Nesom, G.L. 2010. Taxonomic notes on *Fraxinus berlandieriana* and *F. velutina* (Oleaceae). Phytoneuron 2010-34: 1–8.
Mailed 10 August 2010.

TAXONOMIC NOTES ON *FRAXINUS BERLANDIERIANA* AND *F. VELUTINA* (OLEACEAE)

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ABSTRACT

The concept of *Fraxinus berlandieriana* has been applied mostly to trees in the Rio Grande plains of south Texas and adjacent Mexico. An expanded range is recognized here to include counties along the eastern edge of the Edwards Plateau and as far north in Texas as Dallas and Tarrant counties and slightly disjunct further northward to Stephens Co., Oklahoma. *Fraxinus velutina* and *F. pennsylvanica* are closely similar to *F. berlandieriana* — the Texas distributions for all three are mapped and synonymy and typification are provided for *F. velutina* (including *F. papillosa*). Lectotypes are designated for *Fraxinus attenuata*, *F. berlandieriana*, *F. papillosa*, *F. pubescens* var. *lindheimeri*, *F. toumeyi*, *F. trialata*, and *F. velutina* var. *glabrata*.

KEY WORDS: *Fraxinus berlandieriana*, *F. velutina*, *F. papillosa*, *F. pennsylvanica*, Oleaceae

Fraxinus berlandieriana DC. has been treated at specific rank by Texas botanists and most others (eg., Standley 1924; Vines 1960; Preston 1961; Correll & Johnston 1970; Elias 1980; Cox & Leslie 1988; Simpson 1988), although its distinction from *F. pennsylvanica* Marsh. has not been critically studied. The two rarely have been directly compared. Miller (1955), in contrast, treated *F. berlandieriana* as a synonym among many others within her concept of *F. pennsylvanica*.

Wide variability exists within *Fraxinus pennsylvanica* and it is generally recognized in current treatments without formal infraspecific variants, although many have been named. Some of the formally named variants are accounted for below; others are given by Wunderlin and Hansen (2010). Miller (1955) further broadened the concept of *F. pennsylvanica* to include at subspecific rank *F. velutina* Torr. of the southwestern USA. and northwestern Mexico and *F. latifolia* Benth. of California, Oregon, Washington, and British Columbia. In Miller's view, trees of eastern North America are subsp. *pennsylvanica*.

Two varieties of *Fraxinus pennsylvanica* sensu stricto often are recognized: var. *pennsylvanica* (red ash) with tomentose to puberulent twigs, petioles, rachises, and leaf surfaces and var. *subintegerrima* (green ash; synonym var. *lanceolata*) with glabrous twigs and leaves and narrower leaflets. The two appear to be completely sympatric, however, over the range of the species, although they may sort ecologically in some places or at least small enclaves of one expression or the other may occur in some areas. Study of infraspecific variation in *F. pennsylvanica* remains an interesting and potentially informative prospect.

The nomenclatural implication by Miller (1955) that *Fraxinus berlandieriana* is more similar to *F. pennsylvanica* than is *F. velutina* or *F. latifolia* is correct, but *F. berlandieriana* can be recognized as morphologically and geographically distinct. Intermediates perhaps occur where the two are sympatric, but the geographic transition seems abrupt. Jones (1975) recognized the occurrence of both species in the Texas Coast Bend. Both species have been collected in Travis County, Texas, and I have observed both in relatively close proximity in Fort Worth, Tarrant County.

Miller (1955) saw the distributions of *Fraxinus pennsylvanica*, *F. berlandieriana*, and *F. velutina* as a geographic continuum, which is contradicted here (Fig. 1). She noted (p. 18) that "Where the velvet and the red ash [*F. velutina* and *F. pennsylvanica*] meet, … a significant number of individuals are not clearly the velvet or the red ash. Many of these intermediate specimens have been identified in the past as *F. berlandieriana*. Since hybridization seems to occur, indicating a lack of sterility between these two ashes where they are in contact, … the author has reduced the velvet ash to a subspecific level." She observed (by annotation, SMU) *F. velutina* as extending eastward to the Rio Grande plains, and in her view, typical *F. berlandieriana* was "a variation of red ash."

Fraxinus berlandieriana differs from *F. pennsylvanica* in its leaves with fewer leaflets and smaller petiole bases and in its sporadically 3-winged samaras with wings originating from a lower point along the body (see key below). The occurrence of 3-winged samaras was noted by De Candolle in the protologue ("Samarae … rarius triquetrae"), later by Gray (1878), and was beautifully illustrated by C.E. Faxon in Sargent (1894, Tab. 273). As also is the case in *F. caroliniana* Miller, 3-winged fruits are produced in low frequencies (5–10%) on trees with primarily 2-winged fruits, or some trees apparently produce only 2-winged fruits. Both species characteristically occur in riparian and bottomland communities and both produce samaras with strongly flattened bodies with 2–3 smooth and shallow longitudinal channels. Trees of *F. berlandieriana* are (20–)25–60 feet tall; those of *F. pennsylvanica* may range up to 80 feet but smaller trees in the height range of *F. berlandieriana* are common, and in Texas, green ash trees are described (from label data) as (15–)20–40 feet tall.

Fraxinus berlandieriana has generally been considered to be a species of the Rio Grande plains of south Texas (e.g., Turner et al. 2003) and adjacent Mexico. It has been noted to occur "in the Edwards Plateau" (Correll & Johnston 1970) or in the "southern Edwards Plateau" (Cox & Leslie 1988). Simpson (1988) mapped it as disjunct in Travis and Bastrop counties from a more southern distribution. In the present study, trees with 3-winged fruits and predominantly 3–5 leaflets with distinctly serrate distal margins are observed to occur in Texas along the eastern edge of the Edwards Plateau to as far north as Tarrant and Dallas counties (Fig. 1). In some cases, these were correctly identified by the collectors as *F. berlandieriana*.

Similarly, a collection from south-central Oklahoma is identified here as *Fraxinus berlandieriana* — at the northern extremity of its range and apparently slightly disjunct from those in Texas to the south. **Oklahoma**. Stephens Co.: Magnolia Creek, Little Beaver Creek, 8 mi W of Duncan, valley forest of *Celtis*, *Ulmus*, *Carya*, 1100 feet, near stream banks, large tree 60 feet, common, 29 Oct 1980, *Little 36340* (OKLA). The collector noted "a few fruits 3-winged," and these are clearly observable on the specimen. The leaflets are 3–5 on rachises 4–6 cm long, and the petiole bases are relatively shallow and apically concave. From the same locality Little collected a specimen of *F. pennsylvanica* (*Little 36308*, OKLA), noting that it was taken from a "shrub" and calling attention to the comparison with *36340* — it is sterile, but the leaflets are 5–7 on rachises 12–16 cm long, and the petiole bases (leaf scars) are distinctly shield-shaped, typical of *F. pennsylvanica*.

1. Leaflets 3–5, coriaceous to subcoriaceous, (4–)5–9.5 cm x (1.5–)2–4 cm, margins coarsely and sharply serrate on distal 1/2–2/3; leaf scars shallowly hemispheric, 2.2–3 mm wide, apex shallowly concave; samaras mostly 2-winged but often 3-winged among the 2-winged ones, wings gradually expanded from the base to distal 1/3 of body and narrowly flanging the body.
..... **Fraxinus berlandieriana**

1. Leaflets 5–7(–9), subcoriaceous to submembranous, (6–)7.5–11(–12) x 2.5–5(–6), margins subentire to inconspicuously dentate-serrulate; leaf scars shield-shaped, broadly oblong-ovate, 3–4 mm wide, apex truncate to very shallowly concave; samaras consistently 2-winged, wings abruptly expanded from distal 1/4(–1/2) of body. ..... **Fraxinus pennsylvanica**

Differences between *F. berlandieriana* and *F. pennsylvanica* are subtle, and further study in field and lab will provide a more certain resolution of their distinction and evolutionary status. A collection from Refugio Co., Texas (23 Jul 1989, *Jones 3595*), was identified as *F. berlandieriana* and used by Wallander (2008) as a voucher for her molecular study, but it is *F. pennsylvanica*. Collections from Hidalgo, Mexico, sometimes identified as *F. berlandieriana* are apparently not that species. One such, *Pringle 9417* (Hidalgo, valley near Dublan), is the type of *F. pringlei* Lingelsh; another from Hidalgo of the same species, *Pringle 13584*, was used by Wallander (2008) as a voucher of *F. berlandieriana* for molecular analysis.

Fraxinus berlandieriana DC. [as "berlanderiana"], Prodr. 8: 278. 1844. *Fraxinus viridis* var. *berlandieriana* (DC.) A. Gray, Rep. U.S. Mex. Bound. 2(1): 166. 1859. *Fraxinus pubescens* var. *berlandieriana* (DC.) Wenzig, Bot. Jahrb. Syst. 4: 183. 1883. *Fraxinus americana* var. *berlandieriana* (DC.) Wesmael, Bull. Soc. Bot. Belgique 31: 108. 1892. *Fraxinus viridis* forma *berlandieriana* (DC.) Voss, Vilm. Blumegärtn. (ed. 3) 1: 645. 1894. **LECTOTYPE** (designated here): **USA. Texas**. "Orillas del Rio de las Nueces, Julio 1829, *M. Berlandier 1832, No. 2012* (G-DC, fiche!; isolectotype: G-DC fiche!, GH!). The label of the G-DC duplicate says "Tamaulipas, *M. Berlandier 1832, 2012*." The GH specimen label says "Rio de las Nueces, alt. 20–25 feet, Jul 1829, *Berlandier 2012/602*." Two further duplicates with the "602" label are at US: "*602 Berland.*, Nueces" (US 96047, digital image!), is further noted as "From Berlandier's specimen in herb. Gray;" another sheet (US 40778, digital image!) has only the number "602." A duplicate of the 602 collection also is at PH (fide the PH online type database), label information as "Orillas del Rio de las Nueces" in Texas; another is at NY (NY 297176, mounted opposite *Berlandier 2122*), labeled as "Hab. Nueces - Texas." All of the "602's" are also perhaps duplicates of the lectotype. Another possible isolectotype is *Berlandier 2112* (NY 297175, digital image!, no locality or date, mounted with *Berlandier 602*); "2112" is perhaps a mistranscription of "2012."

The protologue notes "in Mexico prov. Tamaulipas, ad villam Austin, et Texas ad Orillas del Rio de las Nueces legit cl. Berlandier. … (v.s. sp. a cl. inv.)" In addition to the lectotype and duplicate, another specimen (syntype) of *F. berlandieriana* is in G-DC (fiche!): "Villa de Austin, Texas, *Hay 1688*." A NY sheet has this label information: "Mexico, prov. Tamaulipas, ad villam Austin, etc. Legit *J.L. Berlandier, n. 2012*."

Berlandier's diary (Berlandier 1980) indicates that the only time in 1829 that he crossed the Nueces River was on June 24th, apparently in north-central Dimmit County, as indicated on Fig. 1. He did not mention the collection of ash but the both the G-DC and GH types, which are fruiting, are indicated to have been collected in July.

Fraxinus pubescens var. *lindheimeri* Wenzig, Bot. Jahrb. Syst. 4: 184. 1883. **LECTOTYPE** (designated here): **USA. Texas**. [Comal Co.:] No other label data, 1847, *F. Lindheimer 653* (SMU!; isolectotypes: BRIT-2 sheets!, GH-3 sheets!, MO!, PH, SMU!, US-digital image!). Wenzig cited simply "F. Lindheimer 653!"; the Oleaceae at B, where Wenzig's herbarium and types were deposited, were destroyed. The lectotype has a handwritten label by Lindheimer: "Am Flussufer und im feuchten Bottomwäldern mittlereg Cursus."

Fraxinus trialata Buckley, Proc. Acad. Nat. Sci. Philadelphia 1862: 5. 1863. *Fraxinus viridis* var. *trialata* (Buckley) Schelle, Handb. Laubholzben., 408. 1903. **LECTOTYPE** (designated here): **USA. Texas**. [Atascosa Co.:] "Atascosa," no other information, *S.B. Buckley s.n.* (PH 1070650 digital image!). **Protologue**: "A shrub or small tree, 15–20 feet high, growing on the banks of the Atascosa River in Western Texas." "Samaras in loose axillary or terminal panicles, about one-half of them 3-winged, and 2–3 lines broad in the widest portion; not terete below; the wings being attenuated as far as the pedicels." The type is mounted on a sheet with young branches of what apparently is *Fraxinus albicans* Buckley (= *F. texensis*) from Hays County, Texas. The label, apparently in Durand's handwriting, says "Fraxinus trialata Buckl., Atascosa, Texas."

Flowering Feb–Mar(–Apr). Pond and lake edges, creek and river banks, among boulders in rivers, alluvial terraces, low woods, canyons, disturbed sites; (5–)50–1300 feet; Okla., Tex.; Mexico (Coahuila, Nuevo León, San Luis Potosí, Tamaulipas, Veracruz). Mexican ash, fresno.

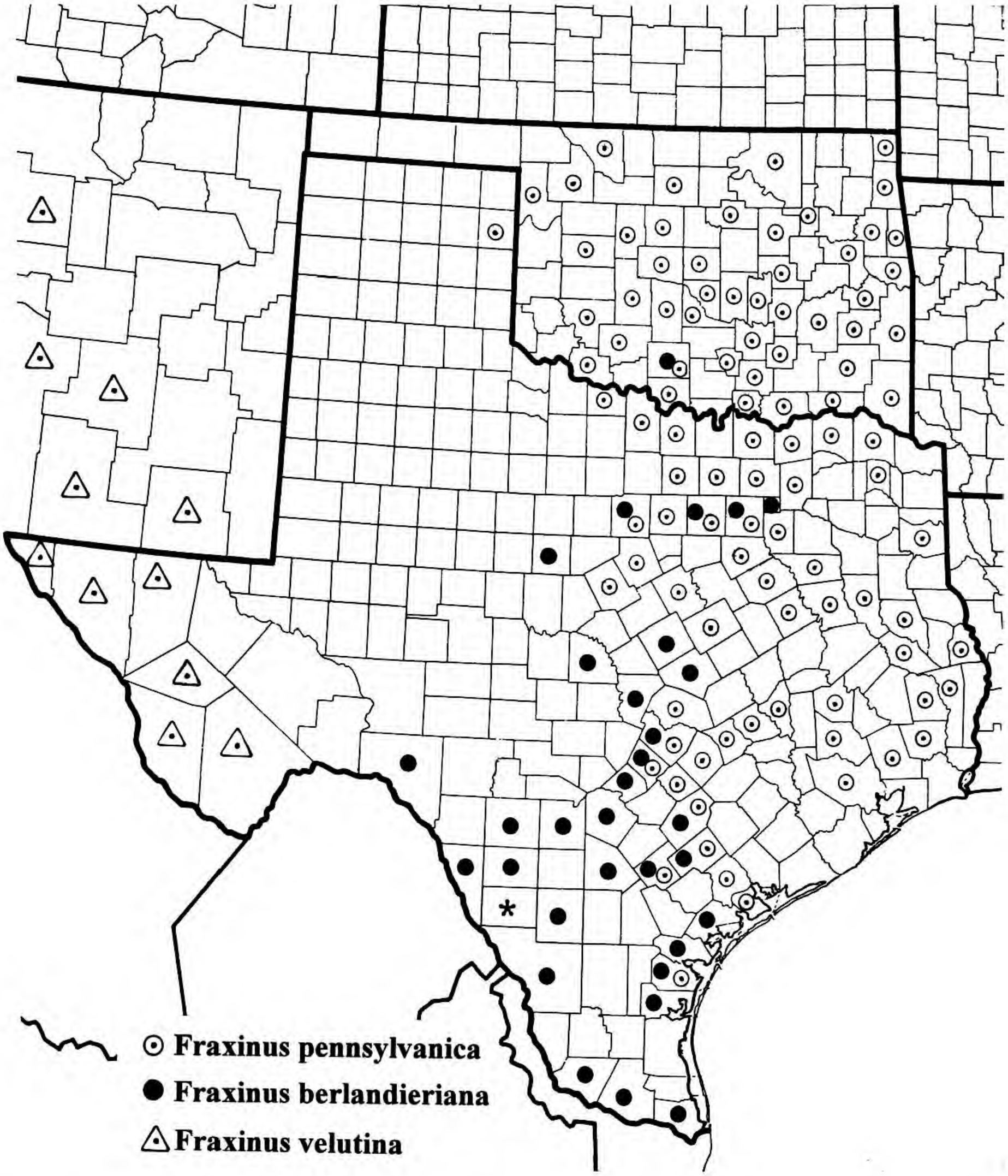

Figure 1. Distribution of *Fraxinus pennsylvanica*, *F. berlandieriana*, and *F. velutina* in Texas and Oklahoma. The asterisk is in Dimmit Co., Texas, from where the type collection of *F. berlandieriana* was made. The distributions of *F. berlandieriana* and *F. velutina* continue into Mexico and *F. velutina* continues to Arizona and southern Utah (see map in Williams and Nesom 2010).

Sargent (1894, p. 54) observed for *Fraxinus berlandieriana* that "For centuries it has been planted in the cities of the Mexican table-land, except in those of Chihuahua, and their parks and places are often dignified by single individuals or noble avenues of this species, which no other Ash-tree surpasses in stateliness and beauty."

Collections of *Fraxinus berlandieriana* from Mississippi have been distributed and apparently are the basis for citation of the species as naturalized there (USDA, NRCS 2010), but these samples are not from a naturalized tree. Bolivar Co.: planted tree beside railroad tracks west of US 61 in downtown Shelby, 12 Jun 1992, *Thomas 129,794* (BRIT, NLU, NY); Shelby, W of US Hwy 61, along abandoned RR track in downtown Shelby, 14 Sep 1990, *Bryson 10380* (MO, VDB-6 sheets). The ten specimens are very similar among themselves and perhaps were all taken from a single tree, noted by collector R.D. Thomas to have been planted. The leaflets are narrower than characteristic for the species in Texas, but the identity seems clear. Of a total of 84 samaras among all the samples, 9 are 3-winged; leaflets (3–)5, narrowly elliptic-lanceolate, 6–9(–11) cm long, margins sharply dentate-serrate on distal 1/3-4/5, glabrous on both surfaces. I also have seen vouchers (BRIT, NLU, VDB) for *F. berlandieriana* in cultivation in Monroe and New Orleans, Louisiana, where it apparently is commonly grown, but naturalization of the species in Louisiana is not confirmed in this study. Collections from Monroe apparently are the basis for its citation as naturalized in Louisiana (USDA, NRCS 2010).

Bessey (1914) reported that "certain green ash trees (*Fraxinus pennsylvanica*) in Lincoln [Nebraska] regularly bear a few tricarpellary fruits." No vouchers were cited but it is possible or even probable that these were cultivated trees of *F. berlandieriana*. I have not seen tricarpellate fruits produced by *F. pennsylvanica*.

Fraxinus velutina — variation and typification.

Variation in *Fraxinus velutina* Torr. has prompted the naming of various taxa at specific and infraspecific rank, but all appear to be intergrading and usually are maintained without formal recognition within the single species. Leaflets in Texas and most of New Mexico are mostly ovate-lanceolate to ovate-elliptic or oblanceolate-obovate. They tend to be narrower—more lanceolate and often with an attenuate apex—in southwestern New Mexico and Arizona, where the plants have sometimes been identified as var. *toumeyi*. Miller observed that "local populations may tend to one end or the other of this range, but both types and all possible intermediates are general throughout the range of [*F. velutina*]." Leaflet vestiture across the range of the species typically is sparsely to moderately short-villous, especially abaxially along the veins and axils, but glabrous forms occur throughout the range. Most trees in Jeff Davis Co., Texas, have glabrous leaves but from one population along Limpia Creek near Fort Davis, one tree had glabrous leaves (*Correll & Johnston 18384*, LL) and one had leaves short-villous abaxially (*Correll & Johnston 18385*, LL).

Miller (1955) observed that significant variation in samara body shape occurs in *Fraxinus velutina*, particularly in New Mexico (as typified by *F. standleyi*), where thicker bodies approaching those of *F. americana* or *F. texensis* are produced. In the observation here, thick bodies actually are fairly typical of *F. velutina* as a whole, compared to *F. pennsylvanica* and *F. berlandieriana*. The samara bodies are terete at the base, and while they are thick-ridged, the bodies are usually not distinctly flattened.

Fraxinus coriacea S. Wats. has often been treated as a synonym of *F. velutina*, but it has been recognized as morphologically and geographically distinct (Nesom 2010).

Fraxinus velutina is variable in the prominence of a cuticular overlay on the abaxial leaf surfaces. Those with a thicker overlay and whitish cast abaxially are mostly in Chihuahua, Sonora,

and Arizona and have previously been identified as *F. papillosa*, but they are intergradient with *F. velutina* and *F. papillosa* is regarded as a synonym of *F. velutina*. The abaxial cuticular surface of *F. papillosa* is not at all "papillose" like the leaves of *F. americana* and its close relatives. The foliar features are discussed in detail and documented by SEM photos in Williams and Nesom (2010).

Fraxinus velutina Torr. in Emory, Notes Milit. Reconn., 149. 1848. *Fraxinus pennsylvanica* subsp. *velutina* (Torr.) G.N. Miller, Cornell Agric. Expt. Sta. Mem. 335: 40. 1955. *Fraxinus pistaciifolia* Torr. [nom. nov. illeg.], Pacific Railr. Rep. 4(5): 128. 1856. *Fraxinus americana* var. *pistaciifolia* (Torr.) Wenz., Bull. Soc. Roy. Bot. Belgique 31: 108. 1892. *Calycomelia pistaciifolia* (Torr.) Nieuwl., Amer. Midl. Naturalist 3: 187. 1914. **LECTOTYPE** (Rehder 1917): **USA. New Mexico**. Sierra Co.: between the waters of the Del Norte and the Gila, 15 Oct 1847, *W.H. Emory s.n.* (NY!, digital image!, photo-GH!). The NY sheet is marked 15 Oct "1846" (the last digit in the year barely legible), but it is the sheet apparently annotated by Torrey first as *F. velutina*, then later as *F. pistaciifolia* (see below). Holmgren (1984) referred to the NY sheet as the "holotype."

A specimen (fragment package) at GH is labeled "On the Mimbres, 15 Oct 1847, *W.H. Emory, Jr. s.n.*" and is noted in the GH database as "Fragment ex Herb. Torrey (NY)." The protologue noted "Grows in the region between the waters of the Del Norte and the Gila; also on the Mimbres, a tributary of the latter river."

In the protologue of *Fraxinus pistaciifolia*, Torrey cited *F. velutina* in synonymy, his epithet "pistaciaefolia" an explicit substitution for the earlier one: "A species occurring in almost all the New Mexico collections, excessively variable in its foliage, and so much more generally smooth than pubescent (still less velvety) that we propose to supercede the little-known name under which an extreme form of it was briefly described in Emory's Report some years ago."

A US specimen (digital image!) was annotated as "Type" by E.L. Little in 1951: California. [no other information on label,] *J.M. Bigelow s.n.* The sheet was further annotated by Little with the observation that the specimen is a mixture of *F. cuspidata* var. *macropetala* and *F. velutina*. "California" is printed on the original label, but Little's annotation indicates that it was collected in "Arizona, Jan 3, 1854."

Fraxinus papillosa Lingelsh., Bot. Jahrb. Syst. 40: 219. 1907. **LECTOTYPE** (designated here): **Mexico**. **Chihuahua**. Colonia Garcia, 7000 ft, 29 Sep 1899, *C.H.T. Townsend and C.M. Barber 354* (US 00735371 digital image!; isolectotypes: BM digital image!, E digital image!, GH, K digital image!, MO!, NY! digital image!, US 347148 digital image!). Lingelsheim cited only *Townsend & Barber 354*!, without specifying the specimen location; he may have had a specimen at Breslau (Wroclaw, WRSL), where he worked. The isolectotype at GH was not located in 2009, but a photo of the GH sheet is on file and a fragment package from the GH sheet is mounted and filed with the types.

Fraxinus toumeyi Britton in Britton & Shafer, N. Amer. Trees, 803, fig. 732. 1908. *Fraxinus velutina* var. *toumeyi* (Britton) Rehder, Proc. Amer. Acad. Arts 53: 204. 1917. **LECTOTYPE** (designated here): **USA. Arizona**. Pima Co.: Tucson, October 1895, *J.W. Toumey s.n.* (NY! digital image!; isolectotypes: US-2 sheets digital images!). Two separate collections are mounted on each of the three sheets—one branch in flower with small, developing leaves (collected March) and one sterile with fully mature leaves (collected October). The protologue notes that "The type specimens were collected by Professor J.W. Toumey of the Yale Forest School, at Tucson, Arizona, March and October, 1895," referring to the pair of collections (syntypes) on each sheet. The collection made in October is designated here as the lectotype.

Fraxinus attenuata M.E. Jones, Contrib. W. Bot. 12: 59. 1908. **LECTOTYPE** (designated here): **Mexico**. **Baja California**. Valley of Palms, 8 Apr 1882, *M.E. Jones 3741* (US 01083329 digital image!; isolectotypes: GH!, MICH digital image!, MO!, US 220686 digital image!).

The protologue also cited a syntype: Arizona. [Pima Co.:] Catalina Mts., 15 Jun 1903, *Thornber s.n.* (RSA). A specimen of *Jones 3741* was not located at RSA-POM, fide Sula Vanderplank at RSA).

Fraxinus velutina var. *glabra* Rehder, Proc. Amer. Acad. Arts 53: 207. 1917. **TYPE: USA. Arizona.** Pima Co.: Range Reserve, 21 Jul 1911, *E.H. Wooton s.n.* (holotype: US 690667 digital image!; isotype: US 660964 digital image!). Rehder cited the unpublished "*Fraxinus glabra* Thornber in U. S. Herb." as a synonym—the handwritten labels of the two US type sheets were supplied with the identification of "*Fraxinus glabra* Thornber sp. nov."

Fraxinus standleyi Rehder, Proc. Amer. Acad. Arts 53: 208. 1917. **TYPE: USA. New Mexico.** Dona Ana Co.: Organ Mts., Van Pattens Camp, 9 Jun 1906, *P.C. Standley s.n.* (holotype: US 560835 digital image!, photo-GH!; isotype: US 564379 digital image!).

Fraxinux standleyi var. *lasia* Rehder, Proc. Amer. Acad. Arts 53: 210. 1917. **TYPE: USA. Arizona.** Coconino Co.: Oak Creek Canyon, S of Flagstaff, 5500 ft, 15 Sep 1916, *A. Rehder 585* (holotype: GH!).

Fraxinus velutina var. *glabrata* Lingelsh., Pflanzenr. 4, 243(Heft 72): 43. 1920 [nom. illeg., non Rehder 1917]. **LECTOTYPE** (designated here): **Mexico. Baja California.** Valley of Palms, 8 Apr 1882, *M.E. Jones 3741* (US 01083329 digital image!; isolectotypes: MO!, US 00220686 digital image!). Lingelsheim worked at Breslau (Wroclaw, WRSL) and may have seen a specimen there, but the protologue cited only "Die varietät scheint auf Mexiko beschränkt zu sein. (Jones n. 3741, Endlich n. 164!, 164a!)." With selection of *Jones 3741* as the lectotype, *F. velutina* var. *glabrata* becomes homotypic with *Fraxinus attenuata* M.E. Jones (see above).

Flowering Mar–Apr. Canyons, streambanks, yellow pine woodland, chaparral, riparian woods; (200–)600–2100 m; Ariz., Calif., N.Mex., Tex., Utah.; Mexico (Baja California, Chihuahua, Coahuila, Nayarit, Nuevo León, Sonora). Arizona ash, velvet ash, desert ash, fresno.

Plants identified as *Fraxinus velutina* from Comanche Co., Oklahoma, by Miller (1955) are identified here as *F. pennsylvanica* — in a county where the latter is very common (*Clemens 11725a*, GH) and where *F. velutina* would be far out of range. Collections of *F. pennsylvanica* from Woods Co., Oklahoma (BRIT, SMU), also have the aspect of *F. velutina* but similarly are far out of range for the latter.

ACKNOWLEDGEMENTS

I am grateful to the staffs at BRIT/SMU/VDB, GH, MO, NLU, NY, OKL, OKLA, SJNM, TEX/LL, and UNM for help during visits to those herbaria and to Sula Vanderplank at RSA for images of specimens and other observations, Alina Freire at PH for an image of *F. trialata*, Mike and Shirley Powell at SRSC for information and photos of trans-Pecos plants, Daniel Atha and Michael Nee at NY for comments and insights, and Kanchi Gandhi for advice on nomenclatural problems. This study was done as part of the work under contract for the Flora of North America Association, in conjunction with preparation of the FNANM treatment of *Fraxinus*.

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