

## CLARIFICATION OF THE STATUS OF *CRATAEGUS OUACHITENSIS* (ROSACEAE) AND A RE-EVALUATION OF ITS VAR. *MINOR*

THEO WITSELL

Arkansas Natural Heritage Commission  
Little Rock, Arkansas 72201  
(affiliation during this work)

Southeastern Grasslands Institute  
Austin Peay State University  
Clarksville, Tennessee 37044  
theo.witsell@segrasslands.org  
(current affiliation)

RONALD LANCE

North American Land Trust  
100 Hickory Hill Rd.  
Chadds Ford, Pennsylvania 19317  
ronwlance55@gmail.com

### ABSTRACT

The taxonomic reassessment of *Crataegus ouachitensis* and its inclusion as a member of series *Pruinosae* are proposed. *Crataegus ouachitensis* var. *minor* is reevaluated on morphological evidence and described as ***Crataegus keeslingii* Witsell & Lance, sp. nov.**, to reflect its distinctness from *C. ouachitensis*, acknowledge its probable interserial hybrid origin, and to honor Jim Keesling, who rediscovered it and found several previously unknown populations. A status update and ecological summary are provided for each taxon.

The distributional and taxonomic obscurity of *Crataegus ouachitensis* E.J. Palmer has been of concern for many decades in botanical evaluations in Arkansas. Since the species was first described in 1926, few references and collections were ascribed to it between 1935 and 2015. Recent field investigations (2006-2022) have documented the presence of *C. ouachitensis* in less than 20 populations in six counties of Arkansas. This species occurs as scattered individual plants in small to extensive local populations and as closely spaced, possibly clonal groves. Habitat preference seems to be subxeric soils over acidic to circumneutral outcrops of shale, sandstone, chert, and novaculite, rocky ridges and slopes, streamsides, and in thin woodlands of west-central Arkansas, primarily within the Ouachita Mountains. This present-day distribution includes the originally described habitat of "Thickets along rocky creek valleys and on open hillsides, about Hot Springs, AR" in the protologue by Palmer (1926). The distribution suggests that it is nearly endemic to the Ouachita Mountains Ecoregion (Garland, Hot Spring, Montgomery, Saline, and Yell counties), with a single locality known from the Lower Boston Mountains Ecoregion (of the Ozark region) in Pope County.

A variety of *Crataegus ouachitensis* was also described by Palmer in the same publication. His var. *minor* was collected in Garland County "on rocky banks along a branch of Gulpha Creek," also in the Ouachita Mountain region. In 1926, Palmer noted similarities of this variety to *Crataegus marshallii* and suspected a possible hybrid origin, but he apparently regarded it sufficiently similar to *C. ouachitensis* that he proposed it as a variety. Phipps in FNA (2014) noted "it is quite possible that var. *minor* is a hybrid ... in which case it is not a form of *C. ouachitensis*." Since the original description and collection, var. *minor* has received very little distributional documentation and investigation of its taxonomic validity. More recently (2015-2022), var. *minor* has been documented by Jim Keesling of Hot Springs Village from 6-12 populations (depending on what is considered a distinct population) in Garland, Montgomery, and Saline counties, all within the Ouachita Mountains Ecoregion. This paper

describes the morphology of *C. ouachitensis* and its var. *minor*, describes their habitats and ecological requirements, and proposes a more appropriate taxonomic and conservation status for them.

## Discussion

The early designation of series in *Crataegus* by Palmer (1925) has been sustained, with minor deviations, in most successive studies of *Crataegus* taxonomy. As in FNA (2014), the retention of *C. ouachitensis* within ser. *Intricatae*, however, as originally suggested by Palmer, is questionable. It varies from most ser. *Intricatae* members in its small, deltate, relatively less glandular leaves and by its 20 stamens and red fruit. The thorns of *C. ouachitensis* are moderately stout (averaging 3 to 4 mm diameter), whereas most members of ser. *Intricatae* bear more slender thorns. Field identification of *C. ouachitensis* has occasionally been difficult vegetatively, since it more resembles a small-leaved form of *C. pruinosa* rather than any regional member of ser. *Intricatae*. Because the thorn size, leaf shape, 20 stamens, and red fruit align more closely to traits of ser. *Pruinosae*, reassignment of *C. ouachitensis* to ser. *Pruinosae* is proposed.

The presence of occasional hairs on the leaves of *Crataegus ouachitensis* does not discomfit consideration of its relation to the often glabrate series *Pruinosae*. Midwestern forms of the normally glabrous *Crataegus pruinosa* sometimes are sparsely hairy on the leaf veins in spring — most conspicuously hairy is *C. pruinosa* var. *virella*, which is documented in Arkansas from the Ouachita ecoregion. It could be theorized that *ouachitensis* may be a regional novelty derived from past combination of ser. *Intricatae* and ser. *Pruinosae*. Phipps (2014) also noted that *ouachitensis* "... is rare and likely of interserial origin ... ."

*Crataegus ouachitensis* is distinct from other regional species in its combination of leaf, flower, fruit, and thorn characteristics. It has been recognized at species rank in Vines (1960), Tucker (1976), Smith (1985), Kartesz (2010), Lance (2014), and Phipps (2014). Var. *minor* has been included within the species accounts of *C. ouachitensis*, but *C. ouachitensis* is recognized here as a species without significant varieties.

A morphological comparison of typical *Crataegus ouachitensis* and var. *minor* provides evidence that these two taxa should be separated taxonomically. Intermediate characters of var. *minor* suggest a hybrid origin involving *C. marshallii*. These include more villous leaves and inflorescence, more lacinate leaf margins, lateral leaf veins occasionally leading to the sinus of the leaf, and a more scaly trunk bark with color mottling.

Despite the probable hybrid origin, populations of multiple individuals of var. *minor* are spread over significant areas, indicating that plants are fertile, reproducing by seed. Further analysis is warranted to determine ploidy level and degree of apomixis that may be involved in its reproduction. This entity may have multiple hybrid origins from the same putative parental species, as suggested by slight morphological differences among the samples.

## Taxonomic descriptions

The following descriptions of the two taxa are followed by a diagnostic key for their separation, as well as a key to all documented *Crataegus* taxa in Arkansas that have broadly ovate or deltate leaf blades. Comparative photographs of the two taxa are provided in figures 1-3 and 5-7.

**CRATAEGUS OUACHITENSIS** E.J. Palmer, J. Arnold Arb. 7: 124. 1926. **LECTOTYPE** (designated here): **Arkansas. Garland Co.:** Near Hot Springs, [34.49082, -93.0028], thickets along small rocky streams, 22 Apr 1924, *E.J. Palmer* 24477 (A 00017060; isolectotype: UARK). Figs. 1-4. Ouachita hawthorn.

**SYNTYPES:** **Arkansas. Garland Co.:** Near Hot Springs, [34.46557, -93.04295], rocky banks of Hot Springs Creek, spiny arborescent shrub, 4-5 m. tall, fruit hard, yellowish-green, 9 Oct 1924, *E.J.*

*Palmer 26459* (A, MO, UARK); near Hot Springs, [34.50795, -93.05472], thickets, rocky uplands, 10 Oct 1925, *E.J. Palmer 29083* (A).

**Leaf** blades ovate to deltate, 2 to 4 cm long and wide (most 2.5 to 3 cm), sharply serrate and slightly to moderately lobed, incised 20-30% to midvein, base broadly cuneate, rounded or truncate, apex acute, surfaces glabrous or sparsely hairy along veins when young and glabrate later; terminal shoot leaves 4-6 cm long and nearly as wide, deltate. **Petiole** slender, 40-60% long as blade, grooved, sparsely glandular near junction with blade, may be slightly villous in spring but soon glabrate, very slightly winged near blade. **Flowers** 15-18 mm wide, stamens 20, anthers rose or purplish, styles 3 or 4; sepals lanceolate, deeply glandular-serrate or glandular-pectinate; inflorescence 3-8-flowered, branches sparsely villous or glabrous, bracteoles elongate, stipitate-glandular and toothed; April, after leaves are half-grown. **Fruit** subglobose, obovoid or pyriform, often glaucous, remaining green and hard until late autumn, then becoming dark red or slightly lustrous-red, 8-12 mm long or in diameter, flesh dense, calyx collar slightly elevated ca. 1 mm; pyrenes 3-4, plane or slightly concave on inner side, 7-8 mm long; Oct.-Nov. **Thorns** stout or moderately stout, numerous, usually straight, 2.5-5 cm long, 3-4 mm diameter near base, tapered abruptly at the tip, reddish-brown or maroon, older thorns gray. **Twigs** red-brown, glabrous. **Bark** dark gray, scaly on older trunks. **Habit** a shrub or small tree, 2-4 m.

**Habitat** dry-mesic to subxeric acidic to circumneutral soils, near sandstone, shale, chert, and/or novaculite outcrops, rocky ridges, slopes, streamsides, thin woodlands. West-central Arkansas, uncommon but may be locally abundant, **G2/S2**. Endemic to the Ouachita Mountain and Boston Mountain provinces of Arkansas, documented from Garland, Hot Spring, Montgomery, Pope, Saline, and Yell counties in the Central Hills, Ridges, and Valleys; Central Mountain Ranges; and Fourche Mountains Level IV Ecoregions of the Ouachita Mountains and the Lower Boston Mountains Level IV Ecoregion of the Boston Mountains (Woods et al. 2004). A single historical (1957) collection from Hot Spring County has imprecise locality information and may have been collected in either the Athens Plateau or the Central Mountain Ranges Level IV ecoregions of the Ouachita Mountains.

The following habitat descriptions are provided on labels on herbarium specimens of *Crataegus ouachitensis*: rocky, open woodlands and glade margins on sandstone substrate (Jackfork Formation); upland pine-hardwood forest/woodland; open hardwoods area along mountain ridge, rocky ground; mountain ridge; mixed pine/hardwood forest; open area in hardwood forest, close to small creek; xeric, open ridgetop woodland on novaculite substrate; mesic upland thicket; margin of pine/hardwood forest; mesic hardwood forest; mesic pine/hardwood forest; mixed pine/hardwood forest; margin of pine/hardwood forest; open woods.

**Additional collections. Arkansas. Garland Co.:** Hot Springs, [34.50795, -93.05472], 15 Apr 1928, *Ashe s.n.* (NCU); Hot Springs and vicinity, Fordyce farm, [34.50795, -93.05472], low woods. 7 Apr 1934, *Scully 171* (A); Hot Springs and vicinity, Fordyce farm, [34.50795, -93.05472], low woods, 5 Aug 1935, *Scully 473* (A); Hot Springs Village, S side of Fineza Way, about 200 yds NE of jct with Balearic Rd. S of Lake Coronado, 34.64479, -92.98316, upland pine-hardwood forest/woodland along road, 8 individuals in a 10 ft diameter area, small trees/shrubs from 3 to 9 ft tall, 15 Apr 2015, *Keesling 15-0022* (ANHC, iNaturalist 203832715); Hot Springs Village, NW of Lake Pineda, N of Carmona Rd, on the cul-de-sac of Estmanque Pl., 400 yds N of the Orense Cir. and Orense Way jct, 34.65152, -93.00676, densely shaded cul-de-sac adjacent to mixed pine/hardwoods forest, 1 specimen at site, additional examples in general area, 13 Sep 2016, *Keesling 16-0112* (ANHC, iNaturalist 34214400); Hot Springs Village, NW of Lake Pineda, 20 yds S of Albacete Cir., and 80 yds SW of the Jacote Way jct., 34.64736, -93.00299, open area in hardwood forest, close to small creek, 15 examples in area 30 x 30 yds, 14 Sep 2016, *Keesling 16-0118* (ANHC, iNaturalist 34214968); along the NW side of W Strawberry Rd., 2.3 mi SW of the AR-7 jct, 34.63909, -93.09907, margin of pine/hardwood forest,



Figure 1. *Crataegus ouachitensis* flowers. Hot Spring County, 2 Apr 2016. Photos by Jim Keesling.



Figure 2. *Crataegus ouachitensis* fruit. Hot Spring County, 2 Nov 2016. Photos by Jim Keesling.



Figure 3. *Crataegus ouachitensis* fruit and stem. Hot Spring County, 13 Sep 2016. Photos by Jim Keesling.

1 specimen, fresh flowers white with bright rose-colored anthers, 13 Apr 2020, *Keesling 20-0068* (ANHC, iNaturalist 42133735); NW side of Mountain Pine Rd., 160 yds NE of the Blakely Dam Rd. jct. at Mountain Pine, 34.57502, -93.16087, pine/hardwood forest, single plant, fresh flowers white, 13 Apr 2021, *Keesling 21-0054* (ANHC, iNaturalist 73936948); SE side of Ragweed Valley Rd., 7.9 mi



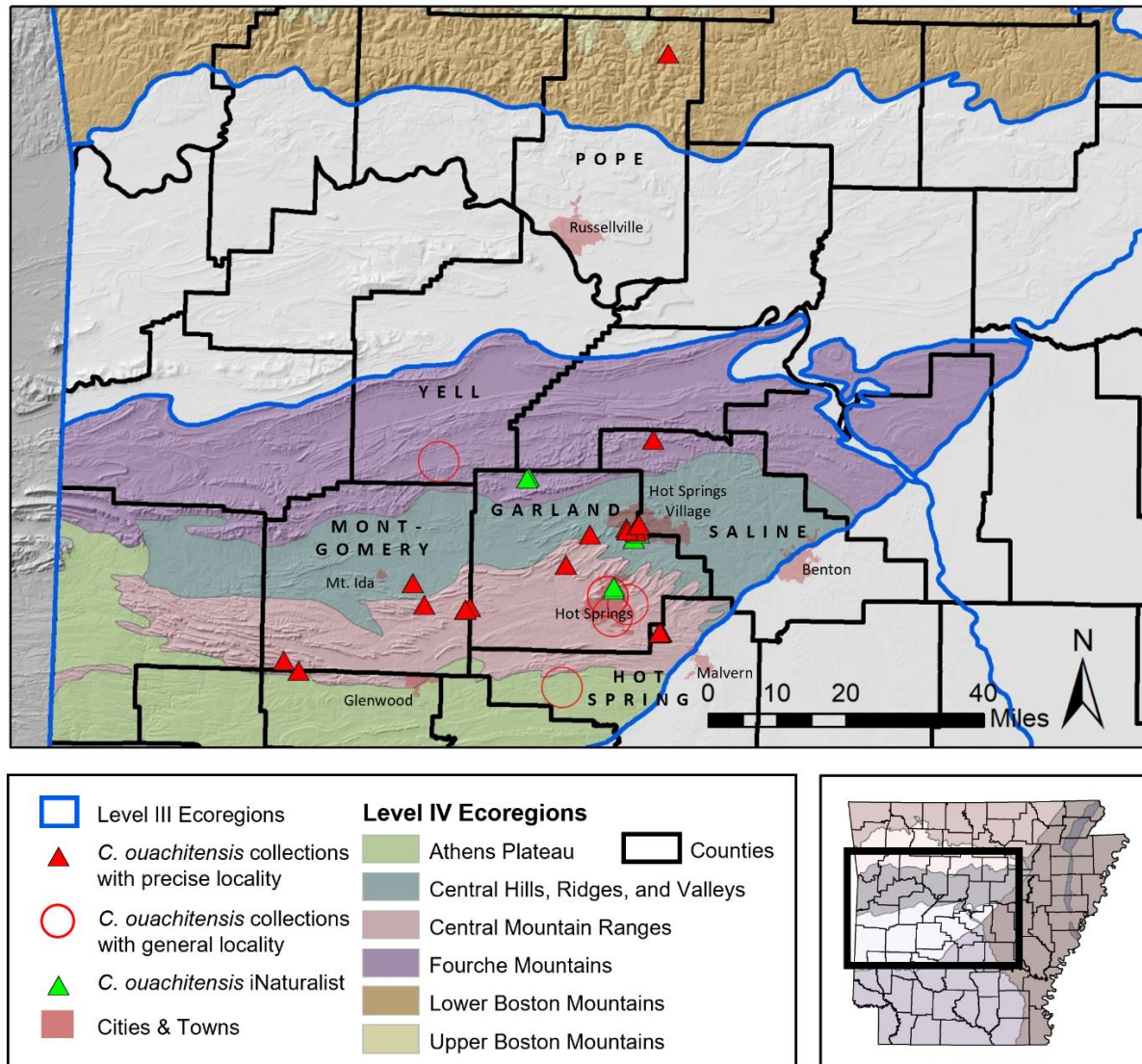


Figure 4. Map of known records of *Crataegus ouachitensis*.

WSW of the US-270 jct., 34.48523, -93.4053, mixed pine/hardwood forest, single plant, fresh flowers white, 13 Apr 2021, *Keesling 21-0056* (ANHC, iNaturalist 73937256). Hot Spring Co.: P.O. Bismarck, [34.31637, -93.17105], dry ridges and rocky creek bottoms, 8 ft tall, 14 Jul 1957, *D. Demaree 39421* (BRIT, FSU, GH, MO); SE of Hot Springs, in the NE portion of Lake Catherine State Park, on the N side of the Horseshoe Mountain hiking trail, about 0.5-0.75 mi WNW (on foot) from the trailhead, traveling the trail counterclockwise, 34.43204, -92.91732, mountain ridge, 52 specimens scattered along 1 mile stretch of hiking trail, 21 Aug 2016, *Keesling 16-0103* (ANHC, iNaturalist 203832987); Lake Catherine State Park, 4.5 mi ENE along SR-171 from the SR-290 jct., then park at trailhead and walk 1-2 mi along the Horseshoe Mountain hiking trail to the site, 34.43218, -92.91737, open hardwoods area along mountain ridge, rocky ground, 18 specimens scattered along 1/2-mile section of ridge, 2 Apr 2016, *Keesling 16-0023* (ANHC, iNaturalist 34201614); Lake Catherine State Park, N ridge of Horseshoe Mountain, along Horseshoe Mountain Trail, 34.43261, -92.92192, xeric, open ridgetop woodland on novaculite substrate, scattered to locally common on this ridgetop in the vicinity of the hiking trail, shrubs or small trees to 9 ft tall, 10 Sep 2016, *T. Witsell 16-0587* (ANHC, NCU, NY, STAR, UWAL). Montgomery Co.: Greasey Cove, near Albert Pike's old home, Ouachita National Forest, [34.37064, -93.87715], 17 Oct 1932, *D. Demaree 9827* (A, BRIT, NY); Entrance to Ouachita

National Forest from Langley, [34.34941, -93.84007], 17 Oct 1932, *D. Demaree* 9827 (GH); NNW side of Ragweed Valley Rd., 8.8 mi SW of the US-270 jct, 34.47941, -93.41722, mixed pine/hardwood forest, single plant, fresh flowers white, 13 Apr 2021, *Keesling* 21-0057 (ANHC, iNaturalist 73937354); S side of US-270, 13.5 mi W of the Crystal Springs Rd. jct., 34.53523, -93.55014, margin of pine/hardwood forest, single plant, fresh flowers white, 13 Apr 2021, *Keesling* 21-0059 (ANHC, iNaturalist 73939634); 5.4 air mi SW of Crystal Springs, 35 yds NNW of Ragweed Valley Rd., 0.4 mi SW of the Benny Burrows Loop jct., 34.47988, -93.41627, open woods, 10 specimens, scattered along 12 mile stretch of road, fresh flowers white, 17 Apr 2022, *Keesling* 22-0023 (ANHC, iNaturalist 111992455); 11 air mi WSW of Crystal Springs, along the S side of Logan Gap Rd., 4.5 mi SSE of the US-270 jct., 34.48987, -93.52134, open woods, 2 specimens at site, fresh flowers white, 17 Apr 2022, *Keesling* 22-0024 (ANHC, iNaturalist 111992881). **Pope Co.:** Ozark National Forest, half way between Smyrna and Nogo, 20 yds S of Smyrna Rd., 1.5 mi NW of the SR-27 jct., 35.65188, -92.8991, mesic upland thicket, 1 plant, anthers purple, 15 Apr 2017, *Keesling* 17-0026 (ANHC, iNaturalist 34243493). **Saline Co.:** Ouachita National Forest, top of Crystal Mountain, 0.4 mi ESE of jct. of FS 132 (Winona Scenic Dr.) & FS 75, W of terminus of road to mountain top (off of FS 132), 34.83819, -92.93725, rocky, open woodlands and glade margins on sandstone substrate (Jackfork Formation), scattered to locally common in thickets with other *Crataegus* spp., shrubs or small trees, 2 Aug 2006, *T. Witsell* 06-0372 (ANHC, NCU, NY); Hot Springs Village, S side of Fineza Way, about 0.75 mi NE of jct. with Balearic Rd. S of Lake Coronado, 34.64923, -92.97452, upland pine-hardwood forest/woodland along road, 15+ trees along a 30 yard stretch of Fineza Way, small trees 2-3 m tall, 12 Apr 2015, *Keesling* 15-0018 (ANHC, iNaturalist 203833324); Hot Springs Village, NW of Coronado Lake, 75 yds SSE of the Balearic Rd. / Cadena Ln. jct., 34.65772, -92.97861, mesic hardwood forest, 20 plants at site, fresh flowers white, 9 Apr 2021, *Keesling* 21-0049 (ANHC, iNaturalist 73419995); Hot Springs Village, NE of Coronado Lake, along the SE side of Ojos Ln., 65 yds W of the Ojos Cir. jct., 34.66058, -92.97492, mesic pine/hardwood forest, 10 plants at site, fresh flowers white, 9 Apr 2021, *Keesling* 21-0050 (ANHC, iNaturalist 73420137). **Yell Co.:** Near Aly, [34.79043, -93.48654], common, young leaves bronze, 20 purple anthers, 10 Apr 1928, *W.W. Ashe* s.n. (NCU).

**Additional observations** (iNaturalist, not linked to specimens above). **Arkansas.** **Garland Co.:** 34.52881, -93.03872, 17 Nov 2019, *Keesling* 35790690; 34.6299, -92.98772, 8 Apr 2020, *Keesling* 41696508; 34.75991, -93.25637, 12 Apr 2022, *Keesling* 111259727; 34.52350, -93.03783, 17 Nov 2019, *tallpaultheforester* 35776178; 34.65152, -93.00676, 13 Sep 2016, *Keesling* 34214400; 34.75671, -93.26036, 12 Apr 2022, *Keesling* 111259946. **Hot Spring Co.:** 34.43042, -92.92390, 31 May 2015, *E. Hunt* 1569174; 34.43259, -92.92208, 19 Nov 2019, *Keesling* 35857067; 34.43296, -92.92011, 2 Nov 2022, *T. Witsell* 140970330. **Saline Co.:** 34.64923, -92.97452, 13 Apr 2015, *Keesling* 34156791; 34.64062, -92.97485, 1 Apr 2020, *Keesling* 41185907; 34.64069, -92.97498, 8 Apr 2021, *tallpaultheforester* 73316096; 34.64058, -92.97486, 29 May 2023, *J. Foucart* 164498094.

**CRATAEGUS KEESLINGII** Witsell & R. Lance, **sp. nov.** **TYPE:** **Arkansas.** **Saline Co.:** Hot Springs Village. SE of Lake Coronado, 20 yds SW of Balearic Rd., 70 yds NW of the Surtidor Way jct, 34.64729, -92.94815, edge of pine/hardwood forest, 3 individuals in close proximity, 19 Apr 2016, *J. Keesling* 16-0033 (holotype: ANHC). iNaturalist 34202641. Figs. 5-8. *Keesling's* hawthorn.

*Crataegus ouachitensis* var. *minor* E.J. Palmer, J. Arnold Arb. 7: 125. 1926 (non *Crataegus minor* (Sessé, Mociño and Morán 1894). **SYNTYPES:** **Arkansas.** Garland Co.: Near Hot Springs, thickets along small stream [protologue: "rocky banks along a branch of Gulpha Creek, spiny shrubs 2-3.5 m tall"],

23 Apr 1924 (flowers), *E.J. Palmer* 24499 (A-2 sheets, MO, UARK)

21 Apr 1925, *E.J. Palmer* 26848 (A);

10 Oct 1925 (fruit), *E.J. Palmer* 29095 (A);

13 Oct 1925, *E.J. Palmer* 29177 (A, UARK).

Distinct from *Crataegus ouachitensis* vernal leaves densely villous adaxially, lateral leaf veins occasionally leading to a sinus, petioles villous and eglandular, inflorescence axes and hypanthia usually villous, and sepals often subentire.

**Leaf** blades broadly ovate to deltate, 3 to 4.5 cm long (most 3.5 to 4 cm), often as wide or slightly wider than long, sharply serrate with acute to acuminate teeth and moderately to deeply lobed (lacinate), incised 20-50% to midvein, a lateral main vein occasionally running to a deep sinus or terminating/branching near a sinus, base abruptly cuneate, truncate or subcordate, apex acute or acuminate, abaxially sparsely villous on veins and adaxially densely villous or appressed-hairy in spring, later slightly hairy; terminal shoot leaves 5-6 (7) cm long and 6-7 (8) cm wide, deltate. **Petiole** slender, 50-100% long as blade (40-60% in terminal shoot leaves), grooved, densely villous, eglandular. **Flowers** 15-18 mm wide, stamens 15-20, anthers rose, styles 3 or 4; sepals lanceolate, subentire to irregularly glandular-serrate; inflorescence 3-8-flowered, branches glabrate to villous or tomentose, bracteoles narrowly lanceolate, glandular-serrate or glandular-pectinate; April, after leaves are half-grown. **Fruit** subglobose or ellipsoid, maturing late in autumn, becoming bright red, 7-12 mm long, flesh dense, calyx collar slightly elevated; pyrenes 3-4, plane on inner side; Oct.-Nov. **Thorns** moderately stout, numerous, usually straight, 2.5-5 cm long, 2-3 mm diameter near base, gradually tapered to a narrow tip, purplish-brown or blackish, older thorns gray. **Twigs** red-brown, sparsely villous, later glabrous. **Bark** gray or brownish, conspicuously scaly on mature trunks, somewhat mottled in color on upper trunk where loose scales abscise. **Habit** a shrub or small tree, 2-5 m.

**Habitat** dry-mesic to subxeric soils of thin woodlands, rocky slopes and streamsides. Rare overall in Arkansas but may be locally abundant; **G1/S1**. Endemic to Ouachita Mountain province of Arkansas, recorded from Garland, Montgomery, and Saline counties in the Central Hills, Ridges, and Valleys; Central Mountain Ranges; and Fourche Mountains Level IV Ecoregions (Woods et al. 2004). Sometimes sympatric with *C. ouachitensis* but distinct morphology establishes clear separation.

The following habitat descriptions come from labels on herbarium specimens of *Crataegus keeslingii*: upland pine-hardwood forest/woodland with shale substrate; heavily shaded pine-hardwood forest/woodland; edge of pine/hardwood forest; mixed pine/hardwood forest; rocky woodland on floodplain; mesic pine/hardwood forest; open woods.

Since the use of *Crataegus minor* is blocked by the *Crataegus minor* of 1894, the name of *Crataegus keeslingii* is proposed to honor Jim Keesling, who has discovered and documented all the extant populations of var. *minor*, as well as most of the currently known *C. ouachitensis* populations.

**Additional collections. Arkansas.** Garland Co.: Near Hot Springs, [34.49082, -93.0028], banks of small rocky stream, stam. 20, anth rose, styles 3-4, 23 Apr 1924, *E. J. Palmer* 24499 (A, Harvard 00017062 and 00017063; MO, MO 1665057; UARK, UARK 071112); Near Hot Springs, [34.49082, -93.0028], rocky banks of small stream, slender tree 3-3.5 m. tall, stam. 20, anthers faded, 21 Apr 1925, *E. J. Palmer* 26848 (A); near Hot Springs, [34.49082, -93.0028], rocky banks of small stream, slender tree about 3 m. tall, 10 Oct 1925, *E. J. Palmer* 29095 (A); near Hot Springs, [34.49082, -93.0028], thickets, rocky uplands, slender erect shrub about 2 m. tall, fruit subglobose, 8-10 mm. diam., becoming bright red, 13 Oct 1925, *E. J. Palmer* 29177 (A; UARK, UARK 071113); 55 yds SW of Meyers Creek Rd., 245 yds NW of the Ironweed Rd. jct., 34.47824, -93.36681, rocky woodland on floodplain of Meyers Creek, single specimen, adaxial leaf surface forest-green, 11 May 2020, *Keesling* 20-0123 (ANHC, iNaturalist 45699173); 6 air mi NW of Jessieville, 10 yds N of Gladstone Forest Rd., 2.3 mi WSW of the AR-7 jct., 34.76885, -93.12984, open woods, fresh flowers white, single specimen, 12 Apr 2022, *Keesling* 22-0021 (ANHC, iNaturalist 111259132). Montgomery Co.: 3.0 air mi ENE of Alamo, 35 yds NNW of Ragweed Valley Rd., 8.7 mi WSW of the US-270 jct., 34.47973, -93.41671, rocky ground, on the terrace of a small creek, single specimen, tree 4 meters tall, flowers with 3-4 styles, 15-20 stamens, and rose-colored anthers, 5 Apr 2024, *Keesling* 24-0036 (ANHC, iNaturalist 205642073). Saline Co.: Hot Springs Village, S side of Hernando Hiking Trail, about halfway between

Lake Cortez & Lake Coronado, just W of Property Owner Association's complex & about 40 yds N of Desoto Blvd./Balearic Rd. intersection, 34.67022, -92.97112, heavily shaded pine-hardwood forest/woodland along trail, 5 individuals, from 9-14 ft tall with trunks 2-3 in. diameter, bark on largest trunks flaking on lower parts & smooth & splotchy above, trunks very thorny, 12 Apr 2015, *Keesling 15-0023* (ANHC, iNaturalist 203837154); Hot Springs Village, S side of Hernando Hiking Trail, about halfway between Lake Cortez & Lake Coronado, just W of Property Owner Association's complex & about 40 yds N of Desoto Blvd./Balearic Rd. jct., 34.67022, -92.97112, mixed pine/hardwoods forest along hiking trail, 5 individuals, fruit calyx elevated, petioles glandular, stamens about 20, leaves broadly deltate & hairy adaxially, 14 Sep 2016, *Keesling 16-0114* (ANHC, iNaturalist 34213711); Hot Springs Village, S side of Fineza Way, about 0.4 mi NE of jct. with Balearic Rd., S of Lake Coronado, 34.64654, -92.97905, upland pine-hardwood forest/woodland with shale substrate along road, 11 individuals in this area, small trees, the largest 12-14 ft tall, 15 Apr 2015, *Keesling 15-0019* (ANHC, iNaturalist 203838752); Hot Springs Village, S side of Fineza Way, about 0.4 mi NE of jct. with Balearic Rd. S of Lake Coronado, 34.64654, -92.97905, upland pine-hardwood forest/woodland with shale substrate along road, 11 individuals in this area, small trees, the largest 12-14 ft tall, 15 Apr 2015, *Keesling 15-0021* (ANHC, iNaturalist 203838752); Hot Springs Village, SE of Lake Coronado, 20 yds SW of Balearic Rd., 70 yds NW of the Surtidor Way jct., 34.64729, -92.94815, edge of pine/hardwood forest, 3 individuals in close proximity, 19 Apr 2016, *Keesling 16-0033* (ANHC; iNaturalist 34202641); Hot Springs Village, on the N side of Banderola Pl., 50 yds NE of the Letrisa Dr. / Delandera Way jct., 34.64844, -92.93529, mixed pine/hardwood forest, four plants at site, fresh flowers white, 9 Apr 2021, *Keesling 21-0048* (ANHC, iNaturalist 73419769); Hot Springs Village, 5 yds E of Meta Ln., 160 yds NNW of the Balearic Rd. / Ola Way jct., 34.64515, -92.96969, mesic pine/hardwood forest, more than 100 plants in area 15 x 20 yds, fresh flowers white, 12 Apr 2021, *Keesling 21-0053* (ANHC, iNaturalist 73779542).

**Additional observations (iNaturalist, not linked to specimens above). Arkansas.** Garland Co.: 34.54791, -93.04565, 15 Nov 2019, *Keesling 35708874*; 34.66381, -93.00047, 8 Apr 2020, *Keesling 41697524*; 34.64120, -92.98641, 28 Nov 2023, *Keesling 192515182*; 34.76887, -93.12976, 29 Apr 2022, *Keesling 113649058*; Montgomery Co.: 34.47927, -93.41771, 29 Mar 2021, *Keesling 72445779*; Saline Co.: 34.64654, -92.97905, 30 Mar 2012, *Keesling 34157063*; 34.64511, -92.96950, 8 Apr 2020, *Keesling 41696848*; 34.64583, -92.96916, 3 Dec 2022, *Keesling 143577713*; 34.64587, -92.96786, 8 Apr 2020, *Keesling 41696911*; 34.64766, -92.93470, 3 Dec 2022, *Keesling 143577193*; 34.64822, -92.94791, 8 Apr 2020, *Keesling 41697339*; 34.64841, -92.93566, 3 Dec 2022, *Keesling 143577108*; 34.64844, -92.93539, 8 Apr 2020, *Keesling 41697412*; 34.65016, -92.93616, 8 Apr 2020, *Keesling 41697452*; 34.65229, -92.93445, 3 Dec 2022, *Keesling 143577434*; 34.65292, -92.93413, 3 Dec 2022, *Keesling 143577504*.

### Notes on habitats and associated species

The habitat for both *Crataegus ouachitensis* and *C. keeslingii* can be described as dry-mesic to subxeric, acidic to circumneutral rocky upland oak or pine-oak woodlands, occasionally extending to embedded xeric glades, barrens, and rock outcrops, and to more mesic rocky riparian woodlands downslope and/or along drainages. These woodlands are a common matrix habitat in upland areas of the eastern Ouachita Mountains where the dominant geology is sandstone, shale, chert, and/or novaculite. Tree canopy ranges from nearly closed to sparse or nearly absent on more extreme xeric sites.

Canopy species (nomenclature follows Weakley et al. 2024) in these matrix woodlands typically include *Carya texana*, *C. tomentosa*, *Fraxinus americana*, *Nyssa sylvatica*, *Pinus echinata*, *Quercus alba*, *Q. falcata*, *Q. stellata*, *Q. marilandica*, and *Q. velutina*. Typical understory trees and





Figure 5. *Crataegus keeslingii* flowers. Garland County, 17 Apr 2016. Photos by Jim Keesling.



Figure 6. *Crataegus keeslingii* leaf adaxial surface in spring, and stems of mature plants. Garland County. Photos by Jim Keesling.



Figure 7. *Crataegus keeslingii* fruits. Garland County, 26 Oct 2016. Photos by Jim Keesling.



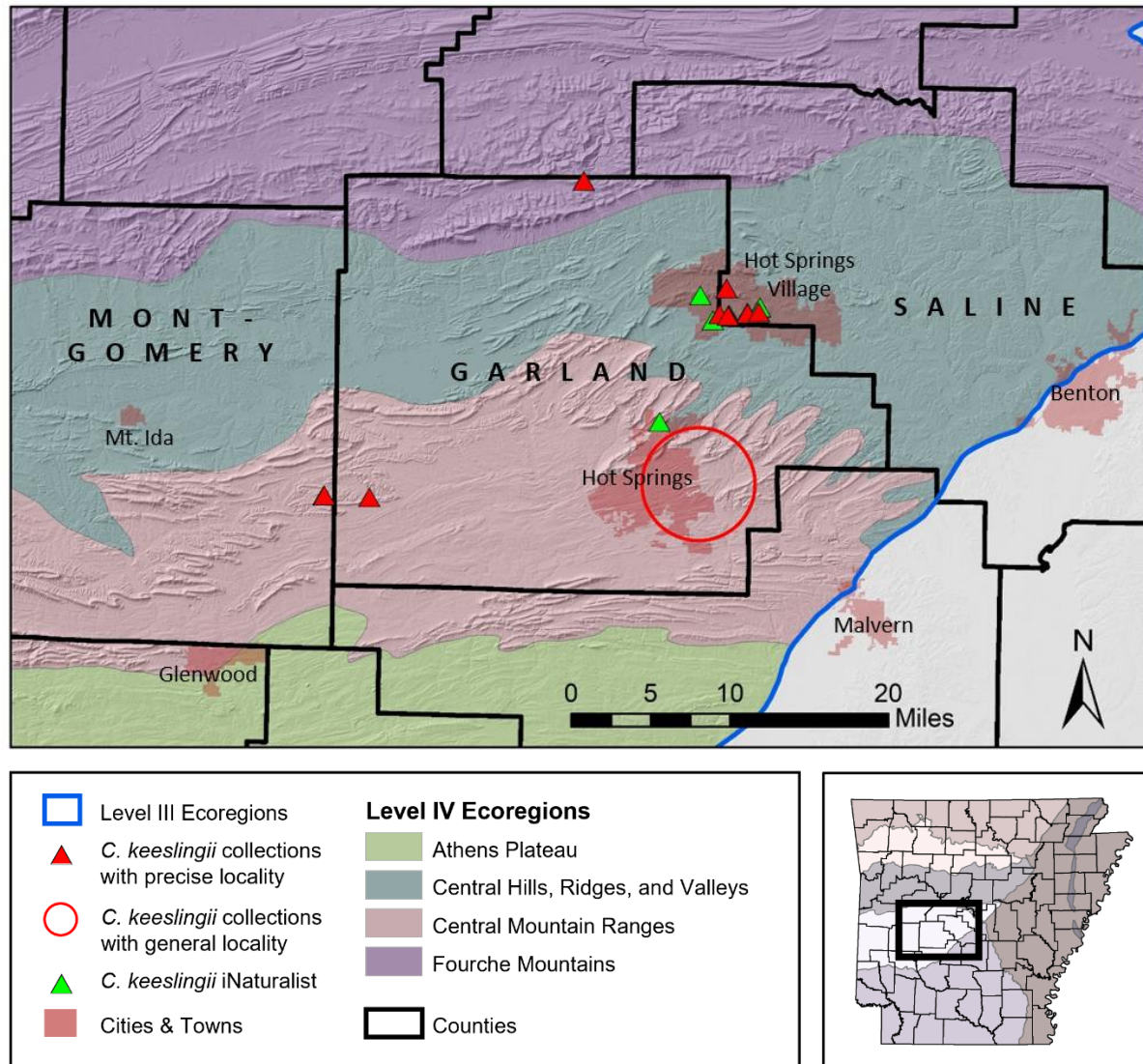


Figure 8. Map of known records of *Crataegus keeslingii*.

shrubs include *Aesculus pavia*, *Amelanchier arborea*, *Callicarpa americana*, *Crataegus berberifolia*, *C. collina*, *C. marshallii*, *C. pruinosa*, *C. spathulata*, *C. uniflora*, *Hypericum hypericoides*, *Ostrya virginiana*, *Prunus mexicana*, *Rhus aromatica* var. *aromatica*, *Rosa carolina*, *Sideroxylon lanuginosum*, *Ulmus alata*, *Vaccinium arboreum*, *V. pallidum*, *V. stamineum*, *V. virgatum*, and *Viburnum rufidulum*. Common woody vines include *Muscadinia rotundifolia*, *Toxicodendron radicans*, *Parthenocissus quinquefolia*, *Smilax bona-nox*, and *Smilax glauca*.

These woodlands are often semi-open and “grassy,” especially on poorer soils, on ridges, and on west- and south-facing aspects. Characteristic grasses and sedges include *Andropogon gerardi*, *Carex albicans*, *C. hirsutella*, *C. muehlenbergii*, *C. nigromarginata*, *C. umbellata*, *Chasmanthium sessiliflorum*, *Danthonia spicata*, *Dichanthelium boscii*, *D. commutatum* subsp. *ashei*, *D. commutatum* subsp. *commutatum*, *D. dichotomum*, *D. laxiflorum*, *D. linearifolium*, *D. sphaerocarpon*, *Piptochaetium avenaceum*, *Schizachyrium scoparium*, *Scleria oligantha*, and *Sporobolus clandestinus*. Common forbs include *Asclepias variegata*, *Baptisia leucophaea* var. *leucophaea*, *Cunila origanoides*, *Desmodium marilandicum*, *D. rotundifolium*, *Euphorbia corollata*, *Eurybia hemispherica*, *Helianthus hirsutus*, *Hieracium gronovii*, *Lespedeza hirta*, *L. procumbens*, *L. repens*, *L. virginica*, *Liatris aspera*,

*L. compacta*, *L. hirsuta*, *L. squarrulosa*, *Monarda bradburiana*, *Monarda stipatatoglandulosa*, *Penstemon arkansanus*, *Phlox pilosa*, *Ruellia pedunculata*, *Solidago nemoralis*, *S. odora*, *S. petiolaris*, *S. ulmifolia* var. *palmeri*, *Symphyotrichum anomalum*, *S. patens*, *Tradescantia hirsuticaulis*, *T. ohimensis*, *Scutellaria ovata*, and *Zizia aurea*.

### **Crataegus ouachitensis**

Herbaceous associates (nomenclature updated to Weakley 2024) listed on herbarium specimen labels include *Corydalis micrantha* subsp. *australis*, *Dichantherium linearifolium*, *Hypoxis hirsuta*, *Iris cristata*, *Liatris compacta*, *Luzula echinata*, *Myosotis verna*, *Nemophila aphylla*, *Oxalis violacea*, *Packera tomentosa*, *Phlox divaricata* subsp. *laphamii*, *Piptochaetium avenaceum*, *Polystichum acrostichoides*, *Schizachyrium scoparium*, *Senna marilandica*, and *Tradescantia hirsuticaulis*. Woody associates include *Callicarpa americana*, *Carya texana*, *C. tomentosa*, *Crataegus berberifolia*, *C. berberifolia* var. *engelmannii*, *C. collina*, *C. marshallii*, *C. spathulata*, *C. uniflora*, *Pinus echinata*, *Quercus marilandica*, and *Quercus stellata*.

While labels on several collections reference “mesic” and “forest” habitats, associated species (when provided) indicate that a more accurate description of the habitat would be a dry-mesic oak- or shortleaf pine-oak-dominated woodland. More mesic sites, with somewhat mesophytic herbaceous plants such as *Iris cristata*, *Phlox divaricata* subsp. *laphamii*, and *Polystichum acrostichoides* may occasionally support *Crataegus ouachitensis*, but these sites are often along rocky drainages or other more mesic pockets in a matrix of drier upland woodland.

Two populations were visited by the first author and notes made on the habitat and associated flora (nomenclature follows Weakley 2024):

(1) A particularly large and well-developed population occurs on the upper slopes and narrow ridgetop of Horseshoe Mountain in Lake Catherine State Park (Hot Spring Co.). This population is concentrated in a dry, open, rocky novaculite woodland (geology = Arkansas Novaculite) with embedded rock outcrop barrens/glades. Tree canopy is scattered and dominated by *Quercus stellata*, *Pinus echinata*, *Quercus marilandica*, and *Carya texana*, with scattered *Amelanchier arborea*. Shrubs and small trees include *Callicarpa americana*, *Celtis pumila*, *Crataegus marshallii*, *C. spathulata*, *Vaccinium arboreum*, *V. pallidum*, and *Viburnum rufidulum*. Graminoids include *Piptochaetium avenaceum*, *Schizachyrium scoparium*, *Elymus glabriflorus*, *Sorghastrum nutans*, *Chasmanthium sessilifolium*, with *Cyperus lupulinus* var. *macilentus*, *Sporobolus clandestinus*, and *Tridens chapmannii*. Characteristic forbs include *Acalypha monococca*, *Baptisia leucophaea* var. *leucophaea*, *Clitoria mariana*, *Coreopsis grandiflora*, *Echinacea pallida*, *Euphorbia ouachitana*, *Houstonia longifolia*, *Manfreda virginica*, *Scutellaria ovata*, *Solidago petiolaris*, *S. ulmifolia* var. *palmeri*, *Streptanthus maculatus* subsp. *obtusifolius*, *Tephrosia virginiana*, and *Trifolium carolinianum*.

(2) Another population occurs on the top of Crystal Mountain in the Ouachita National Forest (Saline County). This population is concentrated in a dry, open, rocky sandstone woodland (geology = Jackfork Formation) with embedded rock outcrop barrens/glades. Tree canopy is scattered and dominated by *Quercus marilandica*, *Quercus stellata*, *Carya texana*, *Pinus echinata*, *Ulmus alata*, and *Amelanchier arborea*. Shrubs and small trees include several other hawthorn species including *Crataegus crus-galli*, *C. marshallii*, *C. palmeri*, *C. pruinosa* var. *virella*, and *C. spathulata* as well as *Celtis pumila*, *Prunus mexicana*, *Ptelea trifoliata*, *Sideroxylon lanuginosum*, *Vaccinium arboreum*, and *V. pallidum*. Graminoids include *Schizachyrium scoparium*, *Andropogon ternarius*, *Aristida purpurascens*, *Dichantherium scribnerianum*, *D. linearifolium* var. *linearifolium*, *D. linearifolium* var. *wernerii*, *Piptochaetium avenaceum*, *Leptoloma cognatum*, *Melica nitens*, *Muhlenbergia sobolifera*, and *Sorghastrum nutans*. Forbs and ferns include *Acalypha monococca*, *Borodinia missouriensis*, *Coreopsis grandiflora*, *Delphinium carolinianum* var. *carolinianum*, *Draba aprica*, *Elymus glabriflorus*, *Erigeron strigosus*, *Glandularia canadensis*, *Heuchera americana* var.

*americana*, *Lespedeza stuevei*, *Liatris compacta*, *Manfreda virginica*, *Monarda stipatatoglandulosa*, *Myriopteris lanosa*, *M. tomentosa*, *Nuttallanthus texanus*, *Scutellaria ovata*, *Solidago radula*, *S. petiolaris*, *S. ulmifolia* var. *palmeri*, *Symphyotrichum anomalum*, *S. oblongifolium*, *S. patens*, *Tephrosia virginiana*, *Tradescantia ohimensis*, *Viola pedata*, and *Woodsia obtusa*.

### **Crataegus keeslingii**

Only two specimens of *Crataegus keeslingii* list associate species on the label but Jim Keesling has provided the following list of associates that he observed growing with it (nomenclature follows Weakley 2024): *Andersonglossum virginianum*, *Crataegus berberifolia*, *C. collina*, *C. crus-galli*, *C. marshallii*, *C. spathulata*, *Croton willdenowii*, *Eupatorium scabridum*, *Galactia regularis*, *Hypericum prolificum*, *Iris cristata*, *Lobelia spicata*, *Penstemon arkansanus*, *Packera tomentosa*, *Phlox pilosa* subsp. *ozarkana*, *Polygala ambigua*, *Schizachyrium scoparium*, *Smilax glauca*, *Solidago nemoralis*, *Tradescantia hirsuticaulis*, *Vicia caroliniana*, *Viola palmata*, and *Viola pedata*.

Keesling (pers. comm.) also notes that this taxon can be identified in the field by a combination of its early flowering period (which coincides with *C. collina*, *C. marshallii*, *C. ouachitensis*, and *C. viridis*), small leaves that are adaxially soft-pilose, and having some leaf blades wider than long on the sterile shoots. He also notes that lower leaf surfaces are glabrate to glabrous (aside from being sparsely villous on the main veins), and the upper leaf surfaces are sparsely to moderately pilose, a combination of characters that is unique among hawthorn taxa in the area

### **Conservation status**

Both *Crataegus ouachitensis* and *Crataegus keeslingii* have limited ranges centered on the central and eastern Ouachita Mountains in west-central Arkansas. *Crataegus ouachitensis* is known from fewer than 20 populations in six counties and *C. keeslingii* is known from 6-12 populations. The Arkansas Natural Heritage Commission has assigned *C. ouachitensis* a conservation status rank of G2S2 and *C. keeslingii* a conservation status rank of G1S1, following evaluation of known occurrence data with the NatureServe Conservation Rank Calculator tool (NatureServe 2020). Both taxa are tracked as elements of formal state conservation concern (ANHC 2024). *Crataegus keeslingii* is treated as a species for conservation status ranking because it apparently is fertile, reproducing by seed.

### **Diagnostic key to *Crataegus ouachitensis* and *Crataegus keeslingii***

1. Leaves sparsely hairy on veins in spring or glabrate, no lateral leaf veins lead to sinuses, petioles glabrate, often glandular; inflorescence stems and hypanthia glabrous or sparsely villous; sepals glandular-serrate or pectinate ..... **Crataegus ouachitensis**
1. Leaves densely villous adaxially in spring, lateral leaf veins occasionally lead to a sinus; petioles villous, eglandular; inflorescence stems and hypanthia usually villous; sepals often subentire ..... **Crataegus keeslingii**

### **Key to Arkansas *Crataegus* with leaves frequently of deltate shape**

1. Stamens 15 to 20 per flower.
2. Inflorescence sparsely hairy or glabrous; leaves glabrous or sparsely hairy in spring.
3. Sepals deeply serrate or pectinate.
4. Leaf blades of spur shoots 2-4 cm long and broad; fruit 8-12 mm diameter, calyx collar elevated ..... **C. ouachitensis**
4. Leaf blades of spur shoots 5-8 cm long and broad; fruit 10-20 mm diameter, calyx collar sessile ..... **C. coccinioides**
3. Sepals remotely serrate or subentire.
5. Primary lateral leaf veins lead to sinuses as well as lobes of leaves; fruit 4-8 mm diameter ..... **C. phaenopyrum**



- 5. Primary lateral leaf veins not leading to leaf sinuses; fruit 8-18 mm diameter.
  - 6. Leaves adaxially glabrous; fruit calyx collar elevated; mature fruit flesh dense ..... **C. pruinosa**
  - 6. Leaves adaxially minutely hairy in spring; fruit calyx sessile; mature fruit flesh soft.. ..... **C. schuettei**
- 2. Inflorescence and leaves distinctly and persistently hairy.
  - 7. Primary lateral leaf veins lead to sinuses and lobes of leaves; styles usually 2; fruit elliptic, usually 4-7 mm diam ..... **C. marshallii**
  - 7. Primary lateral leaf veins lead to lobes only, or to sinuses on a few leaves; styles 3 to 5; fruit subglobose, usually >7 mm diam.
    - 8. Leaves and petiole villous in spring; fruit calyx collar slightly elevated; mature fruit flesh dense.
      - 9. Lateral leaf veins lead only to lobes; most leaves longer than wide ..... **C. pruinosa** var. **virella**
      - 9. Lateral leaf veins occasionally lead to a sinus; leaves broad as long or broader than long ..... **C. keeslingii**
    - 8. Leaves and petiole pubescent, tomentose or lanate in spring, abaxially persistently pubescent on veins; fruit calyx sessile; mature fruit flesh usually soft.
      - 10. Fruit usually 7-8 mm diameter ..... **C. × notha**
      - 10. Fruit 10 mm or more in diameter ..... **C. mollis**
- 1. Stamens 5 to 10 per flower.
  - 11. Sepal margins deeply serrate; leaf petioles distinctly glandular.
    - 12. Leaves and inflorescence villous; fruit calyx collar elevated .. **C. intricata** var. **biltmoreana**
    - 12. Leaves and inflorescence pubescent or glabrate; fruit calyx sessile ..... **C. coccinioides**
  - 11. Sepal margins shallowly toothed or subentire; leaf petioles sparsely glandular or eglandular.
    - 13. Leaves glabrous on both surfaces; fruit with elevated calyx collar . **C. pruinosa** var. **dissona**
    - 13. Leaves minutely pilose adaxially; fruit calyx sessile.
      - 14. Inflorescence often with sparse hairs; mature fruit flesh dense ..... **C. iracunda**
      - 14. Inflorescence glabrous; mature fruit flesh soft ..... **C. macrosperma**

### ACKNOWLEDGEMENTS

We are thankful to Guy Nesom and Brian Keener for their advice on reconciling the typification issues related to these taxa, to Guy Nesom for substantial edits that improved this manuscript, and to Jim Keesling for his tireless and thorough field work to document the *Crataegus* of Arkansas.

### LITERATURE CITED

- Arkansas Natural Heritage Commission (ANHC). 2024. Database of Arkansas elements of state conservation concern.
- Kartesz, J.T. 2010. Floristic Synthesis of North America, version 9-5-2010. Biota of North America Program, Chapel Hill, North Carolina.
- Lance, R. 2014. Haws: A Guide to Hawthorns of the Southeastern United States. Published by the author.

- NatureServe. 2020. Conservation Rank Calculator. <<https://www.natureserve.org/products/conservation-rank-calculator>>
- Palmer, E.J. 1925. Synopsis of North American *Crataegi*. J. Arnold Arb. 6: 5–128.
- Palmer, E.J. 1926. The ligneous flora of Hot Springs National Park and vicinity. J. Arnold Arb. 7: 104–135 (*Crataegus*, 124–125).
- Phipps, J.B. 2014. *Crataegus*. Pp. 491–643, in Flora of North America Editorial Committee. 2014. Flora of North America north of Mexico. Vol. 9, Magnoliophyta: Picramniaceae to Rosaceae. Oxford Univ. Press, New York.
- Sessé, M., J.M. Mociño, and R. Morán. 1894. Flora Mexicana (ed. 2). Mexico, Ministerio de Fomento.
- Smith, E.B. 1985. An Atlas and Annotated List of the Vascular Plants of Arkansas. 2nd ed. Univ. of Arkansas, Fayetteville.
- Tucker, G.E. 1976. A guide to the woody flora of Arkansas. PhD thesis, Univ. of Arkansas, Fayetteville. *Crataegus*, pp. 98–105.
- Vines, R.A. 1960. Trees, Shrubs and Woody Vines of the Southwest. Univ. of Texas Press, Austin. *Crataegus*, pp. 329–387.
- Weakley, A.S., and Southeastern Flora Team. 2024. Flora of the Southeastern United States Web App. Univ. of North Carolina Herbarium, North Carolina Botanical Garden, Chapel Hill. <[fsus.ncbg.unc.edu](https://fsus.ncbg.unc.edu)> Accessed Apr 7, 2024.
- Woods, A.J., T.L. Foti, S.S. Chapman, J.M. Omernik, J.A. Wise, E.O. Murray, W.L. Prior, J.B. Pagan, Jr., J.A. Comstock, and M. Radford. 2004. Ecoregions of Arkansas (color poster with map, descriptive text, summary tables and photographs). Scale 1:1,000,000. U.S. Geological Survey, Reston, Virginia. <[www.epa.gov/wed/pages/ecoregions/ar\\_eco.htm](http://www.epa.gov/wed/pages/ecoregions/ar_eco.htm)>.