Abstract: Chromosome numbers are reported for 67 individuals of 13 species of Solidago sect. Erectae, S. sect. Squarrosae, and S. sect. Villosicarpae from 65 locations in eastern Canada and the eastern United States: S. bicolor, S. erecta, S. hispida, S. jejunifolia, S. pallida, S. puberula, S. pulverulenta, S. rigidiuscula, S. roanensis, S. sciaphila, S. speciosa, S. squarrosa, and S. villosicarpa. Cytogeography maps based on new reports and all 258 previously published reports from 230 locations for the three sections plus S. sect. Brintonia (S. discoidea) are presented for 20 of the 30 species in the four closely related sections. The following are either first documented reports for the taxon or just first counts for a taxon from particular provinces and states: Solidago bicolor, 2n = 18 from Nova Scotia and Prince Edward Island; S. hispida var. hispida, 2n = 18 from New Hampshire, New Brunswick, and Wisconsin; S. jejunifolia, 2n = 18 from Michigan and Minnesota; S. pallida, 2n = 18 from Wyoming; S. puberula, 2n = 18 from Pennsylvania, Prince Edward Island, and Virginia; and first reports for S. sciaphila, 2n = 36 from Iowa, Illinois, and Wisconsin.

Keywords: biogeography; chromosome numbers; goldenrods

1. Introduction

Solidago sect. Erectae G. Don in Loudon is the second largest section in the genus with 26 species that are native to a range of habitats mostly in eastern North America varying from moist woods and wood margins to open sandy barrens and dunes, sandstone and limestone cliff tops and faces, and disturbed soil habitats such as roadsides and fields (Semple and Beck 2021 [1], Semple 2022 [2]). The section is defined by having lower stem rhizomes or stolons, leafy basal rosettes, and pandurate, linear-lanceolate, and lanceolate leaves that are the largest on the plant and usually narrow elongated wand-shaped to club-shaped inflorescences and involucres and upper vegetative parts that are sometimes somewhat to obviously resinous. Most of the species were included in S. sect. Squarrosae A. Gray and S. subsect. Humiles (Ryd.) Semple in Flora North America (Semple and Cook 2006 [3]). The number of species and varieties recognized in the section(s) or subsection(s) has differed among authors (Small 1903 [4], Fernald 1908 [5], Fernald 1915 [6], Fernald 1936 [7], Fernald 1950 [8], Radford et al., 1968 [9]) and over time by the same author or authors (e.g., Cronquist 1968 [10], Cronquist 1980 [11]; Semple et al., 2017a [12], Semple et al., 2017b [13], Semple et al., 2017c [14], Semple et al., 2020 [15], Semple and Nelson 2018 [16]) with 26 species recognized most recently [1]. Semple and Cook [3] adopted much of Cronquist’s treatments [10,11] of taxa in their subsection. Squarrosae and recognized 9 species. Subsequent multivariate morphometric analyses [12–15] resulted in the breaking up of the S. speciosa complex into four separate species based on morphological and habitat preference differences of what had been treated as four varieties within the species and the breaking up of the S. puberula complex. Most recently Semple and Beck [1] presented a revised infrageneric classification based on an unpublished (currently in review) polygenomic DNA sequence data analysis that resulted
in the shifting of all but one species of subsect. Squarrosae to sect. Erectae and dividing the latter section into two subsections and three series; they also broke up subsect. Humiles sensu Peirson et al. (2012 [17]) into a smaller subsect. Humiles that retained the northern and western species: S. bellidifolia Greene, S. chlorolepis Fernald, S. gilmanii (A. Gray) E. S. Steele, S. glutinosa Nutt., S. ontarioensis (G. S. Ringius) Semple & J. A. Peirson, S. randii (Porter) Britt., S. simplex Kunth, and S. spathulata DC. Semple and Beck [1] placed the southeastern species of subsect. Humiles sensu J. A. Peirson into S. ser. Erectae (D. Don in Loudon) Hoffman of S. subsect. Erectae (D. Don in Loudon) Semple & J. B. Beck along with species or varieties previously grouped together in subsect. Squarrosae sensu Semple and Cook [3]: S. arenicola B. R. Keener & Kral, S. austrocaroliniana Semple & J. B. Nelson, S. erecta Pursh, S. jejunifolia Steele, S. kralii Semple, S. pallida (Porter) Rydb., S. plumosa Small, S. rigidiuscula (Torr. & Gray) Porter, and S. speciosa Nutt. Solidago racemosa Greene was also tentatively included in ser. Erectae, but it may belong in the revised subsect. Humiles of sect. Erectae pending further study. Species of the S. bicolor/S. hispida complex were included in S. ser. Albigula (Raf.) Semple & J. B. Beck [1]: S. bicolor L., S. georgiana Semple, S. hispida Muhl., S. porteri Small, and S. sciaphila E. S. Steele. Semple and Beck [1] placed three species with middle and upper stems densely very short canescent in S. ser. Puberulae Semple & J. B. Beck: S. puberula Nutt., S. pulverulenta Nutt., and S. roanensis Porter. Semple and Beck [1] retained just S. squarrosa Muhl. in S. sect. Squarrosae (A. Gray) Semple & J. B. Beck and placed S. villosicarpa LeBlond by itself in S. sect. Villosicarpae Semple & J. B. Beck. Semple and Beck [1] also placed S. discoidea (Ell.) Torr. & A. Gray by itself in Solidago sect. Brintonia (E. L. Greene) Semple & J. B. Beck between S. sect. Squarrosae and S. sect. Thysiflorae (A. Gray) Semple & J. B. Beck [18] that is not dealt with further in this paper but is the terminal clade in the greater S. sect. Erectae clade in S. subg. Solidago. Solidago discoidea was treated as Brintonia discoidea (Ell.) E. L. Greene in Flora North America [19] being the only goldenrod having pappus bristles that are tinted with anthocyanins, but otherwise the morphology is rather typical for S. subg. Solidago. Solidago discoidea was placed with S. bicolor and S. hispida in S. subsect. Albigula (Raf.) Nesom by Nesom 1993 [20].

The cytogeography (biogeography of chromosome count data) of the species now included in S. sect. Erectae (except those included in subsect. Humiles sensu Semple and Beck [1]), S. sect. Squarrosae and S. sect. Villosicarpae was investigated for this study building on a considerable amount of earlier research by multiple researchers between 1957 and 2019. The work of Jean Beaudry and his students and collaborators contributed much to the early cytotaxonomic knowledge of sect. Erectae, sect. Squarrosae, sect. Brintonia in a series of papers beginning in 1957 and ending more than a decade later with many first reports [21–24]. Numerous counts were reported in a series of cytotaxonomic papers over multiple decades by the Semple Astereae Lab [25–34]. Small numbers of counts were reported by various authors over the same period [35–40].

2. Materials and Methods

Meiotic counts (2n = 9n, 2n = 18n, 2n = 27n) were made from pollen mother cells dissected from buds fixed in the field in 3:1/EtOH: glacial acetic acid and subsequently stored under refrigeration in 70% EtOH. Mitotic counts (2n = 18, 2n = 36, 2n = 54) were made from root tip cells taken from transplanted wild rootstocks or from seedlings grown from cypselae collected in the wild. Root tips were pretreated in 0.01% colchicine or saturated P.D.B. for 2–3 h, fixed in either Modified Carnoy’s Fixative (4:3:1/chloroform: EtOH: glacial acetic acid) or Acetic Alcohol Fixative (3:1/EtOH: glacial acetic acid) and hydrolyzed in 1N HCl for 30 min at 60 °C before squashing. Anther sacs containing pollen mother cells and meristematic root tips were squashed in 1% acetic orcein, and counts of chromosomes were made from freshly prepared material. Herbarium vouchers for all new counts are deposited in WAT in MT unless otherwise indicated. Identifications were made by J.C.S. and follow the nomenclature in Semple and Beck [1].

Vouchers for previously published counts were borrowed from or examined at MT and WAT [41] or examined online using SERNEC [42]. In some cases, the cited voucher...
for a count could not be located and the likelihood that the identification was correct was assessed by examining other specimens of the same taxon collected by the author of the count from the same or approximately the same location.

3. Results

Identifications of vouchers were confirmed or revised for nearly all of the 258 previously published chromosome number reports from 230 locations for taxa in Solidago sect. Erectae (except subsect. Humiles), S. sect. Squarrosae, S. sect. Villosicarpae and S. sect. Brintonia and are listed in Appendix A. The previous report of 2n = 18 for S. hispida (Hooper 83091001 WAT [26]) was determined to be the first report for S. hispida Muhl. aff. var. lanata (Hook.) Fernald. Chromosome counts are reported for the first time in Appendix B for 67 individuals from 65 locations in eastern Canada and the eastern United States for 13 species of Solidago sect. Erectae, S. sect. Squarrosae, and S. sect. Villosicarpae. The following are either first documented reports for the taxon or for the taxon for particular provinces and states: Solidago bicolor, 2n = 18 from Nova Scotia and Prince Edward Island; S. hispida var. hispida, 2n = 18 from New Hampshire, New Brunswick, and Wisconsin; S. jejunifolia, 2n = 18 from Michigan and Minnesota; S. palida, 2n = 18 from Wyoming; S. puberula, 2n = 18 from Pennsylvania, Prince Edward Island, and Virginia; and first reports for S. sciaphila, 2n = 36 from Iowa, Illinois, and Wisconsin. All 325 chromosome number counts from 295 locations for all taxa in Solidago sect. Erectae (except subsect. Humiles), S. sect. Squarrosae, S. sect. Villosicarpae and S. sect. Brintonia were used to create cytogeography maps for these taxa (Figures 1–9).

Figure 1. Cytogeography of Solidago erecta based on all counts; range based on all collections seen and the literature.
Figure 2. Cytogeography of *Solidago arenicola*, *S. kralii*, *S. plumosa*, and the range of *S. austrocaroliniana* (red dot indicates range); the subsect. *Humiles*-like species of *S*. ser. *Erectae*; ranges based on all collections seen and the literature.
Figure 3. Cytogeography of *Solidago jejunifolia* and *S. pallida*; ranges based on all collections seen and the literature.
Figure 4. Cytogeography of *Solidago rigidiuscula*; range based on all collections seen and the literature.

Figure 5. Cytogeography of *Solidago speciosa*; range based on all collections seen and the literature.
Figure 6. Cytogeography of *Solidago bicolor*; range based on all collections seen and the literature.
Figure 7. Cytogeography of *Solidago hispida*, *S. georgiana* (red dot indicates range), *S. porter* (green dots indicate unsampled portions of range), *S. sp. nov.* (range in light purple), and *S. sciaphila* range indicated in orange); ranges based on all collections seen and the literature.
Figure 8. Cytogeography of Solidago puberula, S. pulverulenta, and S. roanensis; ranges based on all collections seen and the literature.
4. Discussion

The cytogeography for all taxa in *Solidago* sect. *Erectae* (except subsect. *Humiles*), sect. *Squarrosae*, sect. *Villosicarpae* and sect. *Brintonia* is based on 258 chromosome counts previously published (Appendix A) and 67 additional counts reported here (Appendix B). Only diploids are known in *S. bicolor* (Figure 6), *S. erecta* (Figure 1), *S. hispida* (Figure 7), *S. jejunifolia* (Figure 3), *S. kralii* (Figure 2), *S. pallida* (Figure 3), *S. plumosa* (Figure 2), *S. puberula* (Figure 8), *S. pulverulenta* (Figure 8), *S. rigidiuscula* (Figure 4), and *S. roanensis* (Figure 8).
of sect. Erectae, S. squarrosa (Figure 9) of sect. Squarrosae, S. villosicarpa (Figure 9) of sect. Villosicarpae, and S. discoidea (Figure 9) of sect. Brintonia.

The sizes of the ranges of species vary greatly in the genus Solidago as does the number of known populations within each range. Range size and frequency of occurrence within that range varies from very narrow and very rare, e.g., S. porteri (known only at the hexaploid level 2n = 54) and S. villosicarpa (known only at the diploid level 2n = 18), to relatively widely distributed and common, e.g., S. hispida (known only at the diploid level 2n = 18) and S. speciosa (known at both the diploid and tetraploids levels). The reasons for these differences are not known, although in some cases rare species appear to be found growing in rare habitats with distinct soil characteristics associated with particular communities of dominant plants, e.g., S. villosicarpa (LeBlond 2000 [43]). Semple and Cook [3] included comments on habitats of all species discussed below.

Polyploids occur in S. arenicola (Figure 2; tetraploids), S. porteri (Figure 7; hexaploids), S. sciaphila (Figure 7; tetraploids), S. speciosa (Figure 5; diploids and tetraploids occurring east of the Appalachian Mts. and only tetraploids occurring west of the Appalachian Mts.), and the tetraploid S. sp. nov. of J. Peirson [44] (Figure 7; insert in the S. hispida complex map) of subsect. Erectae. Polyploidy occurs in four of the eight species of subsect. Humiles (Peirson et al., 2012 [17]); S. racemosa includes only polyploids (tetraploids and hexaploids) and may belong in subsect. Humiles rather than subsect. Erectae. Out of the 27 species of S. sect. Erectae, no chromosome counts have been reported for two southeastern US species known only from type material, S. austrocaroliniana and S. georgiana of subsect. Erectae, and for the Mexican species S. simplex of subsect. Humiles. In comparison, only diploids are known in S. sect. Solidago native to Eurasia plus S. macrophylla native to eastern Northern America (Semple 2016 [45]). In S. sect. Thyrsiflorae (A. Gray) A. Gray, the sixth section in S. subg. Solidago, 20 of 21 chromosome counts reported were diploid, with just one tetraploid count known [18,45]. Thus, the majority of taxa in S. subg. Solidago are diploid (27 out of 48 species; 73% of species have been counted), three species include diploids and tetraploids, five species include just tetraploids, 1 species includes tetraploids and hexaploids, 1 species includes just hexaploids. Chromosome number data is unknown for 11 taxa (species and varieties) in S. subg. Solidago; S. decurrens Loureiro var. prae florens (Nakai) Kitamura, S. horieana Kadota, S. pacifica Juz., and S. yambaruensis S. Sakaguchi & Mot. Ito of Solidago ser. Solidago; S. austro caroliniana, S. georgiana, and S. simplex of S. sect. Erectae, and S. buckleyi Torr. & A. Gray, S. capulinensis Cockerell & Andrews, S. orientalis (Nesom) Nesom, and S. spellenbergii Semple of S. sect. Thyrsiflorae.

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Appendix A

Previously Published Chromosome Counts for *Solidago* sect. *Erectae* (Not Including Taxa of subsect. *Humiles*, sect. *Villosicarpae*, sect. *Squarrosae*, and sect. *Brintonia*; *B* = J.R. Beaudry; *Bt* = L. Brouillet; *C* = R.E. Cook; *C*, *C* & *C* = R. Cook, D. Cook and D. Cook; *Ch* = J. Chmielewski; *S* = J.C. Semple; and *S* & *S* = J.C. & B. Semple.

**Solidago sect. Erectae** D. Don in Loudon

**Solidago subsect. Erectae** (D. Don in Loudon) Semple & J.B. Beck

**Solidago ser. Erectae** (D. Don in Loudon) Hoffmann

*Solidago arenicola* B.R. Keener & Kral (all as *S. arenicola*)—2n = 36 U.S.A. **Alabama**: Blount Co., *Semple & B. Semple 11191* (WAT [30]), *Semple & B. Semple 11196* (WAT [30]). —4x by flow cytometry U.S.A. **Alabama**: Blount Co., *Peirson 608* (MICH [17]), *Peirson 606* (MICH [17]). **Tennessee**: U.S.A. **II** (Raf.) Semple & J.B. Nelson—No counts reported

*Solidago austrocaroliniana* Semple & J.B. Nelson

*Solidago rigida* Pursh (all originally published as *S. erecta*)—2n = 91 U.S.A. **Alabama**: Jackson Co., *G. Morton 4461* (NY [26]), *G. Morton 4471* (NY [26]). **New Jersey**: Atlantic Co., *S & Suripto 9501* (WAT [29]). **North Carolina**: Franklin Co., *S & Suripto 9735* (WAT [29]). **Tennessee**: Hamilton Co., *G. Morton 4446* (WAT [26]). **Virginia**: Culepper Co., *S & Suripto 9735* (WAT [29]); Rockbridge Co., *G. Morton 6506* (NY [26]). —2n = 18 U.S.A. **Georgia**: Dade Co., *S 10996* (WAT [30]); Dekalb Co., *Morton & Venn NA16192* (TRT [33]); Greene Co., *S 10868* (WAT [30]); Taylor Co., *S 10974* (WAT [30]). **Kentucky**: Estill Co., *S & Suripto 9454* (WAT [29]); Rockcastle Co., *S & Suripto 9605* (WAT [29]). **Mississippi**: Itawamba Co., *S & Suripto 10175* (WAT [29]). **New Jersey**: Burlington Co., *B 57-197* (MT [23]). **North Carolina**: Richmond Co., *S, Brammell & Hart 3046* (WAT [25]). **South Carolina**: Chester Co., *S & Ch 6098* (WAT [26]). **Tennessee**: Sullivan Co., *S10771* (WAT [30]). **Virginia**: Bath Co., *S 10721* (WAT [30]); Essex Co., *S & Ch 5969* (WAT [26]); Northumberland Co., *S & Ch 5984* (WAT [26]); Wise Co., *S & Ch 6281* (WAT [26]).

*Solidago jejunifolia* Steele—2n = 91 U.S.A. **Wisconsin**: Douglas Co., *S 11848* (WAT [34]).

*Solidago kralii* Semple—2n = 91 U.S.A. **Georgia**: Pulaski Co., *S & S 11208* (WAT [17]); Richmond Co., *S & S 11217* (WAT [40]). —2n = 18 U.S.A. **Georgia**: Ben Hill Co., *S & S 11216-A* (WAT [17]), *S & S 11216-B* (WAT [17]), *S & S 11212* (WAT [17]); Pulaski Co., *C, C & C 701* (WAT [40]). **South Carolina**: Aiken Co., *S & S 11218* (WAT [17]). —2x by flow cytometry U.S.A. **South Carolina**: Aiken Co., *Peirson 605* (MICH [17]).

*Solidago pallida*—2n = 18 U.S.A. **South Dakota**: Custer Co., *S & Bt 4476* (WAT [26]; corrected ident. in Semple and Cook 2004 [30], originally as *S. specios var. angustifolia*).

*Solidago plumosa* Small—2n = 18 U.S.A. **North Carolina**: Standley Co., *Nesom s.n.* (Guy Nesom, unpub., pers. comm. BRIT Feb 2003.) —2x by flow cytometry U.S.A. **North Carolina**: Stanley Co., *Peirson 610* (MICH [17]).

*Solidago rigida* (Torr. & Gray) Porter—2n = 91 U.S.A. **Missouri**: Jasper Co., *Morton 3992* and 3993 (BRIT [26] as *S. speciosa var. rigida*). —2n = 18 CANADA. **Ontario**: Lambton Co., *Lamb s.n* (WAT [26] as *S. speciosa var. rigida*). **U.S.A. South Carolina**: Greenville Co., *S & Ch 9121* (WAT [28] as *S. speciosa*). **Wisconsin**: Jackson Co., *S & Ch 5064* (WAT [26] as *S. speciosa var. rigida*).

*Solidago speciosa* Nutt. —2n = 18 U.S.A. **North Carolina**: Buncombe Co., *S et al. 3028* (WAT [25] to sp.). **Pennsylvania**: Montgomery Co., *B & Wherry 57-236 and 57-238* (MT [23] to sp.). —2n = 181 U.S.A. **New York**: Westchester Co., *Morton 6794* (NY [26] as var. speciosa). —2n = 181 U.S.A. **South Carolina**: Edgefield Co., *S & Suripto 9817* (WAT [29] as var. speciosa). —2n = 36 US. **Tennessee**: Blount Co., *S & Ch 6228* (WAT [26] to sp.). Hamilton Co., *Morton & Venn NA16201* (TRT [33] to sp). —2n = ca. 36 U.S.A. **Arkansas**: Conway Co., *Morton & Venn NA16265* (TRT [33] to sp). **North Carolina**: Macon Co., *Morton & Venn NA16180* (TRT [33] to sp).

**Solidago ser. Albigulae** (Raf.) Semple & J.B. Beck
Solidago bicolor L. (as *S. bicolor* unless otherwise noted)—2n = 91. U.S.A. Maine: Sagadahoc Co., S 10377 (WAT [29]). Pennsylvania: Perry Co., S & Suripto 9487 (WAT [29]). —2n = 18. Belgium: seed from Bruxelles Garden, Morton s913 (TRT [33]). Canada. New Brunswick: Northumberland Co., S & Keir 4690 (WAT [26]). Ontario: Leeds Co., S 2913 (WAT [25] as var. *bicolor*); Leeds Co., B et al. 62-210, 62-216, 62-230, 62-232 (all MT [24] as var. *bicolor*), S 10656 (WAT [30]). Quebec: Argenteuil Co. S & Keir 4592 (WAT [26] as *S. hispida*); Deux-Montagnes Co., B & Louis-Marie 55G-228 (MT [22] as var. *bicolor*); Gaspé-Nord, Ruisseau-Sorel, B & Louis-Marie 58-249 (MT [23]). U.S.A. Connecticut: Hartford Co., S & Bt 3614 (WAT [25] as var. *bicolor*). Maine: Oxford Co., Ringius 1620a (WAT [26]). Massachusetts: Bristol Co., B & Seymour 57-160 (MT [23] as var. *bicolor*), S & Bt 3574 (WAT [25] as var. *bicolor*); Norfolk Co., B & Seymour 57-161 (MT [23] as var. *bicolor*), B & Seymour 57-165 (MT [23] as var. *bicolor*). Plymouth Co., S & Bt 3558 (WAT [25] as var. *bicolor*). New Hampshire: Carroll Co., S & Bt 3473 (WAT [25] as var. *bicolor*); Coos Co., Cook & Tereszchuk C-157 (WAT [34]), C & Tereszchuk C-161 (WAT [34]); Grafton Co., S & Bt 3483 (WAT [25] as *bicolor*), S & Bt 3460 (WAT [25] as var. *bicolor*). New York: Greene Co., S & Bt 3637 (WAT [25] as var. *bicolor*); Rennselear Co., B & Beal 57-134 (MT [23] as var. *bicolor*); Sullivan Co., S 6827 (WAT [26]). North Carolina: Carteret Co., Morton & Venn NA16560 (TRT [33]); Craven Co., S & Ch 6047 (WAT [26]); Edgecombe Co., S & Ch 6002 (WAT [26]). Henderson Co., S 10827 (WAT [30]). Pennsylvania: Greene Co., S 10676 (WAT [30]). Vermont: Addison Co., S 6904 (WAT [26]); Caledonia Co., S & Bt 3487 (WAT [25] as var. *bicolor*). Virginia: Allegheny Co., S 10732 (WAT [30]); Grayson Co., S 10744 (WAT [30]); Montgomery Co., B & Massey 57-312 (MT [23] as *bicolor var. ovalis*), B & Massey 57-313 (MT [23] as *bicolor var. ovalis*). Wisconsin: Marion Co., S 10681 (WAT [30]). —2n = 18 + 0–1 supernumerary. U.S.A. Virginia: Giles Co., B & Massey 57-328 (MT [23] as *bicolor var. ovalis*). —2n = 18 + 0–3 supernumeraries. Canada. New Brunswick: Fundy N.P., Kapoor 69-xx-x (36) not seen or located) [38] as *S. concolor* var. *hispidus* (TRT [37] to sp., near Doctors Brook, Morton & Venn NA12336 (TRT [33] as var. *arnoglossa*). Quebec: Bon Ami Pt., Morton s.n. (TRT [37] to sp.). Solidago georgiana Semple—No counts reported

Solidago hispida Muhl. var. uncertain—2n = 18 CANADA. Quebec: Boudreau s.n. (QFA; Gervais et al., 1999; to sp.); Ringius 1653 (WAT [26] to sp.). Solidago hispida Muhl. var. *arnoglossa* Fernald—2n = 18 CANADA. Newfoundland: Division No. 5, Morton & Venn NA12474 (TRT [37] to sp.); near Doctors Brook, Morton & Venn NA12336 (TRT [33] as var. *arnoglossa*). Quebec: Bon Ami Pt., Morton s.n. (TRT [37] to sp.). Solidago hispida Muhl. var. *hispida*—2n = 91 CANADA. Ontario: Algoma Dist.: S & Brammall 2861 (WAT [25] to sp.), S & Brammall 2868 (WAT [25], to sp.), S & Brammall 2870 (WAT [25] as to sp.); Bruce Co., S & Brammall 2789 (WAT [25] to sp.), S & Brammall 2300 (WAT [25] to sp.); Cochrane Dist.: S & Brammall 2830 (WAT [25] to sp.), S & Brammall 2831 (WAT [25] to sp.); Manitoulin Dist.: S & Brammall 2308 (WAT [25] to sp.); Parry Sound Dist.: S & Brammall 2891 (WAT [25] to sp.); Simcoe Co., S 2933 (WAT [25] to sp.); Thunder Bay Dist.: S & Brammall 2667 (WAT [25] to sp.); Timiskaming Dist., S & Brammall 2818 (WAT [25] to sp.); Quebec: Laviolette Co., B 55-168 (MT [22] as var. *hispida*). U.S.A. Arkansas: Polk Co., S & Heard 8273 (WAT [27] to sp.). —2n = 18 CANADA. Manitoba: Roseau River Valley, L’Ile & L’ile 6213 (not seen or located) [38] as S. *bicol var. concolor*. Newfoundland: Gros Morne Natl. Park., Morton & Venn NA12163 (WAT [37] to sp.). Ontario: Bruce Co., S & Brammall 2979 (WAT [25] to sp.), S10671 (WAT [30] as var. *hispida*); Cochrane Dist.: S, S & Brammall 2824 (WAT [25] to sp.); Kenora Dist.: S & Bt 4142 (WAT [26] to sp.), S & B. Semple. 6723 (WAT [26] to sp.); Lambton Co., C & D. Cook 74 (WAT [30] as var. *hispida*); Manitoulin Dist., Morton & Venn NA10743a (TRT [37] to sp.), Morton & Venn NA10749 (TRT [37] to sp.), S & Brammall 2328 (WAT [25] as to sp.); Sudbury Dist., S & Brammall 2836 (WAT [25] to sp.); Sudbury Dist., S & Brammall 2846 (WAT [25] to sp.); Thunder Bay Dist., Morton & Venn s.n. (WAT [37] to sp.); S et al. 6757 (WAT [27] to sp.). Quebec: Morton s.n. (TRT [37] to sp., Danseurea et al. 58-248 (MT [24] as S. *bicol var. concolor*); Cap Jaseux, B 61-278, 61–279, 61-280 (MT [24] as S. *bicol var. concolor*); Drummondville, Ringius 1653 (WAT [26] to sp.), Ringius 1663.
(WAT [26] to sp.); Ile Maligne, Doucet 59-141 (MT [24] as S. bicolor var. concolor); Labelle Co., Marcellin-Sylvio 55-190 (MT [22] as var. hispida); Lac St-Jean Co., Rolland-Germain & Galiano 55-216 (MT [22] as var. hispida); Parc la Vérendrye, B & Doucet 59-66 (MT [24] as S. bicolor var. concolor). U.S.A. Arkansas: Fulton Co., S & Heard 8315 (WAT [27] to sp.); Searcy Co., S & Heard 8298 (WAT [27] to sp.); Stone Co., Morton & Venn NA16260 (TRT [33] as var. hispida). Maine: Somerset Co., S & Keir 4634 (WAT [26] to sp.). Missouri: Madison Co., S et al. 3774 (WAT [25] as S. drummondii, corrected det. by R.D. Noyes, MO duplicate). New York: Greene Co., S & Bt 3638 (WAT [25] to sp.); Ohio: Hocking Co., S et al. 2982 (WAT [25] to sp.); Sciota Co., S et al. 2987 (WAT [25] to sp.). Virginia: Allegheny Co., C & Tereschuk 348 (WAT [34] as var. hispida). —2n = 18 + 1 supernumerary CANADA. Ontario: Cochrane Dist.: S & Brammall 2825 (WAT [25] to sp.); Sudbury Dist.: S & Brammall 2837 (WAT [25] to sp.)

Solidago hispida Muhl. var. huronensis Semple—2n = 18 CANADA. Ontario: Bruce Co., S 2452 (WAT [25] as var. tonsa), S & Brammall 2806 (WAT [25] as var. tonsa), S 10672 (WAT [30] as var. huronensis); Lambton Co., C & C C-73 (WAT) as var. huronensis). Solidago hispida Muhl. aff. var. huronensis Semple—2n = 18 CANADA. Ontario: Algoma Dist., S & Brammall 2862 (WAT; Ringius & Semple 1987, as S. glutinosa var. glutinosa; corrected in [17] to S. hispida).

Solidago hispida Muhl. aff. var. lanata (Hook.) Fernald—2n = 18 CANADA. Saskatchewan: E of Shoal Lake, Hooper 83091001 (WAT to sp.).

Solidago hispida Muhl. var. tonsa Fernald—2n = 18 CANADA. Newfoundland: Table Mt., Morton & Venn NA12186 (WAT [37] to sp.).

Solidago hispida Muhl. aff. var. tonsa Fernald—2n = 18 CANADA. Quebec: Gaspésie Co., St. Pierre des Monts, Morton NA4086 (TRT [37] to sp.).

Solidago hispida × sp. 2n = 18 CANADA. Quebec: Comté de Gaspé-Ouest, Boudreau s.n. (QFA [39] as S. simplex).

Solidago porteri Small—2n = 27 U.S.A. Alabama: Morgan Co., S & S 11190 (WAT [31]).

Tennessee: Giles Co., Estes 06795 (APSC [31]).

Solidago sp. nov. J.A. Peirson (in press)—4x = 36 (flow cytometry data) U.S.A. Michigan: 4 locations (Mich [43]).

Solidago sciuaphila Steele—no previous counts reported

Solidago ser. Puberulæe Semple & J.B. Beck

Solidago puberula Nutt. —2n = 9½ CANADA. Quebec: Laviolette Co., B 55-162 (MT as var. puberula). U.S.A. Maine: Sagadahoc Co., S 10376 (WAT [29], as var. puberula); York Co., S & Suripto 9586 (WAT [29], as var. puberula). —2n = 18 CANADA. Quebec: Mt. Albert, Morton s.n. (WAT [37] to sp.); Mont Ste-Anne, Danseure 58-253 (MT; [23] as var. puberula); Rivière-aux-Rats, B & Doucet 59-119 (MT [24] as var. puberula). U.S.A. Maine: Oxford Co., Ringius 1621 (WAT [26] to sp.); Penobscot Co., Ringius 1629 (WAT [25] to sp.).

Massachusetts: Franklin Co., S 6672 (WAT [26] to sp.); Worcester Co., S 6867 (WAT [26] to sp.). New Hampshire: Cheshire Co., Seymour 57-27-1, 57-27-1-2, 57-27-1-3 (MT [22], as var. puberula). New Jersey: Burlington Co., S & Ch 6259 (WAT [26] to sp.). New York: Essex Co., Ringius 1534 (WAT [26] to sp.), Ringius 1551 (WAT [26] to sp.); Hamilton Co., S & Bt 3670 (WAT [25] to sp.); S. Lawrence Co., S & Bt 3679 (WAT [25] to sp.), S & Bt 3686 (WAT [25] to sp.).

North Carolina: Mitchell Co., S 10815 (WAT [30] as ssp. puberula). Tennessee: Blount Co., S & Ch 6227 (WAT [26], as sp. puberula); Carter Co., S 10807 (WAT [30] as var. puberula); Sevier Co., Beaudry et al. 57-428 (MT; [23] as var. puberula), B et al. 57-441 (MT; [23] as var. puberula), Morton & J. Venn NA16169 (TRT [33] to sp.). —2n = 18 + 0 or 3 supernumeraries. CANADA. New Brunswick: Sackville, Kapoor 69-119-1 (SMUH not seen [36] to sp.). Québec: Rivière-aux-Rats, B & Doucet 59-120 (MT; [23] as var. puberula), B & Doucet 59-220 (MT [24] as var. puberula).

Solidago pulverulenta Nutt. —2n = 9½ U.S.A. North Carolina: Bladen Co., S & Suripto 9771 (WAT [29] as S. puberula var. pulverulenta). —2n = 18 U.S.A. Florida: Bay Co., Godfrey 63-35-2, 63-35-4, 63-35-5 (MT [24] as var. puberula); Calhoun Co., S & Godfrey 3112 (WAT [25] as S. puberula); Jackson Co., B & Godfrey 57-514 (MT; [23] as S. puberula var. pulverulenta).
Solidago roanensis Porter (all published as S. roanensis)—2n = 9½ U.S.A. Tennessee: Carter Co., Morton 3853 (NY [26]), Morton 3854 (NY [26]); Polk Co., Morton 8546 (not seen; 8545 UTC from same location is S. roanensis [26]).—2n = 18 U.S.A. North Carolina: Haywood Co., C, C & C 557 (WAT [34]); Transylvania Co., B 57-473 (MT; [23]), 57-475 (MT; [23]). Virginia: Giles Co., B & Massey 57-321C, 57-322, 57-323, 57-324, 57-327 (all MT; [23]).—2n = 18 + 0-1 supernumerary. U.S.A. Virginia: Giles Co., B & Massey 57-316 (MT; [23]).

Solidago subsect. Humiles (Ryd.) Semple See Peirson et al., 2012 [17] for review.

Hybrids

Solidago bicolor × S. puberaula—2n = 18 U.S.A. Maine: Oxford Co., S et al. 2989 (WAT [25] as S. hispida).

Solidago hispida × sp.—2n = 18 CANADA. Québec: mon Ste-Anne, Boudreau s.n. (QFA; [39] as S. simplex ssp. simplex).

Solidago sect. Villosicarpae Semple & J.B. Beck

Solidago villosicarpa LeBlond—2n = 18 U.S.A. North Carolina: Onslow Co., S & Tinbrink 11637 (WAT [32] to sp.), Semple 11639-A (WAT [34], Semple 11639-B (WAT [34]), Semple 11639-C (WAT [34]).

Solidago sect. Squarrosae (A. Gray) Semple & J.B. Beck

Solidago squarrosa Muhl. (all published as S. squarrosa)—2n = 9½ CANADA Ontario: Parry Sound Dist.: Co., S & Bramall 2890 (WAT [25]); Sudbury Dist.: Co., S & Bramall 2884 (WAT [25]). Québec: St-Maurice Co., B 55-61 (MT [22]). U.S.A. New Jersey: Warren Co., Morton 7891 (not seen [26]). Pennsylvania: Fulton Co., Morton 6564 (not seen [26])—2n = 18 CANADA. New Brunswick: Victoria Co., S & Keir 4673 (WAT [26]); Victoria Co., Ringius 1651 (WAT [26]). CANADA Ontario: Durham Co., S 3692 (WAT [25]); Frontenac Co., Ch 2319 (WAT [27]), S 10663 (WAT [30]); Haliburton Co., S 10667 (WAT [30]); Leeds Co., B et al. 62-212 (MT [24]); Muskoka Dist., Semple 2932 (WAT [25]); Nipissing Dist.: Ch 2301 (WAT [27]), Ch 2311 (WAT [27]); Renfrew Co., S 2426 (WAT [25]), Ch 2312 WAT [27]; Timiskaming Dist., S & Bramall 2819 (WAT [25]), Ch 2307 (WAT [27]). Québec: Argentueil Co., Beaudry 55-205 (MT; Beaudry and Chabot 1959); Gaspé, Port Daniel, Kapoor 60-125-1 (SMUH not seen [36]), Kapoor 60-125-2 (SMUH not seen [36]); Ile du College, Chmielewski 2308 (WAT [27]); Parc La Vérendrye, B & Doucet 59-91 (MT [24]), B & Doucet 59-94 (MT [24]); Hwy-105 just S of Hwy-117, C & Seiden C-129 (WAT [34]); Rivière-aux-Rats, B & Doucet DO-59-122 (MT [24]). U.S.A Maine: Aroostook Co., S & Keir 4660 (WAT [26]). New Hampshire: Grafton Co., S & Bt 3467 (WAT [25]). New York: Essex Co., Ringius 1543 (WAT [26]).

Solidago sect. Brintonia (Greene) Semple & J.B. Beck

Solidago discoidae (Ell.) Torr. & Gray—2n = 9½ U.S.A. Mississippi: Lauderdale Co., Jones 15336 (GA not seen [46]; other collections of species from MS by S.B. Jones are correctly identified).—2n = 18 U.S.A. Alabama: Blount Co., S & S 11194 (WAT; [32]); Tuscaloosa Co., B & Harper 57-560, 57-562, 57-563, 57-564 (MT; [23]) as S. delicatula in error. Florida: Gadsden Co., B & Godfrey 57-732, 57-333, 57-335, 57-336 (MT; [23]) as S. delicatula in error [-332, -333, -334] and S. discoidae [-335, -336]. Texas: Dallas Co., B & Shinniers 57-631 (MT; there are two sheets in MT with this number, one is S. delicatula [23] and one is S. discoidae indicating a clerical error and making this report questionable).

Appendix B

Previously Unreported Chromosome Number Determinations of Taxa in Solidago sect. Erectae, sect. Squarrosae, and sect. Villosicarpae from Canada and the United States Are Arranged Alphabetically by Section, Subsection, Series, and Species. Bt = L. Brouillet; C = R. Cook; C & C = R. Cook, D. Cook and R. Cook; S = J.C. Semple; S & S = J.C. & B. Semple; and T = K. Terechuk; All Vouchers in WAT in MT.
**Solidago sect. Erectae**

**Solidago subsect. Erectae**

**Solidago sect. Erectae**

*S. erecta* Pursh—2n = 18 U.S.A. **Georgia**: Chattooga Co., US-27 S of Sommerville, C & T 248; Union Co., GA-60 W of Suches, C, C & C 616; GA-180 1 km N of Vogel St. Park, C, C & C 622. **New Jersey**: Atlantic Co., NE of Egg Harbor City, Bremen Ave. (Co.Rd.-674), S 11817. **North Carolina**: Cherokee Co., US-64 ca 3 km E of Murphy, S 11586. **Tennessee**: Coffee Co., S of Manchester, Arnold Center Rd., S & S 11189; US-41 SE of Manchester, S & S 11187. Johnson Co., US-421 N of Mountain City, C & T C-322; Polk Co., US-64/74 W of Greasy Branch Creek, C & T 270. **Virginia**: Mecklenburg Co., E side of La Crosse, US-58 3.8 km E of I-85, S 11611. Prince George Co., VA 10 4 km W of Burrowsville, S 11761.

*S. jejunifolia* Steele—2n = 18 U.S.A. **Michigan**: Cheboygan Co., Indian River, S of Burt Lake, Indian River Snowmobile Trail, S 11838. **Minnesota**: Sherburne Co., SE of Orrock, Sand Dunes State Forest, Ann Lake Campground, S 11850.

*S. pallida* (Porter) Rydb.—2n = 18 U.S.A. **Wyoming**: Crook Co., NW of Sundance, F.S.Rd.-838 6.2 km N of US-24, S & S 11401.

*S. rigidisscula* (Torr. & Gray) Porter—2n = 91 U.S.A. **Tennessee**: Giles Co., ca. 4 mi NW of Minor Hill (SW of Pulaski), W side of Little Texas Rd. S of intersection with Kennedy Rd., S 11866.—2n = 18 U.S.A. **Kansas**: Miami Co., US-169 3 mi N and 3.8 mi E of Beagle, S & Chmielewski 5259. **South Carolina**: Lexington Co., N end of Gaston, US-321, road right of way, S 11775.

*S. speciosa* Nutt.—2n = 18 U.S.A. **Virginia**: Mecklenburg Co., E side of LaCrosse, US-58 3.8 km E of I-85, S 11613.—2n = 36 U.S.A. **Georgia**: Gwinnett Co., W of Loganville, Old Loganville Rd just E of Fox Chase Rd., S 11677. **Minnesota**: Winona Co., SW of Winona, MN-43 5.4 km NE of I-90, bluffs of Mississippi R., S & S 11321. **Tennessee**: Carter Co., TN-131 S of TN-67, C & T 313; Johnson Co., US-321 near NC state line, C & T 310. Monroe Co., S of Sweetwater, TN-68 2.7 km SE of US-11/TN-2, S 11568. **Wisconsin**: Vernon Co., S of Stoddard, WI-35 Scenic Bluff Overlook Area, Semple 11951.—2n = 54. U.S.A. North Carolina: Avery Co., NC-194 ca. 3.2 km E of US-19E, C & T 291 (Identity of voucher correct, but identity of plant transplanted to greenhouse from which count was made could not be confirmed subsequently; count not included in Figure 6).

**Solidago sect. Albigulae**

*S. bicolor* L.—2n = 18 CANADA. **New Brunswick**: Westmoreland Co., W of Bouctouche, junction of NB-11 and NB-475/505, S & S 11466. **Nova Scotia**: Queens Co., Ten Mile Lake Prov. Park, S & S 11510. **Prince Edward Island**: Queens Co., P.E.I.-222, S of Pleasant Grove, S 11472. **U.S.A. Maine**: Oxford Co., US-2 W of Rumford, C & T C-168. **New Hampshire**: Coos Co., US-25 km E of Gorham, C & T C-157, between Gorham and Shelburne, off US-2 on Old Man Park rd., C & T C-161. **Vermont**: Windsor Co., VT-12 ca 2 km W of Hartland, C & T C-189. **Virginia**: Augusta Co., US-250 at Highland Co. line, Shenandoah Mt., C & T C-388.

*S. hispida* Muhl. var. *hispida*—2n = 91 U.S.A. **Wisconsin**: Douglas Co., W of Solon Springs, US-53, S 11847.—2n = 18 CANADA. **New Brunswick**: Restigouche Co., Campbellton, 11 Val D’Amour Rd., vicinity of Quality Inn, S 11450; York Co., W of Pokiak, NB-2 ca 2 km W of NB-105, S & S 11527. **Ontario**: Algoma Co., Dist.-Rd.-556 between Searchmont and Ranger Lake, 47 km E of Hwy-1, S & S 11093; Haliburton Co., S of Bancroft, Bay Lake Rd, by Bay Lake, S 11059; Parry Sound Dist., Hwy-522 at Stumpy Bay Rd. 27.4 km W of Loring, S & S 11071; Peterborough Co., S 7 km N of Woodview, Hwy-28 roadside picnic area by river, S & S 11056; Renfrew Co., Hwy-62 N of Combermere, S & S 11065. **Québec**: Hwy-132 W of Bic, S & S 11426; Gaspé,Île, N of Grande-Caspéda, Hwy-299, fishing access site #27, by Rivière Caspaedia, S & S 11444; Hwy-117 between Val D’Or and Louvicourt, C & IS 112. **U.S.A. New Hampshire**: Coos Co., US-2 ca 1 km E of Gorham, C & T 156. **Virginia**: Augusta Co., US-250 ca 0.2 km E of Calf Pasture Creek, C & T C-382.

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**TAXONOMY 2022**, 2
Solidago sciaphila Steele—2n = 18 U.S.A. Wisconsin: Vernon Co., S of Stoddard, WI-35, bluff scenic overlook, S 11853.—2n = 36 U.S.A. Iowa: Clayton Co., McGregor, S & Chmielewski 5179. Illinois: Carroll Co., Mississippi Palisades St. Pk., Ossei Pt., S 11854. Wisconsin: Vernon Co., S of Stoddard, WI-35, bluff scenic overlook, S 11851, S 11853.

Solidago ser. Puberulae Semple & J.B. Beck

Solidago puberula Nutt. —2n = 18 CANADA. New Brunswick: Gloucester Co., Hwy-11 ca 4 km S of Janeville, S & S 11456. Nova Scotia: Lunenburg Co., Bayswater, provincial park beach, dunes, S & S 11496. Prince Edward Island: Queens Co., PEI-2 between Tenmile House and Tracadie, S & S 11479. Québec: Hwy-117 S of Louvicourt, C & IS C-114; Reserve la Verendrye, Hwy-117 just S of Rd-30, rest stop, C & IS C-126, Hwy-117 S of Rd-30; C & IS C-118. U.S.A. Pennsylvania: Monroe Co., NW of Mt. Pocono, PA-6111 N of Sussex Dr., S 11805. Virginia: Southampton Co., S of Sebrell, Co.Rd.-647, S 11615.

Solidago pulverulenta Nutt. —2n = 18 U.S.A. North Carolina: Pender Co., NE of Clark’s Landing, Clark’s Landing Loup Rd., S 11635.

Solidago roanensis T. C. Porter—2n = 18 U.S.A. Tennessee: Sullivan Co., US-421 W of Shady Hollow, top of mountain, C & T 332.

Solidago sect. Villosicarpae Semple & J.B. Beck

Solidago villosicarpa LeBlonde—2n = 18 U.S.A. North Carolina: Brunswick Co., Oak Island, 32 St. S of East Oak Island Dr., S 11645.

Solidago sect. Squarrosae A. Gray

Solidago squarrosa Muhl. —2n = 18 CANADA. New Brunswick: Victoria Co., E of Perth-Andover, NB-109, road embankment, S & S 11529. Ontario: Temiskaming Dist.: Harris Twp., Hwy-65 E of New Liskeard, 1.7 km W of Twp. Conc. Rd. 3 & 4, C & Seiden C-83. Québec: Hwy-105 just S of Gracefield, C & Seiden C-134; S of Mikamic, Hwy-105, C & Seiden C-132; La Vallée-de-la-Gatineau Co., Hwy-117, S boundary of Reserve la Verendrye, rest stop, C & Seiden C-125.

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