness, staggering, backache, fever and chills, headache, extreme thirst, constipation, diarrhea, blocked urine flow, frequent urination, abortion, eye problems, protracted labor, kidney problems, and unconsciousness. Redbay was also used to make a medicine given for grief, and redbay parts were used in funeral ceremonies.

The portions of redbay used in medicines were leaves (leaf tissues, decoctions, infusions, and burned for smoke) and roots (root tissues and root decoctions). Redbay infusions were made by making a tea with hot water and seeping the tissue (~10 min) at a tissue concentration of 1oz redbay plant material to 8 oz of water. This "tea" contained volatiles, essential oils, and easily dissolved materials. Redbay decoctions were produced by boiling woody tissues in water for a long time (4-10 min) and then letting it seep (3-10 min) before straining the liquid out. This liquid would contain minerals and materials only partially water soluble. Note these historical medical uses can be dangerous and poisonous! They are mentioned here, without correlating tree tissues used, treatments, applications, or recipes followed, only to show historic cultural uses for redbay.

### Stress Impacts

Redbay lives where water is plentiful but quickly drains away. The combination of wet but well-drained soils needed for best growth limits where redbay is found. Because redbay seed will germinate in more mucky, swampy, and poorly drained conditions than where the mature tree will thrive, redbay can be found growing on stressful sites. Lack of drainage can conspire to generate tree stress which limits growth, constrains defenses, and results in a number of pests being more effective. Alternatively, Summer droughts, or sites with large wet-dry fluctuation cycles, can stress and damage redbay.

Redbay has been traditionally thought of as having few native pests of any consequence. Redbay has several pests which cause a few problems. Redbay pests include an psyllid which produces ugly disfiguring leaf galls, an exotic twig boring beetle which generates twig diebacks, several scale insects which damage twigs and branches, several fungal and algal leaf spots, a defoliating fruitworm, and topical sooty mold. Exotic pests are now severely damaging and killing redbays. Redbay and its close relatives could all be at risk to these invaders.

### Major Family Problems

Redbay is under a growing attack from sapwood stain / vascular wilt pathogen *Raffaelea lauricola* (laurel wilt). This disease is similar to tree killers Dutch elm disease and oak wilt. This fungi is carried by an exotic ambrosia beetle (*Xyleborus glabratus*) from South and Southeastern Asia, now called the redbay ambrosia beetle. Other ambrosia beetles have been also associated with some dying redbays. Symptoms on redbay include signs of ambrosia beetle attack: small pin-sized holes in bark, frass sticks, or bark and tree base frass (sawdust). Pathogen symptoms on redbay are like classic wilts: wilted foliage, drooping new shoots, reddish or purple discolored leaves, discolored sapwood streaks, and fast demise (2-3 months) of the tree leaving brown foliage attached to twigs.

The redbay ambrosia beetle probably arrived from Asia in shipping materials before 2002, the year it was first trapped. Fertilized females then started to radiate out from the Port Wentworth, GA area distributed by wind and flight (about one mile distance covered each adult cycle). The redbay ambrosia beetle is a small (less than a 0.1 of an inch long), dark brownish-black colored, round shaped beetle similar to many other

ambrosia beetles. The larvae are curled and white-colored with an amber head. Local spread (beside insect flight or wind storms) is from redbay firewooding, brush removal, and log and limb transport which has assisted movement of laurel wilt by hundreds of miles per year.

Other laurel family species are susceptible to these pests in addition to redbay. Avocado (*Persea americana*) culture in Southern Florida is a key impact species. A small wetland shrub (pondberry -- *Lindera melissafolium*) is on the United States federal threatened and endangered species list is at risk. The state of Georgia already lists *Litsea* as a threatened species. The state of Florida already lists *Licaria* and *Litsea* as endangered species. Sassafras (*Sassafras albidum*) has been killed in the field from laurel wilt. Most of these other native species are found within the native range of redbay.

Figure 4 is a range map showing potential expansion of laurel wilt following laurel family species distributions. Figure 5 is a risk assessment map for Georgia based upon composite climatic data and laurel family species distribution.

In addition, there is a small genetic risk of laurel wilt impacting other primitive angiosperms in the Southern and Eastern United States like magnolias (*Magnolia*), yellow-poplar (*Liriodendron*), pawpaw (*Asimina*), anise tree (*Illicium*), wild cinnamon (*Canella*), and sweet shrub (*Calycanthus*).

### Simply Lousy

Redbay is the principal host for the magnolia psyllid or plant louse (*Trioza magnoliae*). All of the *Persea* species in the Southern and Southeastern United States are susceptible to some degree. This common pest produces large disfiguring galls along redbay leaves. The insect initiates galls which are about one inch long, light green in color with a whitish-blue colored thin surface coating. Galls are formed on redbay leaf margins causing them to roll and curl. A gall contains the growing young of the psyllid which emerges in May through a split in the gall surface. Adults look like a miniature cicada. Redbay tolerates this form of leaf damage well and the pest causes little damage except aesthetic problems due to the gall's appearance and associated leaf deformity.

### Exotic Boring

Redbay is attacked by the black twig borer (*Xylosandrus compactus*). This borer is an exotic ambrosia beetle native to Central America. This beetle chews galleries into the wood of healthy redbays (and dogwoods) across the Southern end of the redbay's range. Redbay loses growth, loses twigs, becomes disfigured and stressed. This pest has been considered only an aesthetic loss for redbay, but can lead to compounding problems resulting in significant tree damage and loss. Symptoms include wilted foliage, droopy shoots, dead twigs and damaged branches.

The adult beetle is small and solid black. It chews into wood to the pith on twigs, or into branch and stem wood about 3/4 inch. Inside this wood-surrounded gallery it lays eggs and deposits the ambrosia fungi (*Fusarium solani*). The ambrosia fungi consumes xylem and ray cell materials. The beetle larvae feed on fungal tissue and wood, expanding the gallery. Larvae growth, pupal rest, and mating all occur inside the gallery and then beetles emerge beginning in April.

### Suckers

Redbay twigs are attacked by a number of scales and aphids. Two of the most common and damaging are: cottony maple leaf scale (*Pulvinaria acericola*) which has a white waxy secretion over its body and sucks on the main veins on redbay leaves leading to tree stress and twig death; and, tuliptree scale (*Toumeyella liriodendri*) a large, irregular oval-shaped, gray-green to black-mottled peach colored, phloem sucking insect attached along twigs and branches of redbay. Tuliptree scale is also a serious pest of magnolias, and is sometimes mistaken for magnolia scale which attacks only magnolias.



Scales can cover redbay tissues so densely they can cause rapid decline. The mobile stage (crawlers) of scales do not have a protective covering and can be killed with pest control materials if carefully timed. Both of these scales can be found on a number of other plants in areas where redbays grow. Scales suck phloem liquids and expel excess materials, including sugars, as drops of honeydew. Honeydew can coat leaves and is a food source for ants and sooty molds.

### Spots & Blotches

Redbay has fungal leaf spots and blotches caused by many fungi including *Phyllachora perseae*, *Dothidea lauri borboniae*, and *Cylindrocladium perseae*. These three organisms are usually not a serious problem. Many times lower leaves, twigs, and bark are covered with sooty mold or black mildews (*Meliola* sp.) which is a superficial, black fungal layer growing over redbay surfaces consuming honeydew.

### Scurfing

Redbay can host a parasitic leaf surface algae sometimes called green scurf (*Cephaleuros virescens*). This algae appears as greenish brown spots on leaf, twig and branch surfaces. The spots look raised and reddish-brown when the algae is reproducing. The spaces between redbay tissues immediately below the algae are invaded and die, leaving a brown or necrotic spot. On sites redbay normally grow (wet, hot, humid), this algae attacks many species of plants, with evergreen, leathery-leaved species of trees most susceptible. Algae spots in bark crevices can start lesions and shallow cankers which slowly girdle the stem or branch. The cork cambium may respond to algae by forming tissues which appear disfigured and extended, with bark eventually looking stringy. Branches up to two inches in diameter have been girdled. This algae usually develops on leaf surfaces after warm summer rains.

### Nibbler

Redbays growing with a mixture of oak trees can be attacked by the ermine moth (*Urodus pavola*). This sooty black moth is the adult of a fruitworm which eats leaf parts, and sometimes whole leaves. This pest species can occasionally have population explosions and defoliate large areas of redbay. The cocoon is a unique dangling net hanging from a leaf tip.

### Chemical Defense

The locations redbay can be found growing have a lot of soil moisture, warm night temperatures, hot day temperatures, and high relative humidities. Given these site conditions, it is interesting redbay does not have more foliage and root pests. Redbay does contain a material called borbonol A (isobtusilactone, a yellow oily liquid discovered in 1973), which is an antifungal compound found in redbay roots and other tissues. Borbonol A has been shown to provide strong resistance to *Phytophthora* root rot.

### Abiotic Stress

Redbay requires wet conditions for seed germination and then wet, well-drained conditions for growth. Short term flooding which does not cover the foliage is usually survivable. Short-term drought is usually not a problem in established trees. Redbay is moderately salt tolerant. Redbay is a poor compartmentalizer and bark breaches, storm injuries to major branches, and fire scarring of the trunk can lead to wood decay and associated structural problems. Redbay can be used in upland landscapes, but providing enough water and drainage are critical constraints. Redbay in protected areas and warmer urban microsites can be moved into hardiness zone 7 with the expectation of eventual damage from freezing and ice storms.

## Fire

Redbay is intolerant of fire. Mature redbay stems can be severely damaged and scarred by fire. Redbay is a late successional species which thrives on sites with little or no disturbance, especially from fire, forest clearing, or soil compaction. Due to its crown form, evergreen leaves, foliage density, stand stocking, and the essential oils in leaves, fire can be devastating in redbay areas. On the other hand, fire does help stimulate seed germination and can help stimulate redbay browse for wildlife.

## Conclusions

Redbay is a biological, ecological, and cultural treasure of deep woods on the edge of an ecological precipice. People of the Southern and Southeastern coasts of the United States have been blessed with redbay along wetland edges. Coastal development, forest changes, and new pests are placing redbay under more stressful conditions. This burial tree of Native Americans, this historic wood of polished trim for captain's cabins on Yankee clippers, and this special food and home for several rare butterflies is being pushed farther into oblivion.

This unique tree species is now under attack from new pests which could destroy this old flavor of Southern gumbo. Understanding how redbay grows and how to identify the tree may help to combat threats as well as appreciate what we have always had but may have overlooked. Care is needed to sustain our redbays for the next generation.

## Selected References For Redbay (*Persea borbonia*)

- Brendemuehl, R.H. 1990. *Persea borbonia* / Redbay. Pages 503-506 in **Silvics of North America – Hardwoods** (volume 2). USDA-Forest Service Agricultural Handbook 654.
- Duncan, W.H. & M.B. Duncan. 1988. Pages 212-213 in **Trees of the Southeastern United States**. University of Georgia Press, Athens, GA. Pp.322.
- Godfrey, R.K. 1988. Pages 413-417 in **Trees, Shrubs and Woody Vines of Northern Florida and Adjacent Georgia and Alabama**. University of Georgia Press, Athens, GA. Pp.734.
- Godfrey, R.K. & J.W. Wooten. 1981. Pages 357-359 in **Aquatic and Wetland Plants of the Southeastern United States – Dicotyledons**. University of Georgia Press, Athens, GA. Pp.933.
- Goodrum, P.D. 1977. Redbay / *Persea borbonia*. Pages 65-66 in L.K. Halls (editor) **Southern Fruit-producing Woody Plants Used by Wildlife**. USDA-Forest Service General Technical Report SO-16. Pp.235.
- Hardin, J.W., D.J. Leopold, & F.M. White. 2001. Pages 259-260 in **Textbook of Dendrology** (9<sup>th</sup> edition). McGraw-Hill, New York. Pp.534.
- Harrar, E.S. & J.G. Harrar. 1962. Pages 298-303 in **Guide to Southern Trees** (2<sup>nd</sup> edition). Dover Publications, New York. Pp.709.
- Hodges, C.S. 1969. A new species of *Phyllachora* on *Persea*. *Mycologia* 61(4 /Jul-Aug):838-840.
- Kirkman, L.K., C.L. Brown, & D.J. Leopold. 2007. **Native Trees of the Southeast**. Timber Press. Portland, Oregon. Pp.370.
- Kopp, L.E. 1966. A taxonomic revision of the genus *Persea* in the Western Hemisphere. *Memoirs of the New York Botanical Garden* 14(1/March):1-120.
- Little, E.L. 1979. Pages 183-184 in **Checklist of United States Trees**. USDA-Forest Service Agricultural Handbook 541. Pp.375.
- Little, E.L. 1979. Four varietal transfers of United States trees. *Phytologia* 42(3/April):219-222.
- Little, E.L. 1980. Pages 448-450 in **The Audubon Society Field Guide to North American Trees – Eastern Region**. Alfred A. Knopf, New York. Pp.714.
- Luttrell, E.S. 1989. Morphology of *Meliola floridensis*. *Mycologia* 81(2):192-204.
- Mayfield, A.E. 2005. Unusual mortality of redbay (*Persea borbonia*). **Pest Alert**. Florida Department of Agriculture and Consumer Services, Division of Plant Industry. 2pp.
- Moerman, D.E. 1998. Pages 387-388 in **Native American Ethnobotany**. Timber Press, Portland, OR.

- Radford, A.E., H.E. Ahles & C.R. Bell. 1968. Pages 476-478 in **Manual of the Vascular Flora of the Carolinas**. University of North Carolina Press, Chapel Hill, NC. Pp.1183.
- Schubert, T.S., R.M. Leaky & N.E. El-Gholl. 1999. *Cylindrocladium perseae*. Mycotaxon 73 (Oct-Dec):465-475.
- Spongberg, S.A. 1975. *Lauraceae* hardy in temperate North America. Journal of the Arnold Arboretum 56(1):1-19.
- Thomas, M.C. 2005. Another Asian ambrosia beetle *Xyleborus glabratus*. **Pest Alert**. Florida Department of Agriculture and Consumer Services, Division of Plant Industry. 2pp.
- Van der Werff, H. 1991. A key to the genera of *Lauraceae* in the new world. Annals of the Missouri Botanical Garden 78(2):377-387.
- Wofford, B.E. & R.W. Pearman. 1975. An SEM study of leaf surface pubescence in the Southeastern taxa of *Persea*. SIDA: Contributions to Botany 6(1/June):19-23.
- Wood, C.E. 1958. The genera of the woody *Ranales* in the Southeastern United States. Journal of the Arnold Arboretum 39(3):296-346.
- Wunderlin, R.P. 1998. Pages 307-309 in **A Guide to the Vascular Plants of Florida**. University of Florida Press, Gainesville, FL. Pp.806.
- Zaki, A.I., G.A. Zentmyer, J. Pettus, J.J. Sims, N.J. Keen & V.O. Sing. 1980. Barbonal from *Persea* sp. – chemical properties and antifungal activity against *Phytophthora cinnamomi*. Physiological Plant Pathology 16(2):205-212.

# *Persea palustris*

swampbay – small tree (up to 30 ft tall and 15 in in diameter)  
common from Virginia to Texas  
poor drained sites and wetland sites  
leaf more leathery and thick, 2-8 inches long, and elongated  
more leaf gall resistant than redbay  
twigs densely hairy  
tend to be in Northern or cooler part of traditional redbay range  
tricombes are erect, very long, bent, and reddish brown in color  
tricombes are dense and provide a shaggy rough texture  
tricombes very dense along leaf mid-rib  
flower stalks much longer than leaf petioles

# *Persea humilis*

silkbay – dwarf tree or shrub (up to 15 ft tall)  
found in Florida and Texas scrub lands only  
dry sites  
more black colored bark  
leaf thin and small (1-3.5 inches long and 0.4-1.2 inches wide  
tricombes straight, flat, fine, and ½ the length of swampbay  
tricombes dense, shiny, silky smooth, and light brown in color  
flowers much later than redbay by a month or more  
flower / fruit stem short

# *Persea borbonia*

redbay – medium tree (up to 60 ft tall & 2.5 ft in diameter)  
found from North Carolina around to Texas on lower Coastal Plain  
well drained but wet sites  
leaf leathery and thick  
tricombes lay flat, short, straight, and shiny golden-brown color  
tricombes sparsely scattered to moderately dense  
flower stalks same length or smaller than leaf petioles

Figure 1: Differentiating the primary species of *Persea* in the Southern & Southeastern United States using growing conditions, tree range, lower leaf tricombes, and flower / fruit stem length.



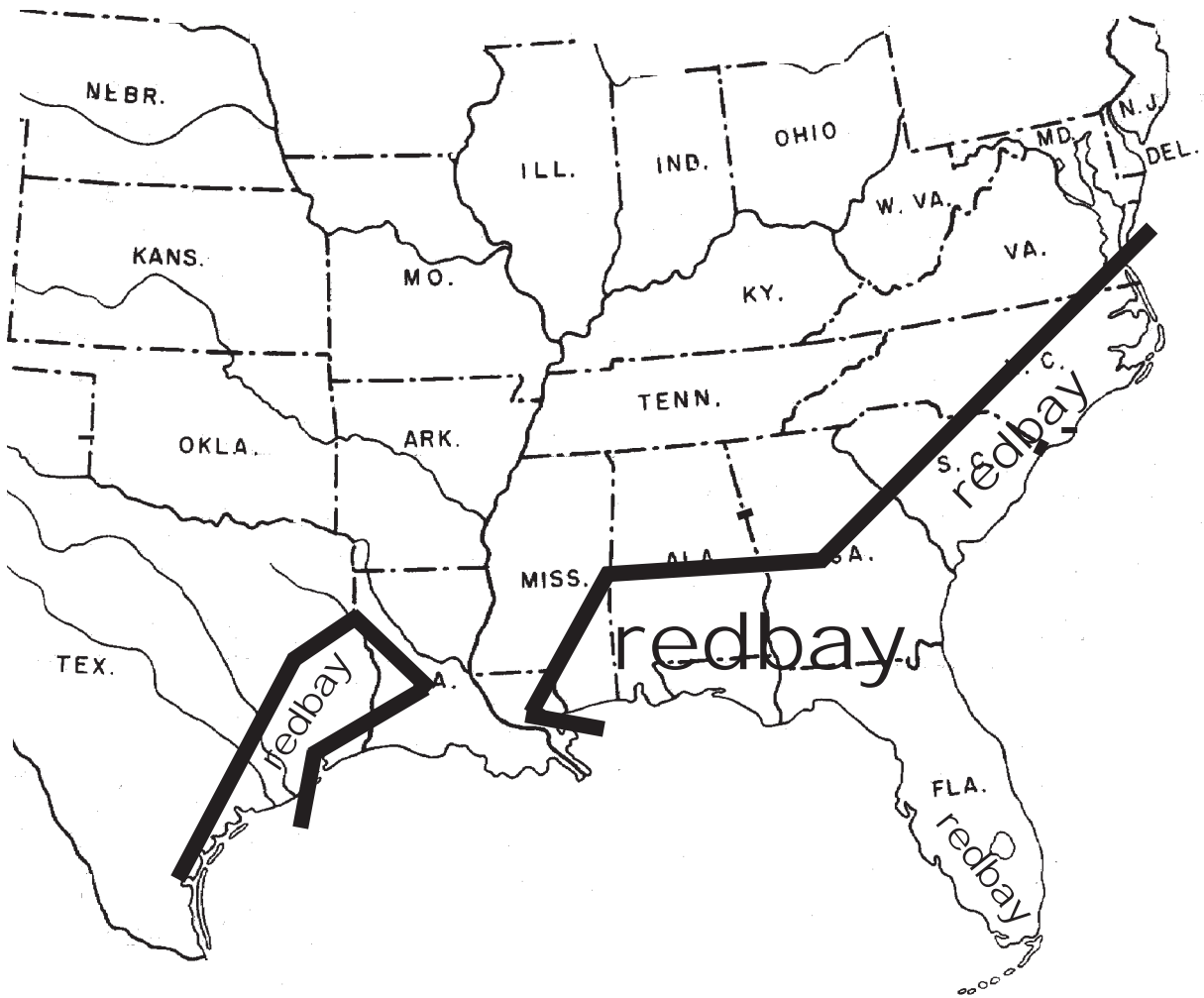


Figure 2: General geographic range map for redbay (*Persea borbonia*). Small outlying populations are omitted. Area within, and South & East of, the lines is the redbay range, extending South to the Florida Keys. Note ranges for other native *Persea* species are found within redbay's range.

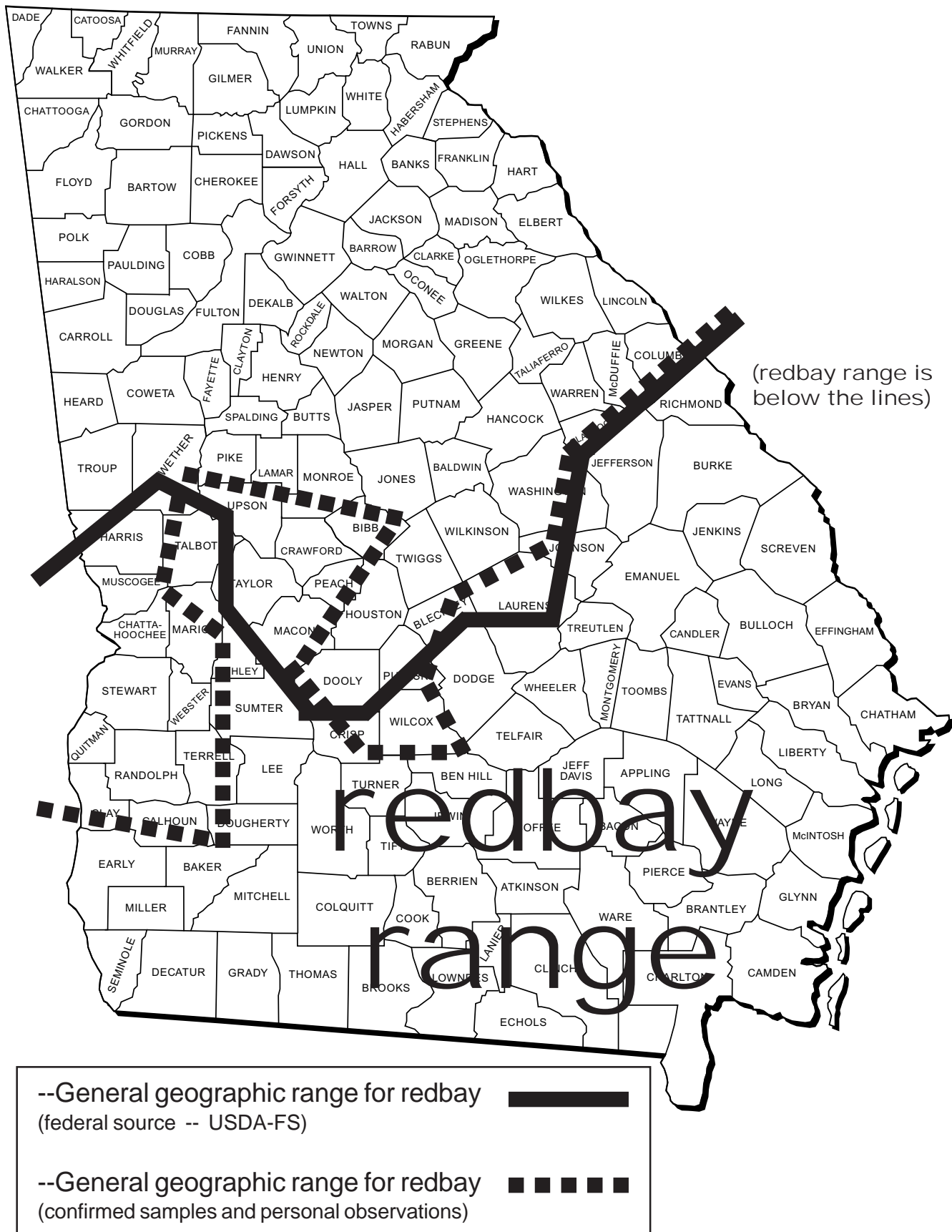


Figure 3: Redbay (*Persea borbonia*) range in Georgia.

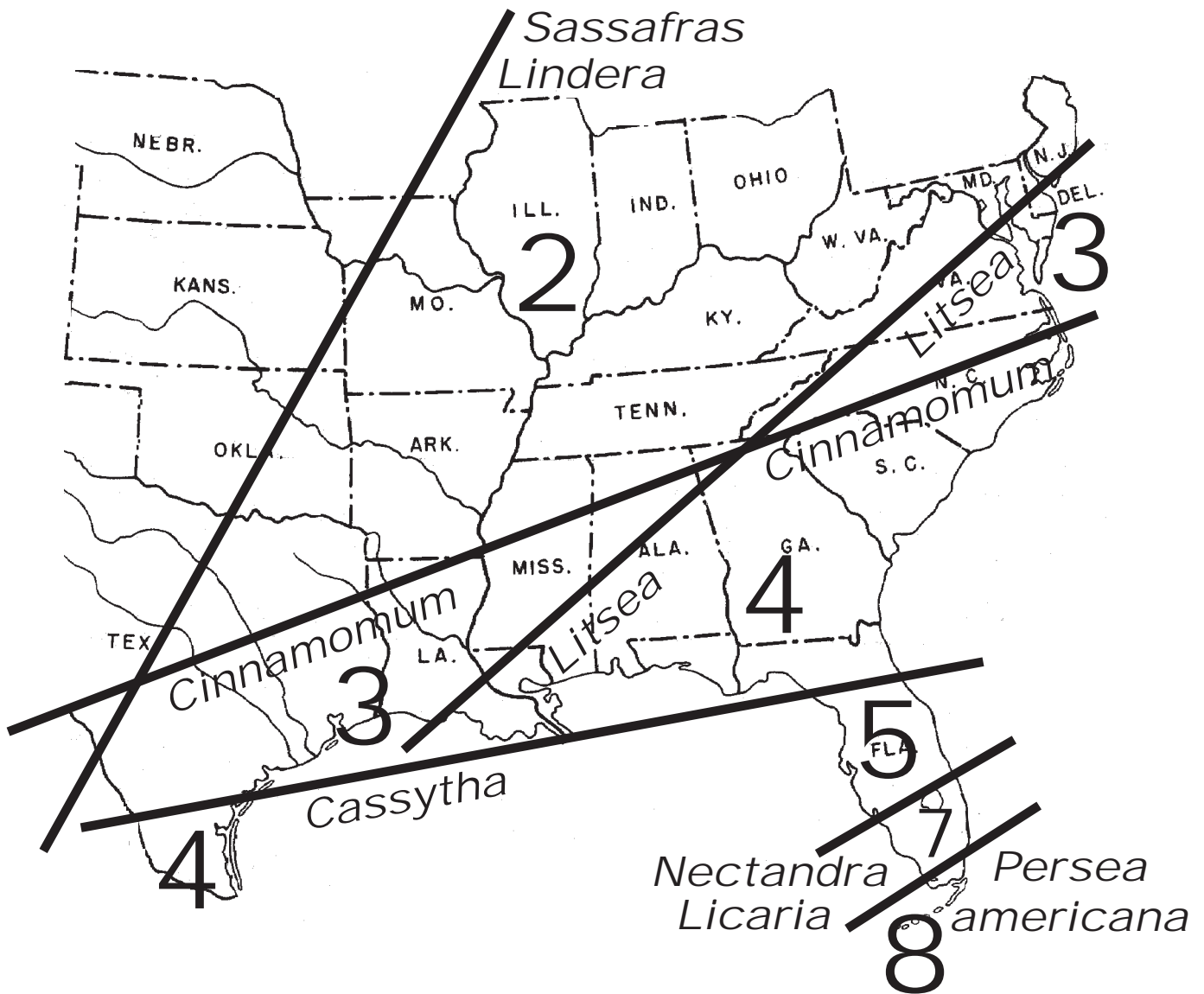


Figure 4: General geographic range map showing potential spread of *Raffaelea lauricola* / *Xyleborus glabratus* following the laurel family genera distributions. Ranges listed are always South and East of the lines. Digits represent the number of woody species in native forests and wetland areas potentially serving as hosts for *Raffaelea lauricola* / *Xyleborus glabratus*.

Note these values do not include the three native *Persea* species along the Coastal Plain of the Atlantic Ocean and Gulf of Mexico.

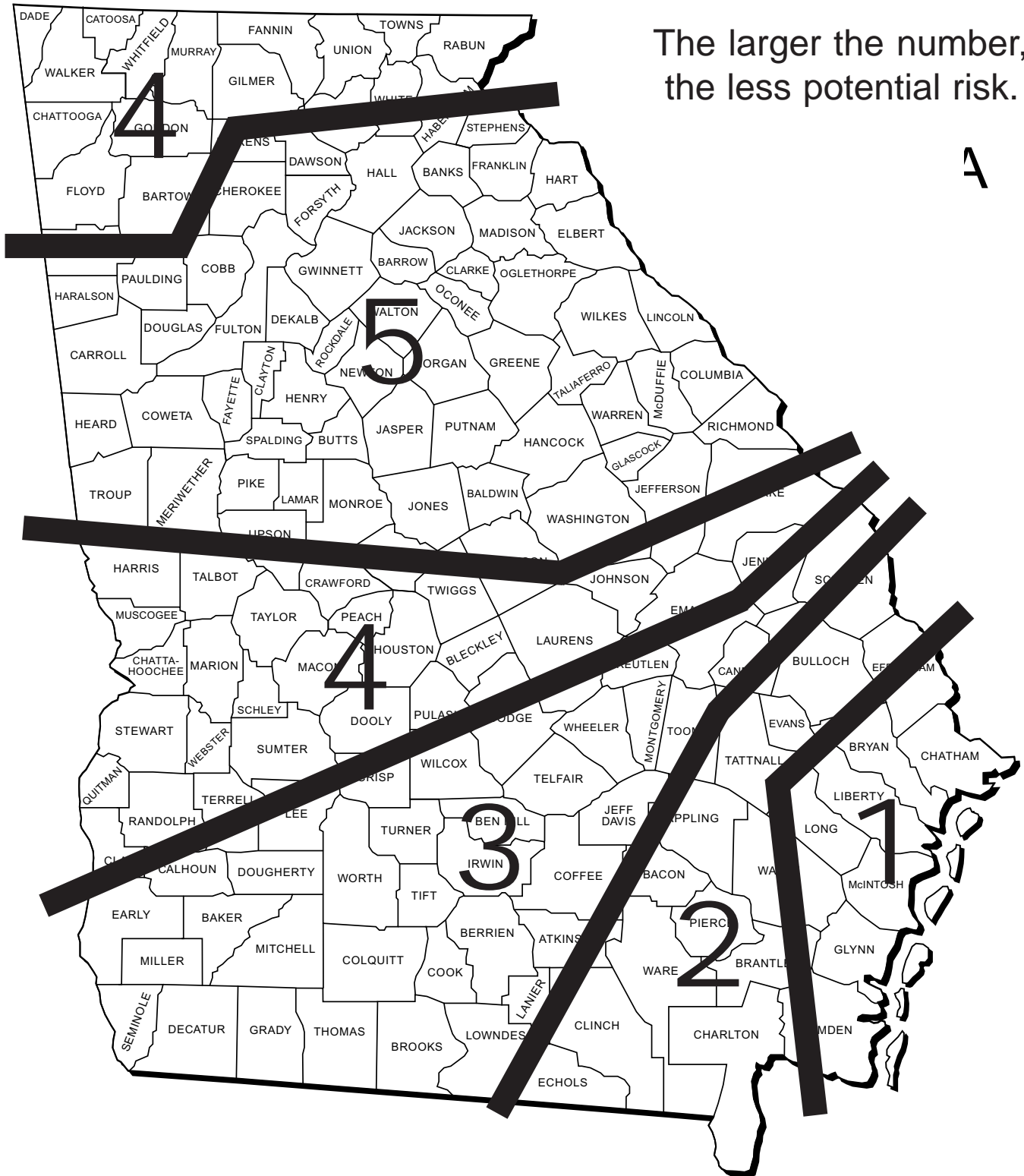


Figure 5: Laurel wilt risk assessment map for Georgia. Risk assessment for *Raffaelea lauricola* / *Xyleborus glabratus* potential range expansion based upon composite climatic data (temperature, precipitation, and evaporation), and susceptible species present (laurel family genera included *Cinnamomum*, *Lindera* (3), *Litsea*, *Persea* (2), & *Sassafras*).