

## ***Penstemon lanceolatus* Benth. or *P. ramosus* Crosswhite in Arizona and New Mexico, a Peripheral or Endemic Species?**

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**ABSTRACT.** The red-flowered member of *Penstemon* sect. *Chamaeleon* from southeastern Arizona and southwestern New Mexico has been treated taxonomically both as part of the Mexican species, *P. lanceolatus* Benth., and as a separate species, *P. ramosus* Crosswhite. Under the former treatment the Arizona and New Mexico populations are peripheral populations of a primarily Mexican species; and, under the latter they represent an endemic species restricted to this area. *Penstemon ramosus* was distinguished from *P. lanceolatus* by branching below the inflorescence and by having narrow, revolute leaves. Morphological examination of herbarium specimens from Arizona, New Mexico, Texas, and Mexico, including duplicates of paratypes cited in the original publication of *P. ramosus*, and of field material in Arizona and New Mexico showed no consistent differences in these characters throughout the entire range. Therefore, *Penstemon ramosus* should be synonymized under *P. lanceolatus*, and Arizona and New Mexico plants that have been distinguished as *P. ramosus* should be treated as peripherals of *P. lanceolatus*.

Peripheral populations of a species are those that occur at the edge of the range of the species. Depending on the connectivity of habitat and topography, these peripheral populations may be continuous with the main body of the species, or fragmented from it. The degree of habitat change may depend on the extent of the overall range of the species. Wide ranging species could have very different environmental conditions at the geographic extremes of their range. In addition, if the habitat conditions, for instance climate and topography, have been altered at the edge of the range, peripheral populations may start to evolve different adaptive characters through incipient speciation; or, isolated peripheral populations may diverge from the rest of the species through founder effects. Also, disjunctions may be an artifact of lack of collections, especially in remote areas.

In the case of *Penstemon lanceolatus* Benth. and *P. ramosus* Crosswhite, the former taxon has been treated as a wide ranging species with scattered occurrences from central Mexico north to southern Texas, New Mexico, and Arizona (Straw 1959, 1992; Kearney and Peebles 1960; Nisbet and Jackson 1960). More recently, Crosswhite (1966) named the peripheral populations of Arizona and New Mexico as a separate species, *Penstemon ramosus*, which became, in consequence, a narrow endemic species; and as a result, it is considered a BLM Las Cruces Field Office sensitive species, a Region 3 Forest Service sensitive species, and a New Mexico State species of concern (Figure 1). Accordingly, the taxonomic status of *Penstemon ramosus* as either an endemic species or the northwesterly peripheral populations of a more widespread *P. lanceolatus* will effect its conservation

status vis-à-vis a sensitive species. Kartez (2003) cites *Penstemon ramosus* for the United States and not *P. lanceolatus*

These two beardtongues are in *Penstemon* section *Chamaeleon* Crosswhite, which is "...separated from other sections by the peculiarly flattened and twisted anther sacs which are usually sharply toothed or stoutly hispid at the suture..." (Crosswhite 1966). Although flower color in species of section *Chamaeleon* may be either red or blue-purple, both *P. lanceolatus* and *P. ramosus* have red flowers. The type collection (Fig. 2) of *Penstemon lanceolatus* (Hartweg 184 GH, NY) is from Aguas Calientes, Mexico. It was named by Bentham in 1839

(Bentham 1970 reprint). The type material upon which Crosswhite (1966) based *Penstemon ramosus* is a collection ("...on a bluff of the Gila River in extreme southwestern New Mexico, near the border of Arizona...", August 30, 1880, *Greene 281* (GH)) used by Greene (1881) as the type of *P. pauciflorus*, a later homonym of *P. pauciflorus* Buckley. In his publication Crosswhite

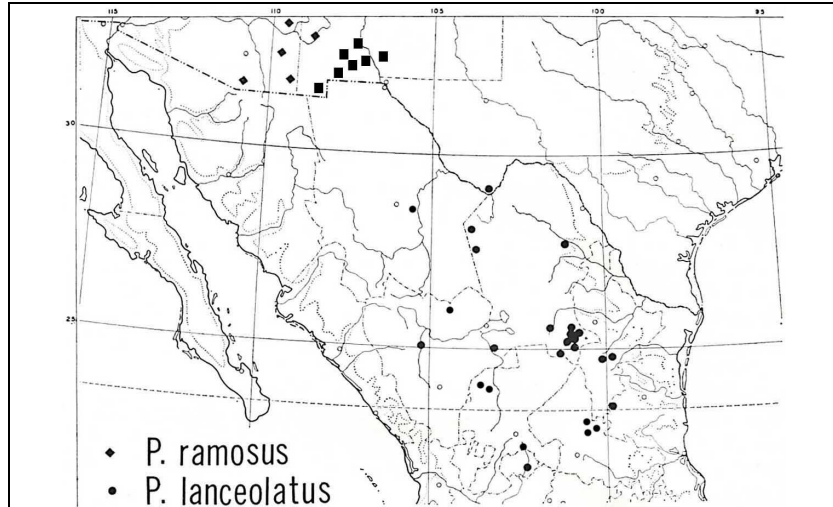


FIGURE 1. Map of the Southwest showing locations of *Penstemon lanceolatus* (circles) and *P. ramosus* (diamonds old records and squares new records) as separate species.



FIGURE 2. Type specimen of *Penstemon lanceolatus*, Hartweg 184 (NY).



FIGURE 3. Duplicate of paratype of *Penstemon ramosus*, Peebles and Loomis 5847 (ARIZ).

(1966) only cited this one population of *Penstemon ramosus* from New Mexico (two others by allusion) and four others from Arizona (Fig. 3) which made *P. ramosus* appear geographically isolated from the rest of *P. lanceolatus*. Crosswhite (1966) morphologically distinguished *Penstemon ramosus* from *P. lanceolatus* based on the characters in Table 1

TABLE 1 □ Comparison of morphological characters used by Crosswhite (1966) to separate *Penstemon ramosus* from *P. lanceolatus*.

| <i>Penstemon ramosus</i>               | <i>Penstemon lanceolatus</i>             |
|----------------------------------------|------------------------------------------|
| Stems branched below the inflorescence | Stems unbranched below the inflorescence |
| Leaves linear, 1-6 mm wide             | Leaves lanceolate 4-8 mm wide            |
| Leaves revolute                        | Leaves not revolute                      |

#### METHODS

At present, there are several more herbarium collections on hand than were available to Crosswhite and, accordingly, more locations are known for *Penstemon ramosus*. For that reason additional existing material is available for comparison of the two taxa. In 2003 we studied thirty eight herbarium collections of both beardtongues at ARIZ, ASU, and NMSU (Table 2) including duplicates of paratypes for *Penstemon ramosus*: Maguire 11723, Maguire 11181, and Peebles and Loomis 5847 (all ARIZ) cited by Crosswhite (1966). Specimens were primarily examined for the specific key characters cited by Crosswhite (1966) of inflorescence branching (“ramosus” means branched), leaf width, and

revolute leaf edge; in addition, other taxonomically important characters in *Penstemon* were looked at. In June 2003 we visited several of these new herbarium collection locations in southwestern NM, obtained mostly from records of the NM Heritage Program Database. These sites included the Sierra de las Uvas Mountains in Dona Ana County, the Cooke’s Range, Florida Mountains, and Tres Hermanas Mountains in Luna County, and the Alamo Hueco Mountains in Hidalgo County. The fieldwork was conducted under extreme drought conditions that affected the results of number of plants found. (Sites were also visited in AZ, but, due to extreme drought conditions, no beardtongue plants were seen). Exact locations, habitat data, and associated species are given in the Appendix.

TABLE 2—List of herbarium specimens examined.

| ARIZ                    | ASU                      | NMSU                      |
|-------------------------|--------------------------|---------------------------|
| Maguire 11723           | Lehto 4034 (first)       | Whitefield s.n.           |
| Maguire 11181           | Lehto 4034 (duplicate)   | Weber s.n.                |
| Peebles and Loomis 5847 | Pinkava et al 5813       | Todsen 8406-1             |
| Loomis and Peebles 5430 | Pinakava et al 6124      | D. L. Anderson 6184       |
| Walker s.n.             | Pinkava and Reeves 13158 | Spellenberg et al 5436    |
| Zimmerman 2337          | Pinkava et al 9490       | Columbus 1299             |
| Worthington 19804       | Lehto et al 21802        | Todsen s.n. (Sierra Co.)  |
| Maguire 11547           | Engard 707 and Gentry    | Todsen s.n. (Hidalgo Co.) |
| Mearns 2353             | Pinkava 13245            | Worthington 21968         |
| Warnock 904             |                          |                           |
| Stanford et al 28       |                          |                           |
| Rodriguez 919           |                          |                           |
| Shreve 8544             |                          |                           |
| Stanford et al 538      |                          |                           |
| Engard and Gentry 23216 |                          |                           |
| Walker s.n.             |                          |                           |
| Lundell 5057            |                          |                           |
| Stanford 612            |                          |                           |
| Hinton 21892            |                          |                           |
| Starr 581               |                          |                           |

## RESULTS

Thirty eight *Penstemon* herbarium specimens were examined morphologically (see Table 2 above). Twenty one specimens from Arizona and New Mexico have been annotated as *Penstemon ramosus* and seventeen from Mexico and Texas as *P. lanceolatus*. Of these thirty eight only three specimens have branched stems: one each from New Mexico, Tres Hermanas Mountains (Worthington 19804 ARIZ); Texas, Big Bend area (Warnock 904 ARIZ), and Mexico, Coahuila-Sierra San Marcos (Pinkava 13158 ASU); the few other specimens with branched stems have had the main stem clipped by herbivory with resultant side branching.

A close assessment of the leaves of these thirty eight specimens showed that, if not flat, they are usually conduplicate, but seldom revolute; and, in those specimens with some revolute leaves, this character state is mixed with conduplicate leaves (Maguire 11723 ARIZ; Weber s.n. NMSU; Todsén s.n. Hidalgo Co. NMSU; Worthington 21698 NMSU). Average width of leaves is 3-6 mm from narrowly linear to narrowly lanceolate; there is a tendency to narrower leaves in Arizona and New Mexico and wider leaves in Mexico, but there is overlap in leaf width on individual plants and throughout the overall geographic range.

The three duplicates of paratypes of *Penstemon ramosus* examined all had unbranched stems similar to *P. lanceolatus* and linear leaves with a combination of leaf edge forms (Figure 3).

Comparison of other *Penstemon* taxonomic characters, such as, for instance, flower color and shape, anther

dehiscence type and denticulation, staminode pubescence and position, calyx shape, and inflorescence glandularity, confirmed no differences between the two taxa.

From June 17-20, 2003, the authors and Douglas Newton, Arizona Native Plant Society volunteer, visited locations of newer records of *Penstemon ramosus*. At the Sierra de las Uvas Mountains we found twenty-five plants on the rocky, lower slopes of Sierra Alta Peak growing on volcanic tuff in juniper-grassland (Figure 4). One plant had one faded flower and several capsules. Some plants were branched due to herbivory, the others plants had unbranched stems and leaves that were either conduplicate or involute. In the Cooke's Range we found only one plant, but it was in full bloom; a single stem was vouchered. This plant was growing in a rocky, igneous basin with pinyon-juniper woodland and chaparral. At Mahoney Park in the Florida Mountains we again found about twenty-five plants, half adult with some in fruit, and half juveniles. This population was growing on limestone hills in Chihuahuan Desertscrub (Figure 5). None of these plants had branched stems and the leaves were conduplicate or involute (Figure 6). At South Peak of the Tres Hermanas Mountains we located just two plants growing on a granite boulder covered hillside with juniper, chaparral, and grassland species. We searched the Thicket Spring area of the Alamo Hueco Mountains without success. Most sites, except Mahoney Park, have been heavily grazed which may have impacted the results of numbers of plants found.

Earlier in June, 2003, Richmond-Williams found a single unbranched plant in flower in Sierra County, Tierra



FIGURE 4. *Penstemon* plant with unbranched stems on volcanic tuff at Sierra Alta Peak in the Sierra de las Uvas, Dona Ana County, NM. Note single flower on left most stem.



FIGURE 5. *Penstemon* habitat in limestone hills at Mahoney Park in the Florida Mountains, Luna County, NM.



FIGURE 6. *Penstemon* plant showing conduplicate leaves from the Florida Mountains, Luna County, NM.

Blanca Canyon, in rocky soils with juniper-grassland. Additional new *Penstemon* locations not visited include: Hidalgo County, the Banner Mine in the Pyramid Mountains, the Big Hatchet Mountains, and the Dog Springs Mountains; Dona Ana County, Summerford Mountain in the Dona Ana Mountains and the San Andres Mountains in White Sands Missile Range; Sierra County near Caballo Dam; and Grant County near Red Rock. Interestingly, the last named location may be near the type locality of the species named by Greene (1881) as *Penstemon pauciflorus*.

## DISCUSSION

*Penstemon* is one of the “macro-genera” cited by Shultz (1993) with a high number of species and endemics in the Utah flora. Its center of diversity is in the Intermountain Region and its high level of endemism is due to “...edaphic endemism and geographic isolation...” (Shultz 1993). This specialized habitat pattern important to the speciation of narrow endemics is not shared by *Penstemon lanceolatus* and *P. ramosus*. These taxa grow on similar common edaphic and vegetative habitat throughout their range: a foothill zone of desert mountains from the upper edge of Chihuahuan Desertscrub, semi-desert

grassland, and chaparral, to the lower edge of pinyon-juniper-oak woodland; each locality may be a combination of species from all of these communities (see Appendix). These biotic communities extend throughout this geographic range (Brown 1982). Soil habitats are diverse, including granite, igneous, limestone, and alluvium, but not specialized edaphic habitats; the common denominator on herbarium labels is “rocky”. Even with these generic habitat types and accordingly large areas of potential habitat, the beardtongues in question are usually described as uncommon on herbarium labels. Although they have large showy red flowers, they are vegetatively quite cryptic in appearance which may have caused them to be overlooked in the field. Their foothill habitat has been heavily impacted by overgrazing in the past and that may have had an effect on their “uncommonness”.

Based on our examination of more recent herbarium specimens and live field material during visits to several new locations, the *Penstemon* specimens, including duplicates of paratypes of *P. ramosus*, showed no consistent differences in the characters used by Crosswhite (1966) to distinguish *Penstemon ramosus* from *P. lanceolatus*, or in other *Penstemon* taxonomic characters as well. Although Crosswhite (1966) lists revolute leaves as a key character of *Penstemon ramosus* (p. 340), his description of the species calls the leaves involute (p. 342). This difference confuses the use of this morphological character in defining and distinguishing the two *Penstemon* taxa. Also, the branched stem specimen from Texas (Warnock 904 ARIZ) is annotated by Crosswhite as *Penstemon lanceolatus* (Figure 7), which seems to further blur

their distinction as different taxa. In the original description of this *Penstemon* by Greene (1881), he states “...stems 2 feet high, suffrutescent at base, and with a few strict branches...” suggesting that his plants were unbranched. In his *Penstemon* treatment for the Chihuahua Desert Flora, Straw (1992), also, treats *Penstemon ramosus* in synonymy with *P. lanceolatus*.

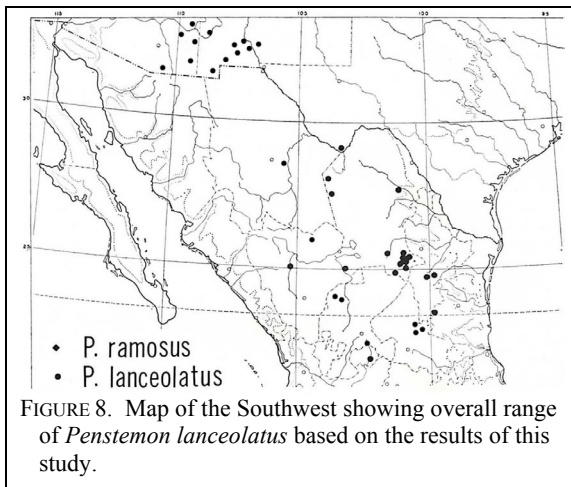


FIGURE 7, Specimen from Texas (Warnock 904 ARIZ) with branched stems and annotated as *Penstemon lanceolatus* by Crosswhite (see center label).

The additional recent collections from several different mountain ranges in southwestern New Mexico have established a more continuous distribution between southeastern Arizona and central Mexico. The formerly “disjunct” populations in Arizona and New Mexico named as *Penstemon ramosus* are now shown to be more closely connected to the remainder of the range of *P. lanceolatus*

in Texas and Mexico. Additional *Penstemon* surveys are recommended in the desert mountains of Chihuahua and western Texas to determine further connectivity in range.

Based on the lack of confirmed morphological differences and lack of geographical or ecological isolation potentially leading to speciation (as a result of greater connectivity of distribution and similar habitat types discussed above), *Penstemon ramosus* should be treated as a synonym under *P. lanceolatus*; and, the Arizona and New Mexico plants included in an endemic *Penstemon ramosus* that were formerly treated as *P. lanceolatus* should again be treated as peripheral populations of *P. lanceolatus* (Figure 8). *Penstemon ramosus* ought to be removed as a BLM Las Cruces Field Office sensitive species, a Region 3 Forest Service sensitive species, and a New Mexico State species of concern.



#### ACKNOWLEDGMENTS

The herbarium curators at ARIZ, ASU, NMSU, and RSA were very helpful in supplying specimens for examination and botanical references from their libraries. Ms. Shannon Doan at ASU provided Power Point assistance and found the slide of the type specimen of *Penstemon lanceolatus* at NY. Greg Gallegos with the Las Cruces BLM provided computer assistance. Doug Newton of the Arizona Native Plant Society assisted in fieldwork. Dr. Richard Straw gave provided helpful discussions on his *Penstemon* research for the Chihuahuan Desert.

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## APPENDIX

Dona Ana County: Sierra de las Uvas Mountains,  
lower north-northwest facing slopes of Sierra Alta  
Peak, growing on volcanic tuff in juniper-grassland;  
with *Juniperus monosperma*, *Rhus microphylla*,  
*Dasyllirion wheeleri*, *Brickellia californica*, *Artemisia*  
*ludoviciana*, *Aloysia wrightii*, *Heterotheca villosa*,  
*Opuntia phaecantha*, *Pleuraphis mutica*, *Bouteloua*  
*gracilis*, *Bouteloua eriopoda*, and *Sporobolus*  
*cryptandrus*; T20S R3W S14; 0300382 N, 3605575 E;  
approx. twenty-five plants.

Dona Ana County: Cooke's Range, basin below  
Cooke's Town, growing in igneous derived soils with  
scattered granitic boulders in chaparral with scattered  
pinyon and juniper; with *Cercocarpus montanus*,  
*Quercus turbinella*, *Nolina microcarpa*, *Parthenium*  
*incanum*, *Rhus aromatica* var. *trilobata*, *Fallugia*  
*paradoxa*, *Fendlera rupicola*, *Krascheninnikovia*  
*lanata*, *Bouteloua curtipendula*, *Bouteloua hirsuta*,  
*Bouteloua eriopoda*, *Bouteloua gracilis*; 5900 ft  
elevation; T20S R8W S19 SW; 0245771 N, 3604236  
E; only one plant (in flower).

Luna County: Florida Mountains, Mahoney Park,  
growing on toeslopes of east and north-facing  
limestone hills with Chihuahuan Desertscrub; with  
*Juniperus monosperma*, *Nolina texana*, *Dasyllirion*  
*wheeleri*, *Rhus aromatica* var. *trilobata*, *Rhus*  
*microphylla*, *Krameria erecta*, *Cercocarpus*  
*montanus*, *Yucca baccata*, *Thymophylla pentachaeta*,  
*Tecoma stans*, *Fouquieria splendens*, *Garrya wrightii*,  
*Dalea Formosa*, *Eriogonum jamesii*, *Hymenoxys*  
*scaposa*, *Escobaria orcuttii*, *Bouteloua curtipendula*,  
*Bouteloua eriopoda*, *Aristida purpurea*; 5220 feet  
elevation; T25S R8W S35; 0251114 N, 3552652 E;  
and 5390 feet elevation; 3552177 N, 0251651 E;  
approx. twenty five plants total in two colonies.

Luna County: Tres Hermanas Mountains, growing  
on steep granitic boulder covered north-facing slopes  
of South Peak; with *Juniperus monosperma*, *Quercus*  
*turbinella*, *Mimosa biuncifera*, *Ericameria laricifolia*,  
*Rhus microphylla*, *Dasyllirion wheeleri*, *Aloysia*  
*wrightii*, *Parthenium incanum*, *Aristida purpurea*,  
*Stipa* sp.; 5205 feet elevation; T27S R8W S31;  
0244301 N, 3533460 E; only two plants found.