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TWO SOUTH AMERICAN SPECIES OF *OXALIS* (OXALIDACEAE) NATURALIZED IN ALABAMA AND THE USA, FIRST REPORT

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ABSTRACT

Two *Oxalis* species native to South America are documented as newly naturalized in Alabama. Neither species has previously been reported as occurring outside of cultivation in North America. Alabama collections of *Oxalis hispidula* Zucc. were made from two separate localities in Baldwin County slightly more than 35 km (22 miles) apart. *Oxalis brasiliensis* G. Lodd. was collected from a single location in Dallas County. All collections were made along disturbed roadside right-of-ways and adjacent ditches and populations of both species appear to be securely established. Descriptions for each species and photographs are provided, along with a key to the acaulescent *Oxalis* species of Alabama.

KEY WORDS: *Oxalis*, non-native, Alabama

Independent field studies by Horne and Barger from three separate locations in southern Alabama (Fig. 1) have identified two naturalized species of *Oxalis* previously unreported for North America.

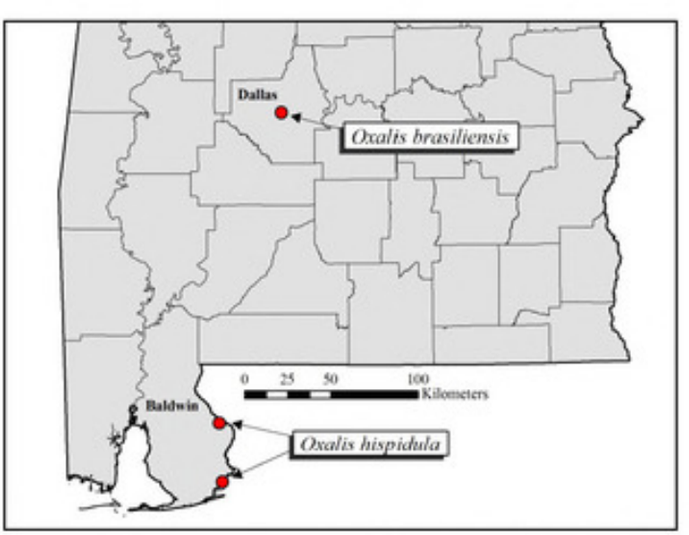

Figure 1. Location of *Oxalis brasiliensis* and *O. hispidula* collection sites in Alabama.

OXALIS HISPIDULA Zucc., Denkschr. Königl. Akad. Wiss. München 9: 143. 1825. **TYPE: Uruguay.** Crescit prope Montevideo, *Anon. s.n.* (holotype: B destroyed, ex herb. cl. Otto). **LECTOTYPE** (Lourteig, Bradea 7: 559. 2000): **Uruguay**. Montevideo, no date, *F. Sello s.n.* (K; isolectotypes: P, W).

SYNONYMS (fide Lourteig 2000)

Oxalis paraguayensis Chodat, Bull. Herb. Boissier ser. 2, 2: 738. 1902. **TYPE: Paraguay.**

Oxalis canelonesensis R. Knuth, Repert. Spec. Nov. Regni Veg. 24: 54. 1927. **TYPE: Uruguay.**

Oxalis uruguayensis Arechav., Anales Mus. Nac. Montevideo 3: 220. 1900; Arech. Fl. Uruguay, 1: 220. 1900. **TYPE: Uruguay.**

Oxalis venustula Arechav., Anales Mus. Nac. Montevideo 3: 216. 1900; Arech. Fl. Uruguay, 1: 216. 1900. **TYPE: Uruguay.**

Plants perennial, acaulescent, arising from a small bulb or tight cluster of bulbs, fibrous-rooted; bulbs mostly 8–15 x 8–15 mm, scales 3[–5]-nerved, nerves strongly thickened, inner scales thick, reddish brown, rugose. **Leaves** all basal; leaflets 3, rounded-obcordate, 4–18 mm, lobed 1/6–1/5 length, lobes apically convex to nearly flat, adaxial surface glabrous, abaxial surface strigose to hirsute-strigose with appressed to loosely appressed-ascending hairs, densely hirsute at the very base, surfaces without oxalate tubercles, margins prominently ciliate with stiff, sharp-pointed, spreading to spreading-ascending hairs 0.5–1 mm; petioles 1.5–15 cm, sparsely villous with spreading to spreading-ascending hairs or glabrous **Flowers** 1(–2)[–4], apparently tristylous (mid-styled flowers observed), [the species noted by Rosenfeldt and Galati 2009 to have three flower morphs: longistylous, medistylous, and brevistylous]; scapes 3–27 cm, completely glabrous or sparsely hirsute-villous proximally, with 1(–2) lanceolate bracteoles (if 1-flowered) 1–1.5 mm long 8–20 mm below flower; sepals oblong to oblong-lanceolate, 4–7 mm, glabrous, yellowish green, apices with a pair of elongate orange tubercles; petals 11–20 mm, deep rose to purple or violet, dark purple-veined proximally, yellow deep in the throat, glabrous; stamens at 2 levels, stigmas in between, styles minutely stipitate-glandular, filaments stipitate-glandular proximally. **Capsules** fusiform, mature size not observed. Measurements in [ ] from Lourteig (2000).

Flowering Oct–Nov. Wet ditches, disturbed roadsides; 10–90 m; naturalized in Baldwin Co., Alabama. *Oxalis hispidula* is native to Argentina, Uruguay, Paraguay, and Brazil (e.g., Burkart & Bacigalupo 2005; Cabrera 1965). It has not been reported (Randall 2011) as naturalized elsewhere in the world.

Vouchers. **Alabama**. Baldwin Co.: SE of Bay Minette, Perdido River Forever Wild Tract, just W of AL/FL state line, E of Hwy 112, near N 30° 41.400', W 87° 28.999', wet ditch near roadside, near bridge, 30 Oct 2007, *Barger and Holt Perd-161* (AMAL); Lillian, N side of West Carrier Drive directly W of its intersection with CR 99, 19 Nov 2012, *Horne 1957* (BRIT); Lillian, same location, 12 Jan 2013, *Horne 1960* (BRIT). The two localities are slightly more than 35 km (22 miles) apart.

Oxalis hispidula (Fig. 2) is recognized by its leaves without oxalate tubercles, outer bulb scales with mostly 3 nerves, flowers 1(–2) per scape, and corollas violet-purple with dark purple veins. The epithet alludes to the strongly strigose to hirsute-strigose abaxial leaf surfaces and the leaflet margins prominently ciliate with stiff, sharp-pointed hairs. The Alabama plants in the wet ditch near Bay Minette produced significantly longer petioles, leaflets, and scapes but the petals were about the same size.

Figure 2. *Oxalis hispidula* collections from Baldwin County, Alabama. Top: *Horne 1957* (BRIT). Right: *Horne 1960* (BRIT).

OXALIS BRASILIENSIS G. Lodd., Bot. Cab. 20: t. 1962. 1833; non *O. brasiliensis* Larrañaga 1922.
TYPE: Plate 62, from a plant cultivated from seeds from Brasil.

SYNONYMS (fide Lourteig 2000)
Oxalis pudica R. Knuth, Notizbl. Bot. Gart. Berlin–Dahlem 7: 309. 1919. **TYPE**: **Uruguay**.
Oxalis maldonadoensis R. Knuth, Repert. Spec. Nov. Regni Veg. 48. 1940. **TYPE**: **Uruguay**.

Plants perennial, acaulescent, arising from a small bulb or tight cluster of small bulbs, fibrous-rooted; bulbs 5–20 x 5–17 mm, outer scales 5–8[–13]-nerved, nerves raised and thickened, margins ciliate, inner scales thick, orangish; about 5% of population reproductive by propagules produced at bracteole region of scape, propagules sessile, fleshy, ovoid, 3–4 mm, green, with small leaves (leaflets 4–6 mm) arising directly from green tissue. **Leaves** all basal; leaflets 3, obdeltate with rounded angles, [2–]10–21[–32] mm, lobed 1/10–1/20 length, lobes apically shallowly convex to nearly flat, adaxial surface glabrous, abaxial surface sparsely but evenly strigose with fine hairs, surfaces without oxalate tubercles, light green above and beneath, margins glabrous to sparsely irregularly ciliate with loose, fine hairs; petioles 3–13[–20] cm, glabrous [to sparsely and finely strigose], often purplish proximally. **Flowers** 1(–2)[–5], apparently tristylous (mid-styled flowers observed); scapes 14–17[–30] cm, glabrous, with 1(–2) lanceolate bracteoles (if 1-flowered) 1–1.5 mm long 15–35 mm below flower, pedicels (if 2-flowered) 15–35 mm; sepals oblong to oblong-lanceolate, 4–7 mm, glabrous, purplish, apices without tubercles; petals 18–20 mm, violet-purple, dark purple-veined proximally, glabrous; stamens at 2 levels, stigmas in between, styles minutely stipitate-glandular, filaments stipitate-glandular proximally. **Capsules** [narrowly cylindric, at maturity ca. 15–22 mm]. Measurements in [ ] from Lourteig (2000).

Flowering Mar–July. Disturbed roadside; naturalized in Dallas Co., Alabama, and also in Australia and Japan (Randall 2011). *Oxalis brasiliensis* is native to Argentina, Uruguay, and Brazil.

Vouchers. **Alabama**. Dallas Co.: SW of Selma, Old Cahawba Forever Wild Tract (AL), W of Cahawba (the first Alabama state capitol), N of Co. Rd. 2, near N32.31490, W87.10881, along edge of woods, dense mats covering roadside for approximately 2.5 km, 5 Mar 2013, *Barger and Holt OC-663* (ALNHS); subsequent collections made from the same location on 24 Apr 2013 and 25 May 2013 were distributed among various southeastern herbaria.

Oxalis brasiliensis is recognized by its leaves and sepals without oxalate tubercles, outer bulb scales with 5–8(–13)-nerves, 1–2(-3) flowers per scape, and violet-purple, dark purple-veined corollas. Figure 3 illustrates the growth habit observed in the Dallas County population, which ranged from small clumps to dense mats formed along the roadside extending to the wood's margin. The large, showy flowers make this species popular in the horticultural trade (see Pacific Bulb Society 2009 for additional horticultural information on the species). Lourteig (2000) studied several cultivated collections of *O. brasiliensis* from North America, including specimens from Alabama, Mississippi, and Maryland. These apparently all represented cultivated material from private gardens and no naturalized populations of *O. brasiliensis* were reported. The Pacific Bulb Society (2009) noted that *O. brasiliensis* may possibly "be invasive in the right climate" when discussing this species' cultivation in California.

Remarkably, and surely diagnostically, a low percentage of the Dallas County *Oxalis brasiliensis* population reproduces by tiny propagules produced at the bracteole region of the scape (Fig. 4). These propagules apparently are highly foreshortened stems, as they produce whorls of small leaves, but they do not produce scales and thus are not "aerial bulbils," miniature bulbs that have been described in some South African species (e.g., *O. convexula* Jacq., *O. inaequalis* Weintroub, *O. fergusoniae* T.M. Salter, and *O. pocockiae* L. Bolus; see comments at the Pacific Bulb Society website 2009). As noted by Oberlander et al. (2009, p. 62), "These aerial bulbils are

structurally identical, if somewhat underdeveloped, to those of bulbils produced underground." In fact, the present authors have not found any other mention in literature of such non-bulboid propagules in *Oxalis* like those produced in *O. brasiliensis*. Lourteig's description (translated from Spanish) of *O. brasiliensis* (2000, p. 557) noted that "aerial bulbs were sometimes present in the inflorescences."

Figure 3. Growth habit of *Oxalis brasiliensis* in Dallas Co., Alabama. Photo by Wayne Barger, 23 May 2013.

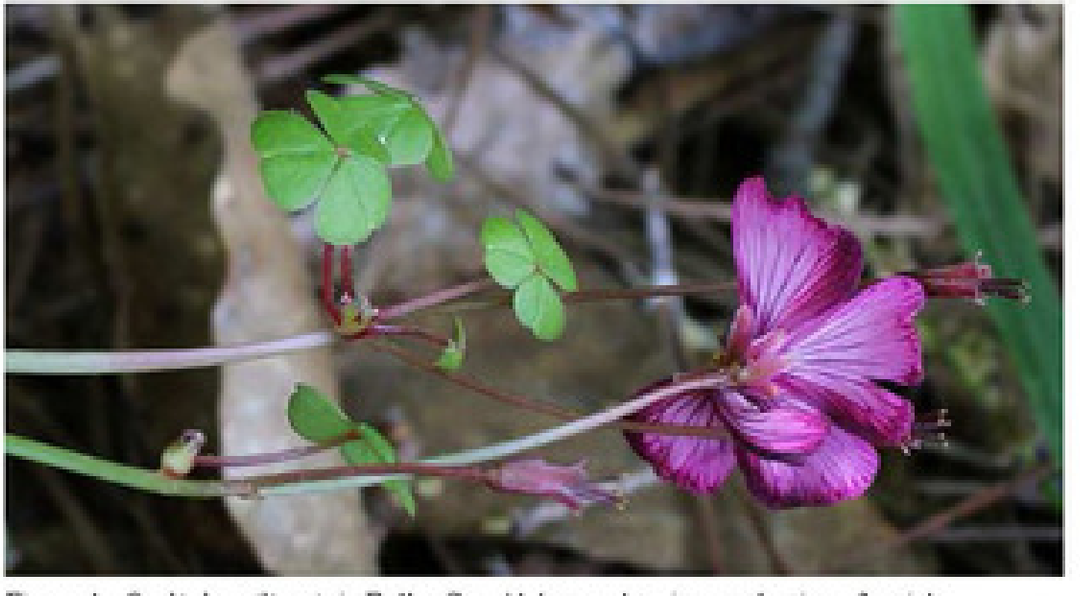

Figure 4. *Oxalis brasiliensis* in Dallas Co., Alabama, showing production of aerial propagules. Photo by Wayne Barger, 23 May 2013.

The following key identifies the acaulescent species of *Oxalis* in Alabama, including *O. hispidula* and *O. brasiliensis*.

1. Leaflets with oxalate deposits (dots) distributed either evenly over the entire surface or around the margins of the leaflets only.

    2. Plants arising from a thick, woody, irregularly nodulate-segmented rhizome often with persistent, thickened, and lignescent petiole bases; flowers 3–12 in umbelliform cymes, less commonly in irregular cymes ..... ***Oxalis articulata***
    2. Plants arising from a dense cluster of sessile bulblets; flowers (3–)8–14(–28) in irregular cymes ..... ***Oxalis debilis***

1. Leaflets not as above; either lacking oxalate dots entirely or (in *O. violacea*) with marginal tubercles only at the base of the apical notch.

    3. Leaflets distinctively obtriangular to obdeltoid; apical lobes angular; plants non-native ..... ***Oxalis intermedia***
    3. Leaflets typically obcordate; not distinctively obtriangular or obdeltoid; apical lobes rounded; plants native or non-native.

        4. Leaflets with oxalate dots at the base of the apical notch, often with a distinctive, adaxial, purple band; petals not dark purple-veined; plants native, typically occurring in natural areas with limestone, occasionally in disturbed situations ..... ***Oxalis violacea***
        4. Leaflets entirely lacking oxalate dots, without a distinctive, adaxial, purple band; petals dark purple-veined proximally; plants non-native, occurring in disturbed situations.

            5. Abaxial leaf surface strongly strigose to hirsute-strigose; leaflet margins prominently ciliate with stiff, sharp-pointed hairs; outer bulb scales 3[–5]-nerved; sepal apices with a pair of elongate orange tubercles; aerial propagules never produced ..... ***Oxalis hispidula***
            5. Abaxial leaf surface sparsely but evenly strigose with fine hairs; leaflet margins glabrous to sparsely irregularly ciliate with loose, fine hairs; outer bulb scales 5–8[–13]-nerved; sepal apices without orange tubercles; aerial propagules sometimes produced at bracteole region of scape ..... ***Oxalis brasiliensis***

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