

INFRASPECIFIC VARIATION IN *GRATIOLA VISCIDULA* PENNELL (SCROPHULARIACEAE)

DAVID M. SPOONER

ABSTRACT

Gratiola viscidula Pennell was separated into two subspecies by Pennell (1935): *G. viscidula* subsp. *viscidula*, and *G. viscidula* subsp. *shortii* Durand ex Pennell. The latter subspecies, which was distinguished by its larger corollas, calyces, and leaves, was only known from southeastern Ohio and from an unspecified site in Kentucky. Examinations of herbarium specimens and field populations have demonstrated that the sizes of various plant parts are highly variable, both within individual populations and throughout the range of the species. Intraspecific categories are unwarranted. The chromosome number of the species is here first reported as $n = 7$.

Key Words: *Gratiola*, Scrophulariaceae, chromosome counts

INTRODUCTION

Pennell (1935) separated *Gratiola viscidula* into two subspecies: *G. viscidula* subsp. *viscidula* [as "*G. viscidula typica*"] and *G. viscidula* subsp. *shortii* [as "*G. viscidula shortii* (Durand) Pennell"]. The latter subspecies was distinguished by its larger corollas, calyces, and leaves and was known only from two collections, one in southeastern Ohio (Jackson County) and one from an unspecified site in Kentucky.

Later workers (Cooperrider, 1976; Cusick and Silberhorn, 1977; McCready and Cooperrider, 1978; Kartesz and Kartesz, 1980; Roberts and Cooperrider, 1982; Spooner, 1982; United States Department of Agriculture, 1982) accepted the validity of these infraspecific taxa. *Gratiola viscidula* was collected in many new localities in extreme southeastern Ohio and immediately adjacent northern Kentucky and West Virginia. Almost all of these populations are located in wetland habitats associated with pre-glacial Teays-age valleys, and the "*shortii*" entity was believed to be a disjunct taxon associated with these sites (Cusick and Silberhorn, 1977; Spooner, 1982).

Others, however, either did not accept these infraspecific taxa (Fernald, 1950), or did not mention them (Fernald, 1937; Gleason and Cronquist, 1963; Radford et al., 1968; Silberhorn, 1970; Godfrey and Wooten, 1981; Brumfield et al., 1982). The purpose of

my study was to determine the taxonomic validity of the above infraspecific taxa by assessing both inter- and intrapopulational morphological variation of *G. viscidula*.

MATERIALS AND METHODS

Numerous specimens, including the types, were borrowed from 22 herbaria (see ACKNOWLEDGMENTS). Fifty-four mature individuals at full anthesis were measured from throughout the range of the species to ascertain the limits of morphological variability (Table 1).

Table 1. Specimens measured for size variation within *Gratiola viscidula* (Fig. 2).

Locational Vouchers
DELAWARE: Newcastle Co., <i>Commons 12</i> (PH); 2 Sep 1897, <i>Commons s.n.</i> (PH).
DISTRICT OF COLUMBIA: <i>Pennell 12415</i> (OS); 11 Aug 1900, <i>Steele s.n.</i> (PH).
FLORIDA: Duval Co., Mar 1882, <i>Smith s.n.</i> (F).
GEORGIA: Floyd Co., 1890, <i>Chapman s.n.</i> (US, two plants measured from this sheet); McDuffie Co., <i>Bartlett 1082</i> (VDB); Wilkes Co., s.d., <i>Chapman s.n.</i> (PH).
KENTUCKY: Estill Co., <i>Lasseter 3054</i> (EKU); Knox Co., <i>Stamper 30</i> (EKU).
MARYLAND: Prince Georges Co., <i>Hotchkiss 7185</i> (US); St. Mary's County, 20 Aug 1904, <i>Chrysler s.n.</i> (MARY).
MISSOURI: Shannon Co., <i>Steiermark 72109</i> (F,GA).
NORTH CAROLINA: Anson County, <i>Beal 4239</i> (DK); Bertie Co., <i>Ahles and Haesloop 52150</i> (UNC); Bladen Co., <i>Ahles and Leisner 33341</i> (UNC); Biltmore 471b (US); Buncombe Co., <i>Biltmore 461c</i> (PH); Columbus Co., <i>Beal 1805</i> (DK); Gates Co., <i>Correll 2249</i> (DK); Henderson Co., 23 Aug 1881, <i>Smith s.n.</i> (US); Radford 4848 (UNC); Jackson Co., <i>Radford 4759</i> (UNC); Lee Co., <i>Beal 4284</i> (DK); Moore Co., <i>Ahles 59588</i> (UNC); New Hanover Co., Aug 1892, <i>Williamson s.n.</i> (PH); Rowan Co., <i>Heller 135</i> (PH, two plants measured from this sheet); Stokes Co., <i>Radford 41497</i> (UNC); Swain Co., Aug 1891, <i>Beardslee and Kofoid s.n.</i> (OS); Transylvania Co., <i>Beal 5826</i> (DK); county unspecified; Aug 1841, <i>Rugel s.n.</i> (US, three plants measured from this sheet).
SOUTH CAROLINA: Anderson Co., <i>Radford 13937</i> (UNC); Chesterfield Co., <i>Radford 15824</i> (TENN); Darlington Co., <i>Smith 639</i> (UNC); Kershaw Co., <i>House 2680</i> (US); Richland Co., 9 Jun (without year), <i>Taylor s.n.</i> (PH).
TENNESSEE: Blount Co., <i>Sharp and Veloira 21520</i> (VDB); Carter Co., <i>Fairchild et al. 11741</i> (TENN); Cocke Co., <i>Kearney 854</i> (OS, UNC, US); Morgan Co., <i>Webb et al. 1056</i> (TENN); White Co., <i>Shaver 4228</i> (TENN).
VIRGINIA: Cumberland Co., <i>Wells 38</i> (UNC); Dinwiddie Co., <i>Kral 11353</i> (UNC); Greensville Co., <i>Harvill 17601</i> (UNC); Fernald and Long 10818 (DK); Nansemond Co., <i>Fernald and Long 7602</i> (PH); Powhatan Co., <i>Corcoran and Diggs 634</i> (UNC); <i>Corcoran and Diggs 1147</i> (UNC); Southampton Co., <i>Fernald et al. 5917</i> (PH); Sussex Co., <i>Fernald and Long 6390</i> (PH).

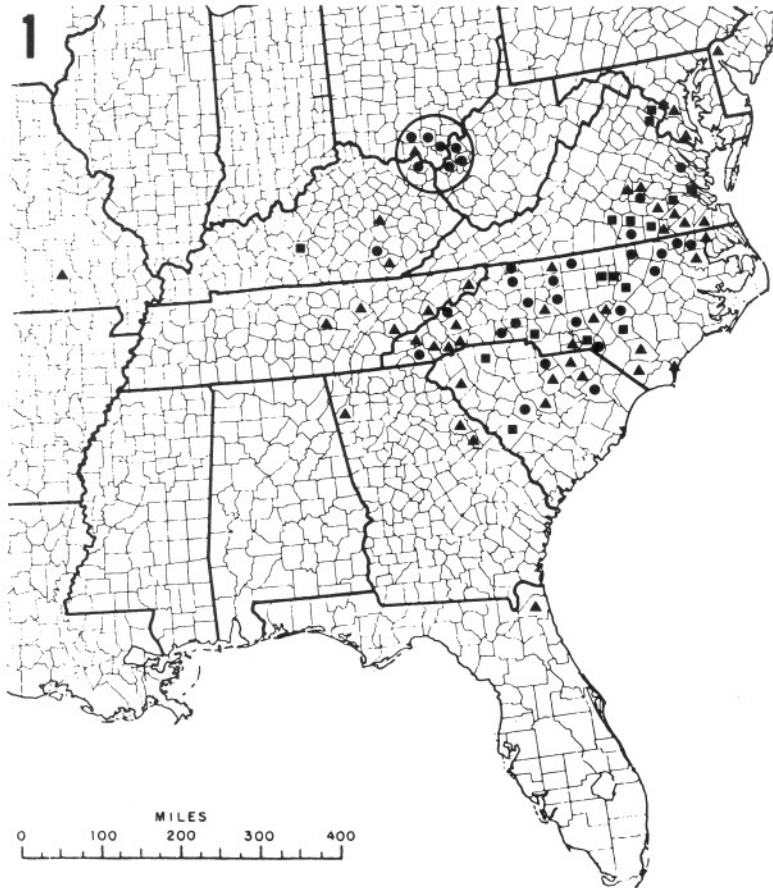
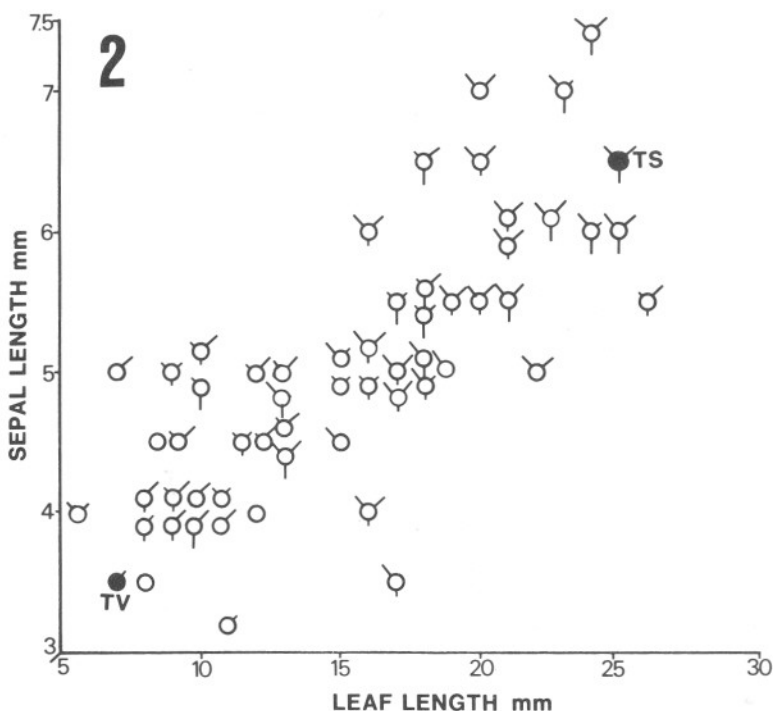


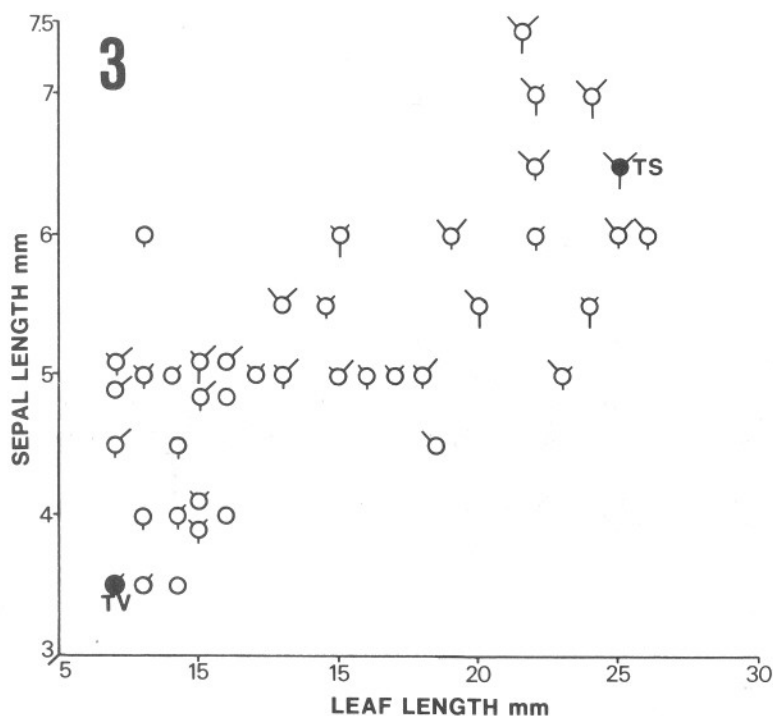
Figure 1. County distribution of *Gratiola viscidula*. Circles and triangles represent specimens examined in this study, with the latter representing populations measured for Figs. 2 and 3. Squares are records from literature references. Circled records represent the previously presumed range of the "shortii" entity in wetland habitats associated with preglacial Teays-age valleys.

These individuals were chosen to represent the morphological variation within the known range of the species (Fig. 1). Additional distributional data were obtained from Pennell (1935), Radford et al. (1968), Harvill et al. (1981), and Medley and Thieret (in litt., 1982). Thirty-nine mature individuals from a population within the presumed "shortii" range [OHIO: Scioto Co., Spooner 2153 (OS)]



Figures 2 and 3. Pictorialized scatter diagrams of measurements from selected populations of *Gratiola viscidula*. From throughout its range, (Fig. 2). Individuals from a single population in Scioto Co., Ohio, *Spooner 2153* (Fig. 3). Measurements of the types of *G. viscidula* subsp. *viscidula* (TV), and of *G. viscidula* subsp. *shortii* (TS) are included for comparison. (See Key at end of Figure 3 - facing page)

were chosen to determine the limits of intrapopulation morphological variation. The largest measurements per individual were taken of corolla length, calyx length, pedicel length, leaf length and leaf width, as these were the characters that Pennell (1935) used to distinguish the infraspecific taxa. Other populations in this area were also collected for visual comparison: KENTUCKY: Greenup Co., *Spooner 2150, 2151* (OS); OHIO: Gallia Co., *Spooner 2155* (OS); Jackson Co., *Spooner 2156* (OS). For chromosome number determinations, the procedures involving conventional squash techniques of flower buds for meiotic stages outlined in Keil and Stuessy (1975) were used.



KEY

Pedicle Length mm	Leaf Width mm	Corolla Length mm
○ < 10.1	○ < 4.9	○ < 9.4
◐ 10.1-14.9	◑ 5.0-7.9	◒ 5.0-7.9
◑ > 14.9	◒ > 8.0	◓ > 10.9

RESULTS AND DISCUSSION

Measurements of individuals from throughout the range of the species, exclusive of southeastern Ohio and immediately adjacent northern Kentucky and West Virginia (the "*shortii*" range), are presented in Fig. 2. It is evident from these data that *G. viscidula* exhibits a wide range of size variation with the extremes connected by a continuous series of intermediates. The type of *G. viscidula* subsp. *viscidula* [NORTH CAROLINA: Forsyth Co., s.d.,

Schweinitz s.n. (PH), (see Stuckey, 1979, for a discussion of this specimen)] falls on the small end of this size range. The type of *G. viscidula* subsp. *shortii* [KENTUCKY: s.d., *Short* s.n. (PH), (Specimen marked as *Gratiola shortii* by Elias Durand)] falls on the large end of this size range. Both specimens are marked as types by Pennell.

Measurements of individuals of the Scioto County, Ohio population are presented in Fig. 3. The degree of size variation in this population is similar to that from throughout the range of the species, with extremes encompassing measurements of the types as above. The range of size variation of the other populations that I collected in the field is similar.

The new distribution map (Fig. 1) fills in considerable gaps in Pennell's (1935) map of the species. There are now in excess of thirty populations known for this species in southeastern Ohio and immediately adjacent northern Kentucky and West Virginia. Pennell (1935) was influenced by the disjunct nature of the "*shortii*" populations, less disjunct now in light of the new distributional data. Other disjunct records are known for this species: (1) MISSOURI: Shannon Co., *Steyermark* 72109 (F, GA, MO, US). These specimens were collected from Gilmore Pond, an upland sinkhole pond. My efforts to relocate the plant at the site were unsuccessful, and the plant is possibly extirpated. The last known collection there was in 1975 [MISSOURI: Shannon Co., *Christ* s.n. (pers. herb.)]. This region of Missouri is dotted with such habitats, however, and the plant possibly occurs in other ponds in the area. Other examples of Coastal Plain and Piedmont disjuncts are known from this portion of Missouri (*Steyermark*, 1952). (2) FLORIDA: Duval Co., Mar 1882, *Smith* s.n. (F). This specimen bears Pennell's annotation as *G. viscidula* dated 1931; it is not known why he did not mention it in his monograph (Pennell, 1935). The Crittenden Co. Arkansas record mentioned in Wilcox (1973) is apparently in error, as was suggested by Smith (1978). I requested a loan of the specimen from MEM, where Wilcox deposited his vouchers, but it has not been located.

Current nomenclatural errors exist with the above infraspecific taxa of *G. viscidula*. Pennell (1935) treated the two taxa as subspecies. Gleason (1952) regarded these taxa as varieties, but did not formally treat them in a manner indicating his acceptance of

them (see Gleason, 1952, Vol. 1, p. xxxv). Cooperrider (1976) accepted the taxonomic validity of these subspecific taxa at the varietal level, but incorrectly cited the "*shortii*" entity as *G. viscidula* var. *shortii* (Pennell) Gleason. This citation continues to be accepted (McCready and Cooperrider, 1978; Roberts and Cooperrider, 1982; Spooner, 1982; United States Department of Agriculture, 1982). Kartesz and Kartesz (1980) incorrectly cited *G. viscidula* var. *shortii* (Durand) Gleason. If these infraspecific taxa are recognized at the varietal level, a new combination is required.

The chromosome number of *G. viscidula* is here first reported as $n = 7$ from two populations: (1) KENTUCKY: Greenup Co., *Spooner 2150* (OS); and (2) OHIO: Gallia Co., *Spooner 2156* (OS). This base number is in agreement with previous counts for the section *Gratiolaria* Bentham (Lewis et al., 1962).

In view of the continuous degree of size variation represented both within individual populations and throughout the range of the species, recognition of infraspecific categories based on the above size characters is unwarranted. In addition, no other consistent differences were observed in any other features that would warrant recognition of infraspecific categories.

The consistent and widespread occurrence of this variation seen both in the field and on herbarium specimens indicates that this is an inherent feature of this species, and is not due to localized introgression with related taxa. The most closely related taxa are *G. brevifolia* Raf., *G. ramosa* Walt., and *G. aurea* Muhl. ex Pursh (*G. lutea* Pursh) (Pennell, 1935), but these species are largely allopatric with *G. viscidula* and not notably different in size from this species.

ACKNOWLEDGMENTS

I gratefully acknowledge the Ohio Department of Natural Resources, Division of Natural Areas and Preserves, for support for field work, and the curators of the following herbaria for making material available for study: ALU, DUKE, EKY, F, FSU, GA, GFND, KE, MARY, MO, MUHW, NCSC, OS, PENN, PH, TENN, UNA, UNCC, US, VDB, WVA. Use of the personal herbarium of Arthur Christ, St. Louis, MO is also acknowledged. Dr. Edward T. Browne searched MEM for the Crittenden Co., Arkansas voucher. Dr. John W. Thieret and Max E. Medley alerted

me to recent Kentucky records of *G. viscidula*; Virginia Wallace and John E. Wylie provided information about the species in Missouri. Dr. Robert K. Jansen, Thomas G. Lammers, Dr. Ronald L. Stuckey, and Dr. Tod F. Stuessy provided suggestions on the final manuscript.

LITERATURE CITED

- BRUMFIELD, B. M., D. K. EVANS, AND A. E. BRANT. 1982. Additions to the wetland flora of West Virginia. *Castanea* 47: 179-180.
- COOPERRIDER, T. S. 1976. Notes on Ohio Scrophulariaceae. *Castanea* 41: 223-226.
- CUSICK, A. W., AND G. M. SILBERHORN. 1977. The vascular plants of unglaciated Ohio. *Ohio Biol. Surv. Bull. N.S.* 5(4): i-x, 153 p.
- FERNALD, M. L. 1937. Local plants of the inner Coastal Plain of southeastern Virginia. *Rhodora* 39: 321-366, 379-415, 433-459, 465-491.
- . 1950. Gray's manual of botany. Ed. 8. American Book Co., New York. i-lxiv, 1632 p.
- GLEASON, H. A. 1952. New Britton and Brown illustrated flora of the northeastern United States and adjacent Canada. The New York Botanical Garden, New York. Vol. 1, i-lxxv, 482 p.; Vol. 3, i-iii, 589 p.
- , AND A. CRONQUIST. 1963. Manual of the vascular plants of the northeastern United States and adjacent Canada. D. Van Nostrand, New York. i-ii, 810 p.
- GODFREY, R. K., AND J. W. WOOTEN. 1981. Aquatic and wetland plants of the southeastern United States. Dicotyledons. University of Georgia Press, Athens. 933 p.
- HARVILL, A. M., JR., T. R. BRADLEY, AND C. E. STEVENS. 1981. Atlas of the Virginia flora. Part II, Dicotyledons. Virginia Botanical Associates, Farmville, Virginia. 148 p.
- KARTESZ, J. T., AND R. KARTESZ. 1980. A synonymized checklist of the vascular flora of the United States, Canada, and Greenland. The University of North Carolina Press, Chapel Hill. i-xlvi, 500 p.
- KEIL, D. J., AND T. F. STUESSY. 1975. Chromosome counts of Compositae from the United States, Mexico, and Guatemala. *Rhodora* 77: 171-195.
- LEWIS, W. H., H. L. STRIPLING, AND R. G. ROSS. 1962. Chromosome numbers for some angiosperms of the southern United States and Mexico. *Rhodora* 64: 147-161.
- MCCREADY, G. A., AND T. S. COOPERRIDER. 1978. The Scrophulariaceae subfamily Scrophularioideae of Ohio. *Castanea* 43: 76-86.
- PENNELL, F. W. 1935. The Scrophulariaceae of eastern temperate North America. *Acad. Nat. Sci. Philadelphia Monogr.* 1: i-xiv, 650 p.
- RADFORD, A. E., H. E. AHLES, AND C. R. BELL. 1968. Manual of the vascular flora of the Carolinas. The University of North Carolina Press, Chapel Hill. i-lxi, 650 p.

- ROBERTS, M. L., AND T. S. COOPERRIDER. 1982. Dicotyledons. 48-84. IN: T. S. Cooperrider, ed. Endangered and threatened plants of Ohio. Ohio Biol. Surv. Notes 16. 92 p.
- SILBERHORN, G. M. 1970. A distinct phytogeographic area in Ohio: The southeastern Allegheny Plateau. *Castanea* 35: 277-292.
- SMITH, E. B. 1978. An atlas and annotated list of the vascular plants of Arkansas. University of Arkansas Bookstore, Fayetteville. i-iv, 592 p.
- SPOONER, D. M. 1982. Wetlands in Teays-age valleys in extreme southeastern Ohio: Formation and flora. 89-99. IN: B. McDonald, ed. Proceedings of symposium on wetlands of the Unglaciated Appalachian Region. Morgantown, West Virginia, May 26-28. 253 p.
- STEYERMARK, J. A. 1952. New Missouri plant records (1949-1951). *Rhodora* 54: 250-260.
- STUCKEY, R. L. 1979. Type specimens of flowering plants from eastern North America in the herbarium of Lewis David von Schweinitz. *Proc. Acad. Nat. Sci. Philadelphia* 131: 9-51.
- UNITED STATES DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE. 1982. National list of scientific plant names. Vol. 1. List of plant names. U.S. Govt. Printing Office, Washington, D.C. 416 p.
- WILCOX, W. H. 1973. A survey of the vascular flora of Crittenden County, Arkansas. *Castanea* 38: 286-297.

DEPARTMENT OF BOTANY
THE OHIO STATE UNIVERSITY
1735 NEIL AVENUE
COLUMBUS, OHIO 43210