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FLORA OF NORTHERN ALABAMA, PART 3. PRIMITIVE ANGIOSPERMS

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ABSTRACT

This paper is a guide to native and naturalized primitive angiosperms of northern Alabama occurring in the Appalachian Highlands and Interior Plains physiographic regions. The families included in this treatment are Cabombaceae, Nymphaeaceae, Illiciaceae, Schisandraceae, Saururaceae, Aristolochiaceae, Magnoliaceae, Annonaceae, Calycanthaceae, and Lauraceae. Photographs, maps, identification keys, habitats, distributional data, and comments are provided for each taxon.

Angiosperms (flowering plants) are the most successful group of land plants in terms of overall biomass, ecological and morphological diversity, and total number of species (Crepet & Niklas 2009; Katz 2017). With a recent estimate of 295,383 species (Christenhusz & Byng 2016), the angiosperms represent approximately 90% of all land plants and over 95% of vascular plant species (Crepet & Niklas 2009; Katz 2017). Their rich diversity stands in contrast to the group's apparent young age, with the first angiosperm fossils appearing during the early Cretaceous, approximately 125 million years ago (Zeng et al. 2014). This apparent contradiction confounded Charles Darwin (1871), leading him to declare the dilemma of rapid diversification an "abominable mystery" (Crepet & Niklas 2009; Friedman 2009; Zeng et al. 2014; Katz 2017).

Monophyly of the angiosperms is strongly supported, based on a large number of phylogenetic studies utilizing multiple nuclear, chloroplast, and mitochondria DNA sequences (Stevens 2001; Judd et al. 2015). Morphological and anatomical synapomorphies (characteristics present in an ancestral species and shared exclusively by its evolutionary descendants) uniting the angiosperms include the presence of double fertilization, triploid endosperm, an extremely reduced female gametophyte (typically consisting of eight nuclei and seven cells), and the production of seeds enclosed within a carpel structure that possesses a stigmatic region for pollen reception and germination (Donoghue & Doyle 1991; Stevens 2001; Judd et al. 2015).

Historically, the angiosperms were divided into two major groups that were believed to represent fundamental natural taxa based on numerous shared reproductive and morphological features. These two groups were first recognized by John Ray in his *Methodus Plantarum Nova* (Ray 1682) and later treated taxonomically as classes (Takhtajan 1980; Cronquist 1981). The "dicots" (Magnoliopsida) were plants that possessed two cotyledons, pollen grains with three pores (tricolpate), reticulated leaf venation, and had their perianth parts typically occurring in multiples of four or five. The "monocots" (Liliopsida) were characterized by having a single cotyledon, pollen grains with a single furrow (monosulcate), generally parallel leaf venation, and three-merous floral parts. Other features separating the two groups include differences in stem vascular bundles (scattered in monocots and occurring in distinct rings in dicots), root origin (adventitious roots in monocots versus developing from a radical, or embryonic root, in the dicots), and the common occurrence of secondary growth (i.e. true woody tissue) in dicots, with monocots lacking true secondary growth (Judd et al. 2015).

Although the flowering plants as a group are clearly monophyletic, their traditional classification into the monocots and dicots is not phylogenetically supported (Judd et al. 2016). Deciphering the primary relationships within the angiosperms was long hindered by the existence of non-conforming plants that exhibited typical dicot-like features (such as two cotyledons, vascular bundles in rings, secondary growth, and net venation), but also possessed other characters that aligned them more with monocots, such as non-tricolpate pollen. These primitive non-monocot, non-tricolpate angiosperms were sometimes misleadingly classified as belonging to a single superorder, the Annonanae (Thorne 1992), or in the subclass, Magnoliidae (Cronquist 1988, cited in Judd et al. 2015). Additional terms such as "paleodicot" and "paleoherb" were sometimes used to refer to the primitive flowering plants that are classified as neither a eudicot nor a monocot (Leitch et al. 1998). The problem with these classification approaches is that the "primitive dicots" are actually a disparate assemblage of early divergent flowering plants, exhibiting pleisomorphic features (ancestral traits) that evolved earlier in the phylogenetic history of vascular plants (Judd et al. 2015).

Modern phylogenetic studies (Zeng et al. 2014; Judd et al. 2015; APG 2016) have now greatly clarified the backbone of angiosperm relationships, identifying eight main clades of flowering plants (Fig. 1). The basal-most members of the angiosperms are represented by a grade of three well-supported evolutionary lineages. These three lineages are collectively known as the ANA grade based on the first letter of each member's order: the Amborellales, Nymphaeales, and Austrobaileyales (Judd et al. 2015; APG 2016). This basal assemblage was also commonly called the ANITA grade in the early literature, when some plant families, like the Illiciaceae and Trimeniaceae, were unplaced to order; however, these families are now placed in the Austrobaileyales (Stevens 2001; Judd et al. 2015; APG 2016).

The order Amborellales is represented by the single species *Amborella trichopoda*, known only from New Caledonia, which is in the southwest Pacific Ocean (Stevens 2001; Judd et al. 2015). Current evidence shows *Amborella* to be the first branching extant angiosperm lineage, basal to all other flowering plants (Stevens 2001; Soltis & Soltis 2004; Judd et al. 2015). However, other phylogenetic analyses alternatively suggest the Amborellales and the Nymphaeales are closely related sister clades (Barkman et al. 2000).

The next two lineages in the ANA grade are the Nymphaeales and Austrobaileyales (Fig. 1), both having members found within the northern Alabama study region. The Nymphaeales comprises the families Hydatellaceae, Nymphaeaceae, and Cabombaceae (APG 2016), of which the Nymphaeaceae and Cabombaceae are represented in this flora. The Angiosperm Phylogeny Group (APG 2016) recognizes three families in the Austrobaileyales: Austrobaileyaceae, Trimeniaceae, and Schisandraceae, the latter broadly defined to include the Illiciaceae. In our present treatment, the

Illiciaceae is treated separately from the Schisandraceae, following the recommendation of Reveal (2012b).

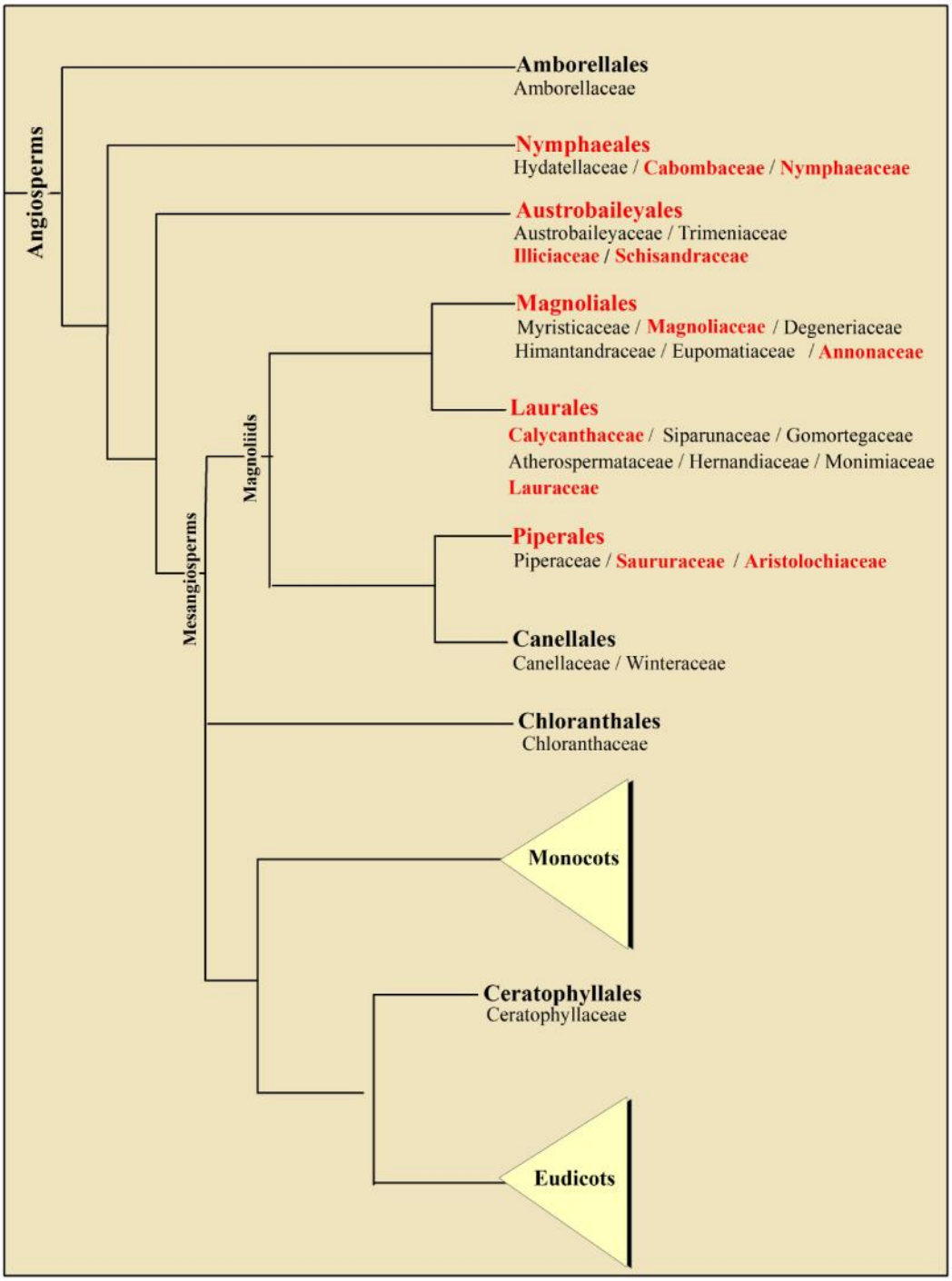


Figure 1. Relationships of the major angiosperm clades. Primitive angiosperms in this treatment are labeled in red (adapted and modified from APG 2016).

The remaining extant members of angiosperms, which constitute 99.95% of flowering plants (Zeng et al. 2014), form a highly-supported clade collectively known as the Mesangiospermae (Cantino et al. 2007). This clade contains five major lineages: eudicots, monocots, magnoliids,

Chloranthales, and Ceratophyllales (Fig. 1). The eudicots and monocots are the two largest clades in the Mesangiospermae and contain 75% and 20% of the angiosperm species, respectively (Zeng et al. 2014). These two lineages plus the Ceratophyllaceae and the Chloranthales are not covered in this present treatment.

The "magnoliids" represent the remaining clade and consist of four orders: Magnoliales, Laurales, Piperales, and Canellales. The Canellales, which includes two families, Canellaceae and Winteraceae, are not present in North America. The Magnoliales comprises six families (APG 2016; Reveal 2012b), of which the Magnoliaceae and Annonaceae have members in the study area. Seven families make up the Laurales, with only the Lauraceae and the Calycanthaceae being present in northern Alabama. Finally, the Piperales sometimes has three families (APG 2016) or includes five families (Reveal 2012b) of which the Saururaceae and the Aristolochiaceae are treated here.

METHODS AND FORMAT OF FLORA

The concept for this flora began in the 1990's when the senior author was in graduate school at Jacksonville State University (JSU). The first project included fellow JSU graduate student, Mark Ballard, and our major professor, Dr. David Whetstone. The treatment was called the *Flora of Northeast Alabama and Adjacent Highlands*, which included twenty-eight counties in northern Alabama. Part 1, the Pteridophytes (Spaulding et al. 2000a, 2000b, 2001a, 2001b 2001c) and part 2, the Gymnosperms (Spaulding et al. 2002) were published in the *Journal of the Alabama Academy of Science*.

This recent floristic project is a continuation of the flora of northeast Alabama project, except it includes six additional counties in order to encompass the area Johnston (1930) defined as northern Alabama (Fig. 2). This region contains counties that occur within the Appalachian Highlands and Interior Plains, which comprises four physiographic provinces (Fenneman 1938): Interior Low Plateaus (Highland Rim section); Appalachian Plateaus (Cumberland Plateau section); Ridge & Valley (Tennessee section); and Piedmont Plateau (Piedmont Upland section).

County distribution maps with physiographic regions (Fig. 3) are provided for each species occurring in northern Alabama. A symbol is used to document its occurrence and is placed within the physiographic province, so there may be more than one symbol per county. Specimens were examined from various herbaria and searches were made online from the following sites: Alabama Plant Atlas (Keener et al. 2017); Floristic Synthesis of North America (Kartesz 2017); and the Southeast Regional Network of Expertise and Collections Data Portal (SERNEC 2017). All vouchered specimens were verified and are deposited in the following herbaria: A, ALNHS, AMAL, AUA, BRIT, EKU, GAS, GH, JSU, KE, NBYC, NCSC, NCU, NY, TENN, TROY, UNA, UNAF, USCH, UWAL, UWFP, US, VSC, and VDB. Herbarium acronyms follow those found in *Index Herbariorum* (Thiers 2016).

Taxonomic nomenclature generally follows Weakley (2015). Families are in arranged taxonomic order, however, genera and species are organized alphabetically. Each genus includes its author and date of publication; below is its derivation in brackets and sometimes remarks about the genus. The format for common names follows Kartesz (2017) and Kartesz & Thieret (1991). Information on taxa is set up in the following arrangement: **Name** author(s) {derivation of specific and infraspecific epithet}. VERNACULAR NAME(S). [*Synonyms*]. Habit/duration. Habitat(s); flowering dates; fruiting dates (listed only if significantly different from flowering times); frequency of occurrence in Alabama provinces. Overall range and distribution. Comments.

Frequency of occurrence is defined as follows, ranging in descending order: *Common* (occurring in abundance throughout a province), *frequent* (occurring throughout a province, but not

abundant), *uncommon* (occurring in scattered localities in a province), *rare* (known only from a small number of populations, 6 to 20 occurrences, often restricted to specific localities or habitats), and *very rare* (known only from a few populations, 5 or fewer occurrences, often narrow endemics, disjuncts, or peripheral taxa, at the edges of their ranges).

The following publications were utilized in creating keys: Blomquist 1957; Clark 1971; Clewell 1985; Cronquist 1981; Elias 1980; Fernald 1950; Flora of North America 1997; Gaddy 1987b; Godfrey 1988; Godfrey & Wooten 1981; Hardin 1972; Horn 2015; Jones 2005; Kral 1960; Latowski et al. 2014; Radford et al. 1968; Small 1933; Smith 1994; Spongberg 1974; Tennessee Flora Committee 2015; Weakley 2015; Wiersema & Haynes 1983; Wilbur 1970; Wofford 1989; Wood 1958, 1959, 1971; Xia & Brach 1997. Specimens from various herbaria of the Southeast, as well as recent collections in the field, were also examined to assist in construction of the keys.

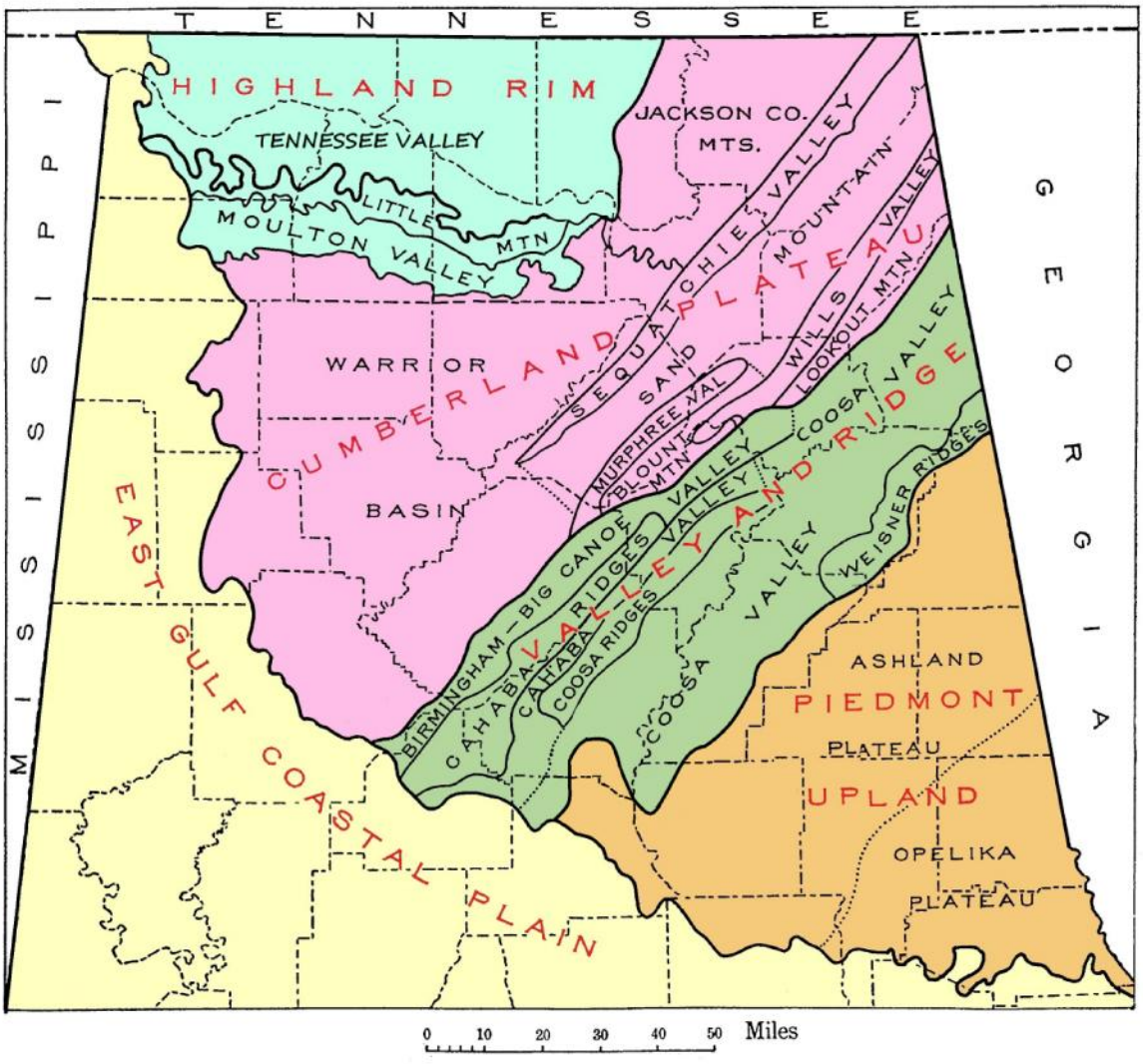
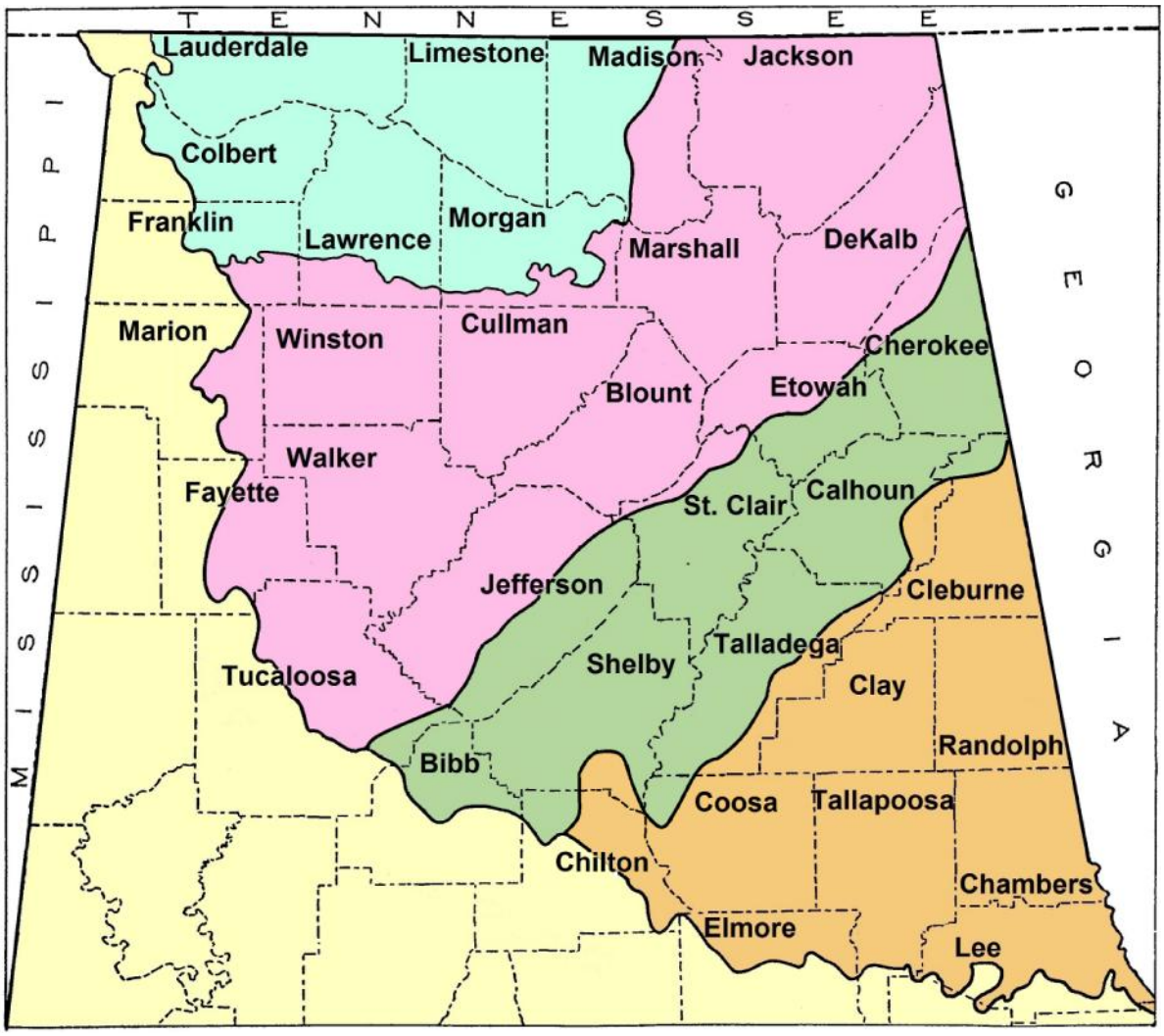


Figure 2. Map of the physical divisions of northern Alabama (adapted and modified from Johnston 1930).



MAP KEY	
●	Native taxon, present in physiographic area of county
✪	Sensitive species, listed as imperiled or rare in Alabama
◉	Introduced in region, but native to southeastern USA
▼	Exotic taxon, adventive or naturalized in Alabama
✱	Waif; cultivated escape, likely not persisting in wild

Figure 3. Counties of study area and map key to symbols.

KEY TO PRIMITIVE ANGIOSPERM FAMILIES

1. Plant woody (tree, shrub, or woody vine).

    2. Plant a woody vine.

        3. Plant glabrous; leaves elliptic and pinnately veined; leaf apices acuminate; flowers unisexual (monoecious); perianth consisting of 9–12 tepals (often pinkish to red); fruit a fleshy, red berry (when ripe)..... **4. Schisandraceae**
        3. Plant tomentose; leaves broadly ovate and palmately veined; leaf apices blunt; flowers bisexual; perianth a bent (S-shaped), tubular calyx with 3-lobes (tube is usually yellowish to green with a purple ring around opening of throat); fruit a dry, green capsule (cylindrical to elliptical) .....**6. Aristolochiaceae** (*Isotrema*)

    2. Plant a tree or shrub.

        4. Leaves opposite; nodes distinctly swollen; flowers with numerous tepals (9–12) and have a fruity/spicy aroma; fruit an oblong, semi-woody, bag-like structure (a pseudocarp) up to 8 cm long; shrubs .....**9. Calycanthaceae**
        4. Leaves alternate; nodes not distinctly swollen; flowers various; fruit not a pseudocarp; shrub or tree.

            5. Stipules present, but caducous (shed early), stipular line scars evident as a ring all the way around the twig at the nodes of younger branches; flowers relatively large (≥ 2.5 cm, in diameter), solitary; tepals white, yellowish, pink or greenish (marked with an orange blotch in *Liriodendron*); fruit cone-like ..... **7. Magnoliaceae**
            5. Stipules and encircling stipular scars absent; flowers smaller (≤ 2.5 cm, in diameter), either solitary or in multi-flowered inflorescences; tepals white, yellowish, greenish or maroon; fruit not cone-like.

                6. Leaves membranous and deciduous.

                    7. Leaves simple and long-obovate to long-oblanceolate; crushed leaves smell like green peppers; leaves and leaf scars 2-ranked (alternating on each side of stem); flowers with maroon tepals, 1–2.5 cm long, bisexual, and solitary; fruits stubby, greenish to yellowish, banana-like berries, 3–15 cm long.....**8. Annonaceae**
                    7. Leaves lobed or all simple and elliptic, ovate, lanceolate to short-obovate; crushed leaves smell spicy or fruity; leaves and leaf scars more than 3-ranked (spiraling up the stem); flowers with small yellow tepals, 2–5 mm long, unisexual (monoecious), and in multi-flowered inflorescences; fruits blue-black to red drupes, 6–10 mm long ..... **10. Lauraceae** (*Lindera*, *Sassafras*)

                6. Leaves thick and evergreen.

                    8. Plant glabrous; leaves punctate (gland-dotted) beneath; upper and lower surface of leaf blade with only midvein evident, lateral veins faint; flowers solitary with numerous red-maroon tepals, 1.5–2.5 cm long; fruit a woody, star-shaped aggregate of follicles, 25–40 mm in diameter .....**3. Illiciaceae**

8. Plant pubescent; leaves not punctate beneath; upper and lower surface of leaf blade with lateral veins and midvein clearly evident; flowers in clusters (stalked cymes) with 6 small yellow tepals, up to 2 mm long; fruit a blackish-blue, globose drupe, 8–10 mm long ..... **10. Lauraceae** (*Persea*)

1. Plant herbaceous.

9. Plant aquatic, uppermost leaves floating or all leaves emersed.

10. Floating or emersed leaves orbicular or broadly ovate and with a basal sinus (petiole attached at base of notch in leaf blade); flowers more than 3 cm in diameter with numerous tepals (more than 10); carpels united with many seeds in each locule ..... **2. Nymphaeaceae**
10. Floating leaves elliptic to linear-elliptic and peltate, lacking a basal sinus (petiole attached in middle of leaf blade), in *Cabomba* submersed leaves fan-like and finely dissected (all leaves floating in *Brasenia*); flowers less than 3 cm in diameter with 6 to 8 tepals; carpels not united (free) with 1–3 seeds in each locule ..... **1. Cabombaceae**

9. Plant terrestrial or emergent aquatic (portions of stem above surface of water); leaves not floating.

11. Flowers lacking a perianth and are borne in a crowded terminal raceme or spike (*Houttuynia* has white, petaloid bracts at base of inflorescence); plants caulescent wetland or terrestrial herbs (with aerial stems bearing leaves and flowers at above-ground nodes) ..... **5. Saururaceae**
11. Flowers with a conspicuous fleshy, tubular calyx that is borne at ground level; plants terrestrial herbs, either caulescent or acaulescent (leaf petioles and flower stalks arising separately from base of the plant)..... **6. Aristolochiaceae** (*Asarum*, *Endodeca*, *Hexastylis*)

FAMILY 1. CABOMBACEAE (Water-Shield Family)

1. All leaves floating, conspicuous (3.5–11 cm long), and broadly elliptic, not divided; plants coated with a sticky, mucilaginous jelly; stamens 18–36..... **1. *Brasenia***
1. Most leaves submersed, fan-like, and divided into linear segments, floating leaves smaller (0.6–3 cm long) and ovate-rhombic to linear-elliptic (present when flowering); plants not mucilaginous; stamens 3–6..... **2. *Cabomba***

1. BRASENIA Schreber 1789

[For Christoph Brasen, 1738–1774, a Moravian surgeon, missionary, and plant collector]

1. Brasenia schreberi J.F. Gmel. {Johann von Schreber, 1739–1810, a German botanist} — WATERSHIELD; DOLLAR-BONNET; WATER-SNOT; WATER-TARGET; PURPLE WEN-DOCK (Fig. 4a–b). [*Brasenia purpurea* (Michx.) Casp.]

Perennial, aquatic herb. Ponds, marshes, lakes, impoundments, sluggish streams, oxbows, and back water sloughs; June–October; uncommon in the Highland Rim, Ridge & Valley, and Piedmont; rare in the Cumberland Plateau; common in the Coastal Plain (Fig. 5). *Brasenia* is a monotypic genus found worldwide, except in Europe. It is sporadically distributed in Asia, Australia, Africa, northern South America, Central America, Mexico, West Indies, and the eastern half of the USA from Florida to Texas, north to Canada, and is disjunct in Western North America from Alaska south to California (Wood 1959).

Wiersema and Haynes (1983) indicated that Watershield is "common in stagnant or slow-moving water throughout the Coastal Plain in Alabama, but rare elsewhere in the state." But since the time of their publication this floating aquatic species has become more frequent outside the Coastal Plain. Collections made in the Highland Rim and Cumberland Plateau (Marshall County) are associated with the Tennessee River.

(4a) Photo: T. Wayne Barger.

(4b) Photo: Brian Finzel.

Figure 4. *Brasenia schreberi*. A. Leaves and flower, Bullock Co., Alabama, 18 Aug 2007. B. Close-up of flower with elongated stamens, Cumberland Co., Tennessee, 9 Jun 2011.

Wiersema and Haynes (1983) stated that "*Brasenia* often vigorously inhabits beaver ponds and small artificial impoundments, and in the latter situation is normally viewed as a weed." Very dense populations of Water-Shield can inhibit the growth of other plants, as well as impacting recreational use by impeding small boat navigation, but it provides good habitat for fish and other aquatic organisms.

The hard spherical seeds are a valuable food for waterfowl (Martin et al. 1951). Watershield has also been utilized by humans. The tuberous "roots" (rhizomes) were consumed by Native Americans and the young leaves and stems were eaten as salad greens by the Japanese (USDA 2010). In Japan, *Brasenia* is called *Junsai*, and is an ingredient of *Miso-shiru* (the traditional *miso* soup), *Suimono* (clear soup), and in other Japanese recipes and dishes. The plant is gathered from small boats in spring or early summer, then dried and sold loose (in plastic bags) or in bottles (Hosking 1996).

Brasenia schreberi differs from other floating aquatics by its peltate, oval-shaped leaves (the petiole is attached in middle of leaf and lacks a notch or slit). The underside of leaves, as well as stems, are heavily coated with a clear jelly-like material (Fig. 6). The flowers of *Brasenia* are wind pollinated (Cook 1988). Osborn & Schneider (1988) observed that the flowers are emergent over a three-day period. The unopened flower bud emerges on the first day and then opens diurnally over the next two days. When the flower first opens, only the stigmas are receptive. At the end of the second day, the flower closes, and the peduncle (flower stalk) bends and is submersed overnight. The next morning, on the third day, the flower emerges and opens again, but the stamens now elongate and shed their pollen (Fig. 4b); the stigmas are not receptive at this time, which assures cross pollination. The aggregate fruit (with separate carpels containing 1 to 2 seeds) is formed below the surface of the water.

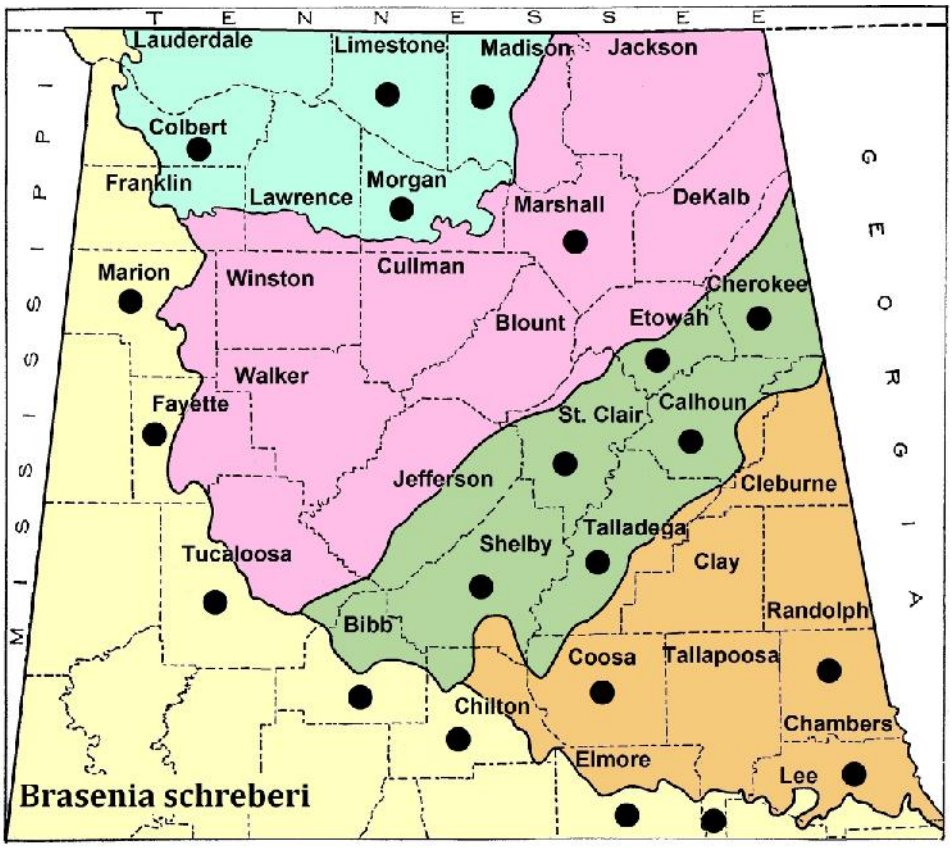


Figure 5. Distribution of *Brasenia schreberi* in northern Alabama.

Figure 6. *Brasenia schreberi*, Catahoula Ranger District, Kisatchie National Forest; Bossier Parish, Louisiana, Sept 2010. Photo: Shannon Sharp.

2. CABOMBA Aublet 1775
[Possibly a Native American name]

1. Cabomba caroliniana A. Gray {of Carolina} — CAROLINA FANWORT (Fig. 7a–b). [*Cabomba caroliniana* var. *pulcherrima* R.M. Harper; *C. pulcherrima* (R.M. Harper) Fassett]

(7a) Photo: Chris Taylor. (7b) Photo: Dan Spaulding.

Figure 7. *Cabomba caroliniana*. A. Fan-shaped submersed leaves and flower, pond in Montgomery Co., Alabama, 29 Aug 2017. B. Floating, peltate leaves with flowers, slow-moving stream by Tennessee River in Limestone Co., Alabama, 4 Jul 2017.

Perennial, aquatic herb. Ponds, swamps, lakes, and slow-moving streams; May–September; rare in the Highland Rim, Cumberland Plateau, and Piedmont; uncommon in the Coastal Plain (Fig. 8). Originally native to Brazil, Paraguay, Uruguay, Argentina and the USA from Virginia west to eastern Missouri south to Texas and Florida (Ørgaard 1991). *Cabomba caroliniana* is often used as an aquarium plant and is introduced elsewhere in the USA, Canada, Australia, Asia, and Europe (Vukov et al. 2013).

Northern populations in Alabama are found in the Tennessee River drainage system. Wiersema and Haynes (1983) reported that the Tennessee Valley Authority (TVA) attempted to eliminate this species from TVA reservoirs. Even though Carolina Fanwort is a native species, it is sometimes treated as an aquatic weed. Unlike *Brasenia*, the flowers of *Cabomba* are insect-pollinated (Cook 1988).

Typically, *Cabomba caroliniana* has white flowers and green stems, but Harper (1903) discovered a purple-tinted population in South Georgia that he named *C. caroliniana* var. *pulcherrima*. He wrote "the purple stem and petals are the most striking features…I find no mention of a purple-flowered *Cabomba* in botanical literature." He was so impressed that he stated "further study may show this to be a distinct species." Fassett (1953), in his monograph on *Cabomba*, elevated this taxon to *C. pulcherrima* and also noted that the perianth segments were emarginated

(notched) at the summit, instead of rounded as in *C. caroliniana*. He maps its distribution in the lower Coastal Plain of South Carolina, southwest Georgia, and adjacent Florida Panhandle. Most treatments sink *C. pulcherrima* in synonymy, though Weakley (2015) believes this entity needs further evaluation.

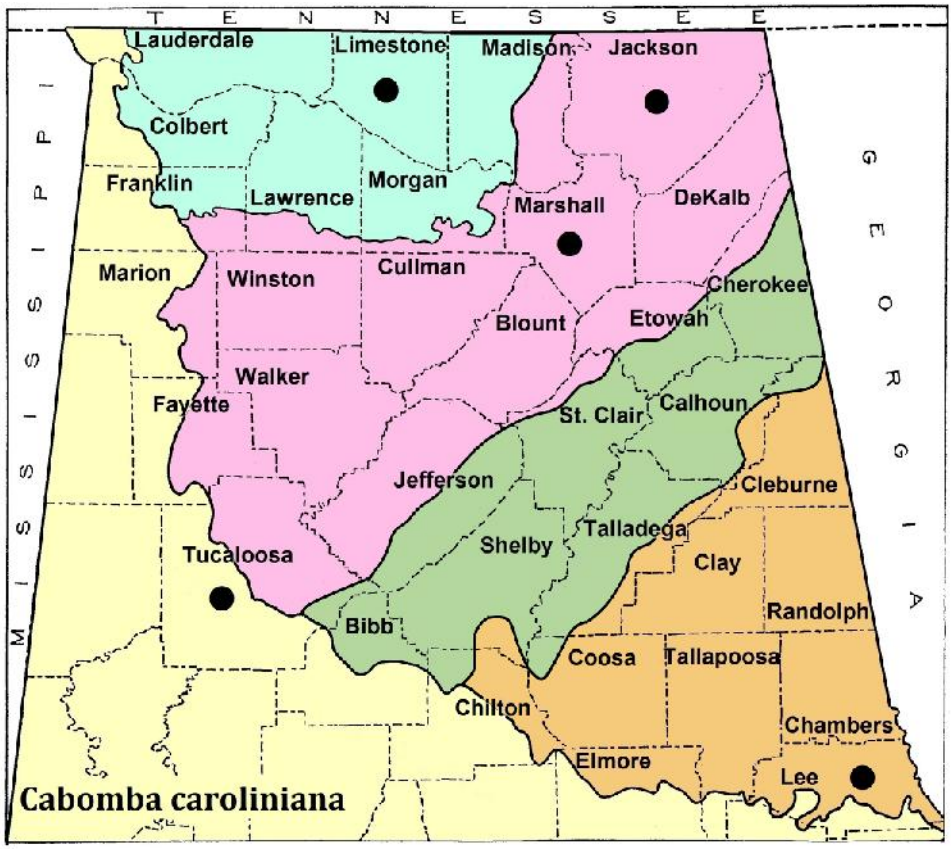


Figure 8. Distribution of *Cabomba caroliniana* in northern Alabama.

FAMILY 2. NYMPHAEACEAE (Water-Lily Family)

1. Flowers yellow, somewhat closed and ball-like (globose), usually protruding above water level; leaves floating and emersed (borne above surface of water) or occasionally submersed; leaf surfaces green on both sides; leaf blade with pinnate venation and basal lobes are broadly rounded (obtuse) ..... **1. *Nuphar***
1. Flowers white (or occasionally pink), conspicuously open and usually floating on the water; all leaves floating; leaf surfaces green above (sometime purplish) and usually purplish underneath; leaf blade with palmate venation and basal lobes are pointed (acute) ..... **2. *Nymphaea***

1. NUPHAR J.E. Smith 1809

[Ancient name; from Greek *nouphar*, the flowers from a medicinal plant mentioned by Dioscorides]

1. Nuphar advena (Aiton) W.T. Aiton {immigrant; first thought to be the European species, *N. lutea*} — YELLOW POND-LILY; BROADLEAF POND-LILY; SPATTERDOCK (Fig. 9). [*Nuphar lutea* (L.) Small ssp. *advena* (Aiton) Kartesz & Gandhi; *Nuphar lutea* ssp. *macrophyllum* (Small) E.O. Beal; *Nuphar puteorum* Fernald; *Nymphaea advena* Aiton; *Nymphaea chartacea* G.S. Miller & Standl.; *Nymphaea fluviatilis* R.M. Harper; *Nymphaea macrophylla* Small]

Perennial, aquatic herb. Swamps, ponds, lakes, impoundments, marshes, and sluggish streams or rivers; April–October; frequent in the Highland Rim; uncommon in the Cumberland Plateau, Ridge & Valley, and Piedmont; common in the Coastal Plain (Fig. 10).

Figure 9. *Nuphar advena*, roadside pond, Marion Co., Alabama, 20 Aug 2017. Photo: Dan Spaulding.

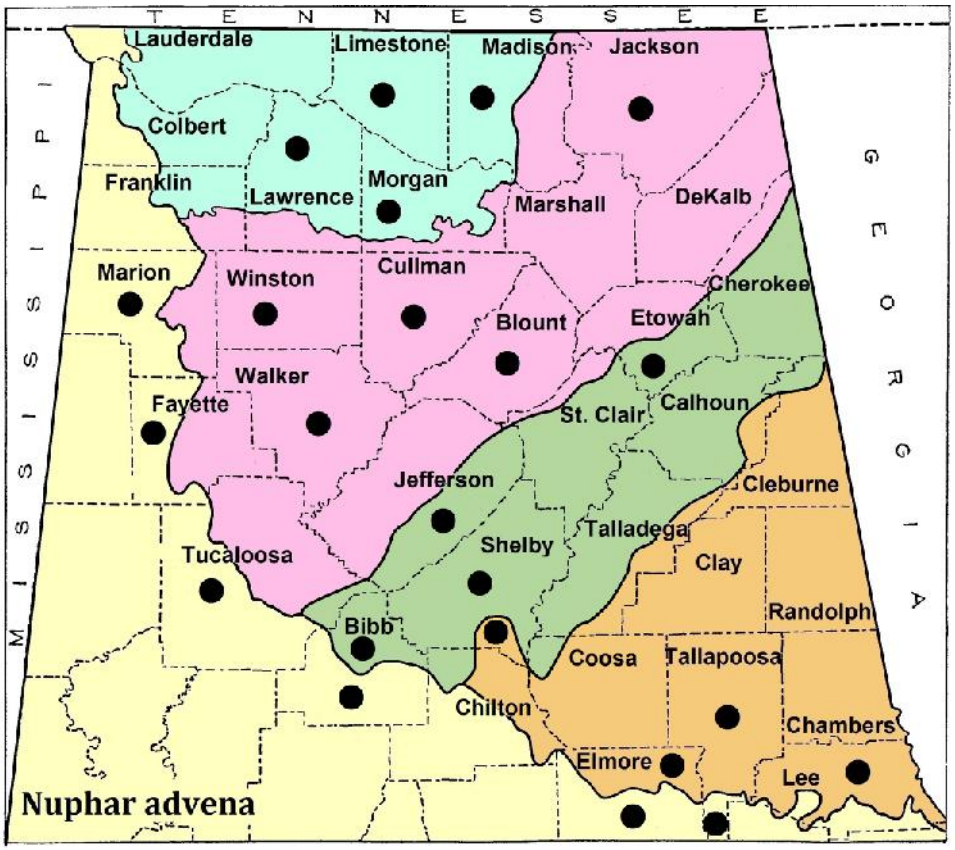


Figure 10. Distribution of *Nuphar advena* in northern Alabama.

The flowers (Fig. 11a) are pollinated by sweat bees, flies, and beetles (Wood 1959). The fruit (Fig. 11b) is slightly constricted toward the apex and splits open to release its seeds. Plants often possess flowers and fruits at the same time (Fig. 11c). Shosteck (1974) wrote that the "large seeds are edible if parched for ten minutes to loosen the kernels, then pounded lightly and winnowed to remove the shells. The starchy rootstock can be boiled, baked, or roasted as a vegetable. Remove the rind before eating."

(11a) Flower.

(11b) Fruit.

(11c) Flower and fruit together.

Figure 11. *Nuphar advena*. A. Elmore Co., Alabama, 17 Jun 2009. Photo: T. Wayne Barger. B–C. Marion Co., Alabama, 20 Aug 2017. Photos: Dan Spaulding.

2. **NYMPHAEA** Linnaeus 1753

[Greek and Latin for water-lily; for *Nympha,* goddess of waters, meadows, and forests]

1. Nymphaea odorata Aiton {fragrant; referring to flowers} — FRAGRANT WATER-LILY; AMERICAN WHITE WATER-LILY (Fig. 12). [*Castalia odorata* (Aiton) W. Wood var. *odorata*; *C. odorata* var. *rosea* (Pursh) Britton; *Nymphaea odorata* var. *gigantea* Tricker; *N. odorata* var. *minor* Sims]

Figure 12. *Nymphaea odorata*, swamp in Cherokee Co., Alabama, 16 Jul 2017. Photos: Dan Spaulding.

Perennial, aquatic herb. Ponds, swamps, marshes, and sluggish streams; June–September; uncommon in the Highland Rim, Cumberland Plateau, Ridge & Valley, and Piedmont; common in the Coastal Plain (Fig. 13). The species is found throughout North America from Canada south to Central America, but it is introduced in the western USA (Wiersema 1997).

The flowers of this water-lily are very fragrant and typically white. The leaves are usually green above and reddish-purple beneath. However, the flowers are occasionally pink and leaves are sometimes purplish on their upper surface (Fig. 14). Other characters that separate *Nymphaea* from *Nuphar* (not found in the key above) are that the perianth of *Nymphaea* has 4 greenish sepals and numerous showy petals; the fruit is roughened with traces of the perianth; the stigmatic disk lacks a stalk, therefore the fruit has a spherical shape (Latowski et al. 2014); the fruits are borne on curved peduncles and ripen under water (Wiersema 1997); the seeds are arillate (Wood 1959); and rhizomes have circular or rounded leaf scars (Conrad 1905).

Wiersema (1997) recognized only two subspecies: *Nymphaea odorata* subsp. *odorata* and *N. odorata* subsp. *tuberosa* (Paine) Wiersema & Hellq., which occurs chiefly in northern portions of eastern USA and adjacent Canada. It differs by its purple-brown striped petioles and leaves that are usually green or rarely faintly purple underneath. Wiersema (1997) acknowledged that these taxa represent the extremes in a morphologic continuum and intermediate plants may be difficult to identify. Weakley (2015) suggests that other entities with larger leaves and flowers (*N. odorata* var. *gigantea*) or with smaller leaves and flowers (*N. odorata* var. *minor*) may warrant further evaluation.

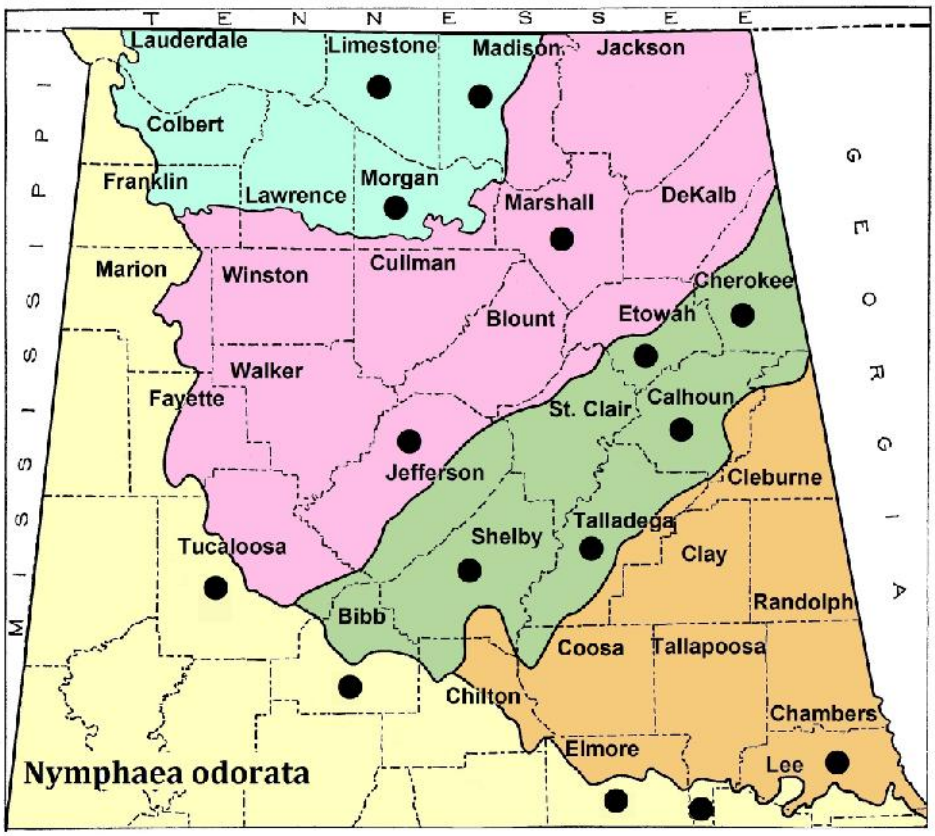


Figure 13. Distribution of *Nymphaea odorata* in northern Alabama.

Figure 14. *Nymphaea odorata* population with pink and white flowers, also with leaves purple or green on the upper surface. Bullock Co., Alabama, 25 Sep 2012. Photo: T. Wayne Barger.

FAMILY 3. ILLICIACEAE (Star-Anise Family)

1. ILLICIUM Linnaeus 1759

[Latin *illicere*, to allure; in reference to the aromatic nature of the plants]

1. Illicium floridanum J. Ellis {of Florida} — FLORIDA STAR-ANISE; FLORIDA ANISE-TREE; ANISE STINKBUSH; POLECAT-TREE; PURPLE-ANISE; FLORIDA ANISE (Fig. 15).

Figure 15. *Illicium floridanum*, Wilcox Co., Alabama, 14 Apr 2007. Photo: Brian Finzel.

Evergreen shrub (2–3 meters tall). Alluvial woods, acid stream margins, wooded creeks, shaded seepage slopes, swamps, moist ravines, and bottomland forests; flowers March–June; fruits May–November; rare in the Cumberland Plateau and Ridge & Valley (found in the southern portions bordering the Fall Line Hills district); uncommon in the Piedmont; common in the Coastal Plain (Fig. 16). *Illicium floridanum* is chiefly native to the Coastal Plain of the southeastern USA from southern Georgia and northern Florida, west to Louisiana, but introduced elsewhere (Kartesz 2017). A related species, *I. parviflorum* Michx. ex Vent., is found in peninsular Florida and adjacent Georgia (Vincent 1997). It differs from *I. floridanum* by its yellow-green flowers and rounded to acute leaf tips.

The crushed leaves of *Illicium* have a pleasant fragrance that is reminiscent of licorice or root beer. Native Americans in Florida used the leaves of *I. floridanum* to make a tea (Wood 1958). The showy, deep red to purple-red flowers (Fig. 17), unlike the leaves, have a rancid odor. Small (1933) described the flowers as having the smell of decaying fish. The color and unpleasant odor of the flowers suggests pollination by carrion flies (Wood 1958).

Florida Star-Anise is a popular ornamental shrub in the Southeast. Chinese Star-Anise, *Illicium verum* J.D. Hook., is another economically important species (Wood 1958). It is cultivated

for medicines, perfume, and as a culinary spice to flavor food (Xia & Saunders 2008), but this species is occasionally confused with Japanese Star-Anise, *I. anisatum* L., which is toxic (Vincent 1997).

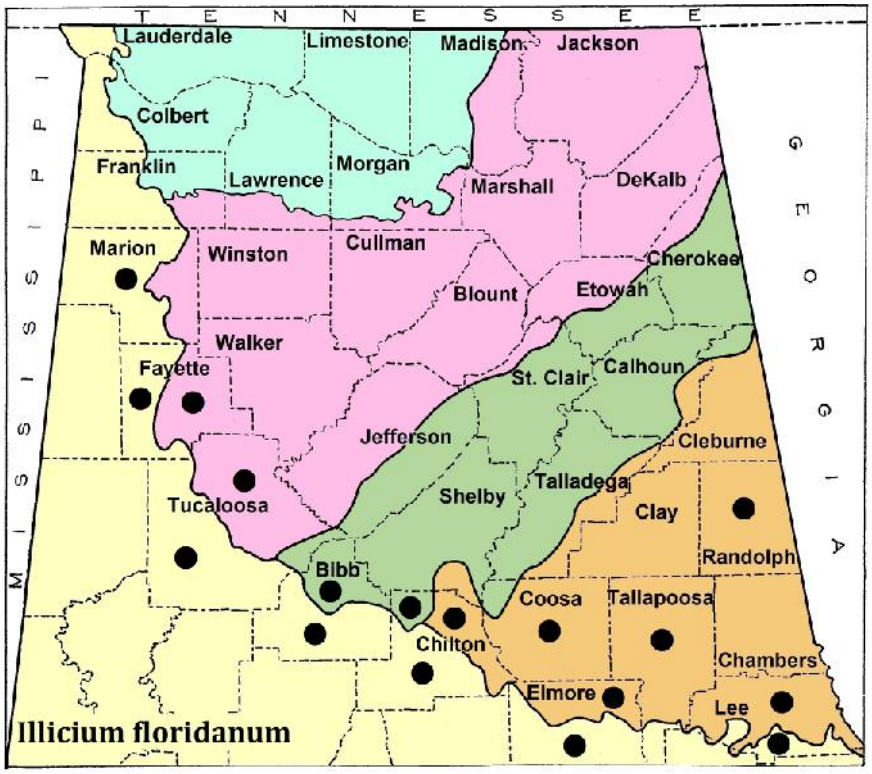


Figure 16. Distribution of *Illicium floridanum* in northern Alabama.


Figure 17. Flowers of *Illicium floridanum*, Tallapoosa Co., Alabama, 16 Apr 2016. Photo: T. Wayne Barger.

Illiciaceae, which contains a single genus of 42 species, is sometimes placed in the Schisandraceae; however, the family is retained in other treatments (Vincent 1997; Weakley 2015). Wood (1958) separated *Illicium* from the Schisandraceae because of its shrubby habit and other characters, such as its bisexual flowers and star-shaped fruits consisting of a ring of follicles (Fig. 18a), which become somewhat woody when fully mature (Fig. 18b). The seeds are dispersed by ballistic explosion (Roberts & Haynes 1983). Ellis' type description of *I. floridanum* was made from specimens collected from a swamp in Pensacola, Florida (Smith 1947).

(18a) Ripe fruit. Photo: Floyd Griffith.

(18b) Dried fruit. Photo: Dan Spaulding.

Figure 18. *Illicium floridanum* fruits. A. Jackson Co., Florida, 17 Aug 2014. B. Cultivated at the Anniston Museum of Natural History, Calhoun Co., Alabama, 3 Nov 2017.

FAMILY 4. SCHISANDRACEAE (Starvine Family)

1. SCHISANDRA Michaux 1803

[Greek *schisis*, splitting, and *andro*, male; named for divided stamens]

1. Schisandra glabra (Brickell) Rehder {without hair; plant is smooth} — BAY STARVINE; CLIMBING-MAGNOLIA; MAGNOLIA-VINE; WILD SARSAPARILLA (Fig. 19). [*Schisandra coccinea* Michx.]

Figure 19. *Schisandra glabra*, Tallapoosa Co., Alabama, 8 Jun 2011. Photo: T. Wayne Barger.

Deciduous, twining, woody vine (to 20 m). Rich or calcareous woods, mesic woods, forested rocky slopes and bluffs, often along streams; flowers May–June, fruits late June–August; rare in the southern Ridge & Valley, lower Piedmont, and Coastal Plain (Fig. 20).

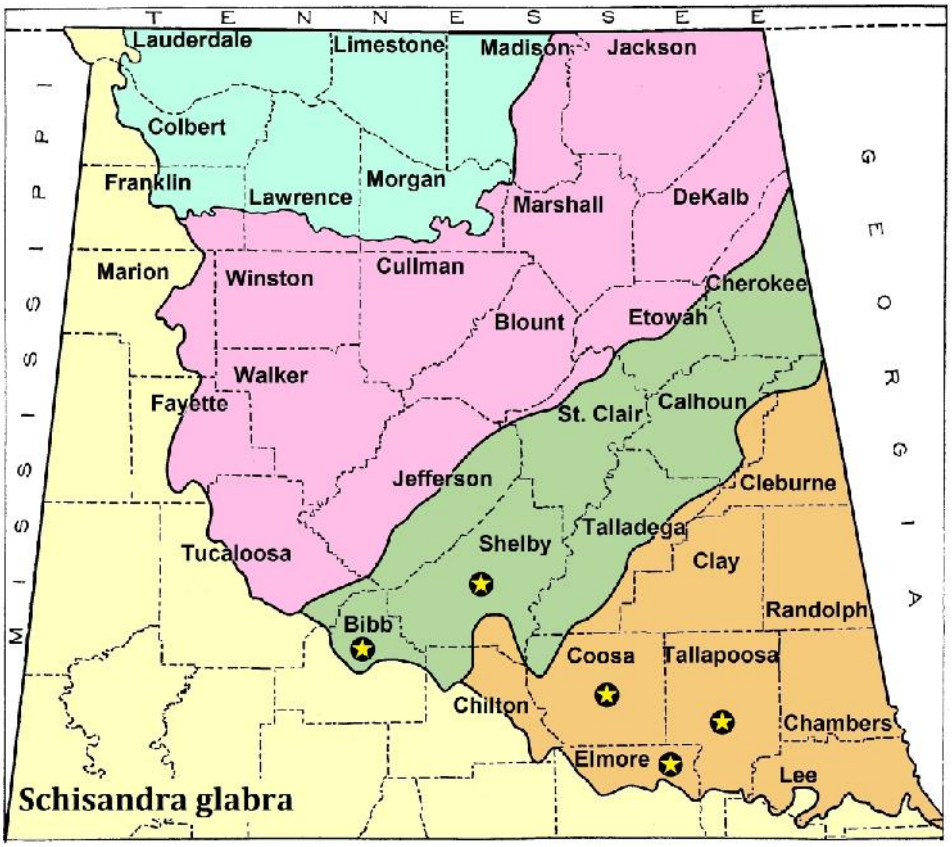


Figure 20. Distribution of *Schisandra glabra* in northern Alabama.

The genus *Schisandra* contains 25 species with *S. glabra* being the only American representative; with the other species ranging from Asia and Indonesia (Smith 1947). *Schisandra glabra* is native to the southeastern USA and occurs in Alabama, eastern Arkansas, northwestern Florida, Georgia, Louisiana, Mississippi, and southwestern Tennessee, with isolated populations in Kentucky and the Carolinas (Kartesz 2017). A fairly recent discovery of this species was made in a cloud forest of Hidalgo in east-central Mexico (Panero & Aranda. 1998).

Schisandra glabra occurs in Clarke, Houston, Marengo, and Monroe counties in the Coastal Plain of Alabama (Keener et al. 2017). The Alabama Natural Heritage Program (ALNHP 2017) lists it as imperiled (S2) in Alabama and globally rare (G3). Duncan (1967) stated that this species might be more common than records indicate because "individual leaves, although alternate, resemble those of the common *Decumaria* [Climbing Hydrangea] and, therefore, may be overlooked." He also noted that *Decumaria* [=*Hydrangea barbara* (L.) B. Schultz] climbs by aerial roots and *Schisandra* climbs by twining.

Bay Starvine is monoecious (staminate and pistillate flowers occur on the same plant). The flowers are solitary and borne on slender peduncles (2.5-5 cm long) attached at the base of petioles (Fig. 21). Wood (1958) stated that *Schisandra* shares many features with *Illicium*, but differs in its twining habit, unisexual flowers (Fig. 22a); and fruits (Fig. 22b), which are berries rather than an aggregate of radially arranged follicles.

Figure 21. *Schisandra glabra* flowers. Tallapoosa Co., Alabama, 8 Jun 2011. Photo: T. Wayne Barger.

(22a) Male flower left; female right.

(22b) Close-up of fruits.

Figure 22. *Schisandra glabra*. A. Cherokee Co., Georgia, 18 Jun 2012. B. Fulton Co., Georgia, 30 Sep 2010. Photos: Alan Cressler.

FAMILY 5. SAURURACEAE (Lizard's-Tail Family)

1. Plant of wetlands, usually in standing water; flowers in long, nodding racemes (5–35 cm), fruiting stalks erect; inflorescence lacking petaloid bracts at base of raceme; crushed leaves with a light, musky green-tea smell ..... **2. *Saururus***
1. Plant not of wetlands; flowers in shorter, erect spikes (< 3 cm long); inflorescence with four white petaloid bracts at the base; crushed leaves with a strong citrus odor..... **1. *Houttuynia***

1. HOUTTUYNIA Thunberg 1783

[Named for Maarten Houttuyn, 1720–1798, a Dutch botanist]

1. Houttuynia cordata Thunb. {heart-shaped; leaves are cordate} **—** CHAMELEON-PLANT; RAINBOW-PLANT (Fig. 23).

Figure 23. *Houttuynia cordata*, naturalized in Madison Co., Alabama, 12 Jun 2017. Photo: Brian Finzel

Perennial, terrestrial herb. Disturbed areas; May–July; very rare in Cumberland Plateau and upper Coastal Plain (Fig. 24). *Houttuynia* is a monotypic genus native to Japan, Korea, southern China, and Southeast Asia, where it grows in moist, shady places (Xia & Brach 1997). It has naturalized in five states in the USA (Kartesz 2017). This ornamental groundcover has recently escaped cultivation and is an aggressive weed, spreading rapidly by rhizomes (Wood 1971).

The common names refer to cultivated plants that are often variegated with cream, bronze, scarlet or light green blotches (Fig. 25a), but plants often turn completely dark green over time. The inflorescence of *Houttuynia* is a terminal spike (Yamazaki 1978) with four prominent petal-like bracts at the base (Fig. 25b). The plant is easy to identify without flowers, because crushed leaves have a peppery-citrus scent. In China, the strongly flavored shoots are eaten as a vegetable and the leaves have been used in Chinese medicine (Wood 1971).

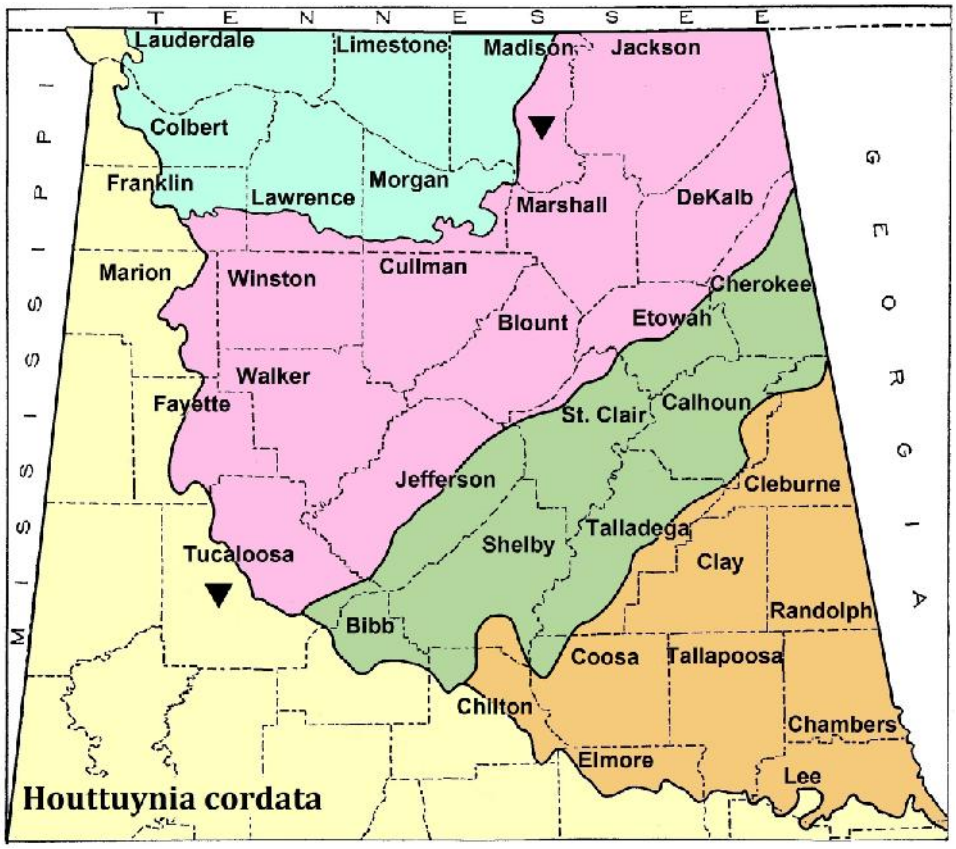


Figure 24. Distribution of *Houttuynia cordata* in northern Alabama.

(25a) Photo: Dan Spaulding.

(25b) Photo: Brian Finzel.

Figure 25. *Houttuynia cordata*. A. Cultivated specimen with mottled leaves at Anniston Museum of Natural History, Calhoun Co., Alabama, 13 Jun 2017. B. Flower close-up, disturbed woods in Madison Co., Alabama, 12 Jun 2017.

2. SAURURUS Linnaeus 1753
[Lizard tail; alluding to the long spike of flowers]

1. Saururus cernuus L. {nodding} — LIZARD'S-TAIL; WATER-DRAGON (Fig. 26).

Figure 26. *Saururus cernuus*, Tallapoosa Co., Alabama, 15 Jun 2007. Photo: T. Wayne Barger.

Perennial, wetland herb. Usually growing in shallow, standing or slow moving waters of streams, marshes, swamps, lakes, and forested wetlands, though sometimes stranded in mud; flowers May–July; fruits late July–September; frequent in the Highland Rim, Cumberland Plateau, Ridge & Valley, and Piedmont; common in the Coastal Plain (Fig. 27). Native to eastern North America from eastern Texas and Kansas, east to Florida, and north to Michigan and Rhode Island, New York and adjacent Ontario (Buddell & Thieret 1997). The genus is ditypic (contains only two members), with a second species, *Saururus chinensis* (Loureiro) Baillon, occurring in East Asia (Xia & Brach 1997).

Lizard's-Tail is a rhizomatous, wetland species that forms colonies in standing water or wet muddy soil. Plants are mostly erect, 30 to 60 cm tall (1 to 2 feet). Wood (1971) stated that "it may be weedy, and its dense growth may favor the breeding of anopheline [malaria transmitting] mosquitoes." The prominently veined arrowhead-shaped or heart-shaped leaves are arranged alternately on the stem. The inflorescence of *Saururus* is racemose and it lacks the white, petaloid bracts that are found in *Houttuynia.* Shosteck (1974) said the common name "lizard-tail" is in reference to the long, nodding bottlebrush-like inflorescence (Fig. 28a). The fruiting stalks become erect (Fig. 28b) after the fragrant, white flowers are pollinated.

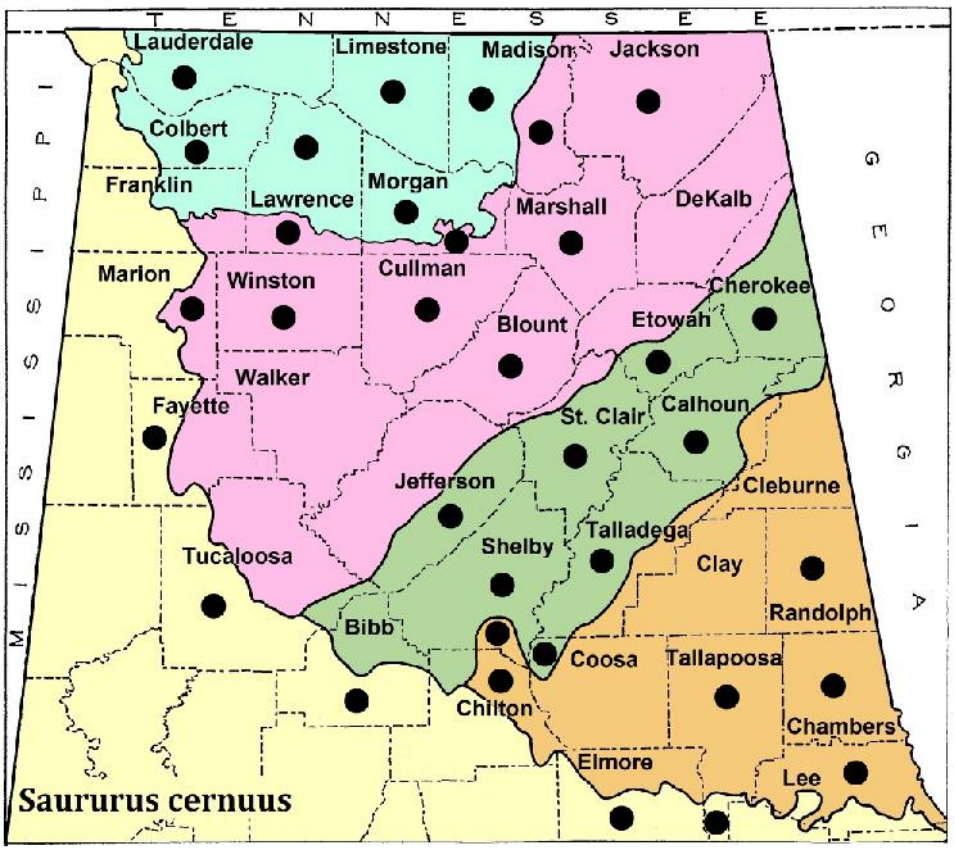


Figure 27. Distribution of *Saururus cernuus* in northern Alabama.

(28a) Photo: Brian Finzel.

(28b) Photo: Dan Spaulding.

Figure 28. *Saururus cernuus.* A. Nodding inflorescence, Limestone Co., Alabama, 15 Jun 2011. B. Plants with erect fruiting stalk, Ballplay Swamp, Cherokee Co., Alabama, 16 July 2017.

FAMILY 6. ARISTOLOCHIACEAE (Birthwort Family)

1. Woody, twining vine; leaves tomentose (velvety to the touch) ..... **4. *Isotrema***
1. Herbaceous perennial, not a vine; leaves glabrous or pubescent, but not tomentose.

2. Acaulescent herb (lacking aerial stem); apices of leaves blunt to round; calyx tube straight and radially symmetrical (flowers lack petals); crushed leaves and roots with a distinct ginger odor; stamens 12.

3. Leaves deciduous, pubescent, paired but not mottled; sepals separate; anthers with prominent appendages; styles united..... **1. *Asarum***
3. Leaves evergreen, glabrous, not paired and often mottled with different shades of green; sepals united into a tube for much of their length; styles separate ..... **3. *Hexastylis***

2. Caulescent herb (with well-developed aerial stem); apices of leaves sharply acute to acuminate; calyx tube bent (S-shaped) and bilaterally symmetrical; crushed leaves nearly odorless, but roots have a strong turpentine-like smell; stamens 6 ..... **2. *Endodeca***

1. ASARUM Linnaeus 1753

[Greek *asaron*, ancient name of an unknown plant in Dioscorides and Pliny]

The recognition of multiple species of *Asarum* in the eastern USA has been controversial and the multiple taxa are often sunk into synonymy under *A. canadense* (Radford et al. 1968; Whittemore et al. 1997). Kelly (2001), in his taxonomic treatment of *Asarum*, recognized only one widespread species, *A. canadense*, in eastern North America and wrote: "*Asarum canadense*, which has at times been divided into several species or infraspecific taxa, is here recognized as a single species based on a lack of reliable differences among the variants." Estes (2015), however, recognizes three distinct species (Fig. 29), including *A. acuminatum* (Ashe) E.P. Bicknell. Weakley (2015) stated that these "taxa recognized at varietal or specific level in the past have recently often been ignored, but have some merit; they deserve further attention."

Figure 29. Flower comparisons of the three species of *Asarum* from eastern North America. Flowers are not to scale; *Asarum acuminatum* tends to be the largest of the three (Estes 2015).

Estes (2015) stated that "most studies of wild ginger variation have relied heavily on examination of herbarium specimens and little on examination of living populations." He discusses the architectural complexity of plants that have complicated flower shapes or other parts that are destroyed upon pressing. Estes (2015) reasoned that "this architectural complexity has made these groups [like *Asarum*] difficult to study using herbarium specimens. Once their parts become smashed and dried the various species often look alike and differences that seem to exist when viewing living plants side-by-side in the field or garden seem to break down in the herbarium. This has led many botanists to do a lot of 'lumping' in some of these groups." Estes concluded the "evidence has been mounting that suggests relying too much on herbarium specimens for interpreting the taxonomy of architecturally complex plant groups may lead to serious underestimation of biodiversity. As such, we may be failing to protect critically endangered species that we don't realize exist."

1. Calyx lobes strongly reflexed, often more-or-less appressed against the calyx tube (lobes usually shorter than the tube); calyx lobes broadly triangular, mostly acute (5–12 mm long), the margins of the lobes convex to the base of the tubular tips, which are 0–4 mm long .....**2. *Asarum reflexum***
1. Calyx lobes spreading to ascending (almost as long as calyx tube); calyx lobes narrowly triangular, acuminate to short-caudate (10–25 mm long) with distinctly concave margins to the base of the tubular tips, which are 4–20 mm long ..... **1. *Asarum canadense***

1. Asarum canadense L. {of Canada} — CANADIAN WILD GINGER (Fig. 30a–c).

(30a) Leaves and flower.

(30b) Top-view of flower.

(30c) Side-view of flower.

Figure 30. *Asarum canadense*. A. Leaves and flower, Jackson Co., Alabama, 13 Apr 2007. Photo: T. Wayne Barger. B–C. Close-up of flowers, Swain Co., North Carolina, 21 Apr 2007. Photos: Brian Finzel

Perennial, deciduous herb. Rich woods; April–May; very rare in the northeastern portion of the Cumberland Plateau (Fig. 30). Native to southern Manitoba and Ontario, south through Minnesota, eastern North Dakota, Michigan, Iowa and Illinois, with disjunct populations in Ohio, Missouri, Arkansas, Kentucky, North Carolina, northern Georgia, Tennessee, and northeast Alabama (Estes 2015).

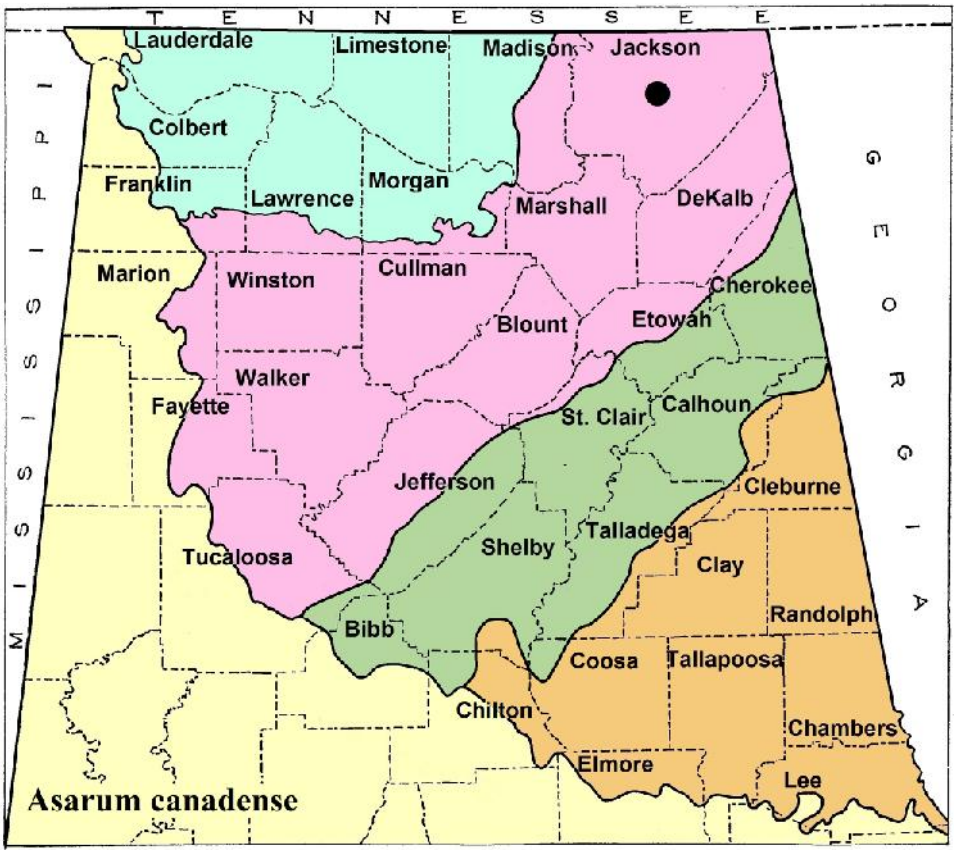


Figure 30. Distribution of *Asarum canadense* in northern Alabama.

The calyx lobes of *Asarum canadense* are somewhat similar to *A. acuminatum*, but are spreading or ascending (forward-directed) rather than long-caudate and mostly erect. The calyx tube of *A. acuminatum* is also larger than *A. canadense* (10–20 mm vs. 4–10 mm long). The leaves of the three eastern species of *Asarum* are roughly the same size while they are in flower, but leaves of *A. acuminatum* keep expanding, and by summer they are often as long as wide. In contrast, *A. reflexum* and *A. canadense* leaves are about the same size at maturity, remaining wider than long (Dwayne Estes pers. comm. 2017). *Asarum acuminatum* is native to southeastern Canada south through the Great Lakes and northeastern USA, mostly along the Appalachians to northeastern Georgia (Estes 2015).

2. Asarum reflexum E.P. Bicknell {reflexed; the calyx lobes} — REFLEXED WILD GINGER (Fig. 32). [*Asarum canadense* L. var. *ambiguum* (E.P. Bicknell) Farwell; *A. canadense* var. *reflexum* (E.P. Bicknell) B.L. Rob.]

Figure 32. *Asarum reflexum*, Lincoln Co., Tennessee, 9 Apr 2007. Photo: Brian Finzel.

Perennial, deciduous herb. Rich woods, often in calcareous soils; April–May; frequent in the Highland Rim, Cumberland Plateau, and Ridge & Valley; rare in the Coastal Plain (Fig. 33). Native to the eastern USA with the center of its distribution in mid-eastern and southeastern states. The species occurs from eastern Iowa and Wisconsin east to Connecticut, and south to Georgia and northeastern Louisiana (Estes 2015).

The flowers of *Asarum reflexum* (Fig. 34) help to separate it from other *Asarum* species in eastern North America. Bicknell (1897) stated that "while the determination of dried specimens is not always easy, living plants may always be distinguished instantly by a glance at the flowers (Fig. 35)." He noted that "the flat and reflexed lobes [of *A. reflexum*] are abruptly acuminate at the apex into a straight obtuse point." Harper (1936) wrote that *Asarum* was first found in the state in ravines along the Warrior River in Tuscaloosa County on April 12, 1933. He referred to Alabama plants as

A. reflexum and wrote "it differs from *A. canadense*, the commoner northern species, a little in the shape of its flowers, and also in odor."

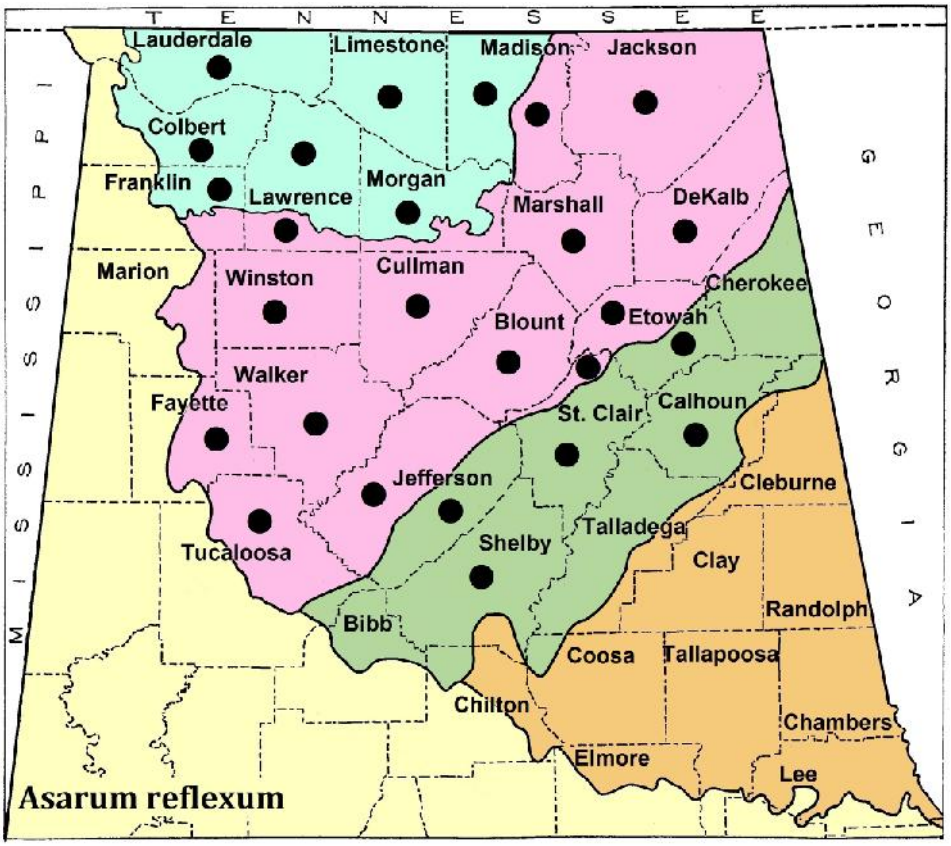


Figure 33. Distribution of *Asarum reflexum* in northern Alabama.

Figure 34. Close-up of *Asarum reflexum* flowers, Lincoln Co., Tennessee, 9 Apr 2007. Photo: Brian Finzel.

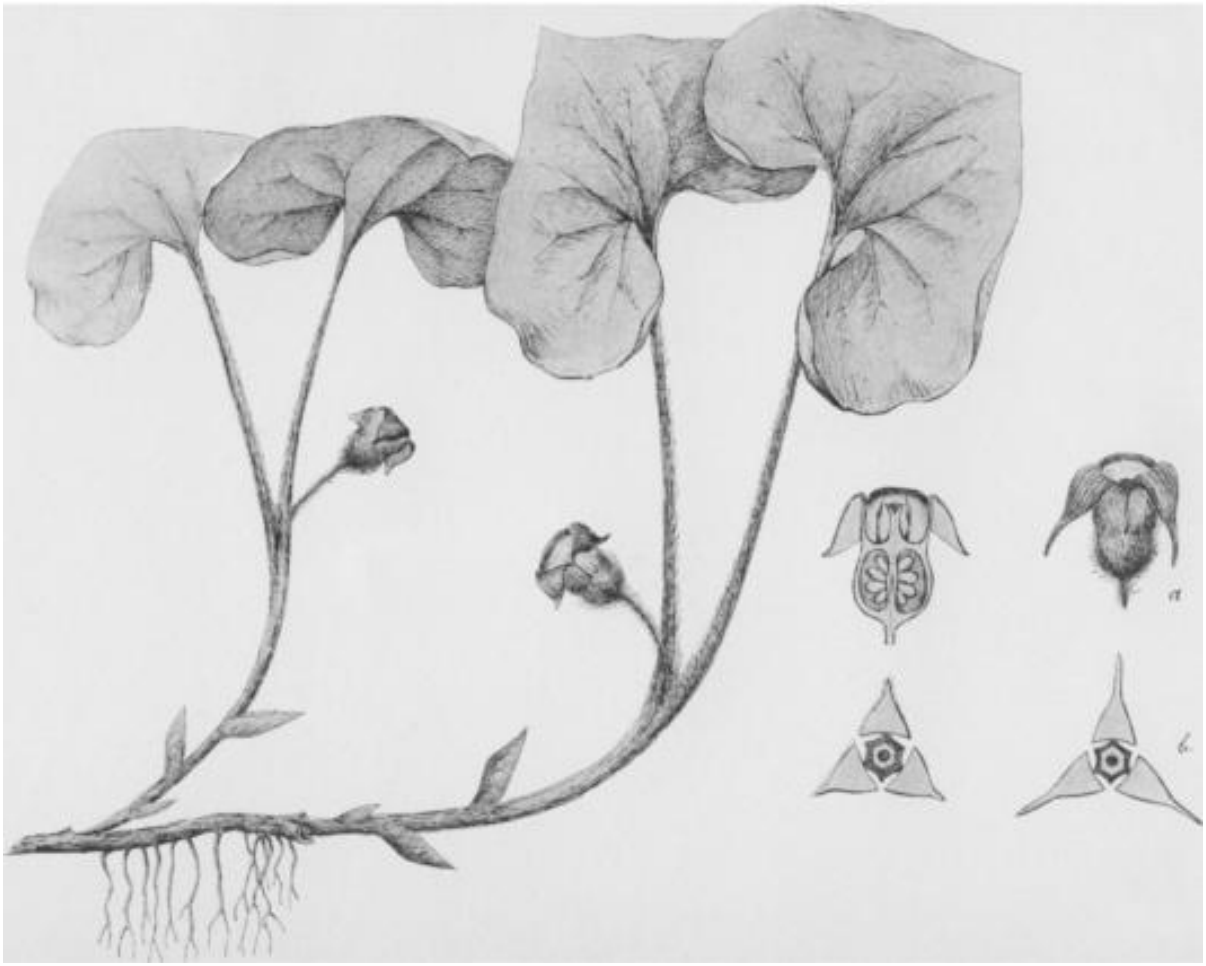


Figure 35. Illustration of *Asarum reflexum* from Bicknell (1897).

Crushed leaves of *Asarum* smell like ginger and the flowers are often hidden among the fallen leaves. Because the flowers are flesh-colored and have an unpleasant odor, it was thought that they were pollinated by carrion flies (Martin 1989). Recent research, however, has shown that *Asarum* is actually self-pollinated rather than insect pollinated, though flies do occasionally visit the flowers (Kelly 1997; Whittemore et al. 1997).

Asarum has been associated with true ginger (*Zingiber officinale*), because of the strong ginger-like odor of the rhizome, but the two species are not closely related. The rootstalk of *Asarum* was used as a seasoning to flavor cookies and cakes or cut up and boiled until tender, then dipped in a heavy sugar syrup to make a candy (Shosteck 1974). Native Americans dried the underground stems and steeped them in water to make a bitter liquid (an infusion), which they drank to relieve heart conditions or sometimes ingested as a contraceptive, believing the concoction prevented impregnation (Coffey 1993). Dwyer et al. (1986) wrote: "Pioneers used the plant to ease intestinal and stomach gas, to promote sweating to break a fever, and as a tonic and appetite stimulant."

Even though there is a long history of medicinal and edible uses of Wild Ginger, the U.S. Food and Drug Administration has banned the use of all plants within the Aristolochiaceae because the family contains aristolochic acid, "which is a substance known to result in serious adverse health effects when taken orally by humans or animals" (FDA 2017).

2. ENDODECA Rafinesque 1828
[Twelve inside; referring to 6 stamens and 6 styles]

1. Endodeca serpentaria (L.) Raf. {snake-like; in reference to the roots} — VIRGINIA SNAKEROOT; TURPENTINE-ROOT; VIRGINIA DUTCHMAN'S-PIPE (Fig. 36). [*Aristolochia convolvulacea* Small; *A. hastata* Nutt.; *A. nashii* Kearney; *A. sagittata* Muhl.; *A. serpentaria* L. var. *hastata* (Nutt.) Alph. Wood; *A. serpentaria* var. *serpentaria*; *Endodeca hastata* (Nutt.) Raf.]

Figure 36. *Endodeca serpentaria* with flower at base of plant (note that leaf litter has been removed), Madison Co., Alabama, 9 May 2015. Photo: Brian Finzel.

Perennial, deciduous herb. Mixed woods, low woods, forested slopes, and bluffs; flowers May–June; fruits June–July; frequent throughout Alabama (Fig. 37). Native to eastern USA from Connecticut west to Iowa, south to east Texas and Florida (Barringer 1997).

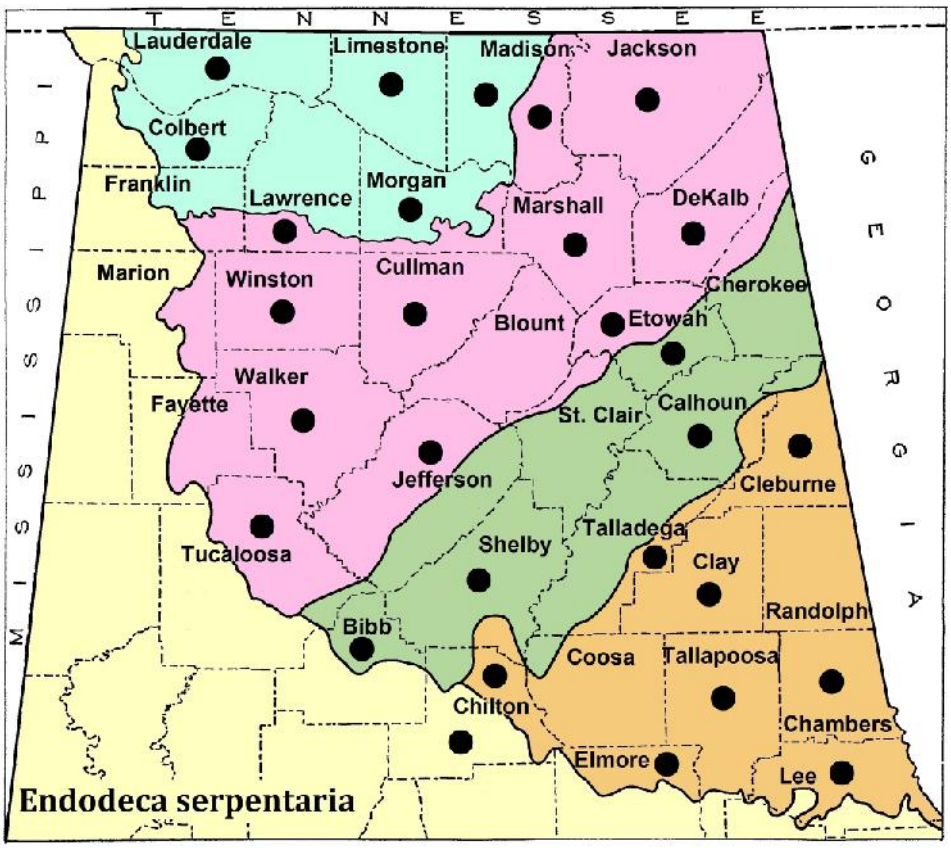


Figure 37. Distribution of *Endodeca serpentaria* in northern Alabama.

Virginia Snakeroot is often overlooked on the forest floor because it occurs in scattered populations or is sometimes solitary. The roots of *Endodeca* have a noticeable turpentine aroma. They contain toxic alkaloids that some southeastern tribes of Native Americans used as an antidote for snakebite (Gerard 2015).

This species was also called "birthwort" because the curved flowers were thought to resemble a human fetus (Stokes 1981) or a birth canal (Coffey 1993). Historically, it was thought to help with childbirth based on a discredited medieval theory called the Doctrine of Signatures, which purported that portions of a plant resembling various parts of the body were divined by God be used to treat ailments of those look-alike parts (Stokes 1981). The S-shaped, reddish calyx tubes of *Endodeca serpentaria* (Fig. 38) are usually hidden under leaf litter and smell like rotting meat. The flowers are pollinated by carrion flies that are attracted to the fetid odor of the flower (Dwyer et al. 1986). The globose fruits are usually pubescent and the capsule splits open apically into six segments to release its seeds (Fig. 39a–b).

Traditionally, *Endodeca serpentaria* has been placed within the genus *Aristolochia* (Fernald 1950; Radford et al. 1968; Barringer 1997). The genus *Aristolochia* sensu lato contains over 400 species, but new research has shown justification in dividing the genus into four genera (Ohi-Toma et al. 2006). Weakley (2015) notes that there is tremendous variation in *E. serpentaria* and believes further study is needed to determine if other taxa should be recognized. He stated that "plants with sparingly pubescent, thin-textured, linear to lanceolate leaves have been called *Aristolochia hastata* (Fig. 40). Plants with broadly ovate, densely pubescent leaves have been called *Aristolochia convolvulacea*. These may represent merely morphologic extremes of a polymorphic complex;

alternatively, some taxonomic recognition of such plants as distinct from *A. serpentaria* may be warranted."

Figure 38. *Endodeca serpentaria* flower, Madison Co., Alabama, 9 May 2015. Photos: Brian Finzel.

(39a) Photo: T. Wayne Barger. (39b) Photo: Dan Spaulding.

Figure 39. *Endodeca serpentaria* fruit. A–B. Wooded bank along trail near Natural Bridge in the Bankhead National Forest, Lawrence Co., Alabama, 7 Jun 2017.

Figure 40. Narrow leaf "hastata" form, Lawrence Co., Alabama, 5 Aug 2017. Photo: Dan Spaulding.

3. HEXASTYLIS Rafinesque 1825
[Six styles; referring to the number of styles]

The genus *Hexastylis* is closely related to *Asarum* and some researchers are of the opinion that all the species should be combined under *Asarum* (Kelly 2001). For a detailed taxonomic history of *Asarum* and *Hexastylis*, see Parresol (2003). *Hexastylis* is pollinated by insects such as wasps, flies, and thrips. The seeds are dispersed by ants, which are attracted to the fleshy, nutritious eliasome that is attached to the seeds. The eliasome is consumed in their nest, leaving seeds to germinate (Niedenberger 2010).

1. Leaf blades triangular-hastate or triangular-sagittate (younger leaf blades are occasionally cordate); calyx tube urceolate-campanulate, gradually contracted near summit and forming a flask-like structure; style extensions split down to stigma (bifid) ..... **1. *Hexastylis arifolia***
1. Leaf blades cordate to orbicular-cordate; calyx tube cylindrical to broadly urceolate-campanulate, forming a cup-like structure; style extensions (horns) only slightly notched at apex (not bifid to stigma).

2. Leaves scattered along the length of the rhizome, plant forming groundcover-like mats; species occurring chiefly in the Fall Line Hills section of the Coastal Plain (but is also found in adjacent Piedmont and Cumberland Plateau)..... **2. *Hexastylis harperi***
2. Leaves clustered at the tip of the rhizome, plant in clusters, not mats; species not occurring in the Coastal Plain (found only in the Piedmont and Cumberland Plateau of Alabama).

3. Calyx tube large, 20–30 mm long, and usually urceolate-campanulate (urn-shaped to bell-shaped); in Alabama, the species is known only from the eastern and middle sections of the Cumberland Plateau ..... **4. *Hexastylis shuttleworthii***
3. Calyx tube smaller, 8–15 mm long, and usually cylindrical to narrowly cylindro-urceolate; in Alabama, the species is known only from the mountainous portions of the upper Piedmont and western section of the Cumberland Plateau..... **3. *Hexastylis heterophylla***

1. Hexastylis arifolia (Michx.) Small {arrow-shaped leaves} — ARROWLEAF HEARTLEAF; ARROWLEAF GINGER; APPALACHIAN HEARTLEAF; LITTLE-BROWN-JUGS (Fig. 41). [*Asarum arifolium* Michx.; *A. callifolium* Small; *A. ruthii* Ashe; *Hexastylis callifolia* (Small) Small; *H. ruthii* (Ashe) Small]

Figure 41. *Hexastlis arifolia*, Shelby Co., Alabama, 27 Nov 2017. Photo: Floyd Griffith.

Perennial, evergreen herb. Mixed upland woods, alluvial woods, forested slopes, and bluffs; March–June; rare in the Highland Rim; common throughout all other provinces in Alabama (Fig. 44). Native to the southeastern USA from Virginia west to Kentucky, south to the southeastern portion of Louisiana and northern Florida (Kartesz 2017).

Hexastylis flowers have no petals; the fleshy, tubular structure is actually a calyx (fused sepals). The flask-shaped flowers of *H. arifolia* are sometimes called "little brown jugs." Harper (1936) wrote that “the whole plant is aromatic, with a characteristic odor suggesting some sort of medicine; and it was formerly supposed to have some medicinal properties.”

Three varieties of *Hexastylis arifolia* are occasionally recognized, but difficult to identify when plants are pressed and dried, since the only real difference lies in the shape of the calyx. Only two varieties occur in northern Alabama: *H. arifolia* var. *arifolia* (Fig. 43), which has slightly spreading calyx lobes, and *H. arifolia* var. *ruthii* (Ashe) Blomq. (Fig. 44), which has erect calyx lobes. The third variety, *H. arifolia* var. *callifolia* (Small) Blomq. (Fig. 45), is found exclusively on the Coastal Plain, from Georgia to eastern Louisiana, and has widely spreading calyx lobes and a larger calyx tube (20–25 mm long x 10–12 mm wide vs. 13–18 mm long x 6–10 mm wide).

Hexastylis arifolia var. *arifolia* occurs throughout the state and *H. arifolia* var. *ruthii* is found in the northeastern portion of Alabama, north through the Appalachians to Virginia (Gaddy 1987b). Ashe (1897) treated all three varieties as separate species within the genus *Asarum*. Ashe (1897) stated *Asarum ruthii* was “named for Prof. Albert Ruth [1844–1932], who sent the species to me. At once separated from *A. arifolium* by its cylindrous calyx, and its tube not being contracted at the

throat as is that of *A. arifolium*." Gaddy (1987b) noted that "along the boundaries of the three varieties, intermediate flowers are occasionally found."

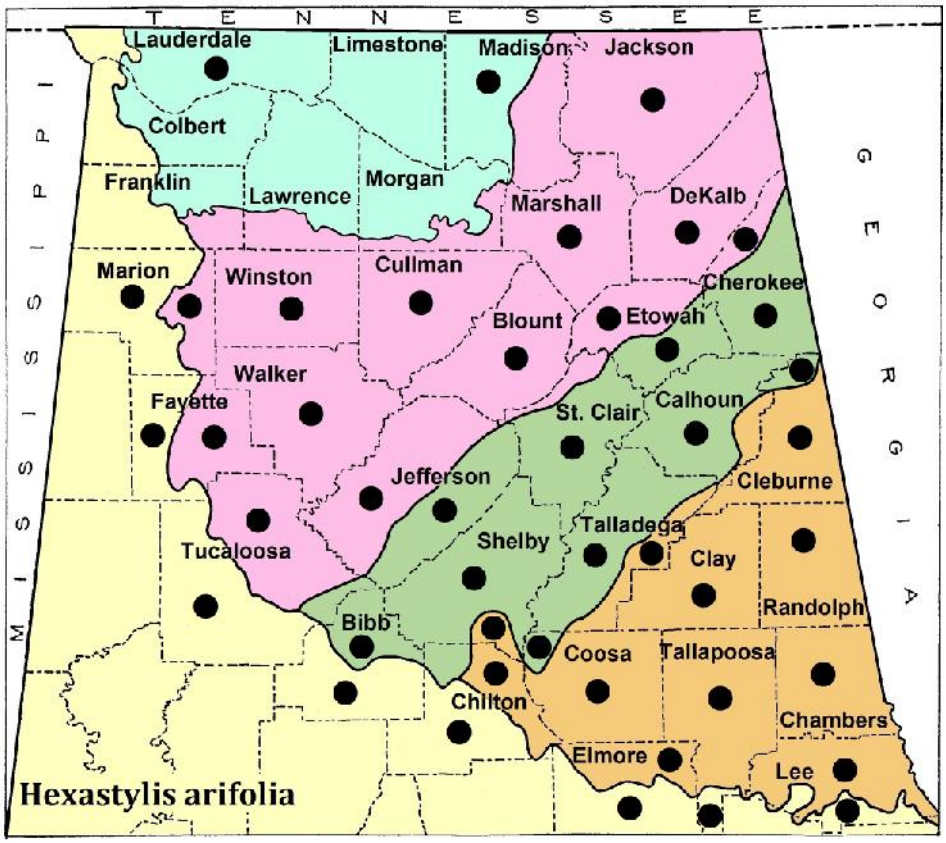


Figure 42. Distribution of *Hexastylis arifolia* in northern Alabama.

Figure 43. *Hexastylis arifolia* var. *arifolia* flowers, Russell Co., Alabama, 17 Mar 2007. Photo: Brian Finzel.

Figure 44. *Hexastylis arifolia* var. *ruthii* flowers, Swain Co., North Carolina, 21 Apr 2007. Photo: Brian Finzel.

Figure 45. *Hexastylis arifolia* var. *callifolia* flowers. Middle flower is mature, one on the left is closed, and calyx lobes on right are opening; Coastal Plain in Macon Co., Georgia, 12 Mar 2016. Photo: Alan Cressler.

Another similar species of *Hexastylis* with triangular-hastate to triangular-sagittate leaves, is *H. speciosa* Harper (Fig. 46), which was discovered and named by Roland Harper in Autauga County on May 19, 1924. This species is endemic to the Fall Line Hills section of the upper Coastal Plain of Alabama, occurring in two other counties: Chilton and Elmore. Kral (1983) was of the opinion that this species is perhaps the rarest species in the genus. Harper (1924) noted that "to the eye the leaves of the new plant are scarcely distinguishable from those of *H. arifolia*, being hastate-cordate…but

they lack the characteristic 'medicinal' odor of *H. arifolia*, and we found the next day that we could distinguish the two species by their odor even when no flowers were present." Harper named the plant for its showy flowers and said that the calyx "is about an inch long, greenish purple outside (like the petioles and peduncles), and instead of being pitcher-shaped as in *H. arifolia*, is abruptly expanded near the middle." Weakley (2015) wrote that the calyx tube of *H. speciosa* has internal raised reticulations and *H. arifolia* is smooth internally. *Hexastylis speciosa* has been called Harper's Heartleaf, but Keener and Davenport (2015) suggested it should be named Alabama Heartleaf, since *H. harperi* is also known as Harper's Heartleaf.

Figure 46. *Hexastylis speciosa*, woods in Autauga Co., Alabama, 28 Apr 2008. Photo: T. Wayne Barger.

2. Hexastylis harperi (Gaddy) B.R. Keener & L.J. Davenport {for Roland Harper, 1878–1966, Alabama botanist} — HARPER'S HEARTLEAF; HARPER'S LARGE-FLOWER HEARTLEAF; HARPER'S GINGER; CALLAWAY GINGER; BOG HEARTLEAF (Fig. 47). [*Asarum harperi* (Gaddy) A. Diamond; *Hexastylis shuttleworthii* (Britten & Baker f.) Small var. *harperi* Gaddy]

Figure 47. *Hexastylis harperi*, upper Coastal Plain of Alabama, 27 May 2010. Photo: John Gwaltney.

Perennial, evergreen herb. Rocky or sandy slopes and bluffs along streams; sandy seeps, and bogs; May–July; very rare in the Cumberland Plateau and Piedmont; rare in the upper Coastal Plain (Fig. 48). *Hexastylis harperi* only occurs in adjacent Mississippi and Georgia (Kartesz 2017).

Hexastylis harperi is chiefly found in the upper Coastal Plain of Alabama, but also occurs in the Piedmont (Randolph County) and along the western edge of the Cumberland Plateau (Marion County). Gaddy (1987a) cites a Marion County specimen, deposited at the Gray Herbarium (GH), which was collected by Roland Harper on June 3, 1936 from "drier spots of a non-alluvial swamp west Guin." This area is located in the Fall Line Hills of the Coastal Plain. The other Marion County population occurs in the Cumberland Plateau portion of the county and was found by Roland Harper on June 16, 1935. Harper (1936) wrote that he discovered "a small colony of the plant on a sandstone rock shaded by hemlocks, in a ravine about six miles northeast of Hamilton, in Marion County …. I did not like to molest anything so rare, so I did not take the specimen or tear the flower open to study its structure."

Robert Kral made the first collection of this species at this site on May 17, 1973 (he originally identified it as *H. shuttleworthii* and later annotated the specimen to *H. shuttleworthii* var. *harperi*). While at Vanderbilt University (VDB), Dr. Kral was working on this genus and anticipated naming the new entity, but was preempted by the publication of Dr. L.L. "Chick" Gaddy, visiting professor at the University of Tennessee, who named the new variety (pers. comm., Robert Kral 1997).

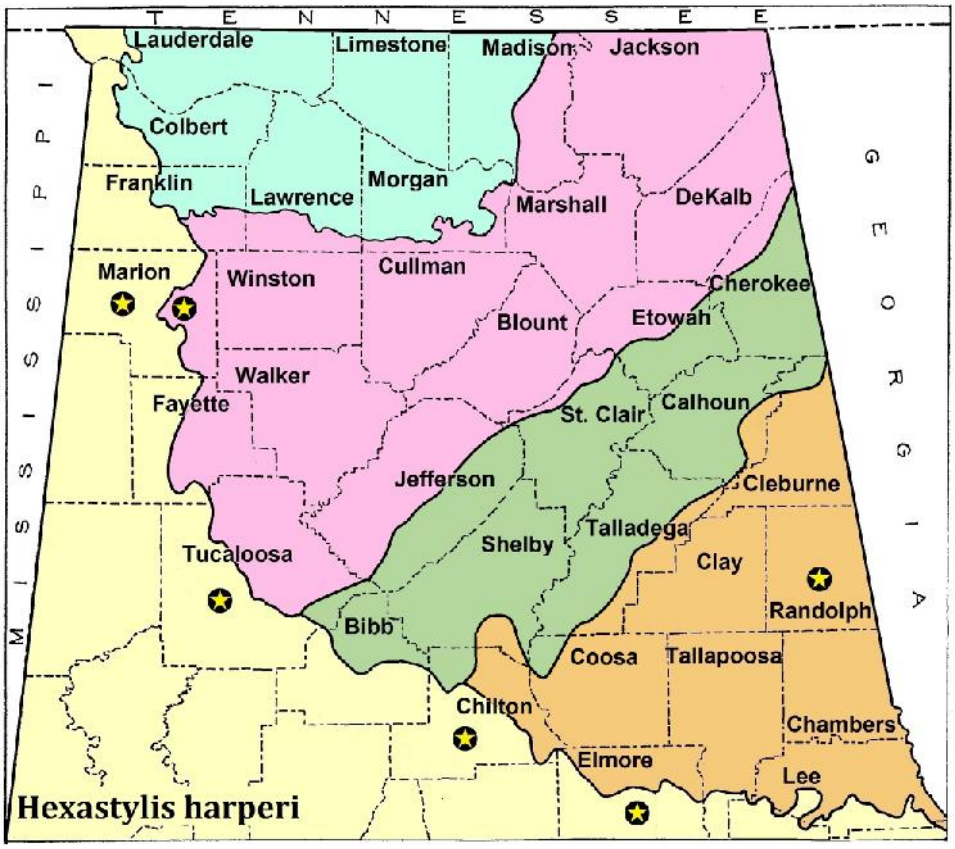


Figure 48. Distribution of *Hexastylis harperi* in northern Alabama.

Hexastylis harperi also occurs in Hale, Macon, and Perry counties (Keener et al. 2017). Two specimens collected in 1896 and 1898, housed at New York Botanical Gardens (NY), were thought to have been from Lee County, but their location (Vaughn's Mill) has been determined to be in Macon County. The Alabama Natural Heritage Program (ALNHP 2017) lists *H. harperi* as imperiled (S2) in Alabama and globally rare (G3). This taxon is perhaps more common in cultivation then in the wild because of efforts by the staff at Callaway Gardens in Pine Mountain, Georgia (Gaddy 1987a). The Director of Horticulture, Fred Galle, at Callaway was the first to cultivate it in 1965, and he later shared plants with other gardeners and nurserymen (Galle 1984).

Harper (1936) made the first collection of this taxon on June 5, 1927 in Autauga County, Alabama and "noticed that the plant usually grows in colonies connected by running rootstocks (Fig. 49), and covering a few square feet." Harper (1936) didn't think there were enough differences to separate it from *Hexastylis shuttleworthii* and said he was inclined to treat his discovery under that species. Gaddy (1987b), however, noted that the elongated and branched rhizomes convinced him that this entity represented a new variety of *H. shuttleworthii*. Gaddy (1987a) wrote that it "forms a nearly continuous ground cover where it is found," and he named it *H. shuttleworthii* var. *harperi* in honor of Roland Harper.

Keener and Davenport (2015) elevated the variety to species rank, stating that it "is distinct in morphology, habitat and distribution" and citing evidence that the two varieties "were polyphyletic rather than 'sister' to each other as would be expected." This is one of the few *Hexastylis* that can be identified in sterile condition because of its long rhizomes and groundcover-like habit (Fig. 50). The flowers of *H. harperi* (Fig. 51) and leaves are very similar to *H. shuttleworthii*. Gaddy (1987b) wrote: "The flowers were usually smaller (15–25 mm long) than those of *H. shuttleworthii* (15–40

mm long), but occasionally large flowers [of *H. harperi*] were found…The plant was different from *H. shuttleworthii* primarily in growth form."

Figure 49. *Hexastylis harperi* rhizomes, Randolph Co., Alabama, 27 Aug 2017. Photo: Dan Spaulding.

Figure 50. *Hexastylis harperi* colony, Randolph Co., Alabama, 30 Jul 2017. Photo: Dan Spaulding.

Figure 51. *Hexastylis harperi* flower, upper Coastal plain of Alabama, 27 May 2010. Photos: John Gwaltney.

3. Hexastylis heterophylla (Ashe) Small {variable-leaved} — VARIABLE-LEAF HEARTLEAF; ASHE'S GINGER (Fig. 52). [*Asarum heterophyllum* Ashe]

Perennial, evergreen herb. Dry to mesic wooded slopes, rich woods, and forested ravines; March–June; uncommon in the upper mountainous region of the Piedmont; rare in the western portion of the Warrior Basin section of the Cumberland Plateau (Fig. 53). Native to the southeastern USA from Virginia west to Kentucky, south to northern Alabama and north Georgia (Gaddy 1987b).

In Alabama, this taxon occurs at the western end of its range. It appears to be disjunct from other populations in the mountains centered in Virginia, North Carolina, and Tennessee (Kartesz 2017). In Alabama, the calyx tubes of *Hexastylis heterophylla* (Fig. 54) appear to have a different shape and color than populations further north. Blomquist (1957), as well Radford et al. (1968), state that the leaves of *H. heterophylla* are usually not variegated (Fig. 55); however, in Alabama, the leaves are always variegated and are sometimes strikingly mottled (Fig. 56).

Research is in progress to determine if the Alabama entity is a new species (pers. comm., Brian Keener 2017). Gaddy (1987b), in his treatment on *Hexastylis*, stated that *H. heterophylla* "is probably the most variable species in the genus." Blomquist (1957) did not list this species for Alabama in his revision of *Hexastylis* of North America, but Gaddy (1987b) mapped *H. heterophylla* as occurring in Alabama. *Hexastylis heterophylla* is very similar to *H. shuttleworthii*, but its calyx tubes are much shorter.

Figure 52. *Hexastylis heterophylla*, steep wooded slope above Jackson Creek in the Talladega National Forest, Cleburne Co., Alabama, 2 Jun 2017. Photo: Melanie Taylor Spaulding.

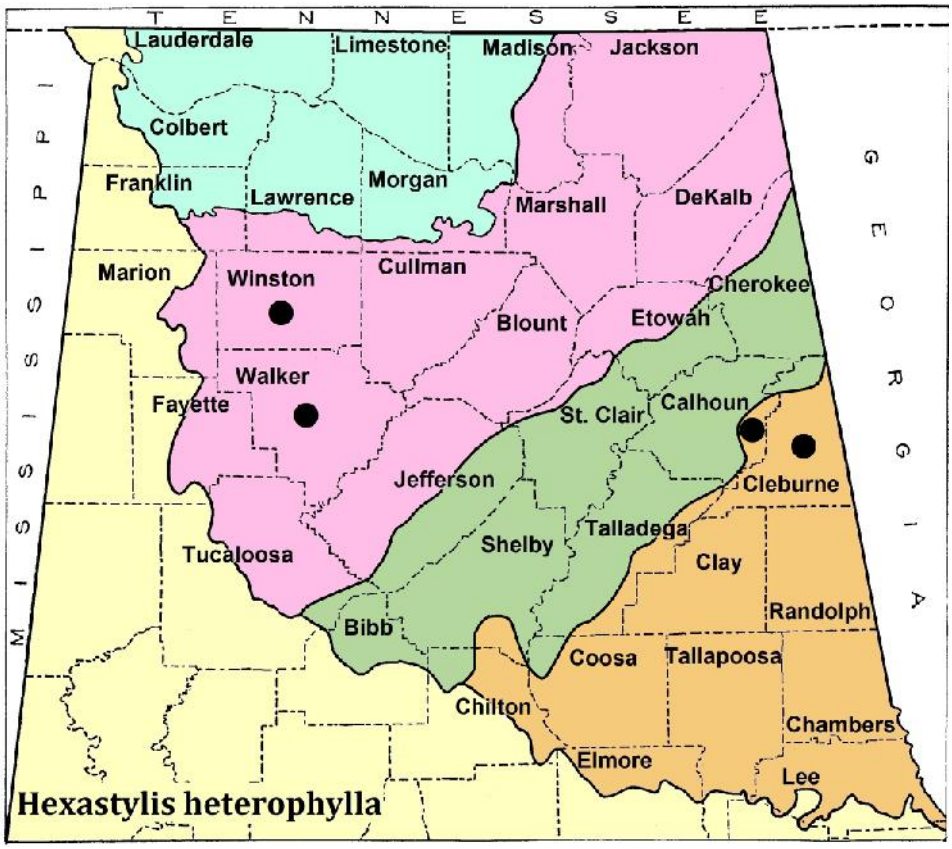


Figure 53. Distribution of *Hexastylis heterophylla* in northern Alabama.

Figure 54. *Hexastylis heterophylla* flowers, sloped woods above Jackson Creek in the Talladega National Forest, Cleburne Co., Alabama, 2 Jun 2017. Photos: Melanie Taylor Spaulding.

Figure 55. Unmottled leaves of *Hexastylis heterophylla* in Burke Co., North Carolina, 30 Jun 2016. Photo: Charles Bryson.

Figure 56. Strongly mottled leaves of *Hexastylis heterophylla*, sloped woods on Horseblock Mountain in the Talladega National Forest, Cleburne Co., Alabama, 16 Jul 2017. Photo: Dan Spaulding.

4. Hexastylis shuttleworthii (Britten & Baker f.) Small {for Robert J. Shuttleworth (1810–1874), an English botanist} — LARGE-FLOWER HEARTLEAF; SHUTTLEWORTH'S GINGER (Fig. 57a–c). [*Asarum macranthum* (Shuttlew.) Small; *A. shuttleworthii* Britten & Baker f.]

Perennial, evergreen herb. Sloped, often rocky woods, bluffs, and ravines, often in acidic soils; April–June; uncommon in the Cumberland Plateau (Fig. 58). Native to the southeastern USA from North Carolina west to Tennessee, south to northeast Alabama and north Georgia (Gaddy 1987b).

(57a) Leaves with flower.

(57b) Side-view of flower

(57c) Top-view of flower.

Fig. 57. *Hexastylis shuttleworthii*. A–C. Rocky slope above West Fork of Little River, DeKalb Co., Alabama, 3 Jun 2017. Photos: Savannah Spaulding

The flowers of *Hexastylis shuttleworthii* are the largest of all our species in North America, and although they may vary in size, they are always larger than those of *H. heterophylla* (Fig. 59a–b). Blomquist (1957) wrote that "when not in flower, it is sometimes impossible to distinguish this species from *H. heterophylla*." In Alabama, *H. shuttleworthii* is known from the middle and eastern portion of the Cumberland Plateau, whereas *H. heterophylla* is found in the mountainous region of the upper Piedmont and western portion of the Cumberland Plateau.

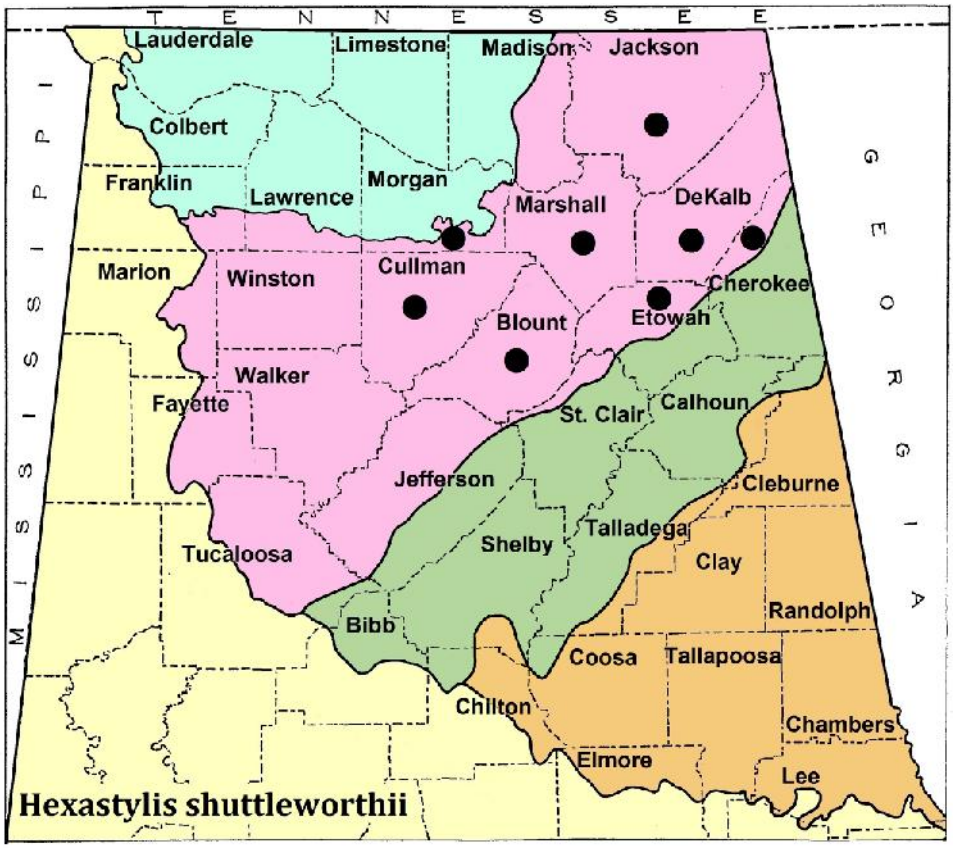


Figure 58. Distribution of *Hexastylis shuttleworthii* in northern Alabama.

(59a) *Hexastylis shuttleworthii* flowers. (59b) *Hexastylis heterophylla* flowers.

Figure 59. Size comparison of *Hexastylis shuttleworthii* and *Hexastylis heterophylla* flowers. A. DeKalb Co. Alabama; collected 3 Jun 2017. B. Cleburne Co., Alabama; collected 2 Jun 2017. Photos: Dan Spaulding.

4. ISOTREMA Rafinesque 1819

[From the Greek *isos* (equal) and *trema* (hole); for the regular calyx-limb around the flower]

1. Isotrema tomentosa (Sims) H. Huber {with velvety hairs} — WOOLLY DUTCHMAN'S-PIPE; WOOLLY PIPEVINE; HAIRY DUTCHMAN'S-PIPE (Fig. 60). [*Aristolochia tomentosa* Sims]

Figure 60. *Isotrema tomentosa* flowering vine, Madison Co., Alabama, 24 Apr 2007. Photo: Brian Finzel.

Deciduous woody vine (to 25 m). Alluvial woods, floodplain forests, and streambanks; flowers late March–June; fruits May–October; frequent throughout Alabama (Fig. 63). Native to the southeastern and south-central USA, from Kentucky west through southern Indiana to eastern Nebraska, south to east Texas and the Panhandle of Florida; adventive elsewhere in the USA (Weakley 2015).

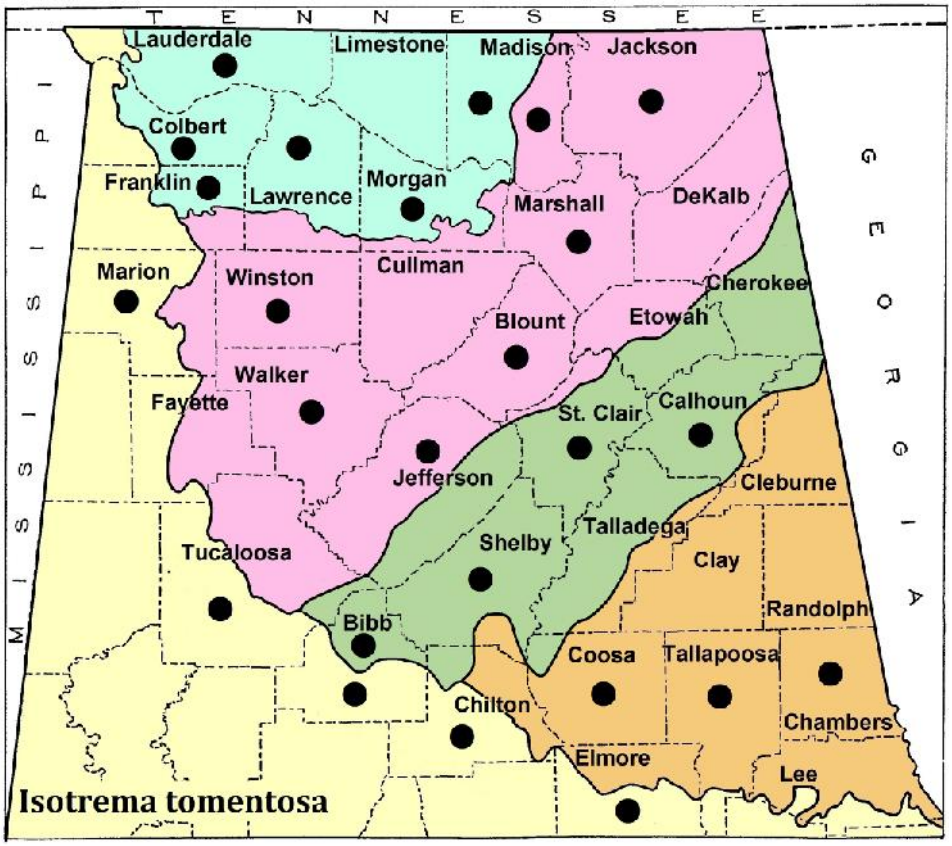


Figure 61. Distribution of *Isotrema tomentosa* in northern Alabama.

The vernacular names refer to the S-shaped flowers (Fig. 62a–b), which look like the curved Dutchman's pipe. The flowers (calyx tubes) have a purple-brown throat and a disagreeable odor that attracts carrion flies as pollinators (Stokes 1981). The fruit of *Isotrema tomentosa* (Fig. 62c) is large and cylindrical; Duncan (1967) said they "resemble those of *Yucca*, being a 6-ridged capsule and containing flat seeds arranged in tiers.

Isotrema is a large twining, woody vine (Fig. 63) and can easily be identified when sterile by its woolly, heart-shaped leaves. This species is a host species for Pipevine Swallowtail (*Papilio philenor*) caterpillars (Stokes 1981). Pipevine Swallowtails are poisonous because the caterpillars ingest toxins from the plant and incorporate the chemicals in to their bodies. The butterflies signal danger to would be predators with their metallic-blue underwings and bright orange spots (Ogard & Bright 2010).

A similar species of pipevine, *Isotrema macrophylla* (Lamarck) C.F. Reed, was reported by Mohr (1901) from Winston County, but no voucher is known. A University of Tennessee (TENN) collection from Monroe County, identified as *I. macrophylla* (SERNEC 2017), is most likely *I. tomentosa*. *Isotrema macrophylla* ranges from eastern Tennessee and northern Georgia north through the Appalachians. Its leaves are nearly glabrous with abruptly pointed tips and the calyx is purple or

brown; whereas the leaves of *I. tomentosa* are hairy with blunt tips and the calyx is yellowish-green with a purple center.

(62a) Photo: Brian Finzel.

(62b) Photo: T. Wayne Barger.

(62c) Photo: Eric Soehren.

Figure 62. *Isotrema tomentosa*. A. Flowering vine and tomentose leaves, Madison Co., Alabama, 24 Apr 2007. B. Flower, Jackson Co., Alabama, 22 Apr 2008. C. Fruit; Madison Co., Alabama, 14 Jun 2006.

Figure 63. 20-year-old *Isotrema tomentosa* vine cultivated in Calhoun, Co. Alabama, 27 Dec 2017. Seeds were collected by Hayes Jackson in 1997 from plants along the Tennessee River in Madison Co., Alabama, and sowed in the woods near his house. Photo: Hayes Jackson.

FAMILY 7. MAGNOLIACEAE (Magnolia Family)

1. Leaves about as broad as long, usually lobed; apices broadly truncate or emarginate (notched); flowers with greenish tepals that have an orange blotch at base; fruit a cigar-shaped aggregate of samaras, composed of dry, winged seeds (samaracetum) .....**1. *Liriodendron***
1. Leaves longer than broad, not lobed; apices obtuse, acute or acuminate; flowers with solid white, cream, yellow or pink tepals; fruit a cone-like aggregate of follicles (follicetum).....**2. *Magnolia***

1. LIRIODENDRON Linnaeus 1753
[Lily tree; alluding to the flowers]

1. Liriodendron tulipifera L. {tulip-bearing} — TULIP-POPLAR; TULIP-TREE; YELLOW-POPLAR; FIDDLE-TREE; WHITEWOOD (Fig. 64).

Figure 64. *Liriodendron tulipifera*, Copiah Co. Mississippi, 14 Apr 2006. Photo: John Gwaltney.

Large deciduous tree (to 45 m). Low woods, mesic forests, swamps, bottomland forests, alluvial woods, and roadside ditches; flowers April–June; fruits September–October; common throughout Alabama (Fig. 65). Native to the eastern USA and adjacent Canada, from southern Vermont west through southern Ontario to Illinois, south to Louisiana and central Florida; it has escaped cultivation in east Texas and Iowa (Kartesz 2017).

The leaves of *Liriodendron tulipifera* are very distinctive, being truncate or notched at the apex and usually 4 to 6 lobed (Fig. 66a). Young stems have large stipules (Fig. 66b), which are shed later in the season. The large flowers (Fig. 67) are faintly fragrant and pollinated primarily by bees (Wood 1958). The fruit is a cigar-shaped "cone" that is borne erect on branches, and unlike *Magnolia*, separate into multiple winged samaras that contain the seeds (Fig. 68a–c).

Liriodendron is an important timber tree with many uses; it has lightweight wood and is one of the softest hardwoods in North America (Elias 1980). Some of the common names were given to this tree because the flowers are tulip-like, the wood is soft like a poplar, and in late summer or early fall the leaves turn yellow. It is a straight-growing tree (Fig. 69) that was historically referred to as "canoewood" because Indians and pioneers, like Daniel Boone, hollowed the trunks to make canoes (Rupp 1990). Tulip-Poplar is widely used in horticulture and often planted as a shade tree.

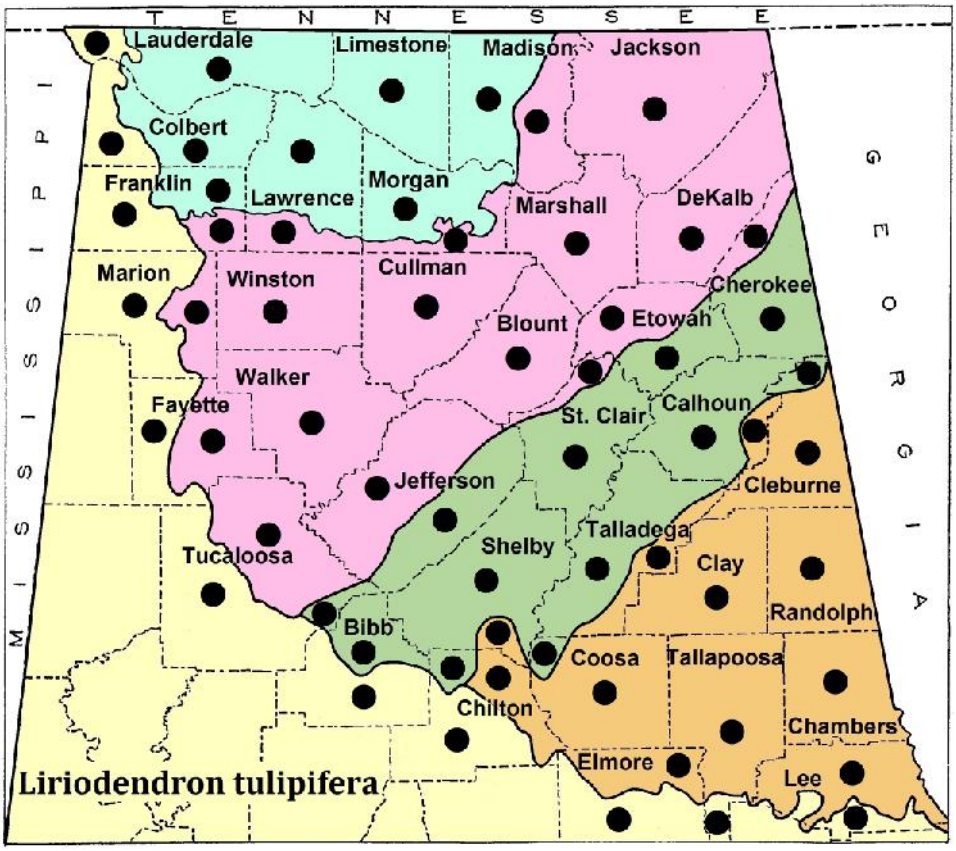


Figure 65. Distribution of *Liriodendron tulipifera* in northern Alabama.

(66a) Photo: John Gwaltney.

(66b) Photo: Melanie Taylor Spaulding.

Figure 66. *Liriodendron tulipifera*. A. Typical leaf, Copiah Co., Mississippi, 17 Nov 2005. B. Stipules below bud, Cleburne Co., Alabama, 17 Jun 2017.

Figure 67. *Liriodendron tulipifera* flower, Etowah Co., Alabama, 30 Apr 2013. Photo: T. Wayne Barger.

(68a) Ripening fruit. (68b) Dried fruit. (68c) Fruit shedding winged samaras.

Figure 68. *Liriodendron tulipifera* fruit from tree in Copiah Co. Mississippi. A. 9 May 2006. B. 2 Feb 2006. C. 2 Feb 2006. Photos: John Gwaltney.

Figure 69. *Liriodendron tulipifera* trunk, low woods along the nature trail at the Anniston Museum of Natural History, Calhoun Co., Alabama, 13 Jul 2017. Photo: Dan Spaulding.

Various species and varieties have been named based mostly on leaf shape, but many authors have reduced this genus to two closely related extant species, *Liriodendron tulipifera* in North America, and *L. chinense* (Hemsl.) Sarg. from central China (Meyer 1997). Wood (1958) recognized only two species and stated: "The leaves although always unmistakable are extremely variable." However, Weakley (2015) recognizes a new species from the Florida Peninsula and a new variety of *L. tulipifera* (Fig. 70) from the Atlantic and Gulf Coastal Plain. The leaves of these entities have 0–4 lobes (on sun leaves), but the new species has caudate lobed tips and smaller cones than the typical species. Plants in the northern Alabama study region all belong to the typical variety; however, more research is needed to determine the northern range extent of the Coastal Plain form.

Figure 70. Leaf shape of Coastal Plain entity, Baldwin Co., Alabama, 17 May 2012. Photo: T. Wayne Barger.

Liriodendron is an ancient genus that dates back in the fossil record to the Cretaceous period (Berry 1902). Some authors (e.g. Barkley 1975; Romanov & Dilcher 2013) place *Liriodendron* and related fossil genera *Archaeanthus* and *Liriodendroidea* in the family Liriodendraceae, separate from the Magnoliaceae sensu stricto, based on a combination of molecular sequence data (Azuma et al. 2001; Kim et al. 2001) and morphological studies (Romanov & Dilcher 2013). Such studies show their isolated position within the Magnoliaceae and their long separation as distinct evolutionary lineages that diverged over 100 million years ago.

2. MAGNOLIA Linnaeus 1753

[Pierre Magnol, 1638–1715; French professor of botany at Montpelier]

Recently, several authors have divided *Magnolia* sensu lato into as many as 16 different genera (Sima & Lu 2012). A multi-genera approach is currently promoted in the *Flora of China* (eFloras 2008), although the adoption of this concept by North American botanists has been somewhat measured. If followed, four additional genera would be recognized in the northern Alabama region: *Houpoea* (*M. tripetala*); *Metamagnolia* (*Magnolia macrophylla*); *Paramagnolia* (*M. fraseri* & *M. pyramidata*); and *Yulania* (*M. acuminata*). *Magnolia grandiflora* and *M. virginiana* would remain in the genus *Magnolia*.

1. Leaf base auriculate-cordate (with ear-like lobes).

    2. Leaf blade glaucous (whitish) beneath with appressed-pubescent; leaves broadly elliptic to obovate-oblong and very large (>50 cm long); buds, twigs and cone-like fruit pubescent ..... **4. *Magnolia macrophylla***
    2. Leaf blade greenish and glabrous beneath; leaves medium-sized (< 50 cm long) and kite-shaped (rhombic-obovate to obovate-spatulate); buds, twigs, and cone-like fruit glabrous.

        3. Medium-sized to large tree when mature (with most flowers high up in tree and sometimes difficult to see); stamens more than 8 mm long; cone-like fruit 5.5–10 cm long; mature leaves often more than 25 cm long (sometimes smaller) ..... **2. *Magnolia fraseri***
        3. Typically a smaller tree (flowers therefore easily observed); stamens less than 8 mm long; cone-like fruit 4–6 cm long; mature leaves usually less than 25 cm long (sometimes larger) ..... **5. *Magnolia pyramidata***

1. Leaf base cuneate or rounded at base, not auriculate.

    4. Leaves evergreen and aromatic when crushed.

        5. Leaves thick-leathery (coriaceous), dark green above (distinctly glossy) and green or rusty tomentose beneath; cone-like fruit silky-villous ..... **3. *Magnolia grandiflora***
        5. Leaves thin-leathery (subcoriaceous), medium green above (dull to slightly glossy) and glaucous (chalky white) beneath; cone-like fruit glabrous..... **8. *Magnolia virginiana***

    4. Leaves deciduous, not aromatic when crushed.

        6. Leaves averaging 35–50 cm and long in terminal umbrella-like clusters, crowded in false whorls toward branch tips; leaf base cuneate-attenuate (conspicuously tapering); buds glabrous; flowers with an unpleasant scent; tepals creamy white ..... **7. *Magnolia tripetala***
        6. Leaves averaging 8–30 cm long and uniformly distributed along branchlets (scattered and alternate); leaf base rounded, subcordate to widely cuneate; buds unmistakably silvery to white pubescent; flowers odorless or with a pleasant aroma; tepals greenish-yellow, pink or rose-purple (rarely white).

            7. Single-trunked native tree; flowers appearing after leaves; tepals greenish-yellow to yellow, often glaucous; anthers dehiscing introrsely; cone-like follicles oblong-cylindrical (cucumber-like) ..... **1. *Magnolia acuminata***
            7. Large spreading shrub or small low-branched or multi-trunked exotic tree (persisting from cultivation); flowers appearing before leaves (though may be present as leaves expand); tepals usually pinkish to rose-purple, not glaucous; anthers dehiscing laterally; cone-like follicles narrowly cylindric ..... **6. *Magnolia ×soulangeana***

1. Magnolia acuminata (L.) L. {acuminate; referring to the leaf tips} — CUCUMBER-TREE; CUCUMBER MAGNOLIA; BLUE MAGNOLIA; COWCUMBER-TREE (Fig. 71). [*Magnolia acuminata* var. *alabamensis* Ashe; *M. acuminata* var. *aurea* (Ashe) Ashe; *M. acuminata* var. *cordata* (Michx.) Seringe; *M. acuminata* var. *ludoviciana* Sarg.; *M. acuminata* var. *ozarkensis* Ashe; *M. acuminata* var. *subcordata* (Spach) Dandy; *M. cordata* Michx.; *Tulipastrum acuminatum* (L.) Small var. *acuminatum*; *T. acuminatum* var. *aureum* Ashe; *T. cordatum* (Michx.) Small; *Yulania acuminata* (L.) D.L. Fu]

Figure 71. *Magnolia acuminata* flowering in rich woods along the Blue Ridge Parkway between Peaks of Otter and the city of Floyd, Virginia, May 2011. Photo: John Gwaltney.

Small to large, deciduous tree (9 to 30 m). Rich woods, forested slopes, coves, bluffs, and streambanks; flowers April–June; fruits July–September; uncommon in the Highland Rim, Ridge & Valley, and Piedmont; frequent in the Cumberland Plateau and Coastal Plain (Fig. 72). Native to the eastern USA from New York south to the Panhandle of Florida, west to Louisiana, western Oklahoma and Missouri (Kartesz 2017).

The flowers of *Magnolia acuminata* are slightly fragrant and the tepals are usually greenish-yellow and glaucous (Fig. 73). The fruit (Fig. 74a–b) was collected by early settlers to infuse whiskey with a pleasant bitter taste, giving the tree the name “Indian bitter” (Peattie 1948). A tea was also made and used as a substitute for quinine to treat malaria or typhoid fever (Martin 1992). The common name refers to the green, unripe "cones" that resemble cucumbers (Meyer 1997). Larger trees have been harvested for their timber, but the wood is somewhat weak and used mainly for crates and boxes (Elias 1980). *Magnolia acuminata* has been popular in cultivation since its discovery in 1736 by Virginia botanist, John Clayton (Peattie 1948).

Unlike Alabama’s three other native, deciduous magnolias, the leaves of *Magnolia acuminata* are scattered along the branches and not in umbrella-like clusters at branch tips (Fig. 75). The bark of mature *M. acuminata* trees is furrowed, rather than smooth with scattered bumps and plates (Fig. 76).

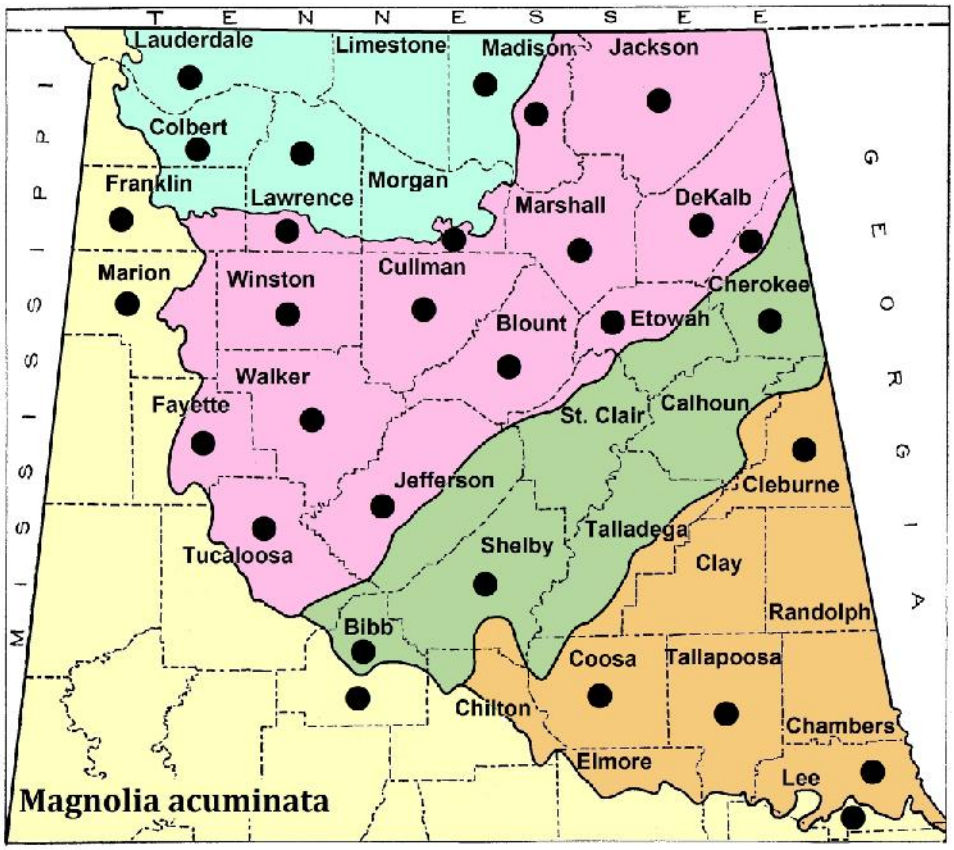


Figure 72. Distribution of *Magnolia acuminata* in northern Alabama.

Some authors, such as Ashe (1931), recognized many varieties of *Magnolia acuminata*. Weakley (2015) recognized only one variety, *M. acuminata* var. *subcordata*, and said: "It has been treated variously as a variety, a species, or merged with *M. acuminata*." Ashe treated this taxon as *M. cordata*, but Harper (1928) stated: "This is a little-understood and somewhat mysterious species, or perhaps only a variety. It is supposed to differ from *M. acuminata* in being a smaller tree, with somewhat differently shaped leaves and smaller yellow flowers."

Coker (1943) treated *Magnolia cordata* as a variety and wrote that it differed "in usually smaller size of trees [to 9 m], pubescent twigs of first and usually second years, somewhat more consistently smaller and more broadly ovate leaves and geographical range (lower altitudes)." Coker (1943), as well as Weakley (2015), restrict this variety to the Lower Piedmont. However, there are trees on the Alabama Coastal Plain that have pubescent twigs and densely pubescent leaves, similar to the description of *M. acuminata* var. *subcordata*. Ashe (1931) noted that "these Alabama trees reached a height of 25 m thus greatly exceeding *M. cordata* [=*M. acuminata* var. *subcordata*]…where it seldom exceeds 10 m. It approaches *M. cordata* in the often soft pubescence of the lower surface of the leaves and in its pubescence twigs but the flowers in place of being canary yellow as are those of *M. cordata* are green or rarely yellowish green." Ashe (1931) named this new entity *M. acuminata* var. *alabamensis* and noted that the flowers were also larger (7.5 to 9 cm). Hardin (1954) recognized three varieties and stated that "*Magnolia acuminata* has been described under two generic, two specific and six varietal names involving some sixteen or more different combinations, all published prior to 1932." Later, Hardin (1972), decided that further study of populations in the field was needed before any varieties were recognized. The *M. acuminata* complex appears to be a very

variable group, possibly connected by many forms, therefore no varieties are recognized by the authors of this paper at this time.

Figure 73. *Magnolia acuminata* flower close-up, Winston Co., Alabama, 12 Apr 2008. Photo: Brian Finzel.

(74a) Photo: Mike Parker.

(74b) Photo: Scott Beuerlein.

Figure 74. Close-up of *Magnolia acuminata* fruits. A. Unripe fruit; Bucks Co., Pennsylvania, 1 Jun 2008. B. Ripe fruit, cultivated tree in Hamilton Co., Ohio, 22 Sep 2006.

Figure 75. *Magnolia acuminata* leaf arrangement (with young fruit at tip of branch), Chocolocco Wildlife Mangement area, Cleburne Co., Alabama, 8 May 1998. Photo: Bill Summerour.

Figure 76. *Magnolia acuminata* bark, cultivated in Hamilton Co., Ohio, 22 May 2006. Photo: Scott Beuerlein.

2. Magnolia fraseri Walter {in honor of John Fraser, (1750–1811), Scottish botanist} — FRASER'S MAGNOLIA; MOUNTAIN MAGNOLIA; EAR-LEAF UMBRELLA-TREE (Fig. 77). [*Paramagnolia fraseri* (Walter) Sima & S.G. Lu]

Figure 77. *Magnolia fraseri*, Blue Ridge Mountains in Tennessee, 7 May 2008. Photo: John Gwaltney.

Medium-sized, deciduous tree (to 25 m). Wooded ravines and mesic to dry forested slopes; flowers April–May, fruits July–September; rare in the upper mountainous area of the Piedmont, which Duncan (1967) includes as part of the Blue Ridge Province (Fig. 78). Native to the mountains from southern Pennsylvania south through West Virginia, Virginia, the Carolinas, Kentucky, Tennessee, Georgia, and northeast Alabama (Kartesz 2017).

British-born American botanist, Thomas Walter (1740–1789) named and described *Magnolia fraseri* in his *Flora Caroliniana* in 1788 (Weaver 1981). Harper (1928) noted that "Prof. Sargent in the latest edition of his Manual of Trees credits *M. fraseri* to northern Alabama, but without definite locality." A locality was finally discovered for Alabama in December 1996 by Jacksonville State University (JSU) professor, Bill Summerour, on Horseblock Mountain in the upper Piedmont of Cleburne County (pers. comm. Bill Summerour 2017). While exploring the area when he discovered the leaves of this magnolia on the forest floor. He collected them, along with a twig and old cone, and brought them to the JSU herbarium to be mounted, but it was incorrectly labeled by herbarium staff "January 1997." Dr. Summerour returned to the site several times in the spring of 1997 hoping to find flowers. On April 14, 1997, he was accompanied by the senior author and fellow JSU graduate, Eric Soehren, who (since he was the youngest) shimmied up the tree to get a flowering branch for Dr. Summerour to photograph (Fig. 79). The population is still extant today and contains trees much larger (Fig. 80) than its close relative, *M. pyramidata*, which occurs chiefly on the Coastal Plain, but has been documented from the adjacent Piedmont (Chilton County) and the Weisner Ridge section of the Ridge & Valley (Calhoun County).

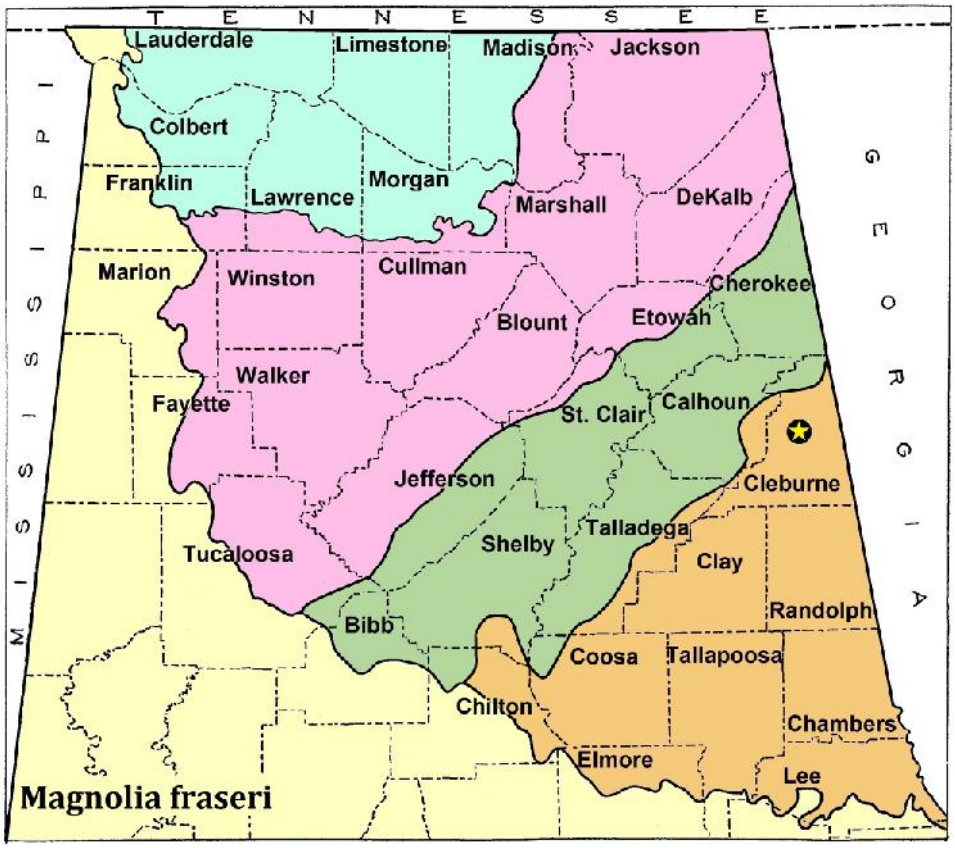


Figure 78. Distribution of *Magnolia fraseri* in northern Alabama.

Figure 79. Eric Soehren and Dan Spaulding with *Magnolia fraseri* along with the flower collected from the canopy; Horseblock Mountain, Cleburne Co., Alabama, 15 Apr 1997. Photo: Bill Summerour.

Figure 80. *Magnolia fraseri* trunks, Cleburne Co., Alabama, 16 Jul 2017. Photos: Dan Spaulding.

Weaver (1981) wrote that *Magnolia pyramidata* is a "shorter, shrubbier plant… with shorter stamens and fruit aggregates than typical *M. fraseri*." In separating these two similar species, Hardin (1972) included tepal and leaf size in his key, and Meyer (1997) included leaf shape in his treatment. The leaves of *M. fraseri* (Fig. 81) tend to gradually taper from the broader upper portion to the base, and the leaves of *M. pyramidata* typically abruptly taper from broadest part to the base; but all these characters are often too variable to be relied upon. The best character separating the two species is the size of the stamens, which are more than 8 mm in *M. fraseri*. (The stamen length of specimens collected in Cleburne Co., Alabama average around 11 mm long.) The flowers of *M. fraseri* are creamy white and fragrant (Fig. 82). The Alabama Natural Heritage Program (ALNHP 2017) lists Fraser's Magnolia as critically imperiled (S1) in Alabama, but the species is globally secure (G5).

Figure 81. *Magnolia fraseri* leaves, Cleburne Co., Alabama, 16 Jul 2017. Photos: Dan Spaulding.

Figure 82. *Magnolia fraseri* flower close-up, Horseblock Mountain in the Talladega National Forest, Cleburne Co., Alabama, 4 May 1997. Photo: Bill Summerour.

3. Magnolia grandiflora L. {large-flowered} — SOUTHERN MAGNOLIA; BULL-BAY; FLOWERING MAGNOLIA (Fig. 83). [*Magnolia foetida* (L.) Sarg.]

Figure 83. *Magnolia grandiflora*, naturalized population in disturbed woods, Cleburne Co., Alabama, 17 Jun 2017. Photo: Dan Spaulding.

Large, evergreen tree (to 35 m). Naturalized in low to dry woods, fence rows, and other disturbed areas; flowers May–June; fruits August–October; uncommon throughout northern Alabama and upper Coastal Plain; frequent in the lower Coastal plain (Fig. 84). *Magnolia grandiflora* is native to bottomland and maritime forests of the southeastern USA in the lower Coastal Plain from North Carolina to east Texas (Godfrey 1988); all records from northern Alabama (Clark 1971) and elsewhere are escapes from cultivation (Meyer 1997).

The showy flowers (Fig. 85a) of *Magnolia grandiflora* are fragrant and chiefly pollinated by beetles (like other magnolias), though honeybees are common visitors (Heiser 1962). Thien (1974) observed beetles entering freshly opened flowers or forcing their way into unopened buds to feed on the nectar, and while crawling around they transfer pollen to the stigmas; but he said that "bees are not efficient pollinators (if at all), for they gain access to the flowers only after the stigmas and stamens have completed their cycles."

Magnolia grandiflora is a well-known and popular ornamental tree with many cultivars on the market. Weakley (2015) proclaimed: "This is, of course, the classic "southern magnolia," along with live oak (*Quercus virginiana*) and bald-cypress (*Taxodium distichum*), a totem tree of the Deep South." According to Harper (1928), the leaves are the largest of any evergreen tree in the south, except for palms and yuccas. The thick leaves and the large, cone-like fruits (Fig. 85b) of *M. grandiflora* are sometimes used by florists in decorations.

Clark (1971) had only two records of *Magnolia grandiflora* from the study area in his flora; however, this species has now spread into natural and disturbed sites. All collections mapped are documented from naturalized populations; cultivated or suspicious collections have been excluded.

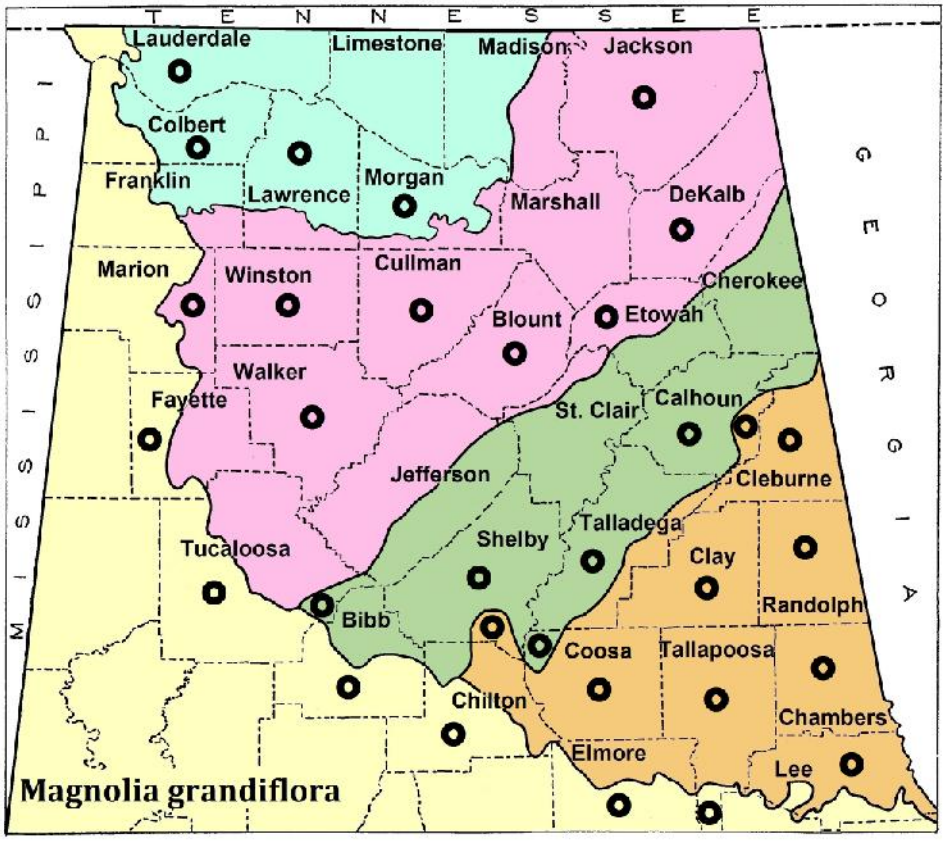


Figure 84. Distribution of *Magnolia grandiflora* in northern Alabama.

(85a) Fragrant flower with white tepals.

(85b) Mature fruit with seeds.

Figure 85. Cultivated *Magnolia grandiflora* in Madison Co, Alabama. A. Flower; 14 May 2011. B. Fruit; 28 Sep 2013. Photos: Brian Finzel.

4. Magnolia macrophylla Michx. {large-leaved} — BIGLEAF MAGNOLIA; OOWAH-TREE; LARGELEAF MAGNOLIA; SILVER MAGNOLIA; BIGLEAF COWCUMBER-TREE (Fig. 86).

Figure 86. *Magnolia macrophylla*, Powell Co., Kentucky, 1 Jun 2008. Photo: Brian Finzel.

Small to medium-sized, deciduous tree (15 to 20 m). Mesic woods, stream margins, forested slopes, coves, gorges, ravines, and bluffs; flowers April–June; fruits July–September; uncommon in the Highland Rim and Ridge & Valley; frequent in Piedmont, western Cumberland Plateau, and Coastal Plain (Fig. 87). Native to the southeastern USA ranging from Virginia to Arkansas, south to Georgia and Louisiana (but not Florida); it has become naturalized in some states north of it range (Kartesz 2017). Even though *M. macrophylla* has not been collected in the northeast corner of Alabama, it is abundant just a few miles north in Marion and Grundy counties, Tennessee (Clark 1966). *Magnolia macrophylla* is an acidophile, almost always growing in acid soil. It develops moderate to severe chlorosis in alkaline soil (pers. comm. Ross Clark 2017).

French naturalist and explorer, André Michaux (1770–1855), first discovered *Magnolia macrophylla* near Charlotte, North Carolina in 1789 (Coker & Totten 1945). Bigleaf Magnolia has the largest simple (non-divided), deciduous leaves (Fig. 88a–b) and largest flowers than any North American tree (pers. comm. Ross Clark 2017). The name "Silver Magnolia" comes from the fact that the leaves are covered with silver hairs underneath (Fig. 89). The flowers (Fig. 90) have a strong, sweet fragrance. Beetles are attracted by this odor and eat the nectarlike droplets that are secreted at the bases of the stigmas; the beetles subsequently get coated by the sticky substance and soon are covered with pollen (Thien 1974). Bumblebees have also been observed pollinating flowers (pers. comm. Ross Clark 2017). The round cones of *M. macrophylla* form in summer and turn pinkish-red later in the season (Fig. 91). The trunk of mature trees has light gray bark that is mostly smooth, but has scattered bumps and small plates on the surface (Fig. 92). The wood is hard and weak, so it is not used commercially (Elias 1980). Planted as an ornamental tree, but needs to be protected from strong winds because the giant leaves are easily torn. You can always tell if there has been a hailstorm during the summer from the condition of its leaves (pers. comm. Ross Clark 2017).

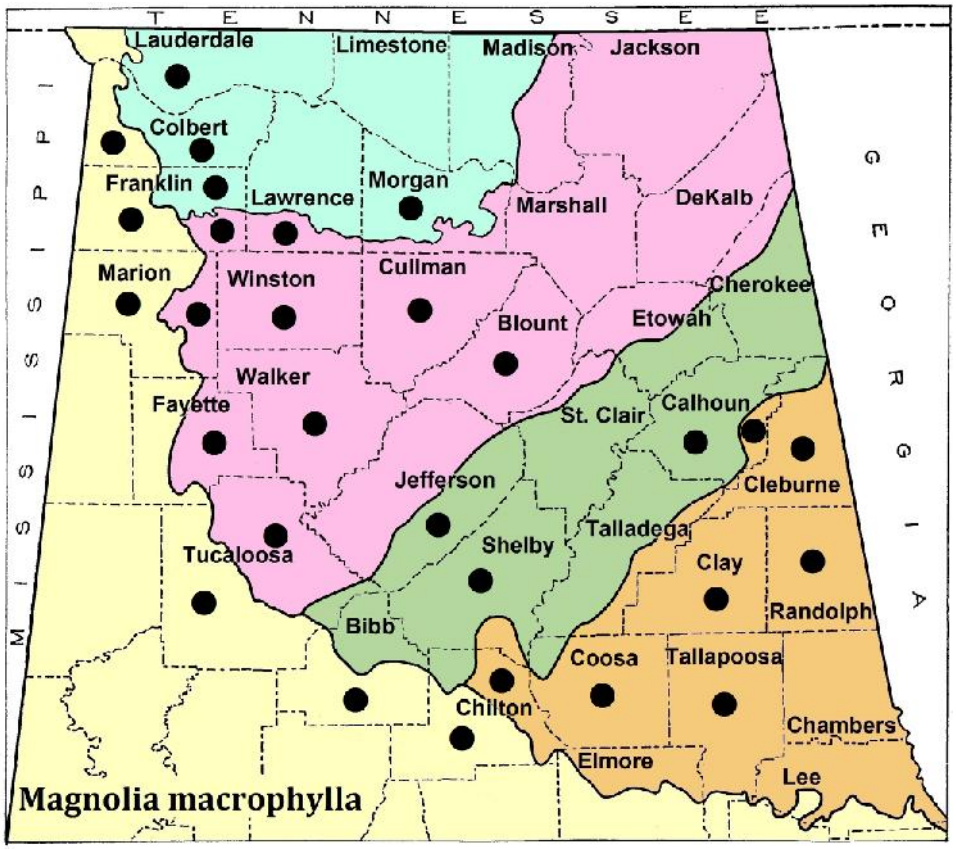


Figure 87. Distribution of *Magnolia macrophylla* in northern Alabama.

(88a) Whorl of leaves.

(88b) John MacDonald with leaf.

Figure 88. *Magnolia macrophylla* leaves. A. Monroe Co., Alabama, 1 May 2012. Photo: T. Wayne Barger. B. Bankhead National Forest; Winston Co., Alabama, 6 Jul 2017. Photo: Dan Spaulding.

Figure 89. *Magnolia macrophylla* with white leaf undersurface, floating in creek in Hamilton Co., Tennessee, 28 Oct 2007. Photo: Alan Cressler.

Figure 90. *Magnolia macrophylla* flower, Bankhead National Forest. Lawrence Co., Alabama, 25 May 2004. Photo: Eric Soehren.

Figure 91. *Magnolia macrophylla* fruit, Tallapoosa Co., Alabama, 13 Sep 2007. Photo: T. Wayne Barger.

Figure 92. *Magnolia macrophylla* trunks, Marion Co., Alabama, 20 Aug 2017. Photos: Dan Spaulding.

Magnolia macrophylla is closely related to the smaller *M. ashei* Weatherby, a Florida Panhandle endemic. Miller (1975) stated that *M. ashei* is "probably a relict that through isolation has adapted to life as a shrub rather than a tree." Weatherby (1926), who named the species, said it has smaller flowers and the pubescence on the undersurface of the leaves is not as dense as that of *M. macrophylla*. Kral (1983) states that *M. ashei* is thought by some to be just a variant, but *M. macrophylla* is much taller, more widespread, and has broader and rounder fruit than *M. ashei* (Fig. 93). It is also noteworthy that he trunk of *M. ashei* is noticeable contorted, while *M. macrophylla* is straight (pers. comm. John Kartesz 2017).

Figure 93. *Magnolia ashei*, Okaloosa Co., Florida, 14 Apr 2001; fruit, 15 Aug 2002. Photos: Bill Summerour.

5. Magnolia pyramidata W. Bartram {pyramidal; referring growth habit} — PYRAMID MAGNOLIA; SOUTHERN CUCUMBER-TREE; BARTRAM'S MAGNOLIA (Fig. 94). [*Magnolia fraseri* Walter ssp. *pyramidata* (W. Bartram) A.E. Murray; *M. fraseri* var. *pyramidata* (W. Bartram) Torrey & A. Gray; *Paramagnolia fraseri* (Walter) Sima & S.G. Liu var. *pyramidata* (Bartram) Sima & S.G. Liu]

Figure 94. *Magnolia pyramidata*, Calhoun Co., Alabama, 20 Apr 1998. Photo: Bill Summerour.

Small, deciduous tree (to 12 m). Mixed wooded ravines, forested slopes, and bluffs; flowers April–May; fruits June–August; very rare in the Ridge & Valley and lower Piedmont; uncommon in the Coastal Plain (Fig. 95). Chiefly native in the Coastal Plain from South Carolina to east Texas (Kartesz 2017).

In Alabama, *Magnolia pyramidata* was documented from the Piedmont of Chilton County by Robert Kral on May 20, 1973. In the summer of 1997, it was discovered in the Wesner Ridge section of the Ridge & Valley province in Calhoun County by two Jacksonville State University (JSU) graduate students, Hayes Jackson and Steven Threlkeld. They were searching for Turkey Oak (*Quercus laevis*) on Reynolds Hill at Ft. McClellan, when came across Pyramid Magnolia under a stand of Longleaf Pine (*Pinus palustris*), about a hundred yards away from the oak on the same slope (pers. comm. Hayes Jackson 2017). Jackson noticed a lower branch of *M. pyramidata* under the pine straw that was starting to root, so he cut this branch and planted it in the woods surrounding his house in Anniston. The word spread about this northern population of Pyramid Magnolia, and in the spring of 1998, JSU professor Bill Summerour (pers. comm. 2017) visited this site with a group from Birmingham, and photographed the tree along with the flowers (Fig. 96a). Years later, the Eastern Bypass from Oxford to Anniston was completed, apparently destroying the habitat where *M. pyramidata* was found. Unfortunately, no herbarium specimen was made from the plant in the 1990s, but the senior author visited Hayes Jackson's house and made a voucher from the original tree that once grew in the wild (Fig. 96b). Recent searches have been made in the area for more trees, but none were found; more field work is planned.

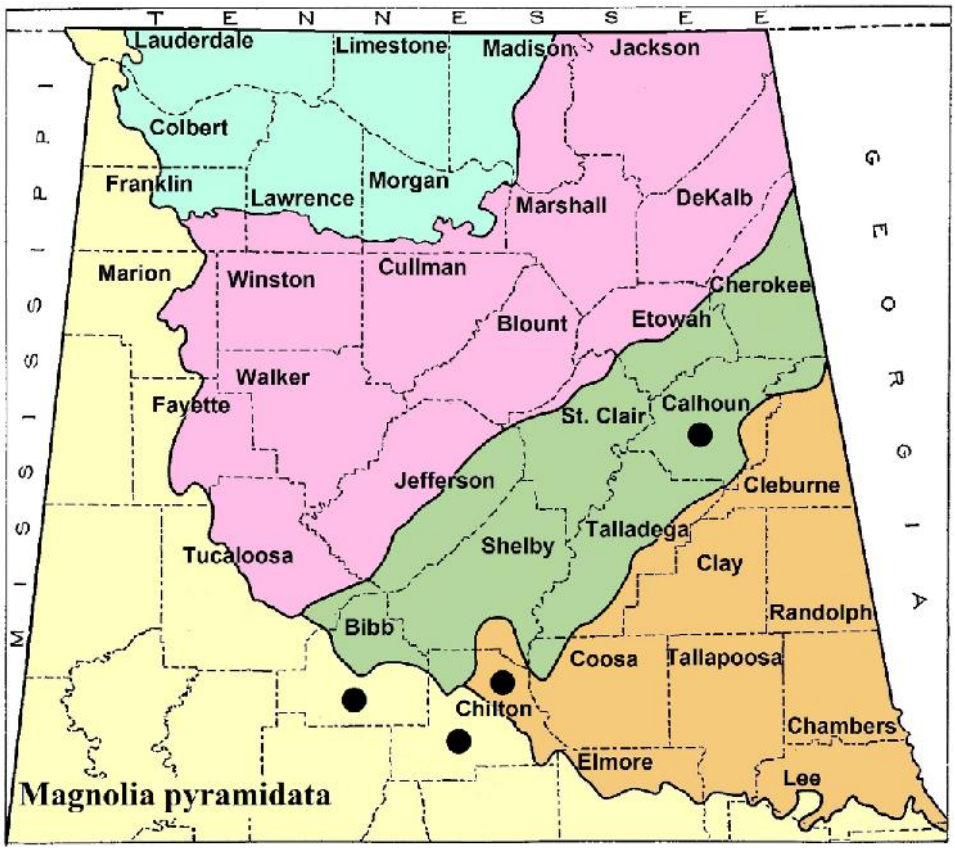


Figure 95. Distribution of *Magnolia pyramidata* in northern Alabama.

(96a) Photo: Bill Summerour.

(96b) Photo: Dan Spaulding.

Figure 96. *Magnolia pyramidata* in Calhoun Co, Alabama. A. Birmingham group observing the shrubby tree with flower buds on Reynolds Hill in Ft. McClellan, 10 Apr 1999. B. Cutting from original tree planted at Hayes Jackson's house in Anniston, 9 Aug 2017.

The flowers of *Magnolia pyramidata* (Fig. 97) are similar in size to *M. fraseri*, but have smaller stamens (< 8mm long). Clark (1971) regarded *M. pyramidata* as synonymous with *M. fraseri* and stated: "There is no apparent reason to consider these as distinct entities, even though there is a range discontinuity." Weakley (2015) noted that *M. pyramidata* is "sometimes treated as a variety or subspecies of *M. fraseri*, to which it is clearly closely related, but the distributional and morphological differences are discrete and specific status seems warranted."

Figure 97. *Magnolia pyramidata* flower, Monroe Co., Alabama, 7 Apr 2011. Photo: T. Wayne Barger.

6. Magnolia ×soulangeana Soul.-Bod. {for Étienne Soulange-Bodin (1774–1846), a French horticulturalist} — SAUCER MAGNOLIA; TULIP MAGNOLIA (Fig. 98).

Figure 98. *Magnolia ×soulangeana* 'Alexandrina' in cultivation at Hayes Jackson's house in Anniston, Calhoun Co., Alabama, 20 Jan 2013. Photo: Hayes Jackson.

Large, multi-trunked, deciduous shrub or small tree with low branches (to 8 m). Commonly cultivated and rarely persistent at old homesteads; flowers late January–April; fruits August–September (sporadically); very rare waif in the Cumberland Plateau and Coastal Plain (Fig. 99). Collections of *Magnolia ×soulangeana* from Colbert, Dallas, and Lauderdale counties were planted and one collection from Barbour County was made along a roadside among pines and oaks (Keener et al. 2017). There is no evidence *M. ×soulangeana* escapes cultivation, and is therefore not truly part of our flora (pers. comm. Ross Clark 2017), but it is included in this paper because the plant can appear to be naturalized.

Magnolia ×soulangeana is often multi-trunked and has deciduous leaves that appear after flowering (Fig. 100). Saucer Magnolia is a hybrid between two Chinese species, *M. denudata* Desr. and *M. liliifolia* Desr., which are sometimes placed in the genus *Yulania* (Xia et al. 2008). Both of these species have been planted as ornamentals, but the hybrid, *M. ×soulangeana*, has far surpassed its parents in popularity. Numerous cultivars of *M. ×soulangeana* have been developed and are grown throughout the USA, Canada, Europe, and other countries.

Dirr (1983) stated: "The original hybrid was raised in the garden of Soulange-Bodin at Fromont, France from seed borne by *M. heptapeta* [=*M. denudata*] fertilized by pollen of *M. quinquepeta* [=*M. liliifolia*]. The plant first flowered in 1826 and the cultivars have become the most popular of all magnolias in American gardens." It is cherished for its beautiful flowers (Fig. 101) that appear well before the leaves.

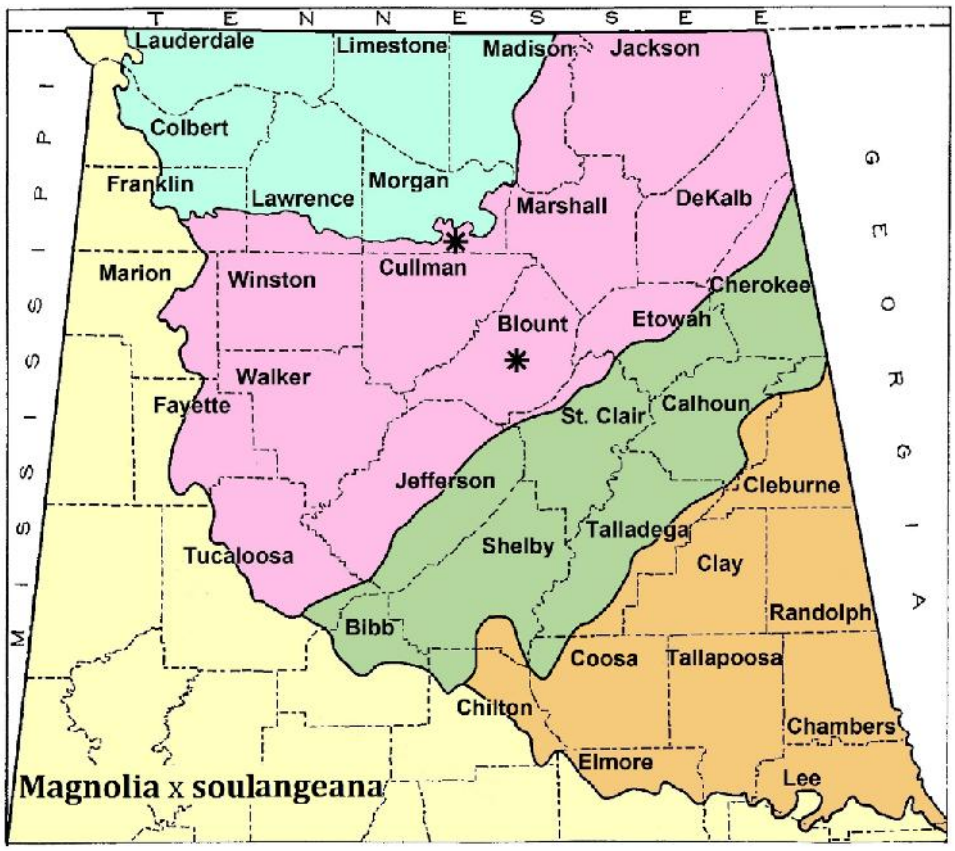


Figure 99. Distribution of *Magnolia* ×*soulangeana* in northern Alabama.

Figure 100. *Magnolia* ×*soulangeana* 'Alexandrina' in cultivation at Hayes Jackson's house in Anniston, Calhoun Co., Alabama, 9 Aug 2017. Photos: Dan Spaulding.

Figure 101. *Magnolia* ×*soulangeana* in cultivation, Lee Co., Alabama, 28 Feb 2010. Photo: T. Wayne Barger.

7. Magnolia tripetala (L.) L. {with three petals} — UMBRELLA MAGNOLIA; UMBRELLA-TREE (Fig. 102). [*Houpoea tripetala* (L.) Sima & S.G. Lu]

Figure 102. *Magnolia tripetala*, St. Clair Co., Alabama, 24 Apr 2008. Photo: Brian Finzel.

Small, deciduous tree (to 15 m), usually with several trunks. Rich woods, stream bottoms, forested slopes, ravines, coves, and gorges; flowers April–May; fruits July–October; frequent in the Piedmont and Ridge & Valley; uncommon in the Cumberland Plateau; rare on the Coastal Plain (Fig. 103). Native to the eastern USA, but centered in the Southern Appalachians, ranging from southern Pennsylvania, southern Ohio, southern Indiana south to the Panhandle of Florida and Mississippi; it is disjunct in the Ouachita Mountains of central Arkansas and eastern Oklahoma (Weakley 2015). This species is occasionally cultivated and records from the northeastern USA are escapes from planted trees (Kartesz 2017).

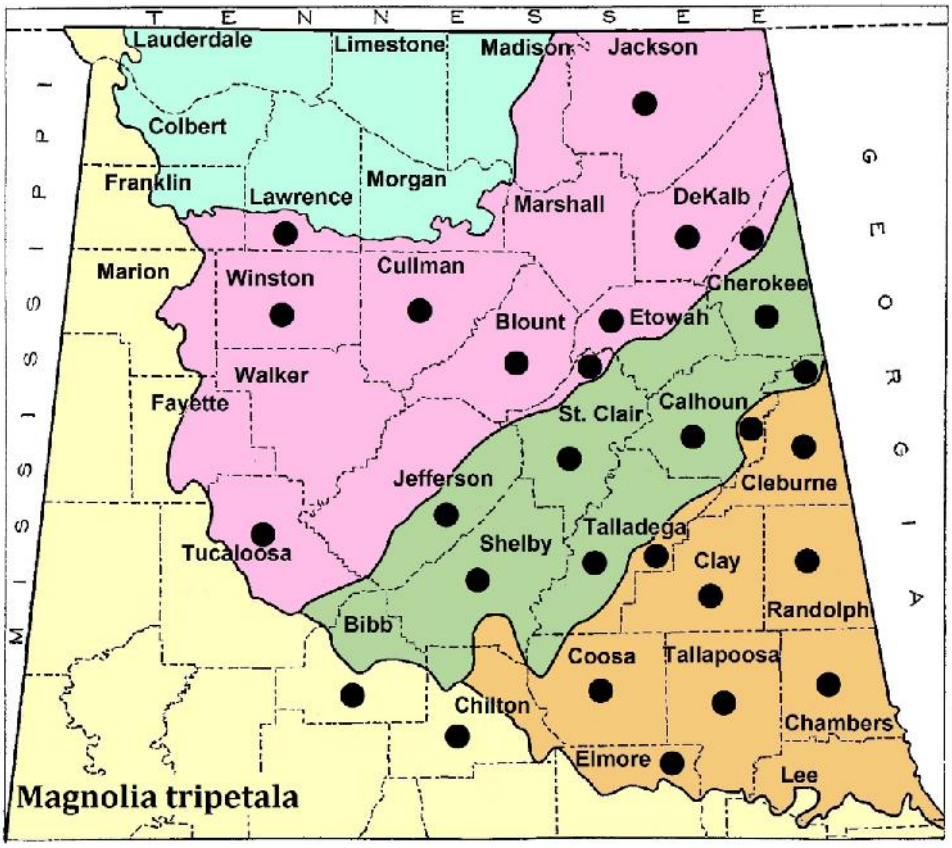


Figure 103. Distribution of *Magnolia tripetala* in northern Alabama.

Although Linnaeus named the species, it was first described by Mark Catesby in 1743 in his publication *Natural History of Carolina* and was introduced in eighteenth century gardens of England (Peattie 1948). Heiser (1962) described the white flowers (Fig. 104a) of *Magnolia tripetala* as having "a rather heavy odor which is frequently described as unpleasant," and after his observation in the field, he said it "seems reasonable to infer that *M. tripetala* is primarily, if not entirely, pollinated by beetles." The cone-like fruits (Fig. 104b) become red when mature and shed their crimson seeds by the end of summer.

Magnolia tripetala has leaves crowded at the ends of branches, giving them a whorled or umbrella-like appearance (Fig. 105), hence the common name. Three other species, *M. fraseri*, *M. macrophylla*, and *M. pyramidata*, are occasionally called "umbrella magnolias" for the same reason. These three species all have auriculate (eared) leaf bases, whereas the leaves of *M. tripetala* taper basally. *Magnolia tripetala* is a fast growing understory tree, but it doesn't get very large. The bark is gray and mostly smooth, but covered with scattered bumps and small plates (Fig. 106).

(104a) Flower. Photo: T. Wayne Barger.

(104b) Fruit. Photo: Dan Spaulding.

Figure 104. *Magnolia tripetala*. A. Coosa Co., Alabama, 30 Apr 2013. B. Floodplain forest along Cane Creek, Randolph Co., Alabama, 27 Aug 2017.

Figure 105. *Magnolia tripetala* with umbrella-like leaves, wooded floodplain along Cane Creek, Randolph Co., Alabama, 27 Aug 2017. Photos: Dan Spaulding.

Figure 106. *Magnolia tripetala* trunks, floodplain along Cane Creek, Randolph Co., Alabama, 27 Aug 2017. Photo: Dan Spaulding.

8. Magnolia virginiana L. {of Virginia} var. **australis** Sarg. {southern} — SWEETBAY MAGNOLIA; SWEET-BAY; SILVER-BAY; SWAMP-BAY (Fig. 107). [*Magnolia australis* (Sarg.) Ashe; *M. glauca* L.]

Figure 107. *Magnolia virginiana*. Jackson Co., Alabama, 2 May 2012. Photo: T. Wayne Barger.

Medium to large, evergreen tree (to 28 m). Swamps, bogs, seeps, and streambanks; flowers April–July; fruits June–October; rare in the Highland Rim; uncommon in the Cumberland Plateau and Ridge & Valley; frequent in the Piedmont; common in the Coastal Plain (Fig. 108). The species is native from Massachusetts south to Florida, and then in the Southeast USA west to east Texas and north to Arkansas and Tennessee (Kartesz 2017). Only *Magnolia virginiana* var. *australis* has been documented from Alabama, even though Kral et al. (2011) reported *M. virginiana* var. *virginiana* from the state. Weakley (2015) maps the range of the type variety only in the eastern Atlantic states from southeast Massachusetts south to east Georgia.

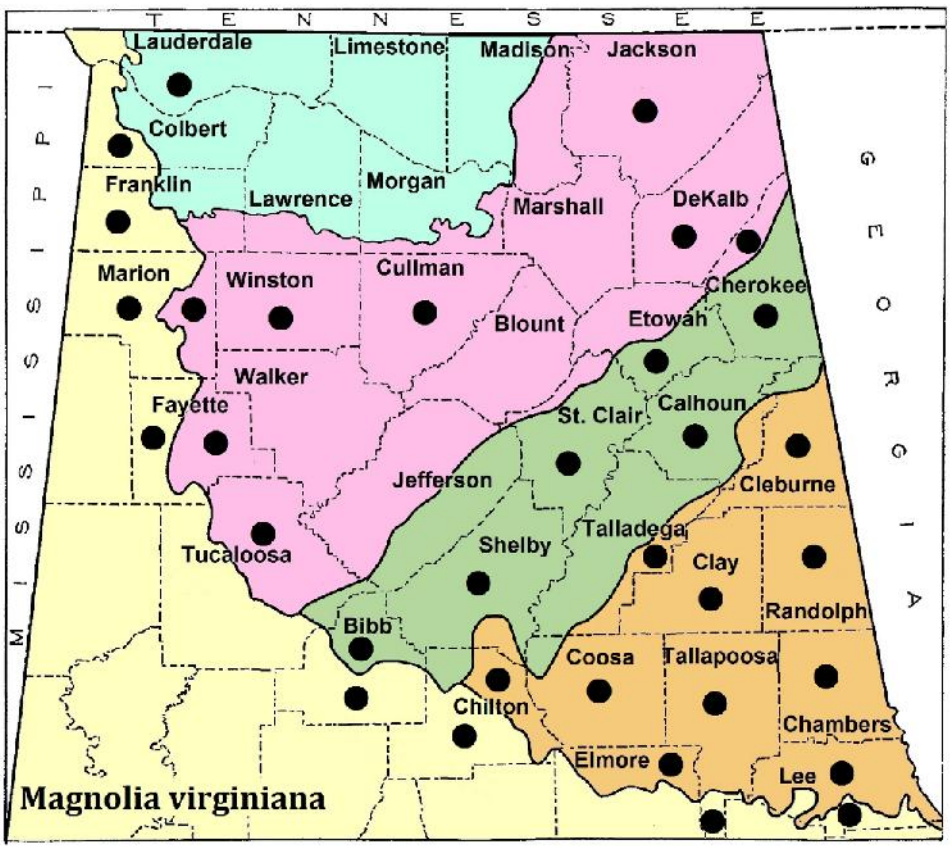


Figure 108. Distribution of *Magnolia virginiana* in northern Alabama.

Sweetbay Magnolia is a very common landscape plant in the eastern USA. It is hardy and even resists drought. Its flowers are extremely fragrant and beetle pollinated (Heiser 1962). The fruits are first green, turn red at maturity and the crimson, arillate seeds later dangle from each follicle (Fig. 109). Historically, the dried, aromatic bark was used as a tonic for its stimulant properties (Harper 1928). When young, this species is sometimes confused with *Persea palustris* (Swamp Bay) because they both have elliptic, aromatic leaves and often grow in the same habitat, however the crushed leaves of *P. palustris* have a spicy aroma and a rusty pubescence beneath. In contrast, *Magnolia virginiana* leaves have a sweet fragrance when crushed and are strongly glaucous and white pubescent beneath (Fig. 110).

Figure 109. *Magnolia virginiana*, swamp in Lee Co., Alabama, 27 Aug 2017. Photos: Dan Spaulding.

Figure 110. *Magnolia virginiana*, Cleburne Co., Alabama, 17 Jun 2017. Photo: Melanie Taylor Spaulding.

Sargent (1919) named the southern variety of this species, *Magnolia virginiana* var. *australis*, which he described as a taller, evergreen tree (Fig. 111) with silky white pubescence on the undersurface of the leaves and on young stems. Ashe (1931) elevated Sargent's variety to a species because he said there were no intermediates between the northern and southern trees. Most northern populations tend to be small, multi-trunked trees (to 10 m) with deciduous to semi-evergreen leaves that are glabrous or slightly pubescent underneath.

McDaniel (1966) was convinced that recognition of var. *australis* was justified, but Spongberg (1976) noted that even though "the characters outlined by McDaniel are indeed evidence of differences between northern and southern populations of *M. virginiana*, it would seem that differences are to be expected within a wide-ranging species." Del Tredici (1981) agreed with Spongberg that this magnolia was just a highly variable species and said "the situation is very complex and confused and that many different forms of *Magnolia virginiana* of uncertain origin can be found."

Recently, however, Azuma et al. (2011) demonstrated that "phylogenetic analysis of the data matrix clearly indicated that populations of *Magnolia virginiana* were divided into two major groups—one in the north and one across the south—which are essentially concordant with the morphological classification." Their analysis utilized cpDNA (chloroplast DNA) and revealed that five nucleotide substitutions in cpDNA separates the two varieties, which is equivalent to similar differences found in other *Magnolia* taxa that are recognized as separate species (Azuma et al. 2011).

Figure 111. *Magnolia virginiana* trunk, swamp in Lee Co., Alabama, 27 Aug 2017. Photo: Dan Spaulding.

FAMILY 8. ANNONACEAE (Custard-Apple Family)

1. ASIMINA Adanson 1763
[From Native American name, *Asiminin*]

The Custard-Apple family (Annonaceae) contains more than 1000 species (75–120 genera). While most are from the tropics, only the genus *Asimina* is found in the temperate to subtropical regions of North America (Wood 1958). A total of 10 species of *Asimina* are found in eastern North America, with most restricted to Florida and Georgia (Horn 2015).

1. Non-clonal shrub of well-drained slopes and upland woods, usually 1–3 meters tall, largest leaf blades <22 cm long (averaging 6–15 cm); peduncle length at anthesis 1–7 mm (sometimes appearing nearly sessile); outer petal length 3–8 (-10) mm long; flowers 1–1.7 cm broad; mature fruit averaging 3 cm long (rarely to 6 cm) ..... **1. *Asimina parviflora***
1. Clonal shrub or tree of floodplains and adjacent slopes, 1–14 m tall; largest leaf blades usually >18 cm long (averaging between 20–25 cm); peduncle length at anthesis (6-) 8–20 mm; outer petal length 10–25 mm; flowers >2 cm broad; mature fruit 2–15 cm long.

    2. Tree (or shrub when young) 3–14 m tall; largest leaves mostly >24 cm long; peduncle length on mature flowers (9–) 11–19 mm; outer petal width (12–) 15–27 mm and curved outward near apex; fruit averaging 7–15 cm long with numerous seeds ..... **3. *Asimina triloba***
    2. Small shrub < 3 m tall; largest leaves mostly <27 cm long; peduncle length on mature flowers (6–) 8–12 mm; outer petal width 7–14 (-16) mm and curved outward near base; fruit rarely forming, but if present, about 2 cm long and with very few seeds ..... **2. *Asimina ×piedmontana***

1. Asimina parviflora (Michx.) Dunal {small-flowered} — SMALL-FLOWER PAWPAW; SMALL-FRUIT PAWPAW (Fig. 112).

Figure 112. *Asimina parviflora* with fruits, woods in Blount Co., Alabama, 13 Sep 2013. Photo: Brian Finzel.

Non-clonal, deciduous shrub. Upland woods, forested slopes, bluffs, and ravines; flowers March–May; fruits late May–September; rare in the Highland Rim (in acidic areas); common in all the other provinces of Alabama (Fig. 113). Native to the southeastern USA, from southeast Virginia west to southern Arkansas, south to east Texas and Florida; apparently absent from Tennessee (Kartesz 2017). Ross Clark (pers. comm. 2017) observed it in Marion Co., Tennessee, but didn't collect a voucher.

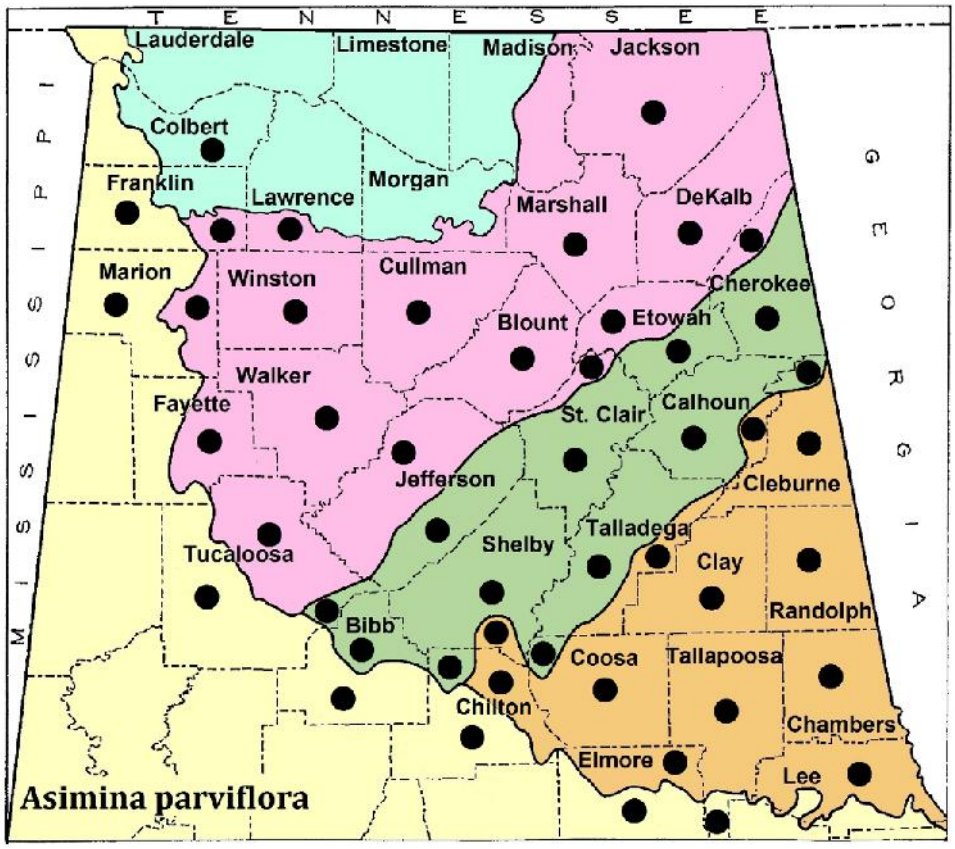


Figure 113. Distribution of *Asimina parviflora* in northern Alabama.

Harper (1928) stated that *Asimina parviflora* is "similar to *A. triloba* except in size, being seldom more than three or four feet tall, and having leaves and flowers only half as large." A hybrid between the two species was not known at the time. It is much easier to identify *Asimina* species in the field than on herbarium sheets, because *A. parviflora* is not clonal (rarely in clusters of more than five stems) and occurs in well-drained habitats (Horn 2015). *Asimina parviflora* is also rarely above one's head (averaging >2 m tall), hence the name "Dwarf Pawpaw." *Asimina triloba* and *A. ×piedmontana* are both clonal and located either in floodplains or on adjacent slopes. However, *A. triloba* is a tree (when mature) and *A. ×piedmontana* is a shrub less than 3 m tall. *Asimina parviflora* flowers (Fig. 114) are smaller and its peduncles (Fig. 115) are shorter than *A. triloba* and *A. ×piedmontana*. The fruit of Dwarf Pawpaw is much smaller than Common Pawpaw, but both are edible. Fruits usually do not form in the hybrid *A. ×piedmontana* (pers. comm. Charles Horn 2017).

The peculiar odor of crushed leaves of *Asimina* is reminiscent of a mixture of green peppers and tomatoes, thus helpful in identification in the field. The caterpillars of the beautiful black and white striped Zebra Swallowtail (*Euripides marcellus*) feed exclusively on pawpaw leaves. The female butterflies are skilled at locating *Asimina* plants and deposit their globe-shaped eggs on twigs, flowers and new leaves (Ogard & Bright 2010).

The brownish flowers of *Asimina* are slightly ill-scented and are believed to be pollinated by beetles (Wood 1958). However, recent research by Kate Goodrich on the pollination of *Asimina*, suggests that flies are possible pollinators (pers. comm. Charles Horn 2017).

Figure 114. *Asimina parviflora* flowering branch, Shelby Co., Alabama, 8 Apr 2015. Photo: Brian Finzel.

Figure 115. *Asimina parviflora* short peduncled flower, Shelby Co., Alabama, 8 Apr 2015. Photo: Brian Finzel.

2. Asimina ×piedmontana C.N. Horn {of the Piedmont; where hybrid was collected and described} — PIEDMONT PAWPAW (Fig. 116).

Figure 116. *Asimina ×piedmontana*, lower wooded slope adjacent to floodplain along Johnson Creek, Union Co., South Carolina, 26 Apr 2008. Photo: Charles Horn.

Clonal, deciduous shrub. Low woods and lower slopes adjacent to floodplains; flowers March–May; seldom fruits; rare in the Cumberland Plateau, Ridge & Valley, and Piedmont (Fig. 117); possible in the Coastal Plain. *Asimina* ×*piedmontana* range overlaps the distribution of its parents (Horn 2015) and the hybrid may be more common than records indicate.

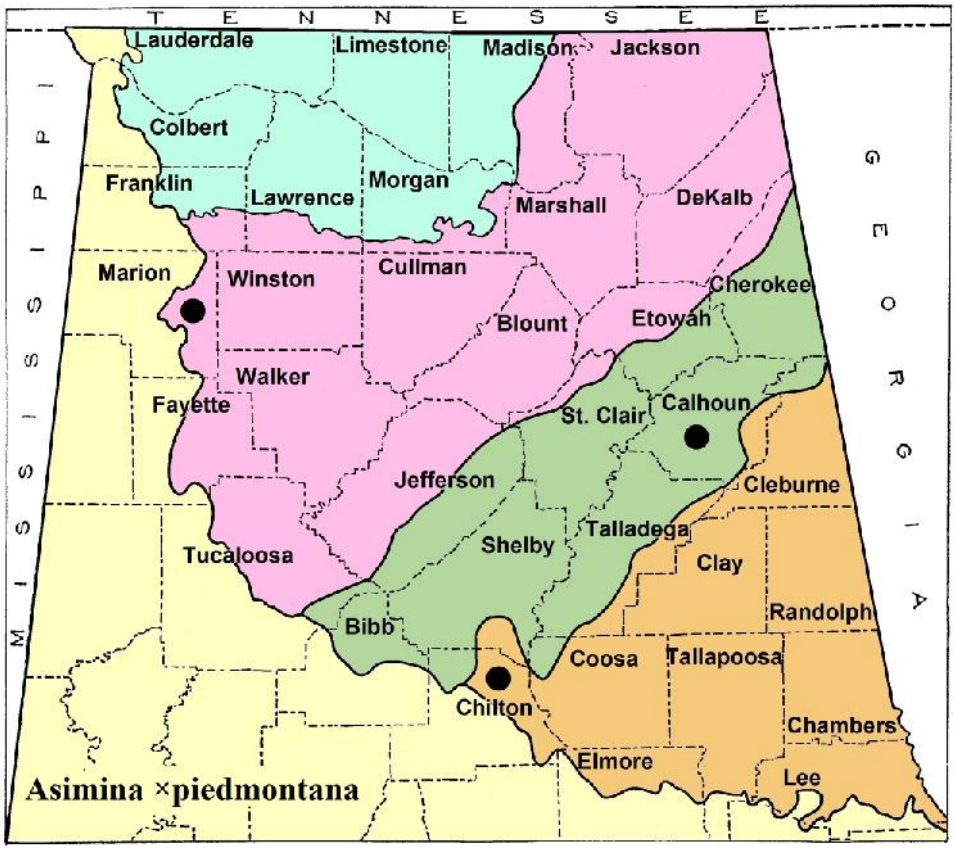


Figure 117. Distribution of *Asimina* ×*piedmontana* in northern Alabama.

Kral (1960) said that "hybrid swarms [in Florida] were common in *Asimina* with sprinklings of both parents" and also stated that "suspected hybrids between *A. triloba* and *A. parviflora* have been found." Kral (1997) mentioned in his treatment of the Annonaceae in the Flora of North America: "Putative hybrids between the two have been observed in northern Alabama."

Horn (2015) investigated variation in leaf size, flower morphology, and habitat of *Asimina* in South Carolina, and demonstrated that a hybrid between *A. parviflora* and *A. triloba* (*A.* ×*piedmontana*) exists, with flowers intermediate in size (Fig. 118a–f). Horn (2015) wrote: "The floral features of peduncle length, petal length, and petal width, are clearly the best flower parameters to help separate the three taxa." He also said: "Most striking was that the outer petals were rolled outwards laterally along their length on the hybrid." The leaves are also intermediate between its parents, largest ones 22–27 cm long (Fig. 119).

Asimina ×*piedmontana* is clonal (Fig. 120) and forms colonies like *A. triloba*, but the hybrid is usually less than 3 meters tall (Fig. 121), with branches commonly arching. Horn (2015) discovered that young plants of *A. triloba* (>3 m tall) are easily confused with mature populations of *A.* ×*piedmontana*. The problem was resolved when he realized that vegetative and floral buds are morphologically different between the two taxa. The vegetative buds of *A. triloba* are more elongate (2–3 times longer than wide), and in plants less than 3 m tall, flower buds are absent because of their

immaturity. Conversely, in *A.* ×*piedmontana* vegetative buds are smaller and not as elongate, and plants the same size as immature *A. triloba* possess rounded floral buds (Fig. 122a–b).

Figure 118. Flower comparison of three *Asimina*. A–B. *Asimina parviflora*. C–D. *Asimina* ×*piedmontana*. E–F. *Asimina triloba*. Photos: Charles Horn. Figure originally published in Castanea 80: 262–272 (Horn 2015).

Figure 119. *Asimina* ×*piedmontana* leaves, woods along floodplain of Johnson Creek, Union Co., South Carolina, 7 Jul 2009. Photo: Charles Horn.

Figure 120. Clonal patch of *Asimina* ×*piedmontana*, woods along Sulphur Spring Branch, Newberry Co., South Carolina, 4 Jul 2007. Photo: Charles Horn.

Figure 121. Charles Horn and *A.* ×*piedmontana*, Union Co., South Carolina, 25 Aug 2007. Photo: Hart Scott.

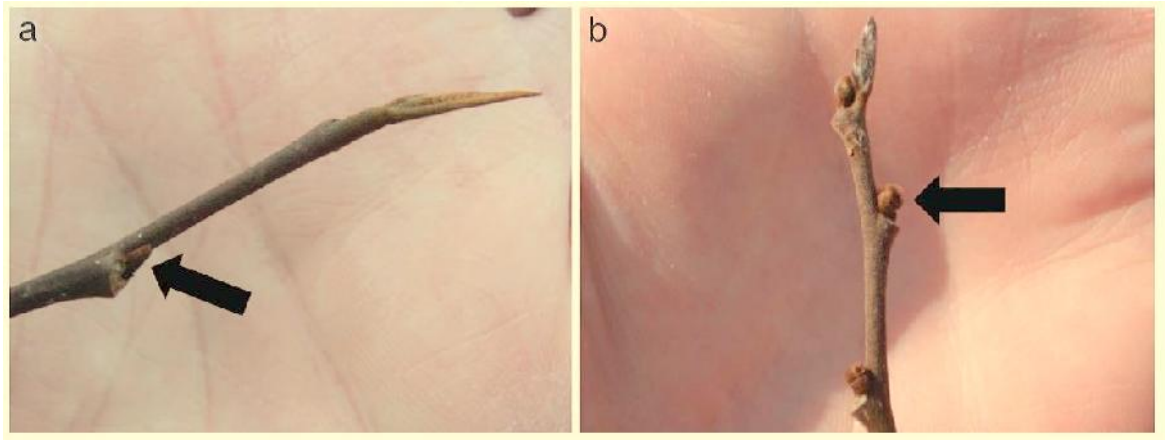


Figure 122. Buds of *Asimina triloba* and *Asimina* ×*piedmontana*. A. Immature *Asimina triloba* twig with terminal and lateral (arrow) vegetative buds (note that flower buds are lacking), Lynch's Woods, Newberry Co., South Carolina, Dec 2014. B. Mature *Asimina* ×*piedmontana* twig with terminal vegetative bud and flowering lateral buds (arrow) (note shorter terminal bud), Lynch's Woods, Newberry Co., South Carolina, Mar 2008. Photos: Charles Horn. Figure originally published in Castanea 80: 262–272 (Horn 2015).

3. Asimina triloba (L.) Dunal {three-lobed} — COMMON PAWPAW; INDIAN-BANANA; CUSTARD-APPLE (Fig. 123).

Figure 123. *Asimina triloba*, alluvial woods in the Bankhead National Forest, Lawrence Co., Alabama, 11 May 2005. Photo: Eric Soehren.

Clonal, deciduous small tree or large shrub (to 14m). Alluvial woods, bottomland forests; creek banks, low woods, mesic hardwood forests, swamp margins, and moist slopes along streams; flowers March–May; fruits late June–October; frequent throughout Alabama, though less common in the lower Coastal Plain (Fig. 124). *Asimina triloba* is native to the eastern USA and Canada from southern Ontario south to northern Florida, west to eastern Texas and Nebraska. It occurs further north and is the most widespread species of *Asimina* in North America (Wilbur 1970).

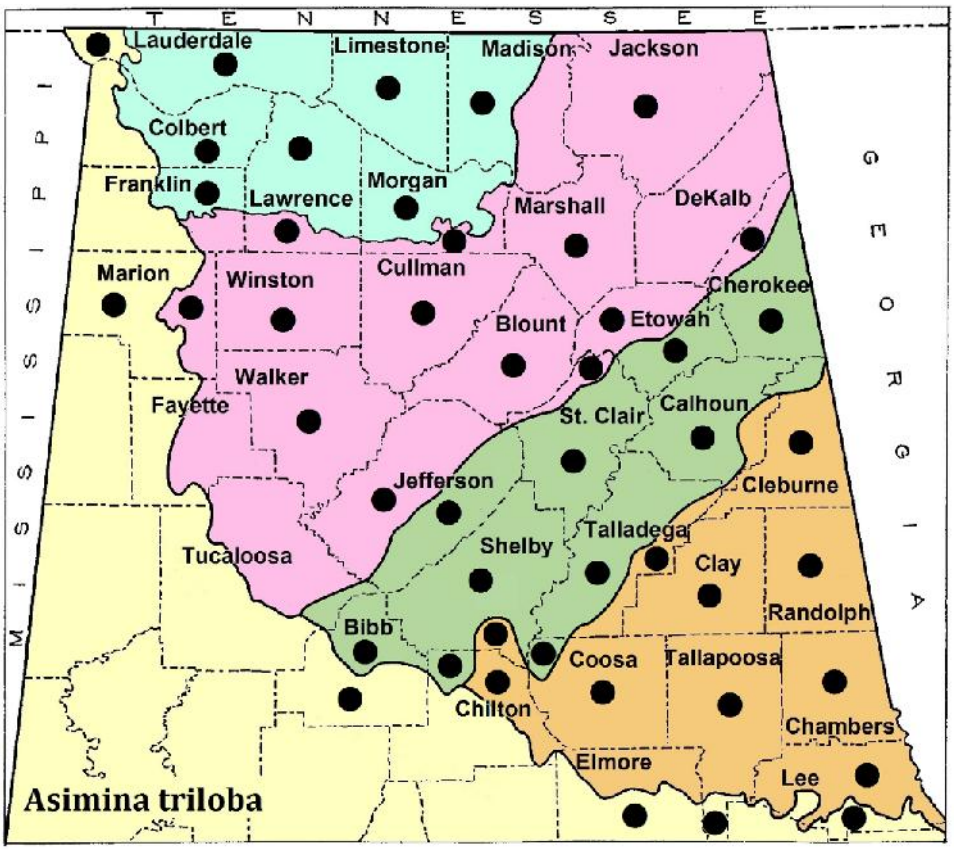


Figure 124. Distribution of *Asimina triloba* in northern Alabama.

Asimina triloba is often confused with *A. parviflora* based on herbarium specimens alone, but the two species are easy to distinguish in the field. Common Pawpaw becomes a single-trunked tree that forms colonies in floodplains (Fig. 125), though immature plants are usually present and often the same size as Dwarf Pawpaw (which occurs in dry habitats). The leaves of *A. triloba* are typically longer than *A. parviflora*, and its flowers (Fig. 126) and fruits (Fig. 127) are larger, with longer peduncles.

Figure 125. *Asimina triloba*, alluvial woods, Randolph Co., Alabama, 27 Aug 2017. Photos: Dan Spaulding.

Figure 126. *Asimina triloba* flowers, Madison Co., Alabama, 19 Apr 2014. Photos: Brian Finzel.

Figure 127. *Asimina triloba* fruit, along creek in Macon Co., Alabama, 31 Jul 2010. Photo: Eric Soehren.

The common name "pawpaw" is believed to be a corruption of Papaya, the name of the tropical fruit (Little 1980). *Asimina triloba* has the largest edible fruit native to North America (Hormaza 2014) and they are sometimes called wild or false bananas, but are technically large berries. They are eaten by wildlife such as opossums, squirrels, raccoons, bears, and turkeys (Elias 1980). The fruit is only palatable when they are fully mature. When unripe, the berries are greenish and hard, but by late fall, they become soft and turn nearly black with wrinkled skin. The flesh of ripe fruit is yellow or orange and has a custard-like consistency (Peattie 1948). Kral (1960) said they "have the taste and texture somewhat reminiscent of a sweetish avocado" and have "been eaten (even relished) by the Indians and settlers of eastern North America."

In 1806, some members of the Lewis and Clark expedition subsisted for days on the fruit of this species and early settlers utilized it when their crops failed (Hormaza 2014). Fruits of some selected cultivars of *A. triloba* can weigh more than three pounds and are occasionally sold at farmers' markets in the fall. (pers. comm. Ross Clark 2017).

Caution should be taken when eating the fruit of Pawpaw, because according to Kingsbury (1964), “a small fraction of the population is sensitive to this plant, reacting with contact dermatitis” and “certain individuals may exhibit severe gastrointestinal symptoms after ingestion of the fruit.” The seeds of *Asimina* contain alkaloids and are therefore poisonous. In the past they were ground into powder and used to kill head lice (Martin 1992). Historically, pioneers in eastern North America made a yellow dye from the ripe pulp of the fruit (Elias1980). The tough bark of *A. triloba* was cut into strips by pioneers to string fish (Peattie 1948) and also used in Mississippi to make ropes and mats (Harper 1928).

FAMILY 9. CALYCANTHACEAE (Strawberry-Shrub Family)

1. CALYCANTHUS Linnaeus 1759

[Cup flower; alluding to the cup-like receptacle at the base of the flowers]

1. Calycanthus floridus L. {flowering} — EASTERN SWEETSHRUB; CAROLINA-ALLSPICE; SWEET BUBBY-BUSH; STRAWBERRY-SHRUB; SWEET-BUBBIES (Fig. 128). [*Butneria fertilis* (Walter) Kearney; *B. florida* (L.) Kearney; *Calycanthus brockianus* Ferry & Ferry; *C. fertilis* Walter; *C. floridus* var. *glaucus* (Willd.) Torrey & A. Gray; *C. floridus* var. *laevigatus* (Willd.) Torrey & A. Gray; *C. mohrii* Small; *C. nanus* Loisel.]

Figure 128. *Calycanthus floridus*, Cleburne Co., Alabama, 7 Apr 2011. Photo: T. Wayne Barger.

Clonal, deciduous shrub (1–3 meters tall). Rich woods, forested slopes, ravines, low woods, and streambanks; flowers late March–June; fruits June–September; uncommon in the Highland Rim and western Cumberland Plateau; frequent in the eastern Cumberland Plateau, Ridge & Valley, Piedmont, and Coastal Plain (Fig. 129). Native to the southeastern USA from Virginia west to southern Illinois, south to east Texas and northern Florida; there are no records from Arkansas, but the species has escaped from cultivation in other mid-eastern and northeastern states (Kartesz 2017).

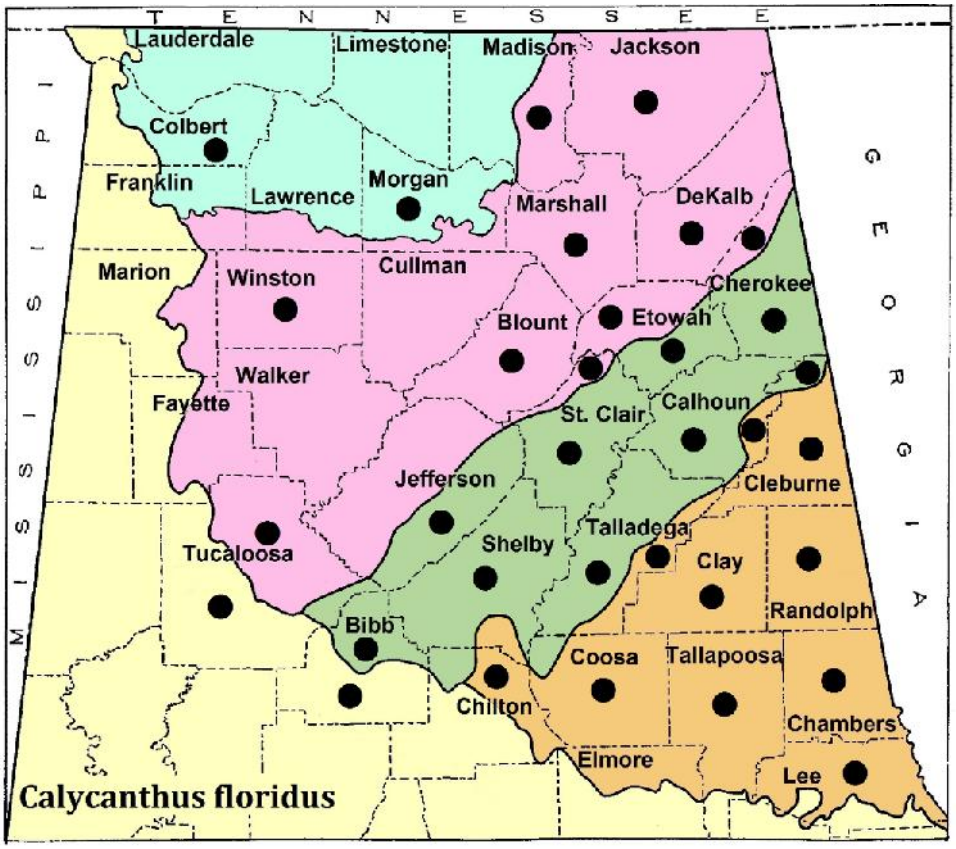


Figure 129. Distribution of *Calycanthus floridus* in northern Alabama.

Pollination of *Calycanthus floridus* is known to occur by at least two species of beetles (Nicely 1965). The flowers have numerous burgundy, strap-shaped tepals (petals and sepals that look alike) and often a fruity fragrance reminiscent of strawberries or pineapples; but sometimes they have a spicy odor or rarely none at all. Sweetshrub flowers have been wrapped in handkerchiefs to make fragrant sachets (Harper 1928). The name "Sweet-Bubbies" possibly comes from the fact that some ladies put flowers in their cleavage to "freshen up" (pers. comm. Ross Clark 2017).

The fruit of Sweetshrub is about the size of a fig, greenish-yellow when immature (Fig. 130a), turning brown to gray at maturity (Fig. 130b); superficially resembling the cocoon of a silk moth (Fig. 130c). The fibrous, bag-like fruit contains brown seeds that resemble baked beans or coffee beans (Sterns 1888). The seeds (achenes) are about 1 cm long and sparsely covered with silky hairs. They contain strychnine and poisoning of livestock has been reported from eating the fruit (Wood 1958). *Calycanthus floridus* is easily identified without flowers or fruits, because of its conspicuously enlarged nodes and widely spaced, opposite leaves with blades that extend beyond the twig tips. (Fig. 131). This clonal shrub often forms large patches from suckering. The bark of *C. floridus* has a strong lemony-pine or camphor smell when scratched and crushed leaves are slightly aromatic.

Sweetshrub is commonly used in gardens and landscaping, especially in the southeastern USA. Typically, the flowers are deep burgundy, however there are now a number of cultivars, including one with white flowers, which originated from a wild population in Tennessee (pers. comm. Ross Clark 2017). The English naturalist, Mark Catesby, discovered *Calycanthus floridus* during his explorations of South Carolina early in 18th Century (Reveal 2012a).

Figure 130. *Calycanthus floridus* fruits in Calhoun Co., Alabama. A. Ripe fruit, 10 Aug 2017. B. Dried fruit, 25 Sep 2017. Photos: Dan Spaulding. C. Silk moth cocoon (*Hyalophora cecropia*). Photo: Garrett Hargiss.

Figure 131. *Calycanthus floridus* leaves, Calhoun Co., Alabama, 25 Sep 2017. Photo: Dan Spaulding.

Some authors recognize two varieties of *Calycanthus floridus* that supposedly differ on amount of pubescence (Clark 1971; Johnson 1997). Plants with glabrous or slightly pubescent twigs and leaves have been called *C. floridus* var. *glaucus* (or var. *laevigatus*). Fernald (1950) treated the smooth variety as a distinct species, *C. fertilis*, and noted that its flowers were less fragrant than *C. floridus*, which he said "when crushed yielding a strong fragrance suggesting strawberries." Weakley (2017), however, concluded that there are no varieties of *C. floridus*. He stated: "Based on field experience and herbarium specimens from across the eastern North American distribution of *Calycanthus*, these two alleged entities have broadly overlapping distributions and no other morphological, ecological, or phenological characters that correlate with the variable pubescence character. There is no apparent basis to regard the variable pubescence character as anything other than trivial and taxonomically uninformative variation."

In North America, a single well-marked and less closely related species, *Calycanthus occidentalis* Hook. & Arn., occurs in the mountains of the Pacific Coast states (Wood 1958) and a third species, Chinese Sweetshrub, *C. chinensis* (W.C. Cheng & S.Y. Chang) W.C. Cheng & S.Y. Chang ex P.T. Li, is endemic to China (Li & Bartholomew 2008).

FAMILY 10. LAURACEAE (Laurel Family)

1. Leaves evergreen; lower surface of leaf blades and petioles with rusty-brown shaggy pubescence; flowers bisexual, blooming late April through June when leaves are present ..... **2. *Persea***

1. Leaves deciduous; lower surface of blades and petioles glabrous or with whitish silky pubescence; flowers unisexual (plants dioecious), blooming March–April before the leaves appear.

    2. Small to medium tree usually with some lobed leaves; leaf blade typically with 3 major nerves (2 lateral ones arising above base of midrib); crushed leaves with a fruity-citrus fragrance; ripe fruit dark blue ..... **3. *Sassafras***
    2. Medium to large shrub with simple, unlobed leaves; leaf blade with one dominant nerve (the midrib); crushed leaves with a strong spicy fragrance; ripe fruit bright red ..... **1. *Lindera***

1. LINDERA Thunberg 1783
[Johann Linder, 1676–1723; Swedish botanist]

1. Lindera benzoin (L.) Blume {old generic name in Lauraceae} — NORTHERN SPICEBUSH; BENJAMIN-BUSH (Fig. 132). [*Benzoin aestivale* (L.) Nees var. *aestivale*; *B. aestivale* var. *pubescens* Palmer & Steyerm.; *B. benzoin* (L.) J.M. Coult.; *Lindera benzoin* var. *pubescens* (Palmer & Steyerm.) Rehder]

Medium to large deciduous shrub (to 5 m tall); rich (often calcareous) woods, alluvial forests, streambanks, low woods, bottomlands, and swamp margins; flowers March–April; fruits late May–October; frequent throughout Alabama (Fig. 133). Native to eastern North America ranging from southern Maine through Ontario to Michigan, southwest to southeastern Kansas, south to Texas and northern Florida (Kartesz 2017).

Lindera benzoin is easily identified by its aromatic leaves and twigs, which have a strong spicy odor. The small, light yellow flowers are among the earliest to appear in the spring, well before the leaves (Fig. 134). They occur in tight umbel-like clusters on the bare twigs and have a sweet, pungent fragrance (somewhat lemon-scented). The fragrant flowers attracts bees, flies, and beetles as

pollinators (Stokes 1981). The oblong fruits (drupes) are bright green in mid-summer, but soon ripen to a rich, shiny red (except for a very rare orange-yellow fruited form in the northeastern USA).

Figure 132. *Lindera benzoin*, Jackson Co., Alabama, 1 Sep 2010. Photo: T. Wayne Barger.

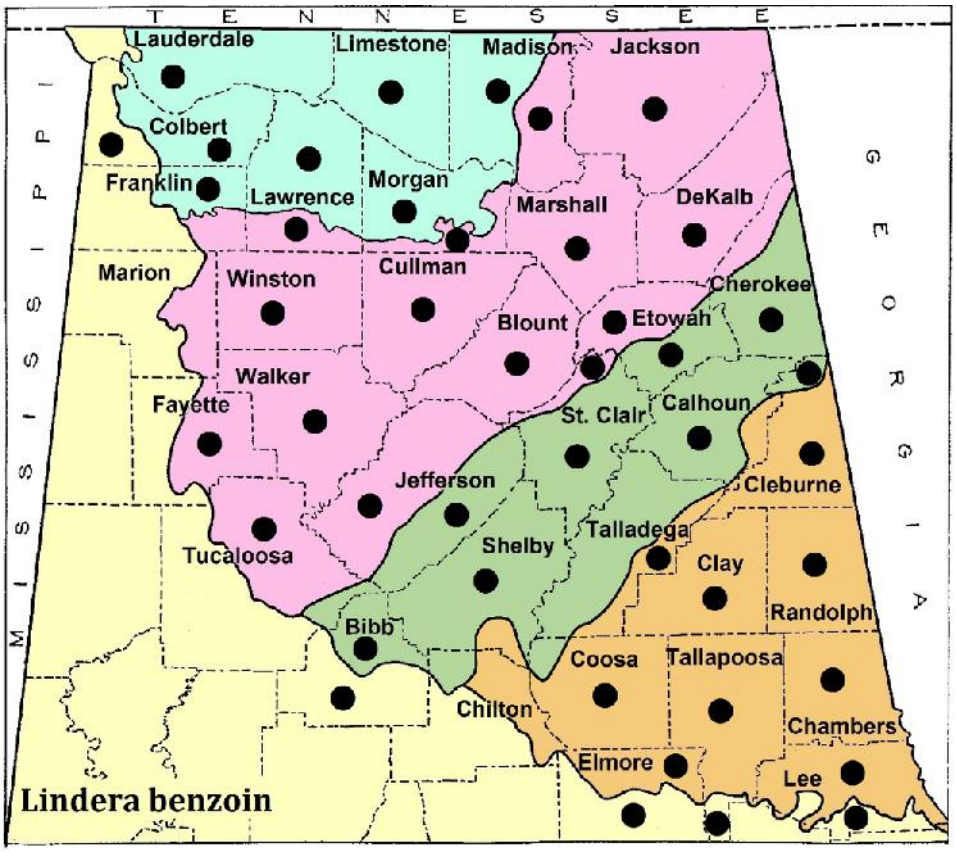


Figure 133. Distribution of *Lindera benzoin* in northern Alabama.

Figure 134. *Lindera benzoin* flowers, Madison Co., Alabama, 6 Mar 2007. Photo: Brian Finzel.

Early pioneers used dried and powdered fruits as a spice and American Indians harvested the berries to make a medicinal tea (Martin 1992). Roland Harper (1928) said he was told that an extraction from the twigs was used for a beverage by local folk in Alabama. *Lindera* and *Sassafras* are hosts for Spicebush Swallowtail (*Papilio troilus*); the caterpillars eat the leaves and often fold over portions of the blades for protection when not feeding (Ogard & Bright 2010).

Some authors (Fernald 1950; Gleason & Cronquist 1963) recognized *Lindera benzoin* var. *pubescens*, which differed by its hairy leaves and twigs, but Weakley (2015) stated that "the varieties so recognized overlap broadly in distribution; it seems best to regard this as mere variation within the species." Two other species of *Lindera* occur on the Coastal Plain of Alabama and are quite rare. Bog Spicebush, *L. subcoriacea* B.E. Wofford, has thick leaves that lack drip tips and have a lemony odor when crushed. Pondberry or Southern Spicebush, *Lindera melissifolia* (Walter) Blume, has thin leaves, like *L. benzoin*, but they are broadly lanceolate, mostly rounded at the base, and have a fruity smell when crushed.

2. **PERSEA** P. Miller 1754

[Ancient name used by Theophrastus and later adopted by Linnaeus]

1. Persea palustris (Raf.) Sarg. {of marshes} — SWAMP BAY; SWAMP RED BAY (Fig. 135). [*Laurus carolinensis* Catesby ex Michx. var. *pubescens* Pursh; *Persea borbonia* (L.) Spreng. forma *pubescens* (Pursh) Fernald; *P. borbonia* (L.) Spreng. var. *pubescens* (Pursh) Little; *P. carolinensis* (Catesby ex Michx.) Nees forma *pubescens* Mez; *P. pubescens* (Pursh) Sarg.; *Tamala palustris* Raf.; *T. pubescens* (Pursh) Small]

Large evergreen shrub or small tree (to 15m tall). Swamps, marshes, seeps, creek margins, wet woods, bottomland forests, and drier wetland margins; flowers April–June; fruits late July–October; rare in the southern Ridge & Valley and Piedmont; common in the Coastal Plain (Fig. 136). Chiefly occurring in the Coastal Plain from Delaware to east Texas (Kartesz 2017).

Figure 135. *Persea palustris*, blackwater swamp in Baldwin Co., Alabama, 3 Oct 2009. Photo: Fred Nation.

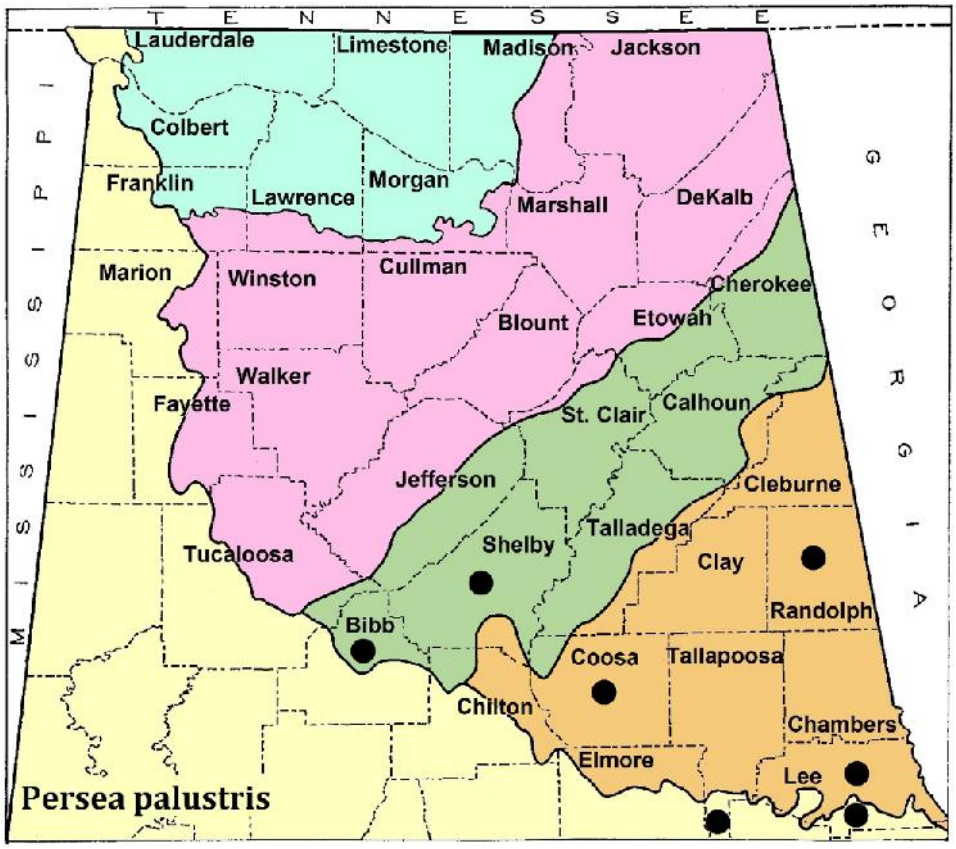


Figure 136. Distribution of *Persea palustris* in northern Alabama.

Ogard and Bright (2010) wrote that the leaves of Swamp Bay "are almost always deformed and disfigured by Redbay Psyllid [*Trioza magnoliae*] larvae, tiny nymphs whose saliva causes leaf margins to swell and curl into popcorn-like galls (Fig. 137)." The authors conclude that this provides additional camouflage for the bumpy caterpillars of the Palamedes Swallowtail (*Papilio palmedes*), also known as swamp butterflies, which feed on the leaves (Fig. 138). The aromatic leaves of this species have been dried and used to flavor soups (Harper 1928). *Persea palustris* is sometimes mistaken for a young *Magnolia virginiana* tree in the field, but *Persea* leaves have a spicy rather than sweet smell when crushed.

Some floristic treatments (Radford et al. 1968; Clark 1971) did not recognize *Persea palustris* as distinct from *P. borbonia*. Fernald (1945) stated: "I have abandoned the futile attempt to see two species or two varieties in the glabrous-leaved material and that with leaves densely pubescent beneath, and I cannot look upon them as anything but glabrous and pubescent forms of one species." Wood (1958) agreed with Fernald and treated it as a form. Little (1979) wrote: "Swampbay was first described as a variety in 1814 [*Laurus carolinensis* var. *pubescens*], as a species in 1838 [*Tamala palustris*] and as a form in 1889 [*Persea carolinensis* forma *pubescens*]."

Kopp (1966), in his taxonomic revision of *Persea*, recognized *P. palustris* (Fig. 139a–b) as separate from *P. borbonia* (Fig. 140a–b) and noted that the erect and crisped pubescence on vegetative parts of *P. palustris*, along with the longer length of the peduncles (4–7 cm long) are the main differences that separate the two species. Weakley (2015) stated: "Though variable in amount of hairs on the leaves, the hairs of *P. palustris* [rusty and spreading] are always of a distinctly different character than those of *P. borbonia* [tan or golden and appressed]." Weakley also noted that the leaf blades of *P. palustris* tend to be longer and more acute than *P. borbonia* (Red Bay), which is

usually a larger tree found on the lower Coastal Plain of Alabama (and the Southeast) in drier maritime habitats, such as sandy hammocks and coastal scrub-dunes. *Persea palustris* is a smaller tree or shrub found in wetter sites (Fig. 141).

Figure 137. *Persea palustris* galls, Moore Co., North Carolina, 10 Jun 2006. Photo: Jeffery Pippen.

Figure 138. Palamedes Swallowtail caterpillar on *Persea palustris*, margin of swampy woods, Fall Line Hills district of the Coastal Plain, Lee Co., Alabama, 27 Aug 2017. Photo: Dan Spaulding.

(139a) *Persea palustris* inflorescence on long peduncles. Photo: Jeffery Pippen.

(139b) *Persea palustris* drupes on long peduncle. Photo: Will Cook.

Figure 139. *Persea palustris*. A. Flowers, Moore Co., North Carolina, 10 Jun 2006. B. Fruits, Columbus Co., North Carolina, 21 Mar 2007.

(140a) *Persea borbonia* inflorescence on short peduncles. Photo: Alan Cressler.

(140b) *Persea borbonia* drupes on short peduncles. Photo: Alan Cressler.

Figure 140. *Persea borbonia* on Jekyll Island in the Atlantic Coastal Plain, Glynn Co., Georgia. A. Flowers, 25 Apr 2012. B. Fruit, 25 Oct 2009.

Figure 141. Trunk of *Persea palustris*, margin of swamp margin in the Fall Line Hills district of the Coastal Plain, Lee Co., Alabama, 27 Aug 2017. Photo: Dan Spaulding.

3. **SASSAFRAS** J. Presl 1825
[Native American name]

1. Sassafras albidum (Nutt.) Nees {whitish} — SASSAFRAS; AGUE-TREE; CINNAMONWOOD (Fig. 142). [*Sassafras albidum* (Nutt.) Nees var. *molle* (Raf.) Fernald; *S. officinale* T. Nees & C.H. Eberm. var. *albidum* (Nutt.) S.F. Blake; *S. officinale* var. *officinale*; *S. sassafras* (L.) H. Karst.; *S. variifolium* Kuntze]

Figure 142. *Sassafras albidum*, Cleburne Co., Alabama, 17 Jun 2017. Photo: Melanie Taylor Spaulding.

Small to medium-sized deciduous tree (to 25 m). Mixed upland woodlands and borders, fence rows, old fields, and roadsides; flowers March–April; fruits June–August; common throughout Alabama (Fig. 143). Native to the Eastern Deciduous Forest ecosystem of North America, from Maine through southern Ontario west to Iowa, and south to central Florida and eastern Texas (Kartesz 2017).

Sassafras is a common understory tree of forests in Alabama, but is also found in open disturbed sites. It often occurs in clumps because the parent tree frequently spreads by underground runners (Elias 1980). Because of its stoloniferous habit, it is quite resistant to fire (pers. comm., Ross Clark 2017). *Sassafras* is dioecious, which means that staminate (male) and pistillate (female) flowers are borne on different trees. The small unisexual, yellowish flowers (Fig. 144a–b) appear before the unfolding of the leaves in early spring and are showier on "male" trees. The fruit ripens in late summer and is a dark blue-black drupe borne on a red fleshy, club-shaped pedicel (Fig. 145).

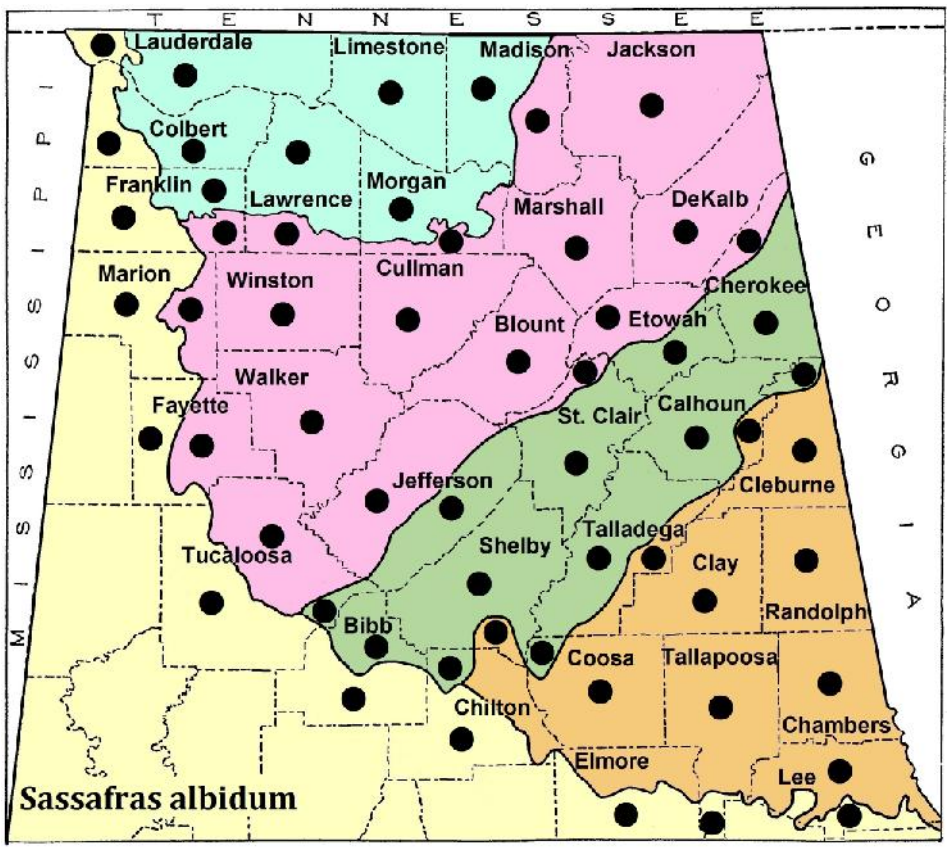


Figure 143. Distribution of *Sassafras albidum* in northern Alabama.

(144a) Male flowers. Photo: T. Wayne Barger.

(144b) Female flowers. Photo: Brian Finzel.

Figure 144. *Sassafras albidum*. A. Staminate (male) flowers, Colbert Co., Alabama, 23 Mar 2016. B. Pistillate (female) flowers, Madison Co. Alabama, 7 Apr 2015.

Figure 145. Fruit of *Sassafras albidum*, Madison Co. Alabama, 31 Jul 2014. Photos: Brian Finzel.

The leaves of *Sassafras* have a citrus-like scent and usually come in three shapes: three-lobed ("turkey-foot"), one-lobed ("mitten"), and a simple, unlobed leaf (Fig. 146). Trees with only simple leaves are very rare. In autumn the leaves turn various shades of orange, yellow, red, and even pink. The wood is soft and weak, but occasionally was used for fence posts and rails (Sargent 1922). Sassafras is sometimes planted as an ornamental tree.

Figure 146. *Sassafras* leaf shapes, Cleburne Co., Alabama, 17 Jun 2017. Photo: Melanie Taylor Spaulding.

The name "sassafras" is an American Indian name that was adopted by Spanish and French settlers in the mid-16th century (Little 1980). It was first brought to England by Sir Francis Drake in the 1580s and soon was claimed to be a panacea because of its reputed medicinal properties (Rupp 1990). It was once thought to be a cure for malaria, hence the name Ague-Tree (Peattie 1948). The word "ague" refers to an illness involving fever and shivering, like malaria.

The leaves of *Sassafras albidum* are the crucial ingredient of gumbo filé powder, which is used in Creole cooking to flavor and thicken gumbo (Wood 1958). This powder was first prepared by the Choctaw Indians of Louisiana (Sargent 1922). The root-beer scented oil from the roots was extracted as a flavoring for tea and is the original source for root-beer (Radford et al. 1968). The aromatic oil was also used to perfume soap (Little 1980).

Harper (1928) said that saplings in Alabama "are often cut for pea-vine supports, brooms, hoops, etc., and the roots are dug for sassafras tea, a popular semi-medicinal beverage or spring tonic in rural districts." Native Americans utilized the twigs as chewing sticks and dentists in the past combined the oil in dental poultices to relieve pain (van der Werff 1997). The use of *Sassafras* has now been banned by the U.S. Food and Drug Administration because the chemical compound safrole is considered to be a carcinogen (Dwyer et al. 1986). Studies in the 1960s have shown that oil of sassafras causes liver cancer in rats (Martin 1992).

Fernald (1950) recognized two varieties of American sassafras: *Sassafras albidum* var. *albidum* (White Sassafras), with leaves glabrous and glaucous underneath, and *S. albidum* var. *molle* (Red Sassafras), with leaves densely pubescent beneath. However, recent floristic treatments do not recognize any varieties (Weakley 2015). The genus *Sassafras* existed as far back as the Lower Cretaceous when the dinosaurs roamed the earth (Berry 1911). Today this genus consists of only three extant species: *S. albidum*, endemic to eastern North America; *S. randaiense* (Hayata) Rehder, endemic to Taiwan; and *S. tzumu* (Hemsl.) Hemsl., endemic to mainland China (Li et al. 2008).

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