

SOLIDAGO VILLOSICARPA (ASTERACEAE: ASTEREAE), A RARE NEW SOUTHEASTERN COASTAL PLAIN ENDEMIC

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ABSTRACT

Solidago villosicarpa, sp. nov., is described from the outer coastal plain of southeastern North Carolina, where collections have been made from four counties. Although it apparently is extant in only two of these four counties, its habitat and evident adaptation to disturbance suggest that the new species may be more frequent along the Carolina coast than is currently known. *Solidago villosicarpa* is placed as a member of sect. and subsect. *Solidago* and is distinctive in its combination of pubescent stems, glabrous to glabrate leaves, thyrsoid inflorescence, large heads with bright lemon-yellow rays, densely villous achenes, and late flowering.

RESUMEN

Se describe *Solidago villosicarpa*, sp. nov., de la llanura costera externa del sudeste de Carolina del Norte, donde se han hecho colecciones en cuatro condados. Aunque aparentemente existe en sólo dos de estos cuatro condados, su hábitat y evidente adaptación a las perturbaciones sugieren que la nueva especie puede ser más frecuente a lo largo de la costa de Carolina de lo que se conoce actualmente. *Solidago villosicarpa* se coloca como un miembro de la sect. y subsect. *Solidago* y es distintiva su combinación de tallos pubescentes, hojas glabras o glabrescentes, inflorescencia tirsoide, capítulos grandes con lígulas amarillo limón, aquenios densamente villosos y floración tardía.

INTRODUCTION

Early collections of a distinctive goldenrod species were made from "live-oak scrub" on a barrier island in Brunswick County, North Carolina, in 1949 and 1950. Specimens from the 1950 collection were annotated as *S. sciaphila* Steele (Fox et al. 1952), a plant otherwise known only from sandstone and calcareous habitats in the Upper Mississippi River region (Minnesota, Wisconsin, Iowa, and Illinois). A subsequent collection of the North Carolina entity was made in 1963 from a sandy roadside in neighboring New Hanover County, N.C., and annotated as *S. erecta* Pursh (NCU). Three more populations were found 1991–1998 in Onslow County, N.C., during a natural area inventory of Camp Lejeune Marine Corps Base by the North Carolina Natural Heritage Program (NCNHP), and a population was found in Pender County in 1998 during another NCNHP inventory. Only the Onslow and Pender county populations are known to be extant.

The original collections of the North Carolina entity from 1949 and 1950 have a curious history. According to Fox et al. (1952) the 1950 collection (Godfrey 50963 & Boyce) was identified as *Solidago sciaphila* by Dr. Arthur Cronquist and it was rechecked by him

after several duplicate specimens were sent to him. Godfrey also checked specimens of the collection against material of the species at the Gray Herbarium, and he concurs with Dr. Cronquist in his determination. We are at a complete loss to account for the occurrence of this goldenrod so far from the hitherto known range of its distribution." The 1949 collection (Godfrey 50132) is not mentioned in the 1952 *Rhodora* article. A specimen from this collection was found in the folder for undetermined *Solidago* specimens at the N.C. State University herbarium (NCSC) during the current investigation. The label of this specimen (herbarium #19998) has a typed and penciled portion. The typed portion reads "*Solidago* ... In live oak scrub on the sand dunes, Long Beach." The penciled portion reads "sp. aff. *S. sciaphila* Steele, less closely aff. *S. glutinosa* sens. lat. May need a name. A.C. 3-22-50." "A.C." undoubtedly is Arthur Cronquist. These circumstances suggest that the 1949 collection had been forgotten by the time the 1950 collection was determined. Adding to the mystery, the three specimens from the 1950 collection at NCSC (herbarium #'s 26549, 26550, 34039) were annotated as *S. sciaphila* by H.E. Ahles, not Cronquist. Yet there is no mention of *S. sciaphila* occurring in the Carolinas in Radford et al. (1968) (Ahles was responsible for the treatment of Asteraceae), nor apparently in any other flora, treatment, or checklist since that time. No specimens from the 1949 and 1950 collections are known from other herbaria, including the New York Botanical Garden (Kallunki 1998), where Cronquist worked.

This distinctive, rare, and narrowly endemic North Carolina plant does indeed "need a name," and is here described as a new species.

Solidago villosicarpa LeBlond, sp. nov. (Figs. 1–6). TYPE: UNITED STATES. NORTH CAROLINA. Onslow Co.: in pine-oak-hickory forest with open hardwood understory, Camp Lejeune Marine Corps Base near Salliers Bay, about 0.6 mi W of Tactical Landing Zone Albatross, 13 Oct 2000, R.J. LeBlond 5435 and B.A. Sorrie (HOLOTYPE: US; ISOTYPES: BRIT, FLAS, FSU, GA, GH, MO, NCU, NY, USCH).

A congeneribus diversa caulibus pubescentibus, foliis glabris vel glabratibus, inflorescentia thyrsoida, capitulis grandibus corollis radii vivide citreis, acheniis dense villosis, et florescentia serotina.

Roots wiry, elongate; caudex stout. Stems usually solitary, occasionally loosely cespitose by short rhizomes, 4.5–15 dm long, 2.5–6 mm wide 2 cm above caudex, ribbed and grooved throughout, the ribs rounded to angled, some decurrent from leaf bases; pubescent with short stiff spreading or appressed trichomes 0.1–0.3 mm long, many uncinata; stem color medium brown to dark brownish purple below, and light brown, stramineous, or purple above. Basal leaf rosette present; basal and lower cauline leaves the largest, petiolate, toothed; larger blades 7–14 cm long (not including petiole) by 4–7 cm wide, elliptic, broadly elliptic, or elliptic-obovate, apices obtuse, subacute, or broadly acute; bases cuneate-attenuate, often somewhat abruptly narrowed; petioles 2–7 cm long; petiole base non-auriculate but sheathing the stem for 1/4–1/2 of its circumference; blade margins toothed, the sinuses 1–2.5 mm long from base of cavity to tip of tooth mucro, the mucros mostly 0.2–0.4 mm long, blunt; teeth margins ciliate-scabrous with recurved-ascending trichomes about 0.1–0.2 mm long; primary veins tending to



FIG. 1. *Solidago villosicarpa* LeBlond. A. Simple thyrsoid inflorescence. B. Panicularly branched thyrsoid inflorescence. C. Flower head at anthesis (top view). D. Flower head at anthesis (side view). E. Pappus and achene. F. Lower stem leaf. Drawn from type collection by Margret Mueller.



FIG. 2. *Solidago villosicarpa* LeBlond. Habitat showing example of paniculately branched thyse.



FIGS. 3–6. *Solidago villosicarpa* LeBlond. FIG. 3 (top left) simple elongate thyrses inflorescence form. FIG. 4 (top right) example of the paniculately branched thyrses. FIG. 5 (bottom left) close-up of the inflorescence. FIG. 6 (bottom right) a well-developed basal rosette.

be raised on both surfaces, the mid-nerve flattish and squarred at the edges, pale stramineous; ultimate nerves distinctly reticulate on both surfaces; adaxial surface glabrous to sparsely pubescent with short stiff trichomes mostly along the mid-nerve and larger veins; glabrous to glabrate abaxially; texture thin, papery, brittle when dried; color drab green to olive-green, the lower surface barely if at all lighter than the upper. Middle and upper cauline leaves gradually reduced upwards, sessile, becoming entire; cauline leaves 15–50 below inflorescence. Inflorescence a simple or paniculately branched thyrse; when simple (elongate terminal thyrse), the terminal axis bracteate, straight, narrow, and cylindric, 7–22 cm long by 3–6 cm wide; when paniculiform, producing straight, elongate, thyrsoïd axillary branches up to 20 cm long; bracteal leaves at the base of the branches similar to the cauline leaves, gradually reduced in size upwards. Short secondary branches and peduncles moderately densely to densely invested with stiff, spreading and ascending, straight and recurved trichomes 0.1–0.4 mm long, which appear resinous and segmented; peduncles 0.5–9 mm long. Heads at anthesis 1.4–1.7 cm wide measured from ray tip to ray tip. Involucre 5–8 mm long by 3–5 mm wide at anthesis, the summit 6–8 mm wide at maturity. Phyllaries strongly imbricate, the outer shorter, ovate, somewhat cucullate, the inner broadly linear; outer phyllaries 1.0–2.0 mm wide, appressed; inner phyllaries 0.8–1.5 mm wide, with rounded to subacute apices becoming somewhat squarrose in age; all phyllaries with a narrow but distinct pale reddish-brown midrib; surface glabrous, glandular centrally and near the apex, greenish near the apex, cream-colored centrally and laterally, the margins hyaline, often lacerate, long-ciliate or ciliate-fimbriate (at least near the apex) with cilia 0.1–0.3 mm long. Ray florets 4–8 per head, limb *in vivo* 5–7.5 mm long, 1–2 mm wide, bright lemon-yellow. Disk florets 10–18 per head, the corolla lobes 1.5–2.2 mm long, the entire disk corolla 4.9–6.8 mm long; stigmatic lobes 0.9–1.1 mm long, anthers 2.1–2.2 mm long. Pappus (4.2–)4.7–6.1 mm long, occasionally some bristles clavate. Achenes villous with ascending hairs 0.3–0.5(–0.7) mm long, the achene body 2.6–2.9 mm long when mature.

Additional specimens examined: **NORTH CAROLINA. Brunswick Co.:** in live oak scrub on the sand dunes, Long Beach, 22 Oct 1949, *R.K. Godfrey 50132* (NCSC); in live-oak scrub thickets on sand dunes, Long Beach, 28 Oct 1950, *R.K. Godfrey 50963* and *S.G. Boyce* (NCSC). **New Hanover Co.:** sandy roadside, Pembroke Jones Park, Wrightsville Sound, 29 Nov 1963, *A. McCrary 1813* (NCU). **Onslow Co.:** in pine-oak forest with open understory, Camp Lejeune Marine Corps Base near mouth of Frenchs Creek, 22 Oct 1991, *R.J. LeBlond 2622* (pers. herb.); same locality, 18 Oct 1992, *R.J. LeBlond 3127* (NCU); in pine forest with open understory, Camp Lejeune Marine Corps Base near Salliers Bay, 08 Oct 1995, *R.J. LeBlond 4440* (pers. herb.); same locality, 11 Oct 1998, *R.J. LeBlond 5074*, *A.S. Weakley*, and *K. Patterson* (R.J.L. pers. herb.); same locality, 18 Oct 1998, *R.J. LeBlond 5082* (DUKE, NCSC, NCU); Camp Lejeune Marine Corps Base, SW of Mock-up Road, 0.9 mi SE of NC 172, 05 Nov 1998, *R.J. LeBlond 5124* and *E. Davis* (NCU). **Pender Co.:** in pine-hardwood forest 0.65 mi WNW of Clarks Landing on Long Creek, 30 Sep 1998, *R.J. LeBlond 5051* and *B.A. Sorrie* (NCU).

DISCUSSION

The most striking feature of *Solidago villosicarpa* is the width of the floral heads at anthesis, which measure 1.4–1.7 cm wide from ray tip to ray tip, and with ray limbs *in vivo* 5–7.5

mm long. The size combined with the bright lemon-yellow color of the ray limbs make this one of the showier goldenrods. The density of the achene pilosity completely obscures the body surface with hairs 0.3–0.5(–0.7) mm long. The combination of thyrsoid inflorescence, persistent and glabrous to glabrate basal leaves, upwardly reduced cauline leaves, and pubescent achenes place the new species in *Solidago* sect. *Solidago* subsect. *Solidago* in Nesom's 1993 overview of infrageneric goldenrod taxonomy. North American members of subsect. *Solidago* are *S. calcicola* (Fernald) Fernald, *S. glomerata* Michx., *S. multiradiata* Ait. (including = *S. cutleri* Fernald), *S. nana* A. Gray, *S. plumosa* Small, *S. sciaphila*, *S. simplex* Kunth, *S. spathulata* DC., and *S. spithamea* M.A. Curtis. *Solidago villosicarpa* differs from other members of the subsection by a combination of stem pubescence, floral head width at anthesis, involucre length (5–8 mm), pappus length (4.2–6.1 mm), length of disk corolla and lobes (4.9–6.8 mm), and nature of achene pubescence (villous, the hairs 0.3–0.7 mm long). Also, it flowers late September to early November, one to two months later than the others. It superficially resembles *S. bicolor* L., *S. hispida* Muhl., and *S. squarrosa* Muhl., members of sect. *Solidago* subsect. *Albigula* in Nesom's treatment. It is readily distinguished from all three by its pubescent achenes, from *S. bicolor* and *S. hispida* by its glabrous (–glabrate) leaves, and from *S. squarrosa* by its appressed outer phyllaries.

The following key distinguishes southeastern U.S. *Solidago* taxa with thyrsoid inflorescences, basally disposed leaves conspicuously larger than middle and upper cauline leaves, and pubescent stems.

1. Inner phyllaries very narrow, <0.5–0.75 mm wide at mid-length, tapering to slender tip
 2. Stems and leaves finely pubescent with minute, stiffly spreading viscidulous hairs; ray florets mostly 9–16 _____ ***S. puberula***
 2. Stems irregularly or decurrently short-hairy (–glabrous) below the inflorescence; leaves glabrous; ray florets mostly 6–9 _____ ***S. roanensis***
1. Inner phyllaries broader, 0.75–1.5 mm wide at mid-length, the margins usually parallel and the tips blunt to broadly acute
 3. Leaves glabrous (–sparsely pubescent adaxially); involucre 5–8 mm long; ray florets 4–8; pappus (4.2–)4.7–6.1 mm long; achenes villous _____ ***S. villosicarpa***
 3. Leaves pubescent on both surfaces; involucre 3–6 mm long; ray florets 7–14; pappus 2.5–4 mm long; achenes strigose-puberulent or glabrous
 4. Achenes strigose-puberulent; disk flowers 14–27; larger leaves 3.5–12 cm long; plants flowering in spring _____ ***S. verna***
 4. Achenes glabrous (sometimes sparsely hairy when immature); disk flowers 7–16; larger leaves 8–20 cm long; plants flowering late summer–fall
 5. Ray limbs white (rarely yellow), often turning yellowish in drying; phyllaries whitish to stramineous, usually with a well-defined green tip _____ ***S. bicolor***
 5. Ray limbs deep yellow to orange-yellow; phyllaries yellowish, the tip weakly or not at all greenish _____ ***S. hispida* var. *hispida***

Although similar to *Solidago sciaphila* in overall habit, *S. villosicarpa* is distinguished by several characters, particularly within the inflorescence (Table 1). The stem of *S. villosicarpa* is pubescent throughout, while that of *S. sciaphila* is normally glabrous below the

TABLE 1. A comparison of floral characters used to distinguish *Solidago villosicarpa* from *S. sciaphila*.

Character	<i>Solidago villosicarpa</i>	<i>Solidago sciaphila</i>
Involucre length	5–8 mm	3–6 mm
Phyllary cilia length	0.1–0.3 mm	<0.05–0.1(–0.2) mm
Ray flower limb length	5–7.5 mm	2–4 mm
Disk corolla length (limb and lobes)	4.9–6.8 mm	3.2–4.9 mm
Disk corolla lobe length	1.5–2.2 mm	0.8–1.4 mm
Pappus length	(4.2–)4.7–6.1 mm	2.3–3.8 mm
Density of achene pubescence, length of hairs	villous, 0.3–0.5(–0.7) mm	sparsely to moderately hairy, 0.1–0.3 mm

inflorescence (Fernald 1950; Gleason 1952; Gleason & Cronquist 1991), though *S. sciaphila* occasionally can have sparsely to moderately pubescent stems (frequently so just below the inflorescence). The basal and lower leaves of *S. villosicarpa* tend to be sparsely pubescent to glabrous adaxially and glabrous abaxially, while those of *S. sciaphila* tend to be either glabrous on both surfaces or, less frequently, sparsely pubescent on both surfaces.

With so few collections and known populations, the ecology of *Solidago villosicarpa* is only partially understood. The 1949 and 1950 Brunswick County collections are from “live-oak scrub” or “live-oak scrub thickets” on the Long Beach coastal barrier island. This likely is either Maritime Evergreen Forest or Maritime Shrub (Schafale and Weakley 1990). Maritime Evergreen Forest typically has a canopy dominated by *Quercus virginiana*, usually with *Pinus taeda* and *Q. hemisphaerica*. Characteristic understory species include *Juniperus virginiana* var. *silicicola*, *Ilex vomitoria*, *Persea borbonia*, *P. palustris*, and *Osmanthus americana*. Wind-borne sand and salt spray often produce dense thickets along the ocean-facing side of such forests. In areas closer to the ocean or more exposed, the Maritime Shrub community forms. It is characterized by a dense growth of such shrubs as *Cerothamnus cerifera* (= *Myrica cerifera* var. *cerifera*), *Ilex vomitoria*, *Baccharis halimifolia*, and stunted *Juniperus virginiana* var. *silicicola* and *Quercus virginiana*.

The three *Solidago villosicarpa* sites in Camp Lejeune Marine Corps Base in Onslow County have been altered by past logging. Canopies at all three sites are dominated by pine (*Pinus taeda*), with hickory (*Carya glabra* var. *megacarpa* or *C. alba*) and/or oak (*Quercus falcata*, *Q. nigra*, and *Q. stellata* the most common). Frequent understory species are *Q. margarettiae*, *Liquidambar styraciflua*, and *Ilex opaca*. This composition suggests the Dry or Dry-Mesic Oak-Hickory Forest natural community of Schafale and Weakley (1990), perhaps transitional to Coastal Fringe Evergreen Forest (*ibid.*) at the site near Salliers Bay, where *Q. virginiana* is a subcanopy component. Two of the sites occur on excessively drained Wando fine sand entisol, and the third site occurs on well-drained Marvyn and Norfolk loamy fine sand ultisol.

The site in Pender County near Clarks Landing occurs on slopes above a drain; it also has been disturbed by past logging. Tree species include *Pinus taeda*, *Acer rubrum* var. *trilobum*, *Gordonia lasianthus*, *Quercus nigra*, and seedling *Pinus palustris*. Understory

and shrub species include *Ilex opaca*, *Lyonia lucida*, and *Vaccinium arboreum*. This mix suggests a former longleaf pine community grading downslope to a pocosin streamhead, and likely influenced by proximity to tidal freshwater swamp 300 feet downstream (*S. villosicarpa* itself appears to be an indication of that influence). The upland soil at this site is classified as well-drained Baymeade fine sand ultisol.

Two of the four currently known sites—in Camp Lejeune near Salliers Bay and near Mock-up Road—are within one mile of the ocean, and each was impacted by the hurricanes of 1996 and 1998, with considerable canopy blow-down. Increased seedling establishment and reproductive maturation was observed in 1998, suggesting a positive response to the hurricane impacts. At the Salliers Bay site, 300–400 flowering individuals and 1000+ vegetative rosettes were estimated in 1998, compared with 50 flowering and 100 vegetative rosettes under a closed canopy in 1995. The Mock-up Road site, first discovered in 1998, had 500+ flowering/fruiting individuals. The other two sites are considerably inland, with the Frenchs Creek site in Camp Lejeune seven air miles from the coast and the Clarks Landing site in Pender County 16 air miles from the coast. Each site, however, is located on low uplands or upland slopes adjacent to fresh or slightly brackish tidal creeks or floodplains. Due to their more inland locations, these sites were much less impacted by the 1996 and 1998 hurricanes. Comparative population data are available only for the Frenchs Creek site: 25 flowering with 75 vegetative rosettes in 1998, and 40 flowering with 150–200 vegetative rosettes in 1992. Another observed habit of *Solidago villosicarpa* that may be associated with hurricane impacts is the tendency of plants in canopy openings to produce more robust inflorescences with paniculate thyrsoid branches, while plants in shaded areas tend to produce a simple elongate terminal thyrse.

These variable conditions and evident adaptation to disturbance suggest that *Solidago villosicarpa*, while likely restricted in range, may be more frequent along the Carolina coast than is currently known.

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