

PENSTEMON KRALII (PLANTAGINACEAE),
A NEW SPECIES FROM ALABAMA AND TENNESSEE,
WITH AN UPDATED KEY TO THE SOUTHEASTERN U.S. TAXA

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ABSTRACT

Penstemon kralii, a new species of *Penstemon* subgenus *Penstemon* section *Penstemon*, is described from the limestone slopes of the southwestern escarpment of the Cumberland Plateau of northeastern Alabama and southeastern central Tennessee. This narrow endemic appears to be allied with *P. tenuis* and *P. smallii*. A key differentiating this new species from all southeastern U.S. *Penstemon* is provided.

RESUMEN

Penstemon kralii, es una nueva especie de *Penstemon* subgénero *Penstemon* sección *Penstemon*, que se describe de las laderas calcáreas del suroeste del Cumberland Plateau en el noreste de Alabama y sureste de Tennessee central. Este endemismo restringido parece esta relacionado con *P. tenuis* y *P. smallii*. Se aporta una clave para diferenciar esta nueva especie de todos los *Penstemon* el sureste de los Estados Unidos.

Penstemon Schmidel is the largest vascular plant genus endemic to North America. More than 250 of the 270+ species of this taxonomically challenging genus occur in western North America with the center of diversity in the Intermountain Region (Wolfe et al. 2006). About 20 species occur naturally in the southeastern United States. Many new species have been described over the past few decades from western North America but none have been described from eastern North America since Pennell's (1935) monograph, *The Scrophulariaceae of eastern temperate North America*. During a recent examination of *Penstemon* specimens for the *Flora of Tennessee* project, specimens of an unusual *Penstemon* from just across the state line in northeastern Alabama were encountered that did not fit any known species. These specimens bore a similarity to *P. smallii* A. Heller of the Southern Appalachians and *P. tenuis* Small of the southern Mississippi River Valley. Further assessment led to the determination that these populations represent an undescribed species. This species joins *Blephilia subnuda* Simmers & Kral (1992), *Clematis morefieldii* Kral (Kral 1987), *Polymnia johnbeckii* D. Estes (Estes & Beck 2011), *Silphium brachiatum* Gatt., and *Vernonia flaccidifolia* Small as the latest addition to the endemic flora of rocky limestone woods of the southwestern escarpment of the Cumberland Plateau.

Penstemon kralii D. Estes, sp. nov. (Figs. 1–2). TYPE: UNITED STATES. ALABAMA. Jackson Co.: 3.8 km S of Paint Rock, eastern base of Keel Mountain at the western edge of the Paint Rock River Valley, along NW side of County Road 5, 1.6 km by road W from jct. with US Hwy 72, edge of dry deciduous forest over Mississippian limestone, 34.626176° N, -86.329163° W, 4 May 2011, D. Estes 11,900 with D. York and C. Gorman (HOLOTYPE: MO; ISOTYPES: APSC, GH, KANU, NCU, NY, PH, RM, TENN, UC, US, UNA, VDB).

Penstemon kralii differs from *P. tenuis* in its generally wider leaves, paler lavender to nearly white corollas with prominent (sometimes faint) purple guide lines, preference for rocky, calcareous woodlands, and Southern Appalachian distribution. *Penstemon kralii* differs from *P. smallii* in its much smaller corollas that are pale lavender to nearly white and in its lance-attenuate and strongly recurved sepals.

Plant a perennial herb from a caudex. **Stems** 4–7 dm tall, erect to ascending, solitary or clustered, unbranched below inflorescences, terete, 4–5 mm in diameter at midstem, with 6–9 leafy nodes below inflorescence, pale green, densely to moderately puberulent with spreading or retrorse, straight, eglandular, sharp-tipped white hairs 0.1–0.3 mm, the eglandular pubescence above the distalmost non-bracteal leaf becoming more sparse and replaced by mostly spreading, glandular-capitate hairs 0.5 mm. **Leaves** simple, oppositely-decussate, spreading, often with apices recurved in life (not often evident in specimens), proximal oblanceolate and taper-



Fig. 1. Paratype of *Penstemon kralii* from Jackson Co., Alabama (S. & G. Jones 4880 VDB).



FIG. 2. Inflorescence of *Penstemon kralii*, Franklin County, Tennessee (based on *Estes 11,901 with York & Gorman APSC, TENN.*). Photo taken by Dawn York, 4 May 2011.

ing to a narrowly attenuate petiole-like base, medial lanceolate or oblong, those just proximal to the inflorescence ovate-lanceolate, medial blades 12–15 cm \times 3–4 cm, usually larger than proximal and distal cauline leaves, apex acute to acuminate, margins sharply and coarsely serrate with mostly 4–7 acuminate teeth per cm (fewer on proximal leaves), base subcordate to rounded and clasping (proximal leaves tapered to a narrowly clasping base); blades dark green, abaxial surface glabrate or those toward inflorescence moderately pubescent; adaxial surface with scattered, eglandular, straight, sharp-tipped white hairs 0.1–0.3 mm, especially near midvein, otherwise glabrate. **Inflorescence** a terminal thyrses, 5–20 cm \times 3–12 cm, bracts at base of inflorescence 3–6(–8) cm \times 0.7–3 cm, half to sometimes equaling the distalmost non-bracteal stem leaves, primary inflorescence bracts narrowly lanceolate with dilated bases, secondary inflorescence bracts narrowly lanceolate to linear, sometimes abruptly dilated at base; inflorescence glandular-capitate. **Flowers** slightly nodding; pedicels 1.5–4 mm, pubescent with glandular-capitate hairs. **Calyx** campanulate with 5 subequal sepals; these distinct nearly to base, lance-attenuate and becoming strongly recurved, green with thin hyaline margins proximal to middle, 4–5.5 mm \times 1 mm, abaxial surface and margins moderately covered with gland-tipped

hairs, adaxial surface glabrous. **Corolla** bilabiate, tubular-funnelform, 10–16 mm, prominently 2-ridged within on abaxial surface, pale lavender (adaxial surface of lobes nearly white) or sometimes nearly white with prominent (sometimes faint) purple guide lines, especially on the abaxial surface of the corolla throat and on the adaxial surface of corolla lobes, pubescent externally with glandular-capitate hairs; tube 6–7 mm, throat 5–7 mm long, open, abruptly expanded from the tube, lobes 5, 4–5 mm, abaxial lobes 3, spreading and declined, projecting beyond the adaxial lobes, adaxial lobes 2, slightly shorter than the abaxial ones, upwardly curved to erect. **Stamens** 4, included in throat, filaments strongly curving, 10–12 mm, anthers very finely papillose, the 2 locules strongly divergent, each 0.8 mm × 0.5 mm. **Staminode** 7–8 mm, reaching the orifice and slightly exserted, densely bearded in distal 4–5 mm, beard golden-brown, beard hairs 1–1.2 mm. **Cap-sules** broadly ovoid, narrowly rounded at apex, 5–6 mm × 3.5–4 mm. Seeds ca. 1 mm (not seen at full maturity). **Chromosome number** unknown.

Additional specimens examined: **UNITED STATES. ALABAMA. Blount Co.:** banks of small calcareous branch near NW base of Warnock [sic, recte Wornock] Mountain, 4 May 1938, R. Harper 3658 (MO); 2.25 air mi. NW of Brooksville, area just N of Curtis Williams Lake, E of US Hwy 231, 30 Apr 2011, B.R. Keener 6430 with T. Keener & W.K. Webb (UWAL). **Jackson Co.:** 0.4 of a mi E on US 72 from its jct. with Jackson County Road 63, 19 May 1990, S. & G. Jones 4880 (VDB). **Madison Co.:** mountain region, Huntsville, 29 May 1896, L.M. Underwood s.n. (ALU); along brook at dead end of Ridgeview Circle in SE Huntsville, 3 May 1964, A. Aller 42 (VDB); open woods on a hill off Highway 231 in vicinity of Mt. Charon, May 1973, P. Benson s.n. with K. Gentle & P. Weeks (UNA); rich woods along Mountain Fork Creek outside New Market, 9 Jun 1997, S.J. Threlkeld 1044 with J.F. Duke (JSU). **Morgan Co.:** edge of mesic woods above cutoff of Flint Creek, 1.2 mi S [of] Lacon, 29 May 1970, R. Kral 39341 (MO, VDB); Newsome's Sinks 1.0 mi W of Morgan City, 24 May 1980, R.A. Meigs 625 (UNA). **TENNESSEE. Franklin Co.:** 6 km SE of Huntland, lower S slope of Cedar Ridge near junction of Arkansas Hollow and Opossum Hollow, along N side of Arkansas Hollow Road, edge of dry oak-hickory forest over Mississippian limestone, 35.005382°N, -86.235979° W, 4 May 2011, D. Estes 11,901 with D. York & C. Gorman (APSC, TENN); 4.3 km SSE of Cowan, S end of Keith Cove, along jeep trail on lower NE facing slope above Keith Cove Road, edge of oak-hickory forest over Mississippian limestone, 35.126885° N, -86.000705° W, 25 May 2011, D. Estes 11,902 with D. York, C. Gorman, M. Bruton, R. Shepard et al. (APSC, TENN, NCU).

Etymology.—The epithet “*kralii*” was chosen to honor Dr. Robert Kral (1926–), one of the top 20th-Century American plant taxonomists. Dr. Kral is Professor Emeritus of Vanderbilt University, curator of the VDB herbarium and research associate at the Botanical Research Institute of Texas in Ft. Worth. He has arguably been one of the most significant contributors to the flora of the eastern United States and is widely renowned for his knowledge of the flora of the southeastern U.S. Dr. Kral's professional accomplishments are extraordinary. During his 52-year career he has collected nearly 100,000 specimen numbers, not to mention hundreds of thousands of duplicates that have been widely disseminated to dozens of herbaria. Additionally, he has named more than 100 new species, including new taxa from both North and South America. He has tackled many difficult taxonomic problems in eastern North American botany and his work has clarified such difficult genera as *Carex*, *Eriocaulon*, *Fimbristylis*, *Rhynchospora*, and *Xyris*. Although not widely circulated, Dr. Kral's two-volume, 1,305-paged U.S. Forest Service report, “A Report on Some Rare, Threatened, or Endangered Forest-Related Vascular Plants of the South” remains perhaps the most important single contribution to our understanding of rare and narrowly endemic plants of the southeastern U.S. since J.K. Small published his *Manual of the Southeastern Flora* in 1933. Dr. Kral continues to publish and work on taxonomic treatments, especially of New World Xyridaceae, and *The Flora of Alabama and Middle Tennessee*. Given Dr. Kral's exceptional taxonomic eye and the fact that he has collected plants all over the Southeast, it is no surprise that he collected this new *Penstemon* from Morgan County, Alabama in 1970. I have always admired and been inspired by Dr. Kral's accomplishments and quality of work and it is my pleasure to name this new species in his honor.

Common Name.—Kral's Beardtongue

Distribution and Ecology.—*Penstemon kralii* is endemic to the lower slopes of the southwestern Cumberland Plateau escarpment of northeastern Alabama and southeastern middle Tennessee (Fig. 3). It is found at the edges of calcareous juniper-oak-hickory woodlands over Mississippian-aged limestone at elevations ranging from 198–335 m (650–1,100 ft) above sea level. Tree species characteristically found with *P. kralii* include *Quercus muehlenbergii* Engelm., *Q. shumardii* Buckley, *Carya carolinae-septentrionalis* (Ashe) Engl. & Graebn., *Fraxinus americana* L., *Juniperus virginiana* L., *Ulmus alata* Michx., and *Cotinus obovatus* Raf. Small tree and shrub species include *Cercis canadensis* L., *Viburnum rufidulum* Raf., *Sideroxylon lycioides* L., *Hypericum frondosum* Michx., and *Forestiera ligustrina* (Michx.) Poir. Herbaceous species at

these sites include *Camassia scilloides* (Raf.) Cory, *Clematis glaucophylla* Small, *Helianthus microcephalus* Torr. & A. Gray, *Polymnia canadensis* L., *Silphium brachiatum* Gatt., *Sisyrinchium* sp. nov., *Solidago auriculata* Shuttlew. ex S.F. Blake, *Spigelia marilandica* (L.) L., *Verbesina virginica* L., and *Vernonia flaccidifolia* Small.

Conservation Status.—*Penstemon kralii* is known only from a few sites in five counties of Alabama and Tennessee. The paucity of collections in herbaria gives some indication as to its rarity. Judging from the absence of herbarium specimens, *P. kralii* apparently has not been collected from Tennessee prior to this study. This is intriguing given the abundance of fieldwork that has been conducted in southern Franklin County. Although more extensive surveys will almost certainly result in the discovery of additional populations it is likely that this species is truly rare and deserving of protection at the state level.

Collection History.—The earliest collection found for *P. kralii* dates to 1896 from near Huntsville, Alabama. In 1938, Roland Harper collected it in Blount County, Alabama. His typed label originally did not give a specific epithet for the collection. Sometime after the original label was made, the inscription “*laevigatus?*” was added in pencil, though it is not clear whether this was by Harper or someone else. In 1970, Robert Kral collected this species from Morgan County, Alabama, and identified his specimen as “*P. laevigatus?*”. From Kral’s inclusion of the question mark, it is clear that he was not satisfied with his determination. Between 1964 and 1997, the species was collected several times by various botanists, adding additional collections from nearby Jackson and Madison counties in Alabama. The first collections of this species from Tennessee were made in May 2011 during this study. A review of specimens at TENN, UOS, UCHT, APSC, and VDB failed to reveal any prior collections from Tennessee.

Comparison with Similar Species.—In the herbarium *Penstemon kralii* resembles *P. laevigatus* Ait., *P. tenuis*, and *P. smallii*. *Penstemon laevigatus* is considered to be closely allied to *P. calycosus* Small and *P. digitalis* Nutt. ex Sims (Pennell 1935). *Penstemon laevigatus* shares the following characteristics with *P. digitalis* and *P. calycosus*: (1) leaves generally entire to remotely toothed; (2) stems, below the inflorescences, eglandular-puberulent with very short trichomes either arranged in lines or essentially lacking, usually not consistently covering the stems; (3) corolla tubes conspicuously and greatly dilated into the much expanded throats; (4) interior ventral surfaces of the corolla throats flat and not distinctly 2-ridged. In contrast *P. kralii* differs in having (1) leaves that are consistently closely and sharply serrate; (2) stems that are closely and consistently eglandular-puberulent throughout; (3) corolla tubes that are slightly expanded and lack conspicuously dilated throats; and (4) interior abaxial surfaces of the corolla throats distinctly and prominently 2-ridged. It should be noted that corolla tube dilation is relative. *Penstemon kralii* has tubes that are dilated compared to other *Penstemon* species (e.g., *P. tenuiflorus* Pennell), but they are not nearly as dilated as in *P. calycosus*, *P. digitalis*, and *P. laevigatus*.

The combination of features described above for *P. kralii* is also found in *P. smallii* and *P. tenuis*. None of these species overlaps in distribution with *P. kralii*. From *P. tenuis*, *P. kralii* differs in its wider leaves, paler corollas (lavender to whitish with conspicuous dark purple veins vs. darker lavender, purple, or pink and inconspicuously-lined in *P. tenuis*), and less-dilated corolla throats. *Penstemon kralii* also grows in a very different habitat compared to *P. tenuis*. It is an upland plant of dry to submesic or rarely rich soil in edge habitats or along streams over limestone on mountainsides. In contrast, *P. tenuis* is a wetland plant that grows in bottomland hardwood forests, seasonally wet flatwoods, wet ditches, and wet prairies. *Penstemon kralii* and *P. tenuis* also occur in two different regions. *Penstemon kralii* is endemic to the southern Cumberland Plateau escarpment of Alabama and Tennessee; *P. tenuis* is found from coastal east Texas east to southeastern Louisiana north to southeastern Missouri where it is found mostly in the floodplain of the Mississippi River and its major tributaries. *Penstemon kralii* is separated 300 km from the nearest populations of *P. tenuis* in the Mississippi Alluvial Plain of west-central Mississippi. Small’s (1903) report of *P. tenuis* from Alabama may be based on *P. kralii*.

Based on morphology, *P. kralii* and *P. tenuis* seem to form a natural group with *P. smallii*. *Penstemon smallii* is readily differentiated from smaller-flowered *P. kralii* and *P. tenuis* (corollas of both 10–16 mm) by its much larger corollas (28–35 mm long). The corollas of *P. smallii* are dark pinkish or purplish and more closely resemble the pinkish or purplish corollas of *P. tenuis* than the very pale lavender to nearly white corollas of *P. kralii*. It also has generally larger leaves. In terms of habitat *P. smallii* and *P. kralii* are somewhat similar. Both occur in upland, dissected, and generally mountainous terrain, and both often grow in edge habitats. *Penstemon smallii* typically occurs in moister habitats than *P. kralii* and is rarely associated with limestone-derived

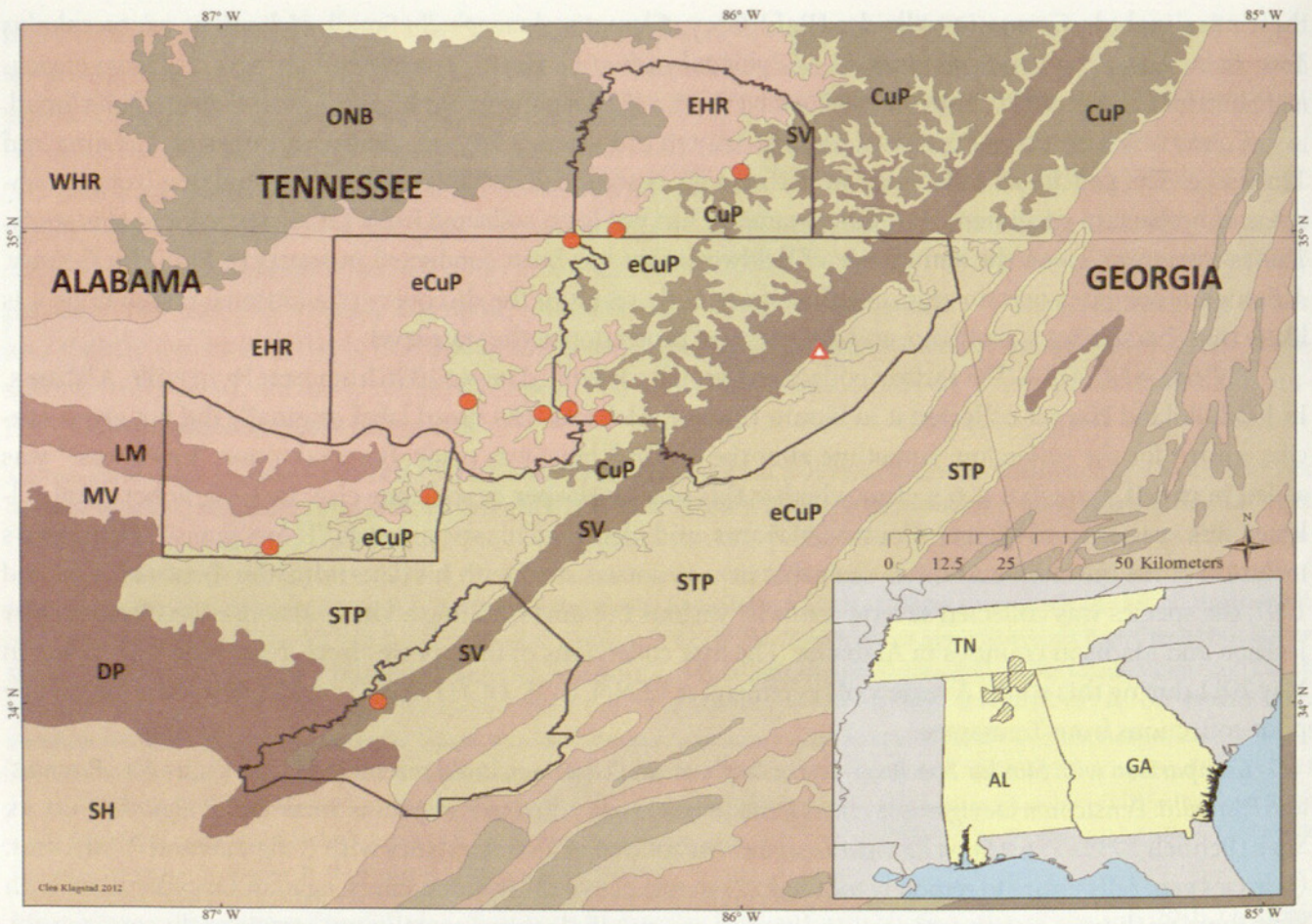


Fig. 3. Distribution of *Penstemon kralii* (circles). The triangle represents a fruiting specimen (Gunn & Bailey 2008, VDB) that is either *P. kralii* or *P. smallii*; its specific identity cannot be determined at this time without flowers. Physiographic designations primarily follow Griffith et al. (2001). CuP = Cumberland Plateau; eCuP = Cumberland Plateau Escarpment; DP = Dissected Plateau; EHR = Eastern Highland Rim; LM = Little Mountain; MV = Moulton Valley; ONB = Outer Nashville Basin; SH = Shale Hills; STP = Southern Table Plateaus; SV = Sequatchie Valley; WHR = Western Highland Rim.

soils. *Penstemon smallii* is a Southern Appalachian endemic found in the Blue Ridge Mountains and adjacent Ridge and Valley province. It is known from western North Carolina, eastern Tennessee, northern Georgia, and northwestern South Carolina. The southwestern-most occurrence of *P. smallii* is from banks of the Tennessee River near Chattanooga, Hamilton County, Tennessee, ca. 95 km NE of the nearest *P. kralii* population in Jackson County, Alabama. In the course of this study, all records of *P. smallii* from Tennessee and Alabama were carefully checked for accuracy. Previous Alabama reports from Clay and Pike counties proved to be based on misidentifications of *Penstemon australis* Small (C. Hansen, Auburn University, pers. comm. & A.R. Diamond, Troy University, pers. comm.). Two additional specimens from northeastern Alabama were found that were identified as *P. smallii*. One of these, a collection from Madison County (Threlkeld & Duke 1044, JSU), is actually *P. kralii*. The other is a fruiting collection from bluffs above the Tennessee River in eastern Jackson County (Gunn & Bailey 2008, VDB). This population is located 44 km E of the nearest *P. kralii* population in extreme western Jackson County and 55 km SW of the nearest occurrence of *P. smallii* in Hamilton County, Tennessee (also on a bluff of the Tennessee River). Because this specimen is in fruiting condition, it cannot be positively determined whether it is *P. kralii* or *P. smallii*. A visit to this population during flowering will be necessary to make a correct identification. If it is *P. kralii*, then it would be the easternmost population. If it is *P. smallii*, then it would be the southwesternmost occurrence for what is primarily a Blue Ridge species and Alabama's only population.

UPDATED KEY TO *PENSTEMON* OF THE SOUTHEASTERN* UNITED STATES

1. Cauline leaves deeply pinnatifid to bipinnatifid _____ ***P. dissectus* Ell.**
1. Cauline leaves entire or toothed.

2. Leaves connate-perfoliate, glaucous; corollas scarlet _____ ***P. murrayanus*** Hook.
2. Leaves sessile, not glaucous; corollas white, pink, lavender, or purplish.
 3. Corollas 35–55 mm; capsules 13–18 mm × 8–10 mm.
 4. Corollas white to pink _____ ***P. cobbiae*** Nutt. var. ***cobbiae***
 4. Corollas violet to purple _____ ***P. cobbiae*** Nutt. var. ***purpureus*** Pennell
 3. Corollas 12–35 mm; capsules 7–14 mm × 3–6 mm.
 5. Anther sacs only partially dehiscent, the distal halves or two-thirds remaining indehiscent _____ ***P. multiflorus*** Chapm. ex Benth.
5. Anther sacs dehiscent completely from connectives to tips.
 6. Corollas weakly bilabiate, white, unlined, tubes glandular-puberulent internally, gradually dilated into the throats; stems glabrous; cauline leaves abruptly reduced distally _____ ***P. tubaeiflorus*** Nutt.
 6. Corollas distinctly bilabiate, variously colored, lined (except *P. hirsutus*, *P. tenuiflorus* and *P. oklahomensis*); corolla tubes glabrous or eglandular-pubescent internally, abruptly or gradually dilated into the throats; stems pubescent throughout, pubescent in lines or patches, or glabrous; cauline leaves gradually reduced distally or not notably reduced.
 7. Abaxial and adaxial corolla lobes about equal in size, corollas not strongly 2-ridged on the abaxial surface within, corolla tubes conspicuously dilated into the throats; stems (proximal to inflorescences—check midstem) glabrous or puberulent with short, eglandular hairs distributed in patches or lines and not covering entire stem surfaces (*Penstemon digitalis* Complex).
 8. Corollas 20–35 mm long.
 9. Corollas white with purple lines; sepals ovate to ovate-lanceolate, acuminate into apex, 4.5–6.5 mm at anthesis; anthers with several to many hairs _____ ***P. digitalis*** Nutt. ex Sims
 9. Corollas purplish to lavender; sepals linear-lanceolate, straight-attenuate into apex, 5–9 mm at anthesis; anthers finely glabrous to papillose _____ ***P. calycosus*** Small
 8. Corollas 15–23 mm long.
 10. Sepals 1.5–3.5(–4) mm; corollas white _____ ***P. deamii*** Pennell
 10. Sepals 3–6 mm; corollas tinged with lavender or white.
 11. Leaves mostly 1.5–2.5 cm wide; anthers glabrous or papillose _____ ***P. laevigatus*** Ait.
 11. Leaves mostly 2.5–4 cm wide; anthers bearded or with long papillae _____ ***P. alluviorum*** Pennell
 7. Abaxial corolla lobes exceeding adaxial lobes, corollas strongly 2-ridged on the abaxial surface within, corolla tubes slightly to moderately dilated into the throats; stems (proximal to inflorescences—check midstem) pubescent throughout, the hairs either with a mix of longer glandular and shorter eglandular hairs or with only short, eglandular hairs.
 12. Stems (proximal to inflorescences—check midstem) with a mix of longer glandular and shorter eglandular hairs.
 13. Corolla throats closed or nearly so (abaxial lips arching upward pressing against the adaxial lips); corollas unlined or very obscurely lined (except *P. australis*).
 14. Corollas lined; inflorescence branches stiffly erect, nearly paralleling the inflorescence axes _____ ***P. australis*** Small
 14. Corollas unlined; inflorescence branches spreading-ascending, diverging from inflorescence axes (*Penstemon hirsutus* Complex).
 15. Corollas tinged with purplish-violet, lobes often white; leaves sparsely pubescent to glabrate (at least between veins) _____ ***P. hirsutus*** (L.) Willd.
 15. Corollas creamy-white to ochroleucous throughout; leaves moderately to densely pubescent or puberulent.
 16. Leaves moderately to densely glandular pubescent; plants of AL, TN, and KY _____ ***P. tenuiflorus*** Pennell
 16. Leaves puberulent; plants of OK and TX _____ ***P. oklahomensis*** Pennell
 13. Corolla throats open (abaxial lips not arching up against the adaxial lips, except sometimes nearly closed in *P. australis*); corollas lined (at least internally) (*Penstemon canescens* Complex).
 17. Corollas 14–23 mm.
 18. Sepals 2–3.5 mm, 1–1.5 times longer than wide; corollas pale lavender (sometimes appearing nearly white, especially on herbarium specimens) _____ ***P. brevisepalus*** Pennell
 18. Sepals 3–5 mm, 1.5–2.5 times longer than wide; corollas creamy white with violet lines _____ ***P. pallidus*** Small
 17. Corollas 20–32 mm.
 19. Corollas 20–25 mm; sepals 4–5.2 mm; inflorescence branches stiffly erect, nearly paralleling the inflorescence axes _____ ***P. australis*** Small
 19. Corolla 20–30 mm; sepals 3.2–4.5 mm; inflorescence branches spreading-ascending, diverging from inflorescence axes _____ ***P. canescens*** (Britt.) Britt.
 12. Stems (proximal to inflorescences—check midstem) with only short, eglandular hairs (rarely with a few glandular in *P. smallii*).
 20. Leaves linear-lanceolate, 4–5 times longer than wide, 4–28 mm wide.
 21. Corollas 20–35 mm; leaves usually dilated at base; capsules 8–10 mm × 6–7 mm _____ ***P. laxiflorus*** Pennell
 21. Corollas 10–20 mm; leaves not conspicuously dilated at base; capsules 4–7 mm × 4–5 mm _____ ***P. arkansanus*** Pennell

20. Leaves ovate-lanceolate to lanceolate, 2.5–4 times longer than wide, 15–60 mm wide (*Penstemon smallii* Complex).
22. Corollas 28–35 mm, lavender, violet, or purple; staminodes 15–18 mm, densely bearded in the distal 13–15 mm; largest leaf blades mostly 30–60 mm wide _____ **P. smallii** Heller
22. Corollas 10–16 mm; staminodes 7–9 mm, densely bearded in the distal 4–5 mm; largest leaf blades mostly 10–40 mm wide.
23. Leaves mostly 10–30 mm wide; corolla lavender, pink, or violet, inconspicuously-lined with reddish-purple lines, sepals ovate-lanceolate; plants of wetlands _____ **P. tenuis** Small
23. Leaves mostly 30–40 mm wide; corolla pale-lavender to whitish, usually strongly lined with dark violet lines, sepals linear-attenuate; plants of dry or mesic calcareous uplands _____ **P. kralii** D. Estes

**Penstemon fendleri* Torr. & A. Gray, *P. grandiflorus* Nutt., and *P. triflorus* A. Heller occur along the extreme western portion of what some consider the Southeastern U.S. in central Texas. These species have ranges that occur primarily west of the Eastern Deciduous Forest region and are excluded from the above key. Measurements in the key and text refer to length unless specified otherwise.

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REFERENCES

- ESTES, D. AND J. BECK. 2011. A new species of *Polymnia* (Asteraceae: Tribe Polymnieae) from Tennessee. *Syst. Bot.* 36:481–486.
- GRIFFITH, C.E., J.M. OMERNIK, J.A. COMSTOCK, G. MARTIN, A. GODDARD, AND V.J. HULCHER. 2001. Ecoregions of Alabama. U.S. Environmental Protection Agency, National Health and Environmental Effects Research Laboratory, Corvallis, OR.
- KRAL, R. 1987. A new “Viorna” *Clematis* from northern Alabama. *Ann. Missouri Bot. Gard.* 74:665–669.
- PENNELL, F.W. 1935. The Scrophulariaceae of eastern temperate North America. *Acad. Nat. Sci. Philadelphia Monogr.* No. 1.
- SIMMERS, R.W. AND R. KRAL. 1992. A new species of *Blephilia* (Lamiaceae) from northern Alabama. *Rhodora* 94:1–14.
- SMALL, J.K. 1903. *Flora of the southeastern United States*. New Era Printing Company, Lancaster, PA.
- WOLFE, A.D., C.P. RANDLE, S.L. DATWYLER, J.J. MORAWETZ, N. ARGUEDAS, AND J. DIAZ. 2006. Phylogeny, taxonomic affinities, and biogeography of *Penstemon* (Plantaginaceae) based on ITS and cpDNA sequence data. *Amer. J. Bot.* 93: 1699–1713.



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