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A NEW BEEBALM, *MONARDA AUSTROAPPALACHIANA* (LAMIACEAE), FROM THE SOUTHERN APPALACHIANS

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ABSTRACT

A new species of *Monarda* subg. *Monarda*, **Monarda austroappalachiana** Floden, **sp. nov.**, endemic to the Southern Appalachians, is described and illustrated. Its distribution is limited to calcareous phyllite and limestone in the Southern Unaka Mountains and Southern Cumberland Plateau, respectively. Its morphology is compared to that of *M. clinopodia*, the species with which it has been confused, and to *M. fistulosa*, its hypothesized sister species. Taxonomic significance of morphological characters of the *M. fistulosa* group (defined here) — such as a hispidulous style, fibrous stems, and hirsute calyx orifice — are discussed.

Specimens of a post-anthesis *Monarda* L. were collected by the author the first week of June, 2008, from phyllite talus of the Walden Creek formation in the Ocoee River Gorge in Polk Co., Tennessee. The plants are short with 4-5 internodes per flowering stem and glabrous except for some nodal stipular bands of retrorse trichomes and a few retrorse trichomes on the angles of the internode subtending the inflorescence. Examination of specimens at TENN showed that plants of this morphology have mostly been identified as *M. clinopodia* L., but compared to the latter, they are nearly glabrous, flower earlier where sympatric, are thicker-leaved, and have larger, emaculate, white corollas with the upper corolla lobe apex with pilose trichomes. The clinopodia-like plants are described here as the novel species *M. austroappalachiana*, based on examination of specimens at TENN and MO, personal cultivation of most taxa discussed, fieldwork over the 2008-2013 seasons in Arkansas, Texas, Missouri, and Tennessee, and data presented here. The new species has been collected from glade-like habitats and talus slopes and roadsides predominantly from the Ocoee River Gorge in the Southern Appalachians and in the Southern Cumberland Plateau of Tennessee and Georgia.

Monarda austroappalachiana is more similar to *M. fistulosa* than *M. clinopodia* in morphology and habitat. Both species produce hairs at the apex of the upper corolla lobe, a hirsute calyx orifice, firm-textured leaves, ligneous stems (in contrast to the fleshy stems of *M. clinopodia* and *M. didyma*), and hispidulous styles (Table 1).

Monarda consists of about 18 species native to North America including Mexico. These are divided into two subgenera supported by molecular analyses (Prather et al. 2002): subg. *Monarda* with 11 species and subg. *Cheilyctis* with 7 species. Subg. *Monarda* occurs in eastern North America and Mexico with one species, *M. fistulosa*, extending westward to the Rocky Mountains. There are two distinct morphological groups in subg. *Monarda*: the *M. didyma* group and the *M. fistulosa* groups are distinguished by leaf shape, indument of the leaves and stems, inflorescence characters, and corolla sizes (McClintock & Epling 1942; Scora 1967; Turner 1994). The *M. fistulosa*-group is united by the presence of hispidulous styles, densely hirsute calyx orifices, and pilose to comose upper-corolla lobe apices (Table 2). In this group I include the following species: *M. austroappalachiana*, *M. fistulosa* var. *fistulosa*, *M. fistulosa* var. *brevis*, *M. lindheimeri*, *M. luteola*, and *M. stipitatoglandulosa*. Of these *M. austroappalachiana* is presumably more closely related to the latter four members of the group (all of the group except typical *M. fistulosa*) and an unnamed

taxon from Kentucky (J. Campbell, pers. comm.) — see Discussion below for characters shared between the new species and the *M. fistulosa* group. All of these taxa usually begin flowering before sympatric *M. fistulosa* (Waterfall 1970; Kimball et al. 2001; Singhurst & Holmes 2011).

MONARDA AUSTROAPPALACHIANA Floden, **sp. nov. TYPE: USA. Tennessee**. Polk Co.: US 64/ Hwy 30, ca. 1 mi N of Hwy 64, on slope on W side of road, 16 May 2012, *A. Floden 2128* (holotype: TENN; isotypes: MI, MICH, US, MO, BRIT, NCU, GA, UTC, TENN). Figures 1–3.

Differs from *M. clinopodia* L. in its shorter stems 30–50 cm tall, firm-textured leaves, hirsute calyx orifice, stipitate-pilate-glandular calyx tube, calyx lobes with stout dark-colored stipitate glands, larger corolla 25–30 mm that is white and emaculate, the upper corolla lobe 12–14 mm vs. 5–8 mm, and in its distinctly earlier blooming period where the two species are sympatric. It differs from the more similar *M. fistulosa* L. in the reduced density of trichomes of the comose upper corolla lobe apex, white vs. pink corolla, leaves glabrous on both surfaces and dark green vs. gray, stems glabrous except at the nodes, and earlier flowering.

Plants perennial, erect. **Rhizomes** short, internodes 2–5 cm, 4-angled, purple to green, ca. 3 mm diameter. **Stems** 4-angled, 30–50 cm, purple below, green above, minute retrorse to spreading trichomes at internodes, lowermost (2–3) internodes finely puberulent, glabrous above, rarely some retrorse trichomes present on internode below the inflorescence, 1–3 branched. **Leaves** simple, opposite, petiolate; **petioles** 0.5–1.5 cm, 1–2 mm wide, glabrous; **blades**, proximal stem leaves ovate-elliptic, distally lanceolate, 2.5–7 × 1.5–2 cm, lamina glabrous, dark green adaxially, paler grey-green abaxially, punctate, strongly *Oregano*/thymol-scented, margins ciliate, 8–11 pairs per stem, internode 1.5–7 cm, shorter below, elongate above, nodes with few spreading trichomes, ca. 1 mm long. **Inflorescences** terminal, 1(–3) per stem, subtended by 6–8 large bracts; **glomerules** 1.5--2 cm wide excluding corollas, subtended by foliaceous bracts, lowermost glandular punctate, ovate-lanceolate to lanceolate, the largest 5 × 2 cm, and 5–10 smaller lanceolate to linear bracts, 1.5–3 × 0.5–1.5 cm successively reduced in size, grayish, occasionally pink-tinted, with green margins, strongly ciliate with smaller bracts with cilia to 1mm, larger with cilia to 0.5 mm, surfaces glabrous, 40—90-flowered. **Calyx** 8–12 mm, tubular, strongly 13 nerved, stipitate glandular on nerves, trichomes ca. 0.5 mm, with interspersed eglandular trichomes, calyx lobes, ca. 0.75–1.25 mm, with 2–5 stipitate-pustulate, anthocyanic (dark-based) glands, calyx orifice with introrse trichomes, 0.5–1 mm, margins often strongly purple colored. **Corolla** white to creamy, emaculate, 25–35 mm, stipitate glandular with longer spreading pubescence, upper lip 12–14 mm, apex with 5–15 uniseriate trichomes 1–3 mm long, lower lip 6–9 mm, 3-lobed, center lobe 2–4 mm, margins parallel, apex bifid. **Anthers** purple, segments 1.5–2 mm, ovate, pollen yellow; **filaments** glabrous, exserted 4–6 mm beyond upper corolla lip. **Style** hispidulous proximally to near middle, apex bifid, exserted 4–8 mm beyond the upper corolla-lobe apex, reddish-purple at apex. **Nutlets** 1–1.5 mm, light to dark brown.

Common name. Southern Appalachian beebalm.

Etymology. Named for the area to which it is endemic, the Southern Appalachians, a region of high endemism in eastern North America.

Phenology. Flowering middle to late May into early June, fruiting July to September.

Distribution and ecology. *Monarda austroappalachiana* is endemic to limited area of northern Georgia, southwest North Carolina (no specimens cited), southeast Tennessee. This species grows in talus slopes, open woodland, road edges, and steep rocky slopes in sub-xeric habitats with reduced competition from other forbs or woody plants. It most frequently grows in the Walden Creek geologic formation, a calcareous phyllite. No specimens are cited from North Carolina, but photographs of plants *in situ* and one cultivated accession from Macon County southwest of Franklin (D. Probst, pers. comm.) confirm its presence there.

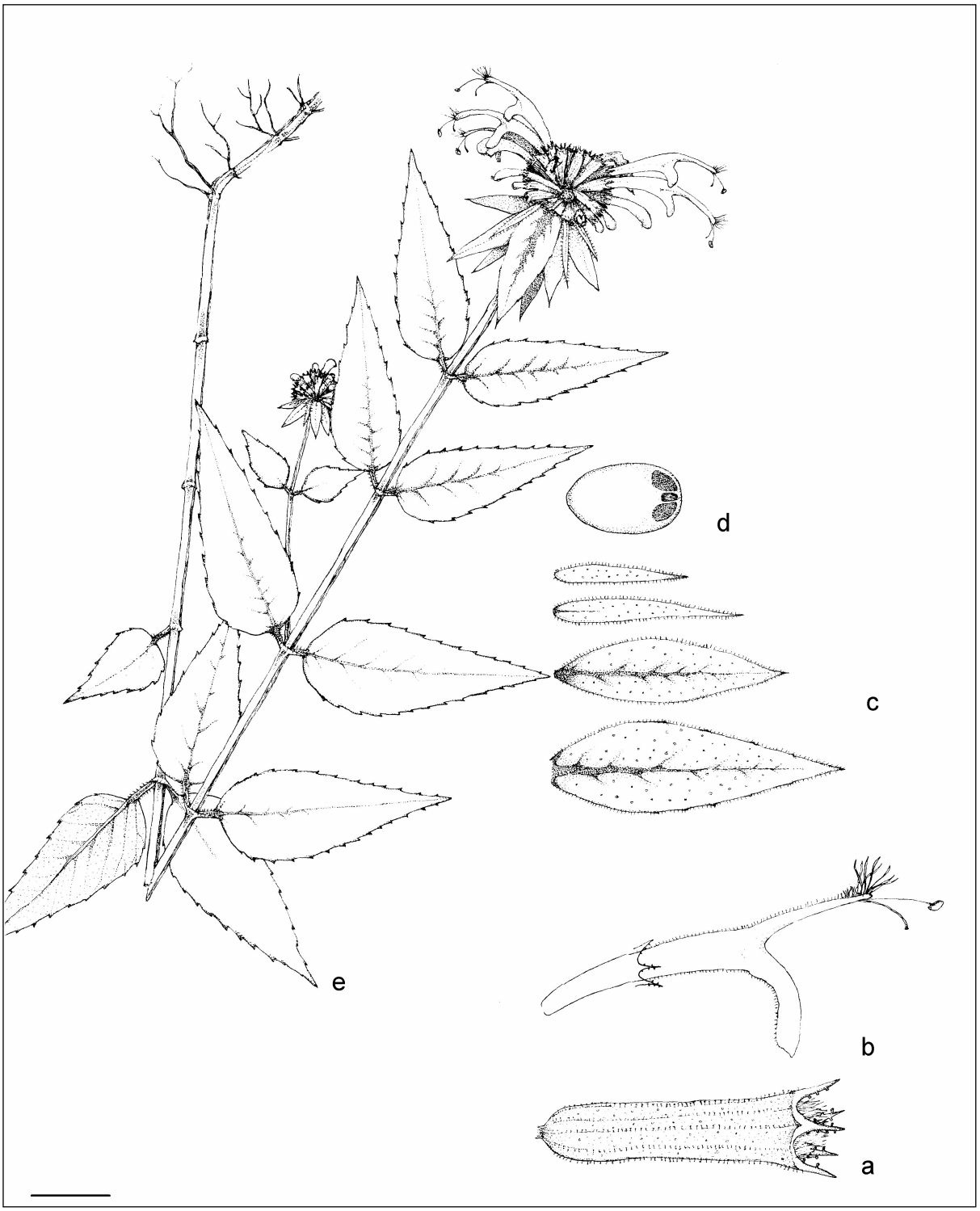

Figure 1. *Monarda austroappalachiana*, drawn from *Floden 912* (TENN). A. Calyx. B. Calyx and corolla. C. Glomerule bracts. D. Nutlet/mericarp. E. Whole plant. Scale bar: a = 2 mm; b = 0.7 cm; c = 1 cm; d = 1 mm; e = 2 cm.

Figure 2. *Monarda austroappalachiana* in its naural habitat, Ocoee River Gorge, Polk County, Tennessee. Photo by the author

Figure 3. Calyces of *Monarda austroappalachiana* showing the short stipitate glands on the tube, the reddish stout glands on the calyx lobes, and the hirsute calyx orifice. Calyces ca. 1 cm long.

Additional specimens examined. **Georgia.** Walker Co.: cultivated accession from Pigeon Mt., *Campbell s.n.* (TENN). **Tennessee**. Hamilton Co.: N. Chickamauga Creek, common along trail and parking lot at Bowater Pocket Wilderness parking lot, 25 May 1995, *Pyne 95-083* with Bowen (VDB, TENN). Marion Co.: along roadside of Raccoon Mt. Rd ¼ mi beyond Pumped Storage Reservoir toward Massengill Rd, N 35 03.743, W 085 22.999, 1319 ft., 24 May 2011, *Blyveis 641* (UTC, TENN); W-facing slope, upslope from Kellys Ferry/Mullins Cove Road near Tenn. River-mile 445.7, Wauhachia Quadrangle, oak-pine forest with fairly open canopy (burned in 2007), 35.0707,-85.3949 (NAD-83), 30 May 2008, *McCoy & Bishop s.n.* (TENN). Polk Co.: Hwy 64 W of Goforth Creek and E of Caney Creek, 21 Jul 2011, *Floden & Hart 1660* (TENN); along Hiwassee River just before Hwy 68 crosses the river, near NC border, 11 Aug 2011, *Floden 1696* (TENN); Powerhouse Rd along Hiawasee River, at parking area before Cappy Branch growing on limestone shelves on roadside, post anthesis!, 15 Jun 2011, *Floden 1602* (TENN); forest area at Spring Creek N of Hiwassee, 2 Jun 1971, *Somers Jr., Bowers, Smith, & Skorepa 46085* (TENN); Hwy 40 near dam #2 on N side of rd, 18 Jun 2008, *Floden 562* (TENN); Hwy 30, ca. 1.2 mi W of Reliance along shaley slope on roadside, 5 Jun 2009, *Floden 903* (TENN); Hwy 40/74 E of Parksville on wooded roadside above Lake Ocoee, 5 Jun 2009, *Floden 905* (TENN); Hwy 40/74, near a small waterfall on N side of road, 5 Jun 2009, *Floden 909* (TENN); Hwy 40/74 ca. 2 mi before dam #2, shaley slope with abundant plants on roadside, 5 Jun 2009, *Floden 912* (TENN); Hwy 40/74 before dam #2, 5 Jun 2009, *Floden 918* (TENN); Hwy 40/74 before dam #3, 5 Jun 2009, *Floden 919* (TENN); roadside along US Rte 64 near the margin of Lake Ocoee, corollas cream colored with a blush tinge, 10 May 1959, *Carter & Houk 25777* (TENN); along roadside (Rte 64) on the banks of Lake Ocoee, cream flowers with a blush tinge, 10 May 1959, *Carter & Houk 25776* (TENN); roadside along Hwy 64, ca. 5 mi E of Parksville along the Ocoee River between Greasy Creek and Madden Creek, 9 May 1977, *Wofford, Webb, & Evans 77-59* (TENN); along Ocoee Lake on moist shaded slope, white flowers, 8 Jun 1958, *Sharp, Norris, & Russel 23616* (TENN); mesic, open roadside, Rte 30, ca. 1 mi N of Rte 64, 4 Jun 1989, *McNeilus 89-332* (TENN); bluff of Lake Ocoee above Parksville, white flowers, 21 April 1961, *Sharp & Pringle 28456* (TENN); roadside, road from Parksville to Ducktown, ca. 11 mi from Parksville, 7 Jun 1940, *Shaver 7882* (TENN); Hwy 30, ca. 1 mi N of Hwy 64, on slope on W side of road, 16 May 2012, *Floden 2128* (TENN); Spring Creek Road, N of Hiwassee River, along Spring Creek, substrate largely Walden Creek Shale, 5 Jun 2012, *Floden 2156* (TENN) and *Floden 2159* (TENN); Ellis Rd, FS44, near creek, 7 Jun 2012, *Floden 2188* (TENN); Oswald Dome Rd, shalely slope with spring-fed ditch at base, highly shaded N-facing slope, 7 Jun 2012, *Floden 2192* (TENN); Baker Creek Rd, S of Ocoee River on FS 302 just past Baker Creek on small shaley slope, 18 Aug 2012, *Floden 2208* (TENN). Van Buren Co.: Fall Creek Falls State Park, 3.0 km N of junction of Hwys 285 and 30, growing on limestone bench above two waterfalls, ca. 1 km E of Old Cane Creek Church, Bald Knob Quad, 365 m, 23 May 2002, *Fleming, Smith, Bowman FCF-2084* (TENN).

The following specimens from Tennessee are cited because of their proximity to or disjunction from populations of *Monarda austroappalachiana*, and they also serve to show ranges in flowering times.

Monarda clinopodia. Polk Co.: Hiwassee River at bridge below Farner, Hwy 68, 15 Jul 1969, *Rogers & Bowers 43926* (TENN); rocky mesic woods along Big Creek, elev. 550 m, corolla white, 12 Jul 1983, *Murrell 368* (TENN); Hwy 30 near Taylors Island parking area on N side of road, 5 Jun 2012, *Floden 2153* (TENN) and 7 Jun 2012, *Floden 2177* (TENN); Powerhouse Rd along Hiawasee River, at parking area before Cappy Branch, moist woodland and river floodplain, 15 Jun 2011, *Floden 1601* (TENN).

Monarda austroappalachiana and *M. clinopodia* only occur within close proximity at two sites in Polk Co., Tennessee. Observations over four field seasons shows that their flowering periods rarely

coincide with the last flowers of the former in anthesis as the first of the latter begin. They also occupy different habitats — *M. austroappalachiana* on subxeric, open sites and *M. clinopodia* in mesic, heavily shaded woodland.

Monarda fistulosa. Bradley Co.: Moist roadside NE of Cleveland, near McMinn Co. line, purple flowers, 15 Jun 1948, *Fairchild, Clebsch, Sharp 48-11* (TENN); near Cleveland, 26 May 1934, *Sharp & Hesler 1103* (TENN). McMinn Co.: Hwy 39, just before 310, on shaley slopes on NE side of road, 7 Jun 2012, *Floden 2166* (TENN). Monroe Co.: Roadside bank on Tenn. Hwy 72, 8 Oct 1961, *Sharp, Pringle, Drumke, Ellis, Ramsey 29668* (TENN); road from Tellico Plains to Farmer, near Polk Co. line, in moist soil by stream in mountains, 30 Jun 1935, *Wilson 3791* (TENN). Polk Co.: Hwy 315, ca. 1 mi N of Spring Creek Rd, on Tellico Drainage, not within the Hiwassee Drainage, 7 Jun 2012, *Floden 2191* (TENN).

Monarda fistulosa is not syntopic with Tennessee populations of *M. austroappalachiana* in the Ocoee River Gorge or along the Hiwassee River. All populations of *M. fistulosa* observed in Polk County occur within the Tellico River drainage approximately 20 kilometers north of the closest *M. austroappalachiana* populations. The next closest population of *M. fistulosa* occurs west of the Ocoee River Gorge in Bradley Co., Tennessee.

Discussion

Monarda austroappalachiana is described based on morphological study of nearly all species of *Monarda* subg. *Monarda*. Subg. *Monarda* contains two morphologically distinct groups, each defined by several shared characters (e.g., calyx orifice hirsute vs. not, pubescence on the upper corolla lip, depth of stamen attachment) (Scora 1966) with two anomalous species, *M. bradburiana* and *M. russeliana*. The *M. fistulosa* group is united by several morphologies: the presence of a hispidulous style from the middle to the proximal portion, a densely hirsute calyx orifice, comose to pilose upper corolla apices, and dark-colored, fibrous, hard stems. The *M. didyma* group has glabrous styles throughout, non-comose corolla lobe apices, and usually distinctly fleshy green stems.

A direct comparison of *Monarda austroappalachiana* to *M. fistulosa* shows that it differs in the merely pilose upper corolla lobe apex, rather than comose apex of the corolla. Furthermore the density of calyx orifice trichomes is reduced. The leaves of the new species are glabrous and dark green whereas those of *M. fistulosa* and *M. stipitatoglandulosa* are short gray-canescent with a distinctly grayish appearance. In *M. austroappalachiana* the stem is glabrous, but the other species are usually canescent with short curled trichomes, pubescent with sparse, long trichomes on the stem angles, or densely pilose mixed with shorter curled trichomes. In *M. austroappalachiana* trichomes on the stems are restricted to the internode subtending the inflorescence and a thin stipular line of hispid trichomes at each node. The stem indument in *M. fistulosa* is densely short and canescent or intermixed with longer spreading trichomes (rarely glabrous on the faces). *Monarda stipitatoglandulosa* has densely pilose stems and *M. fistulosa* var. *brevis* has glabrous stem faces but long spreading trichomes on the angles (Fig. 1). The leaves of *M. austroappalachiana* are similar to *M. fistulosa* var. *brevis*, but that species is lustrous rather than matte in appearance (Fig. 2). It is also distinct from *M. clinopodia*, which has membranous, hispid-pubescent leaves, a smaller, maculate corolla (Table 1), and mesic habitats. Moreover the blooming period of *M. austroappalachiana* is complete or nearly so before both sympatric species begin to flower.

The taxonomic history of the *Monarda fistulosa* group and its subdivision into species or varieties has varied by author: none recognized by McClintock and Epling (1942); 5 varieties by Scora (1967) and by Fosberg and Artz (1953); and 2 by Turner (1994). Nonetheless, many of the species are easily diagnosed by their morphology and generally geographically restricted though often sympatric with *M. fistulosa*. Despite their sympatry with *M. fistulosa,* they often flower before it,

Table 1. Comparative table of morphology of *Monarda austroappalachiana, M. fistulosa, M. clinopodia,* and *M. stipitatoglandulosa*. All measurements in centimeters unless noted.

Species	***austroappalachiana***	***clinopodia***	***fistulosa***	***stipitatoglandulosa***
Rhizome				
internode	pachymorphic	leptomorphic	variable	pachymorphic
Stem				
height	20--50	40--100	40--130	20--50
color	purple	greenish	green-purple	green-purple
vestiture	mostly glabrous, nodes pubescent	glabrate to long pubescent	pubescent	pubescent
Foliage				
petiole	0.5-2.0	1.5-2	0.5-1.5	0.5-1.5
petiole indum.	glabrous	pubescent	pubescent	pubescent
base	cuneate, to rounded	truncate rounded	sub-cordate, rounded	rounded
apex	long acuminate	acuminate	acuminate	acuminate
vestiture	glabrous	pubescent	canescent	pubescent
texture	subcoriaceous	membranous	herbaceous	herbaceous
Bract number	6--8	6+	6--10	6--12
length	1.5--5	0.5--1.5	1.5--3	1--2.5
width	0.5--2	0.2--1	1--2	0.5--1
color	white with pink	pale green-white	silvery	silvery
vestiture	minutely canescent	lamina canescent veins pubescent	canescent veins pubescent	canescent
Perianth				
calyx	0.9--1.2	0.6--1	0.8--1	0.7--0.8
teeth	1-1.5 mm	1 mm	1-1.2 mm	1-2 mm
vestiture	stipitate glandular on veins	canescent, stipitate glands interspersed	canescent	densely stipitate glandular
corolla	2.5--3.5	1.5--2.5	2.4--3.0	2.0--3.0
color	white	white, red spotted	lavender-purple	white to cream (sometimes pink)
vestiture	stipitate glandular, long pubescent	short pubescent	short pubescent	stipitate glandular
upper lip	1.2--1.4, apex pilose	0.5--0.8 (0.8--1), apex glabrous	1--1.2, apex comose	0.9--1.3, apex comose
lower lip	3-lobed, middle lobe margins parallel, apex bifid	3-lobed, middle lobe acuminate, apex erose to bifid	3-lobed, middle lobe margins parallel, apex bifid	3-lobed, middle lobe margins parallel, apex bifid
style	hispidulous	glabrous	hispidulous	hispidulous
Flowering	late April-early June	mid-June—July	late June, July into August	late May-June

Table 2. Indument characters of the style and calyces of the species of *Monarda* subg. *Monarda* recorded from herbarium specimens (sample size n=20+, *n=<10) and supplemented from literature. *Monarda clinopodia* is listed three times because each form is morphologically distinct; two of them representing corolla-size forms (see McClintock & Epling 1942) and the other representing a non-maculate corolla form (J. Campbell personal communication).

Species	**style**	**calyx vestiture**	**calyx lobes**
austroappalachiana Floden	hispidulous	glandular-pubescent	glandular-pubescent
bradburiana Beck	glabrous	puberulent	glandular-pubescent
clinopodia L. (greenish-spotted)	glabrous	glandular-pubescent	glandular-pubescent
clinopodia (unspotted)	glabrous sparse	glandular-pubescent	glandular-pubescent
clinopodia (reddish-spotted)	glabrous	pubescent	glandular-pubescent
didyma L.	glabrous	glandular-pubescent, eglandular	glandular-pubescent, glabrous
fistulosa L.	hispidulous	canescent	glandular-pubescent
**lindheimeri* Engelm. & A.Gray	hispidulous	hispid-pubescent, hirsute	glandular-pubescent
**luteola* Singhurst & Holmes	hispidulous	glandular-pubescent	glandular-pubescent
**malloryi* Gilly	glabrous	puberulent	short-glandular-pubescent
media L.	glabrous	pubescent, glandular	glandular-pubescent
menthifolia Graham	hispidulous	dense pubescent	sessile-glandular
russeliana Nutt. ex Sims	glabrous	glandular-pubescent, pubescent	pustulate-glandular
sp. nov. KY	hispidulous	glandular-pubescent, pubescent	glandular-pubescent
stipitatoglandulosa Waterfall	hispidulous	glandular-pubescent	glandular-pubescent

with only occasional overlap. Species of this early-flowering group are united by their white to creamy corollas and stout stipitate calyx lobe glands (Fig. 3). *Monarda stipitatoglandulosa* has distinctly pilose stems and is mostly found in the Ouachita Mountains of Oklahoma and Arkansas (Waterfall 1971). The recently described *M. luteola* (Singhurst & Holmes 2011) and *M. lindheimeri* are morphologically similar to one another but allopatric in distribution. Another unique variant for which Kimball et al. (2001) provided distinctive molecular evidence is the limestone barren endemic *M. fistulosa* var. *brevis* of the Ridge and Valley of Virginia and West Virginia. This taxon is strongly distinct from *M. fistulosa* and should be recognized at species rank. Similarly, a morphologically

distinct plant undetermined to species occurs on the Knobs of Kentucky and is undoubtedly related to *M. fistulosa* var. *brevis*.

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