

The Genus *Trillium* (Liliaceae) in Virginia

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ABSTRACT

Ten species of *Trillium* (Liliaceae) are known to occur in Virginia. Taxonomic key, morphological descriptions, distribution maps and chromosome numbers are presented. A chromosome number of $2n = 10$ was verified for: *Trillium cernuum*, *T. erectum*, *T. flexipes*, *T. grandiflorum*, *T. luteum*, *T. nivale*, *T. pusillum*, *T. sessile*, *T. sulcatum*, and *T. undulatum*. Some chromosome morphology data are applied to the discussion of *T. pusillum*, and also reinforce that *T. sulcatum* and *T. erectum* are separate taxa.

INTRODUCTION

The genus *Trillium* is represented in three areas of the world: eastern Asia (8 spp.); western North America (7 spp.); and ca. 35 spp. in eastern North America (Freeman 1975). The genus probably reaches its broadest development in the Southern Appalachians (Barksdale 1938). Case (1981) states that by far the greatest number of species occur in the mountains, upper piedmont, and foothills of the southeastern United States from the Carolinas to Alabama and on the Cumberland Plateau and surrounding areas of Kentucky and Tennessee. It is also within the area of the Southern Appalachians that *Trillium* earns its reputation as a taxonomically difficult genus. Variation is common between and within some populations (Duncan and Calhoun 1962, Serota 1969). Hybridization is a factor causing some of the variation, as is the case for the *T. erectum* group (Case 2002).

The purpose of this paper is to present a treatment of the genus *Trillium* as it is known in Virginia. Chromosome numbers are also presented for the ten species.

Various taxonomic treatments of the genus over larger geographical areas have proposed two subgenera based on the presence or absence of a pedicel. Key characters in the genus are ovary lobation, features of the stigma, anther/filament ratio, leaf (or bract) shape, and whether or not the leaves are sessile or petiolate (Barksdale 1938, Freeman 1975, Gleason 1906, Gates 1917, and Case and Case 1997).

In Virginia there are reported chromosome counts of $2n = 10$ for *T. grandiflorum* (Fukuda and Grant 1980), *T. nivale* and *T. pusillum* (Hill 1995a) and for *T. cernuum* (Hill 1995b). Chromosome morphological studies of Virginian trilliums are published for *T. grandiflorum* (Fukuda and Grant 1980) and *T. pusillum* (Baldwin 1949).

MATERIALS AND METHODS

The genus was studied from (1) herbarium specimens borrowed from LYN, WILLI, VPI, TENN, WVA, GH, NA, GMUF and NCU, (2) field work in Virginia, and (3) observations from the greenhouse. Floristic studies in Virginia were also consulted (Thorne and Cooperrider 1960, Carr 1965, Jervis 1969, Grimshaw and Bradley 1973, Hathaway and Ramsey 1973, and Ramsey et al. 1993).

For the chromosome work, a Fuelgen technique modified from Sharma and Sharma (1965) was constructed using a pretreatment of colchicine. The slide was made permanent using

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a previously described technique (Hill and Rogers 1970). Drawings were taken using a Zeiss phase contrast microscope under oil at 1,000× using a drawing tube and a standard micrometer for measurements. These drawings are appended to the herbarium voucher specimens that are deposited at BDWR.

TAXONOMIC TREATMENT

TRILLIUM LINNAEUS, Sp. Pl. 1:339. 1753; Gen. Pl. ed. 5, 158. 1754

Perennial scapose herbs with simple stems from short, stocky, horizontal rhizomes bearing a whorl of 3 net-veined, green or mottled, ovate-obovate or elliptical bracts (leaves), petiolate or sessile, flower solitary. Flowers perfect, sessile or pedicellate; sepals 3, alternating with the leaves, green, reddish or purplish; petals 3 (rarely 4–8), white, red, maroon, purple, pink, yellow or green, ovate or obovate to linear; stamens 6, anthers linear on short filaments; ovary superior, 3–6 lobed or winged, red, white or pink, stigmas 3, sessile or style very short. Fruit a berrylike capsule, many seeded, globose or ovoid.

A Key to the genus *Trillium* in Virginia

- 1a. Ovary 3-angled, lobed or winged 2
- 1b. Ovary 6-angled, lobed or winged 4
 - 2a. Bracts sessile; flowers sessile or pedicellate up to 3 cm *T. pusillum*
 - 2b. Bracts with petioles 5–10 mm; flowers not sessile 3
 - 3a. Bracts up to 5 cm long, obtuse to subacute *T. nivale*
 - 3b. Bracts more than 5 cm long, ovate to long-acuminate *T. undulatum*
 - 4a. Flowers sessile 5
 - 4b. Flowers not sessile 6
 - 5a. Petals typically maroon, anther connectives purplish-brown, projecting 2–5 mm beyond anther sacs *T. sessile*
 - 5b. Petals typically yellow-green, anther connectives green, projecting only slightly beyond anther sacs *T. luteum*
 - 6a. Stigma erect or nearly so, slender, of uniform diameter *T. grandiflorum*
 - 6b. Stigma recurved, stout, tapering distally 7
 - 7a. Filament scarcely a fourth as long as the anther, 2 mm or less *T. flexipes*
 - 7b. Filament mostly more than fourth as long as the anther, 2 mm or more 8
 - 8a. Flower on a short, recurved pedicel hidden beneath the bracts; anther 3–7 mm long *T. cernuum*
 - 8b. Flower held above the bracts on an erect or declined pedicel; anthers 5–12 mm long 9
 - 9a. Flowers cup-shaped, gaping; petals ascending below, recurved, spreading above; pedicels declined or flexed, sepals less than half pedicel length *T. sulcatum*
 - 9b. Flowers wide open, petals spreading from the base; pedicels erect, sepals more than half the pedicel length *T. erectum*

- 1. *Trillium pusillum* Michaux., Fl. Bor.-Amer. 1:215. 1803. Dwarf trillium, early trillium.
 - T. pusillum* Michx. var. *virginianum* Fernald. Rhodora 45: 397, plate 773, Figures 1,2. 1943.
 - T. pusillum* Michx. var. *monticulum* Bodkin & Reveal. Brittonia 34: 142, Figure 1. 1982.

Rhizomes white, horizontal to erect, up to 10 mm thick, 3–6 cm long. Scapes 1–2, 1–2 dm high; glabrous. Bracts sessile or nearly so, horizontal to drooping distally, 3–5 veined, not mottled, 3–8.5 cm long, 1–2.5 cm wide, lance-elliptic or lance-ovate, obtuse. Flower above bracts, pedicel 0.5–2.5 cm long, ascending. Petals white, aging to pink, and then to a pale purple, 1.5–3.5 cm long, 4–10 mm wide, undulate, nearly equal to or slightly longer than the sepals, linear-elliptic to linear. Stamens 5–10 mm long, filaments broadened at the base, about as long as the yellow anthers. Ovary white, obtusely 3- angled with white stigmas spreading-ascending. Fruit about 1 cm long, ovoid or ellipsoid, greenish white. (2N = 10). Late March–late April. In the Coastal Plain, the habitat is very often an open or shaded swamp. In western Virginia the habitats vary from dense mixed deciduous forest of *Quercus*, *Hamamelis* and *Rhododendron* sp. (Elliot

Knob–Augusta County) to a more open forest at Flagpole Knob (Rockingham County) of *Pinus rigida* Miller, *Pieris floribunda* (Sims) B & H, *Quercus rubra* L, and *Kalmia latifolia* L. with the trillium scattered under the shade of these plants in haircap moss (*Polytrichum*). Figure 1a.

The distribution of this species in Virginia has led to some interesting interpretations. It is called *Trillium pusillum* Michaux in Harvill et al. (1992). The better-known coastal plain populations were named *Trillium pusillum* var. *virginianum* by Fernald (1943). A western mountain population discovered by Roe (1978), which was then followed by other discoveries in that region (Bodkin and Reveal 1983) was named *T. pusillum* var. *monticulum* by Bodkin and Reveal (1982). Evidence has been presented against this determination (Cabe and Werth 1995a, 1995b). A morphometric study of the entire *Trillium pusillum* complex over the southeastern United States (Timmerman-Erskine et al. 2002a) produced a similar conclusion to Cabe and Werth that *Trillium pusillum* is a highly variable species that doesn't warrant varietal designations, although *Trillium pusillum* var. *texanum* was elevated to *Trillium texanum* Barkley (Timmerman-Erskine et al. 2002b). Preliminary data from ITS sequences of the proposed *T. pusillum* varieties show insufficient variation for their recognition (Farmer 2003).

A study of chromosome morphology of samples from mountain and coastal plain populations of *T. pusillum* reveals no differences. These data agree with the published morphology of a coastal plain population by Baldwin (1949). The present study of *Trillium* in Virginia will employ the species name without the varietal designations pending further studies at the biochemical level.

2. *Trillium nivale* Riddell, Syn Fl. West. States, 93. 1835. Snow trillium.

Rhizomes short, white. Scapes 1, 8–15 cm high, glabrous. Bracts petiolate, elliptic to lance-ovate to ovate, 2–5 cm long by 1–3 cm wide. Flower erect, pedicels 5–20 mm long, recurving below the leaves after pollination, sepals 1–3 cm long, spreading, much shorter than the petals; petals white or white with a pinkish base, elliptic or oblong-elliptic, 2–5 cm long, spreading, margins entire to slightly wavy. Stamens 5–18 mm long, pale yellow anthers equal to or slightly exceeding the white filaments. Ovary greenish white, obtusely 3-angled; style 0.5–1.5 cm long with spreading tips. Fruits greenish white, globose to ovate, about 1 cm long. (2N = 10). Early March–early April. The single report of this species in Virginia is in Highland County on a limestone bluff overlooking the South Branch of the Potomac River very close to the West Virginia border. Scattered over this site are *Acer saccharum* Marshall and *Tilia* sp. Figure 1b.

3. *Trillium undulatum* Willdenow, Ges. Naturf. Freunde Berlin Neue Schriften 3:422. 1801. Painted Trillium, Painted Lady.

Rhizome horizontal, brown, 2–7 cm long, 10–15 mm wide. Scapes 1-several, 1–5 dm tall, glabrous. Bracts strongly petiolate, 5–20 mm long, blade green-maroon, not mottled, ovate to long-acuminate, 5–20 cm long, 5–15 cm wide. Flower erect above the bracts, pedicels 1–6 cm long, sepals spreading, red to maroon-green, lanceolate-acuminate, petals 2–5 cm long by 1–2 cm wide, white with conspicuous red to purplish stripes at the base, elliptic to elliptic-lanceolate, sometimes undulate. Stamens 5–10 mm long, anthers yellow or purple, white filaments similar in length to the purple to maroon anthers. Ovary white, sometimes pink-tipped, 3-angled, 3–10 mm long. Fruits bright red, 1–2 cm long. (2N = 10). Late April–June. Rich moist woods and stream banks. Figure 1c.

4. *Trillium sessile* Linnaeus, Sp. Pl. 1: 340. 1753. Sessile Trillium, Toad Trillium, Toadshade.

Rhizome thick (1–2 cm), brownish, stout. Scapes 1–3, 1–3 dm high. Bracts mottled, green to bluish green, 7–10 cm long, 2–8 cm broad, oval, obtuse or quickly short-tipped, rounding to sessile base. Flower erect, sessile, sepals spreading, green, oblanceolate to elliptic, slightly shorter than the petals. Petals erect, maroon to reddish purple or purple, lance-ovate, 1–4 cm long, 1–2 cm wide, margins entire. Stamens 10–25 mm, filaments red to purple, anthers gray-purple, thick, connectives projecting 2–5 mm beyond the anther sacs. Ovary greenish white, 4–9 mm high; stigmas erect, purple, fleshy. Fruits dark greenish purple, with 6 somewhat wing-like angles. (2N = 10). March–early May. Rich woodlands, floodplains, riverbanks. Figure 1d.

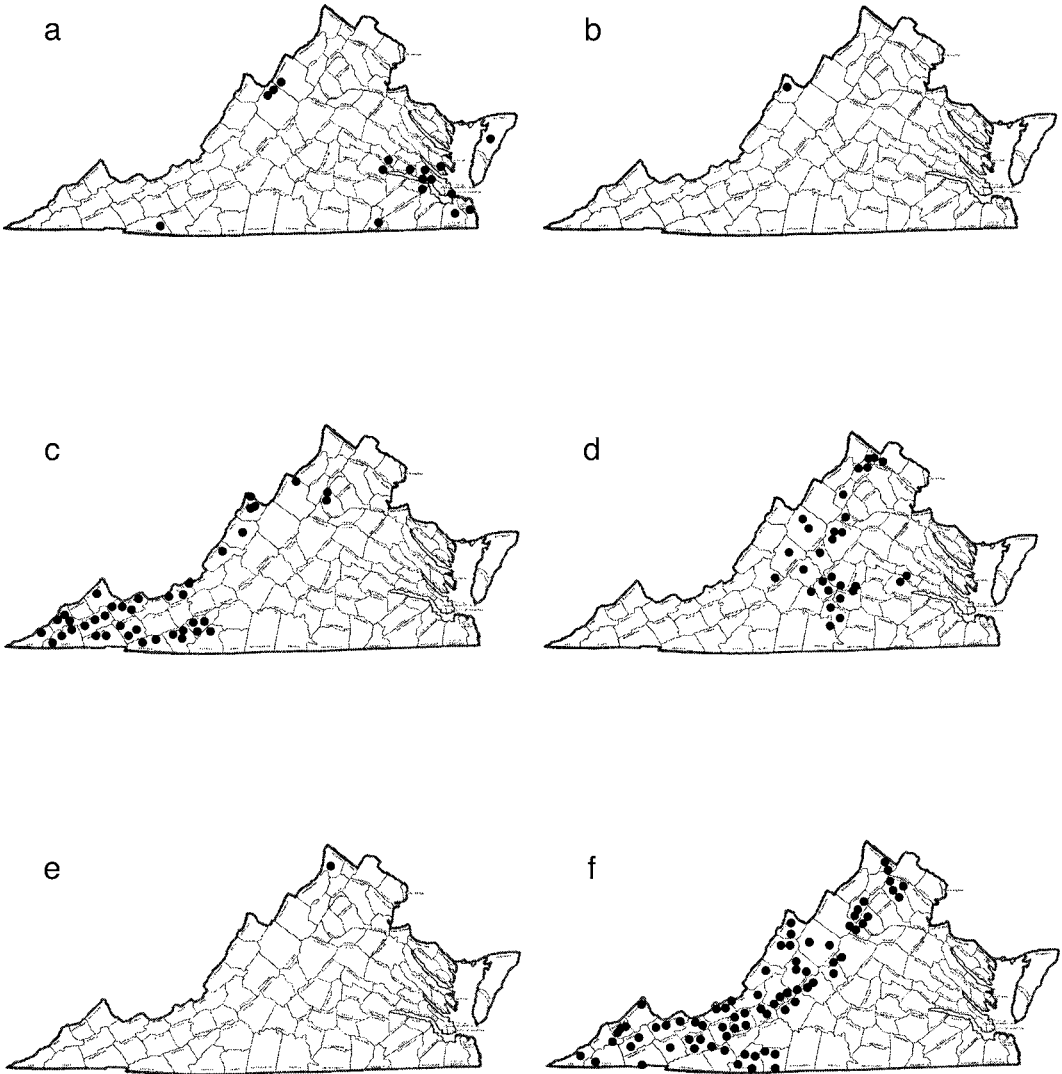


Figure 1. Distribution in Virginia of a) *Trillium pusillum*, b) *T. nivale*, c) *T. undulatum*, d) *T. sessile*, e) *T. luteum*, f) *T. grandiflorum*, g) *T. flexipes*, h) *T. cernuum*, i) *T. sulcatum*, and j) *T. erectum*.

5. *Trillium luteum* (Muhlenberg) Harbison, Biltmore Bot. Stud. 1:21. 1901. Yellow Trillium, Yellow Toadshade.

Rhizomes brown, horizontal. Scapes 1–4, 2–4 dm, stout, glabrous. Bracts sessile, well above ground, mottled, ovate-elliptic, apex acuminate. Flower erect, sessile, sepals green, widely spreading, oblong-lanceolate, 2–5 cm long, 1 cm wide. Petals long-lasting, greenish yellow, elliptic-lanceolate, 3–7 cm long, 1–2 cm wide, with a long acuminate apex. Stamens 10–18 mm long, filaments greenish white, anthers yellow; connectives green, extending slightly or not at all beyond the anthers. Ovary light green, 4–8 mm high, 6-angled. Stigmas erect, greenish white. Fruits reddish purple, ovoid, 3 cm high. (2N = 10). April to May. In the one report of this species from Clarke County, the taxon is scattered in clearings along a riverbank in association with *Cercis canadensis* L., *Cornus florida* L., and *Lindera benzoin* (L.) Blume. Figure 1e.

This population has been interpreted as a local escape from cultivation. If this one known population in Virginia is native, then it is significantly disjunct since the nearest native

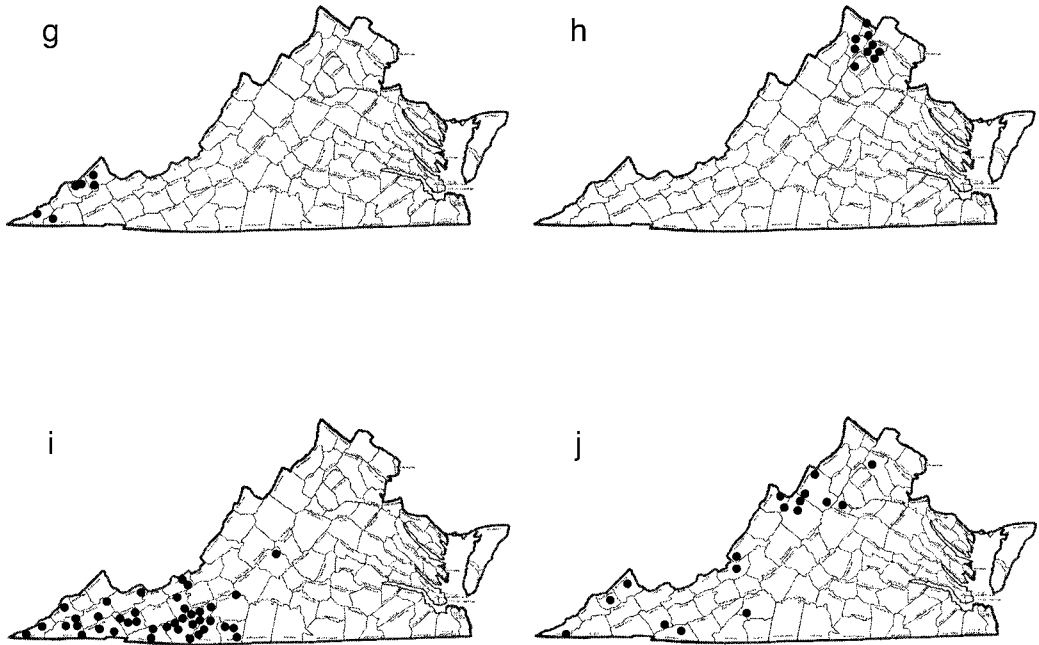


Figure 1. (Continued).

populations are in eastern Tennessee, according to Case (2002), who also reports escapes as far north as Michigan.

6. *Trillium grandiflorum* (Michaux) Salisbury, Parad. Lond. 1: plate 1. 1805. Large White Trillium, White Trillium, White wake robin.

Rhizome white, 2–4 cm long, 10–30 mm wide. Scapes 1–3, 2–5 cm high, green, sometimes purple. Bracts sessile to subsessile, 8–14 cm long, 4–10 cm wide, not mottled, ovate or rhombic, narrowed from below the middle to a cuneate base, apex acuminate. Flower erect or somewhat inclined, pedicel 4–8 cm long, sepals spreading, green, lanceolate, 2–5 cm long, 10–25 mm wide. Petals erect basally, 4–6 cm long, 2–4 cm wide, recurving from the middle; white changing to pink and then to varying shades of purple, margins overlapping at the base, often undulate, lanceolate, oblong to obovate. Stamens 10–25 mm long, filaments white, shorter than the anthers, anthers pale yellow. Ovary pale green or white, 6-angled, 10–20 mm high; fruit greenish white, 1–1.5 cm high. (2N = 10). April–June. Rich deciduous or mixed upland woods, floodplains, riverbanks, roadsides. Figure 1f.

7. *Trillium flexipes* Rafinesque, Autik. Bot., 133. 1840. Bent Trillium, Declined Trillium.

Rhizome ascending to erect, gray. Scapes 1-several, 2–4 dm high, glabrous. Bracts sessile; rhombic, 7–16 cm long, 7–16 cm wide. Flower flexed to face outward, pedicel 3–12 cm long. Sepals green, lanceolate, 1–4 cm long, about equal to the petals, apex acuminate. Petals creamy white, spreading, lance-ovate to ovate, 2–5 cm long, 1–4 cm wide, with deep veins. Stamens 1–2 cm long, filaments white, shorter than the creamy white anthers. Ovary white, 0.5–1.5 cm high. Fruit burgundy to reddish purple, 2–3 cm high. (2N = 10). April–early June. Slopes of rich deciduous forest and floodplains. Figure 1g.

8. *Trillium cernuum* Linnaeus, Sp. Pl. 1:339. 1753. Nodding Trillium.

Rhizome brown, 3–6 cm long, ascending; up to 3 cm wide. Scapes 1-several, 2–6 dm high, glabrous. Bracts sessile to slightly petiolate, not mottled, 3–15 cm long, 8–15 cm wide, broadly rhombic-ovate, acuminate. Flower hidden beneath the bracts, nodding. Sepals spreading, green,

1–3 cm long, equaling or shorter than the petals. Petals creamy white or pale pink, 1.5–3 cm long. Stamens 5–15 mm high, filaments white, not as long as the pale pink to gray anthers. Ovary white to pinkish, 5–10 mm high. Stigmas recurved at the apex, purplish. Fruit dark red, 2–3 cm high. (2N = 10). April–June. Rich, moist deciduous forests. Figure 1h.

9. *Trillium sulcatum* T.S. Patrick, Brittonia 36: 27, figs 1–4. 1984. Barksdale's Trillium, Southern Red Trillium.

Rhizome horizontal or somewhat erect, brownish, 3–6 cm long. Scapes 1–5, 3–6 dm high, glabrous. Bracts sessile, not mottled, broadly elliptic to obovate, 2–5 cm long, 1–3 cm wide, acuminate. Flower facing outward at right angle to the pedicel, above the bracts, pedicel 4–10 cm long; perianth gaping, cup-like; sepals spreading, green or entirely purplish maroon, apically sulcate, 1.5–4 cm long, 1–1.5 cm wide. Petals recurved at the apex, maroon to reddish purple, concealing the ovary from side view, 2–5 cm long, 1–3 cm wide. Stamens 15–20 mm, filaments purple to white, longer than the anthers, anthers purplish to yellow. Ovary dark purple, 1.5–2 cm high. Stigmas purple, recurved. Fruits red, 1–3 cm high. (2N = 10). April–May. Rich, moist, deciduous woods that are scattered with *Tsuga canadensis* (L.) Carr. and *Rhododendron maximum* L., more common on north-facing slopes. Figure 1i.

Trillium sulcatum was erected as a species out of *Trillium erectum* by Patrick (1984). He cites the robust habit, flower profile and sepal/pedicel length as distinguishing characters in *T. sulcatum*. A chromosomal study of these two species reveal karyotypes that are differentiated from each other. Using the chromosome identification protocol of Huskins and Smith (1935), the differentiation is most evident in three of the five chromosome pairs marked as "B," "C" and "D." *Trillium sulcatum* chromosomes were shorter than *T. erectum* chromosomes.

10. *Trillium erectum* Linnaeus, Sp. Pl. 1: 340. 1753. Stinking Benjamin, Ill-scented Trillium, Red Trillium, Stinking Willie.

Rhizome brown, 2–6 cm long, 1–3 cm wide. Scapes 1-several, green to purplish, 2–6 dm tall, glabrous. Bracts sessile to short-petiolate, not mottled, 5–20 cm long, 5–20 cm wide, often wider than long, broadly rhombic-ovate, acuminate. Flowers with a fetid odor, erect, pedicels 1–10 cm long. Sepals flat, streaked with maroon, lanceolate-acuminate, 2–5 cm long, 0.5–1.5 cm wide; petals maroon or white, lanceolate to lance-ovate, 3–6 cm long, 1–3 cm wide, widely spreading from the base. Stamens 5–15 mm long, filaments white, pink to dark purple; anthers maroon or yellowish; ovary purple to maroon, 5–10 mm high; stigmas purple, recurved. Fruits maroon to reddish purple, black in populations from the higher altitudes, 1–1.5 cm high. (2N = 10) Early April–May. Rich, moist, deciduous upland woods, riverbanks. Figure 1j.

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