

***CORYDALIS INCISA* (FUMARIACEAE)
IN BRONX AND WESTCHESTER COUNTIES, NEW YORK**

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ABSTRACT

Spontaneously growing plants of the East Asian *Corydalis incisa* (Thunb.) Pers. (Fumariaceae) are reported from Westchester Co., New York, for the first time. The species was previously only known from a small area along the Bronx River in Bronx Co., New York. The Westchester County plants documented here represent the second known wild population in North America. This discovery increases the number of *Corydalis* species in North America from ten to eleven and from four to five in the northeastern USA. It is the only spontaneous, purple- or white-flowered species in the Northeast.

Corydalis incisa (Thunb.) Pers growing outside of cultivation in North America were first discovered on the floodplain of the Bronx River, near the Burke Avenue Bridge in Bronx Park, New York, by Michael Sundue during the 2005 Bronx River BioBlitz (Sundue, pers. comm). No voucher specimens were collected. Soon after, Steve Glenn collected the species at the same locality and noted "dozens" of individuals along both banks of the River, reported for the first time as naturalized in North America by Lamont et al. (2011). The population has since persisted and expanded. In 2014, a second population was discovered by the authors and is detailed below.

In 2010, Daniel Atha found one plant, sterile at first (*Atha* 6925) and then in flower (*Atha* 7021) on the grounds of The New York Botanical Garden and later the same year, he and Rob Naczi visited the original 2005 BioBlitz site, about 1000 meters north and found the plants thriving along both banks of the river.

The genus *Corydalis* (Fumariaceae) comprises 450–465 species (Tebbitt et al. 2008; Zhang et al. 2008), most of which are native and endemic to China (Tebbitt et al. 2008; Lidén & Zetterlund 1997). There are currently thirty-five recognized sections (Tebbitt et al. 2008). *Corydalis* sect. *Incisae* Fedde is characterized by the presence of tubers and pendent capsules from patent pedicels (Zhang et al. 2008). The section consists of nine species, eight of which are endemic to China (Zhang et al. 2008). *Corydalis incisa* is the one species of the section native outside of China. It is said to be "widespread and common" in Korea, Taiwan, and eastern China (Tebbitt et al. 2008). Within sect. *Incisae*, *C. incisa* is distinguished by its deeply incised leaflet lobes, racemes with 5–15 flowers, sepals 1–2 mm long, spur straight, and fruits narrowly oblong to linear (Zhang et al. 2008).

Ten species of the genus are reported for the Flora of North America North of Mexico (Stern 2007). In the flora area of the Manual of Vascular Plants of Northeastern United States and adjacent Canada, four species are reported (Gleason & Cronquist 1991). In the Northeast, three species have yellow flowers and one has pink flowers (*Corydalis sempervirens* (L.) Pers.). *Corydalis incisa* is the only species with purple flowers native or naturalized in the northeastern USA.

***Corydalis incisa* (Thunb.) Pers.**

Biennial herb, glabrous, 10–50 cm tall, the sap watery; leaves ternate to bi- or tri-ternate; ultimate segments rhombic, the bases cuneate, the margins deeply incised; first-year plants from fusiform tuber ca 12 × 5 mm; leaves few, reduced; second-year plants from fibrous roots, erect to ascending, branched; leaves usually numerous, the petioles 5–20 cm long, the blades 4–12 × 4–12 cm; upper-most leaves reduced near the inflorescence; racemes erect, 6–9 cm long (in fruit), bracteate, the bracts rhombic, incised 4–10 mm long; flowers 10–16 per raceme; pedicels 10–15 m long, patent; sepals reduced, lacerate; corolla tubular, 8–15 mm long, the petals connivent, purple (rarely white), dilated and darker at the apex, saccate at the base; capsules pendent, oblong, 12–18 × 3 mm, green, explosively dehiscent; seeds ca 1 mm long. Flowering and fruiting May to June. (The description is derived from field observation in New York and study of preserved Asian specimens at NY).

Vouchers. **New York.** Westchester Co.: Crestwood, Bronx River Reservation, between the Bronx River Parkway and Dale Road at about Cross Hill Road, in the annual floodplain forest of the Bronx River with *Acer saccharinum*, *Acer saccharum*, *Acer negundo* and *Morus alba* in the overstory and *Reynoutria japonica*, *Rosa multiflora* and *Laportea canadensis* dominating the understory, 40.965898 N, 73.818284 W (±25 m), 31 m, 10 Jun 2014, *Atha 14519* (NY). Data will be available online through the C.V. Starr Virtual Herbarium (2014). All other vouchers cited are at NY.

Inspired by Linda Rohleder of the New York-New Jersey Trail Conference and Steve Young of the New York Natural Heritage Program, the authors conducted a rapid survey of the original sites to assess the current extent of the population. The survey, conducted in May and June of 2014, revealed scattered individuals of mostly second-year plants around the Magnolia Way Bridge at the north end of The New York Botanical Garden (*Atha 14402, 14403, 14406, 14407*). No plants were found further south in the Garden, perhaps because the banks are rocky and unsuitable for germination.

At the original site in Bronx Park, as reported by Lamont et al. (2011), north of the Garden, the survey confirmed dense stands on both sides of the river, extending throughout the annual floodplain. The population consisted of both first-year seedlings and second-year flowering and fruiting plants (*Atha & Lumban Tobing 14408, 14410, 14411, 14412, 14413, 14414*). Within one heavily infested area, 32 seedlings were counted in an area of 10 cm² (*Atha & Lumban Tobing 14414*) and Figure 1.

The authors also discovered a previously undocumented population 11.5 kilometers northeast in the Bronx River Reservation of Westchester County, representing the second known population in North America and the first report of the species for Westchester County (USDA, NRCS 2014; Weldy & Werier 2014). The sighting was immediately reported to Westchester County Parks Department and the population was vouchered (*Atha 14519*).

Corydalis incisa appears to thrive on fine, alluvial sediments, competing with native riparian understory plants including *Persicaria virginiana*, *Ageratina altissima*, *Impatiens capensis*, *Laportea canadensis*, and woody seedlings. The very aggressive *Ficaria verna* and *Reynoutria japonica* were also present and abundant (Fig. 2). When very young, *C. incisa* plants resemble *Anthriscus sylvestris*, *Artemisia vulgaris*, *Cryptotaenia canadensis*, and *Osmorhiza claytonia*, all of which may grow abundantly in the same habitat.

It is not known how the species became established in the wild, but given the plant's limited range and its biological traits, we suspect that they were first cultivated in Westchester County near the Bronx River. The fruits are explosively dehiscent and we suspect that seeds were dispersed downriver during floods. The plants quickly flower, fruit, disperse their seeds and then die back, leaving no trace above ground. The first-year tubers may also be dispersal agents.



Figure 1. *Corydalis incisa*. Seedlings (Atha & Lumban Tobing 14414, NY). Note: scale in centimeters.



Figure 2. *Corydalis incisa*. Mature second-year plant (Atha & Lumban Tobing 14408, NY).



Figure 3. *Corydalis incisa*. Mixed population of purple- (*Atha & Lumban Tobing 14413*, NY) and the rare white -flowered (*Atha & Lumban Tobing 14412*, NY) forms.

In one of the densest stands along the west bank of the Bronx River we found three plants with entirely white flowers (Atha & Lumban Tobing 14412). The plants were otherwise morphologically identical to sympatric plants with purple flowers (Atha & Lumban Tobing 14413 and Figure 3). The white flowered form has been named *Corydalis incisa* var. *alba* S.Y. Wang.

The New York Botanical Garden, the New York City Department of Parks and Recreation (NYC Parks), the Bronx River Alliance, and the Westchester County Parks Department are working in collaboration with the Lower Hudson Partnership for Regional Invasive Species Management (Lower Hudson PRISM) to assess the extent of the invasion and determine how it should be monitored and managed in the future. Thain Family Forest staff of The New York Botanical Garden weeded the plants in the Garden this year and will continue to monitor and manage the species in the future. NYC Parks staff members have made plans to hand-pull second-year plants before they fruit and disperse their seeds next year.

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