Semple, J.C. and J.G. Chmiewlewski. 2022. Cytogeography of *Solidago* ser. *Canadenses* (Asteraceae: Astereae): *S. brendae, S. canadensis*, *S. elongata*, *S. fallax*, *S. lepida*, *S.* rupestris, *S. shortii*, and *S. turneri*. Phytoneuron 2022-57: 1–17. Published 21 December 2022. ISSN 2153 733X

CYTOGEOGRAPHY OF *SOLIDAGO* SER. *CANADENSES* (ASTERACEAE: ASTEREAE): *S. BRENDAE, S. CANADENSIS, S. ELONGATA, S. FALLAX, S. LEPIDA, S. RUPESTRIS, S. SHORTII,* AND *S. TURNERI*

JOHN C. SEMPLE
Department of Biology
University of Waterloo
Ontario, Canada N2L 3G1
jcsemple@uwaterloo.ca

JERRY G. CHMIEWLEWSKI
Department of Biology
Slippery Rock University
Slippery Rock, Pennsylvania 16057

ABSTRACT

The cytogeography of *Solidago brendae*, *S. canadensis*, *S. elongata*, *S. fallax*, *S. lepida*, *S. rupestris*, *S. shortii*, and *S. turneri* is presented based on 513 previously published chromosome counts and 16 new counts reported here. Herbarium vouchers for nearly all counts were examined and the identification accepted or revised following the most recent classification of *Solidago* ser. *Canadenses*. The cytogeography of *S. altissima* is not included in this study but has been reported separately.

Solidago ser. *Canadenses* Semple & J.B. Beck includes nine species all native to North America (Semple & Beck 2021; Semple 2021, 2022a occasionally updated): *Solidago altissima* L., *S. brendae* Semple, *S. canadensis* L. var. *canadensis*, *S. canadensis* var. *hargeri* Fernald, S. *elongata* Nutt., *S. fallax* (Fernald) Semple var. *fallax*, *S. fallax* var. *molina* (Fernald) Semple, *S. lepida* DC. var. *lepida*, *S. lepida* var. *salebrosa* (Piper) Semple, *S. rupestris* Raf., *S. shortii* Torr. & Gray, and *S. turneri* Semple. The most widely distributed species is *S. altissima*, which has become an established invasive in eastern Asia, multiple Pacific islands, and India and has been found recently in Belgium and South Africa (see Semple 2022b). The cytogeography of *Solidago altissima* was reviewed in Semple (2022b). Numerous chromosome counts have been published for the other eight species of ser. *Canadenses* (see Appendices 1 and 2), but the cytogeography has never been mapped in detail for these species.

Materials and methods

Chromosome counts were made following the methods detailed in Semple (2022b) for *Solidago altissima*. Vouchers for all Chmielewski collections (including with other collectors) are deposited at UAC or WAT in MT (acronyms follow Thiers 2017). Vouchers for J.C. Semple and L. Brouillet collections are deposited in WAT in MT. All identifications were made by J.C. Semple.

Results and discussion

Data on 16 previously unpublished chromosome counts from 16 locations and 513 previously published chromosome counts from 475 locations for eight species of *Solidago* ser. *Canadenses* are listed in Appendix 1 and Appendix 2 respectively. Identifications of nearly all vouchers were confirmed or corrected as indicated in Appendix 2. Some vouchers could not be located: e.g., *Löve & Löve S3744* (WIN or COLO, not located at either; Löve & Löve 1982a), the collection from Churchill, Manitoba, from a location where only one taxon in *S.* ser. *Canadenses*, *S. lepida* var. *lepida*, occurs and the original identification was for *S. canadensis*, a name often applied to specimens of *S. lepida* historically.

Most vouchers of Beaudry chromosome reports were seen in MT, but a few remain unseen. It is the first author's conclusion that the original identifications by Beaudry were nearly always correct, taking into account that some taxa had not been described when he was actively publishing chromosome data in the late 1950s through the late 1960s.

Nearly all vouchers of counts for *Solidago brendae* (protologue Semple 2013) were originally identified as *S. canadensis* var. *canadensis* (e.g. those of Melville in Melville & Morton 1982). Vouchers of *S. lepida* var. *salebrosa* chromosome counts were frequently originally identified as *S. canadensis* (var. *canadensis*, "montane form," var./subsp. *salebrosa*, "western phase") or sometimes as *S. gigantea* before Semple (2003) proposed the combination used here based on work done in preparing the treatment of *Solidago* for Flora North America (Semple & Cook 2006), but has been significantly revised following additional work (see Semple 2022a occasionally updated).

The majority of chromosome counts for J.K. Morton collections were reported recently following the nomenclature used here (Morton, Venn, & Semple 2022) and these include a significant number of the reports for *Solidago lepida*.

If the cytogeography maps included here were made using the nomenclature that the chromosome counts were originally reported under, the distribution of taxa and the counts would look very different and conclusions about patterns of ploidy level distributions would be misleading. The cytogeography of each species is presented below in alphabetical order. The numbers of counts for each taxon and each ploidy level within the taxon and the numbers of separate geographic locations for these counts are summarized in Table 1 for all nine species of *S.* ser. *Canadenses*.

Table 1. Summary of all chromosome counts for taxa in *Solidago* ser. *Canadenses.*

Taxon	New counts here/ number of locations	Published counts/ number of locations	Total counts/ locations
S. altissima		522 cnts / 482 locations	522 cnts / 482 locations in North America
S. brendae	1 / 1 location	69 2*x* / 63 locations	70 / 64 locations
S. canadensis var. *canadensis*		164 2*x* / 135 locations	164 2*x* / 134 locations
S. canadensis var. *hargeri*		49 2*x* / 43 locations	49 2*x* / 43 locations
S. canadensis all counts		213 2*x* / 178 locations	213 2*x* / 177 locations
S. elongata	1 / 1 location	29 2*x* / 27 locations 2 4*x* / 2 locations	31 cnts / 29 locations
S. fallax var. *fallax*		7 2*x* / 7 locations 1 6*x* / 1 location	8 cnts/ 8 locations
S. fallax var. *molina*		5 2*x* / 5 locations 2 4*x* / 2 locations 2 6*x* / 2 locations	9 cnts / 9 locations
S. fallax all counts			17 cnts / 17 locations
S. lepida var. *lepida*	7 2*x* / 7 locations 2 4*x* / 2 locations	14 2*x* / 12 locations 6 4*x* / 6 locations 69 6*x* / 67 locations	21 2*x* / 19 locations 8 4*x* / 7 locations 69 6*x* / 67 locations
totals	9 cnts/ 9 locations	89 cnts/ 85 locations	98 cnts/ 94 locations
S. lepida var. *salebrosa*	1 2*x* / 1 location 1 4*x* / 1 location	14 2*x* / 14 locations 8 4*x* / 8 locations 62 6*x* / 55 locations	15 2*x* / 15 locations 9 4*x* / 9 locations 62 6*x* / 55 locations
totals	2 cnts / 2 locations	84 cnts / 77 locations	86 cnts/ 79 locations
S. lepida all counts	11 cnts from 11 locations	30 2*x* / 28 locations 14 4*x* / 14 locations 131 6*x* / 124 locations	41 2*x* / 39 locations 14 4*x* / 14 locations 131 6*x* / 124 locations
totals		175 cnts / 166 locations	186 cnts/ 176 locations

S. rupestris		2 2*x* / 1 location 1 4*x* / 1 location	3 cnts / 2 locations
S. shortii		3 4*x* / 2 locations	3 cnts / 2 locations
S. turneri		1 2*x* / 1 location	1 2*x* / 1 location
Hybrids	1 *2x lepida* var. *lepida* × *multiradiata*	1 3*x brenda* × *lepida* 1 6*x altissima* × *lepida*	3 cnts / 3 locations
Totals of all counts for *Solidago* ser. *Canadenses*			**1051 cnts / 957 locations**

In total, 70 diploid counts 2*n*=18 from 64 locations are known for *Solidago brendae* (Fig. 1). The range is mostly in the boreal forest region north of the deciduous forest region in eastern North American and mostly allopatric north of the range of *S. canadensis*. The species can be difficult to separate from *S. canadensis* when the inflorescence is broadly secund-conical and the branches much longer than the subtending leaves, but *S. brendae* has at least some small stipitate glands on inflorescence parts. The majority of the published counts for *S. brendae* were published under the name *S. canadensis* before *S. brendae* was described (Semple 2013). Examination of the vouchers for all counts for this manuscript resulted in the conclusion that *S. brendae* replaces *S. canadensis* across northern Ontario, Québec, and in Newfoundland. The ranges of the two species are regionally sympatric in southern Ontario, southern Québec, New Brunswick, northern Nova Scotia, northern Vermont, and northern Maine, where *S. brendae* is rare.

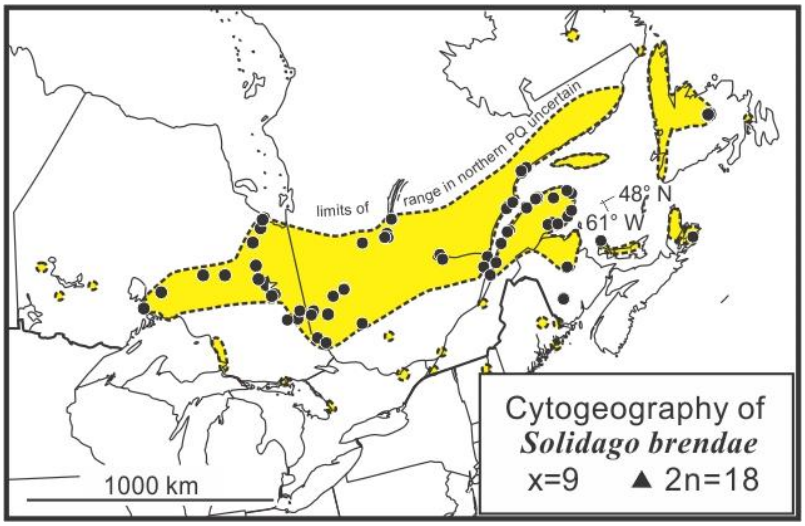


Figure 1. Cytogeography of *Solidago brendae* based on all published counts; the location in Ontario of the putative *S. brendae* × *S. lepida* triploid collection is shown by the single half dot/half star symbol.

In total, 213 diploid counts from 178 locations are known for *Solidago canadensis*; 164 counts from 134 locations for var. *canadensis* (Fig. 2, dots) and 49 counts from 43 locations for var. *hargeri* (Fig. 2 stars). A narrow delimitation of *S. canadensis* is followed here restricting the range to the midwestern and east central and northeastern USA and adjacent Canada. In contrast, Cronquist (1980, 1994) treated the species as transcontinental by including *S. altissima* as *S. canadensis* var. *scabra* (Muhl. ex Willd.) Torr. & Gray in the southeastern USA and treating *S. canadensis var. gilvocanescens* Rydb. and *S. elongata* in synonymy and *S. lepida* in the species as *S. canadensis* var. *lepida* (DC.) Cronq. In contrast, Cronquist (1980) treated *S. rupestris* and *S. shortii* with 4-8 ray florets as species separate from *S. canadensis* with (8-)-10 or more rays. Thus, Cronquist lumped most species of ser. *Canadenses* into the single broadly defined and distributed species *S. canadensis* s.l. Earlier, Cronquist (1968) recognized *S. elongata* (encompassing *S. brendae*, *S. fallax*, and *S.*

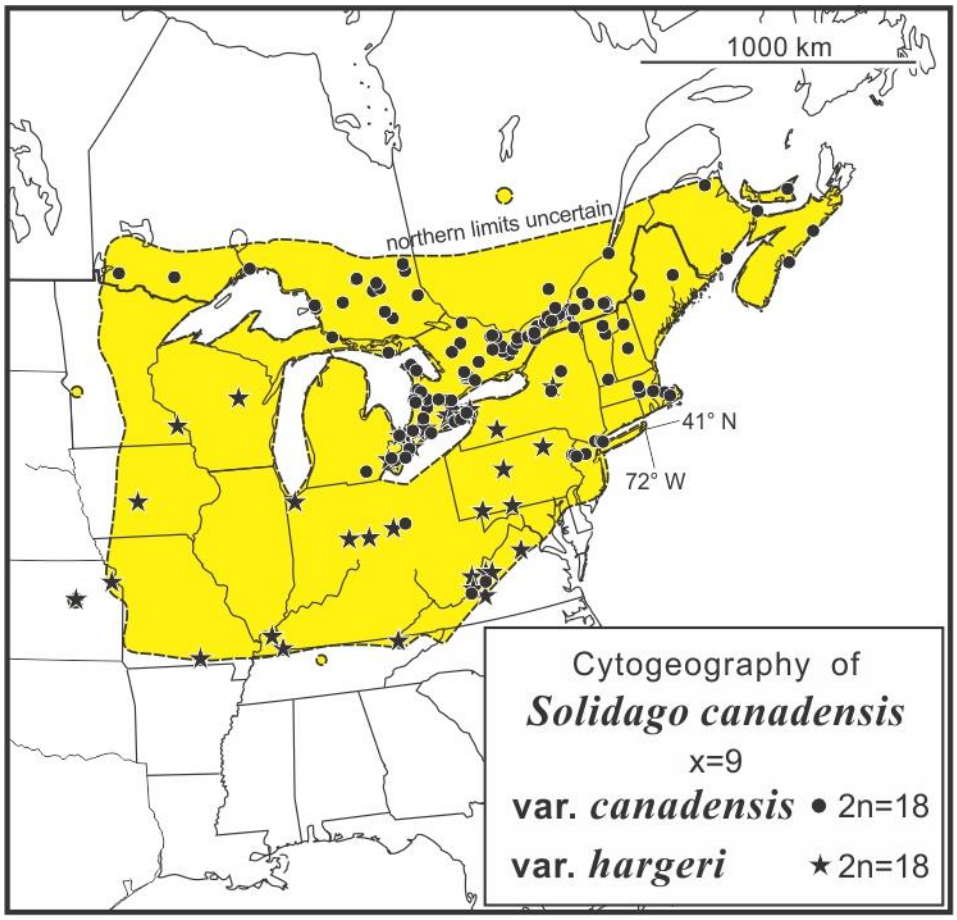


Figure 2. Cytogeography of *Solidago canadensis* based on all published counts in eastern Canada and midwestern and northeastern USA; the range of var. *hargeri* is more southern generally than var. *canadensis*.

lepida) and *S. altissima* as separate species indicating that he opted to expand his concept of *S. canadensis* over multiple decades later in his career.

In total, 32 counts from 30 locations are known for *Solidago elongata* (Fig. 3); 1 new and 29 previously published diploid counts from 28 locations and 2 previously published tetraploid counts from 2 locations. As treated here, *S. elongata* is the only race of ser. *Canadenses* found in the Cascade Mts. from southern British Columbia, Washington, and Oregon and southward along the Pacific coast and Sierra Nevada Mts. in California. *Solidago elongata* includes individuals with mostly elongated narrow inflorescences with lower branches typically short and ascending rather than having lower branches that are long and spreading arching as found in most of species in ser. *Canadenses*. Some diploid individuals of *S. lepida* with small inflorescences from southeastern British Columbia, Idaho, and western Montana can be difficult to distinguish from *S. elongata*.

In total, 18 counts from 18 locations are known for *Solidago fallax*; 8 counts from 8 locations for var. *fallax* (Fig. 4, 7 dots for diploids and 1 square for a hexaploid) and 9 published counts and 1 new count from 10 locations for var. *molina* (Fig. 4, small black stars for diploids, white stars for tetraploids, and a large gray star for a hexaploid). *Solidago fallax* is similar to *S. brendae* but generally has broader leaves. Two varieties occur with var. *molina* having more hairy stems that are sometimes hairy all the way to the base and could be confused with *S. altissima*. Because var. *molina* includes some hexaploids involucre height sometimes falls within the range of involucre height for

var. *altissima*. The distributions of *S. fallax* and *S. altissima* are allopatric except in parts of Maine and New Brunswick. Further work is needed to determine the full extent of the range of *S. fallax* in Québec, New Brunswick, Nova Scotia, and Maine.

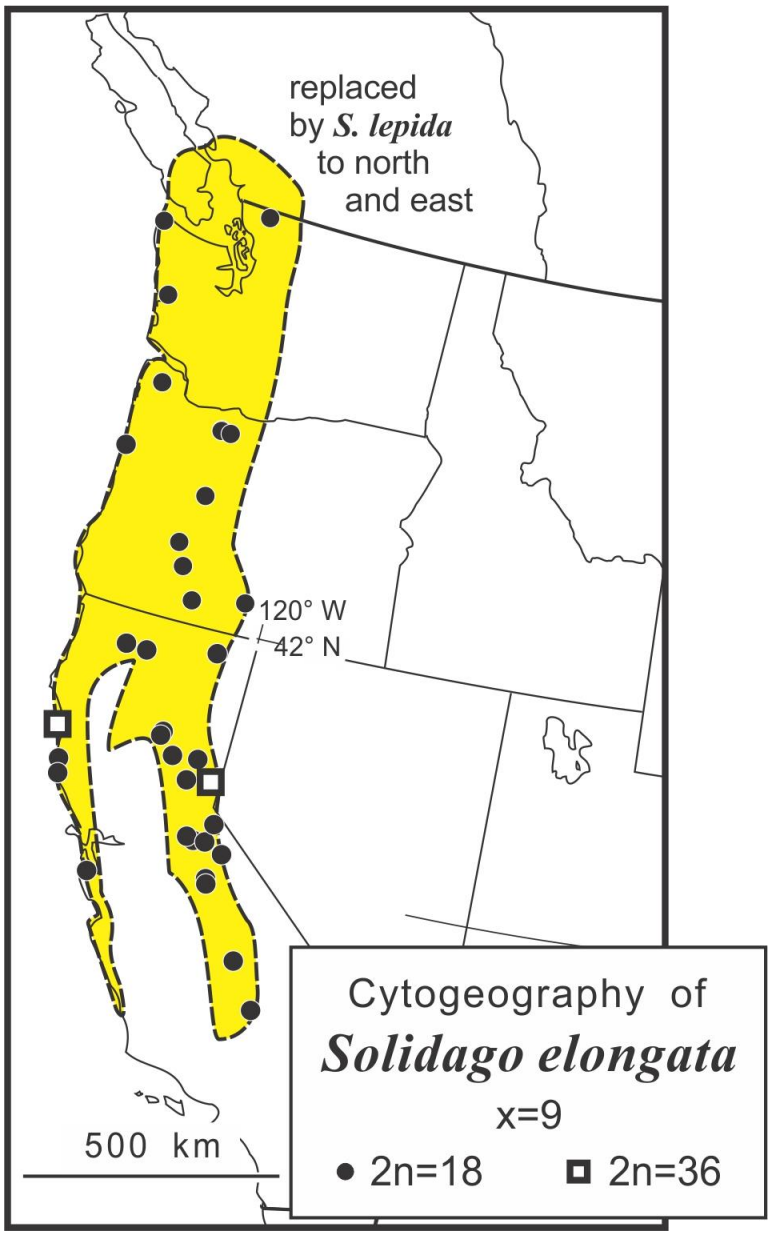


Figure 3. Cytogeography of *Solidago elongata* based on all published counts; southwestern British Columbia to central California.

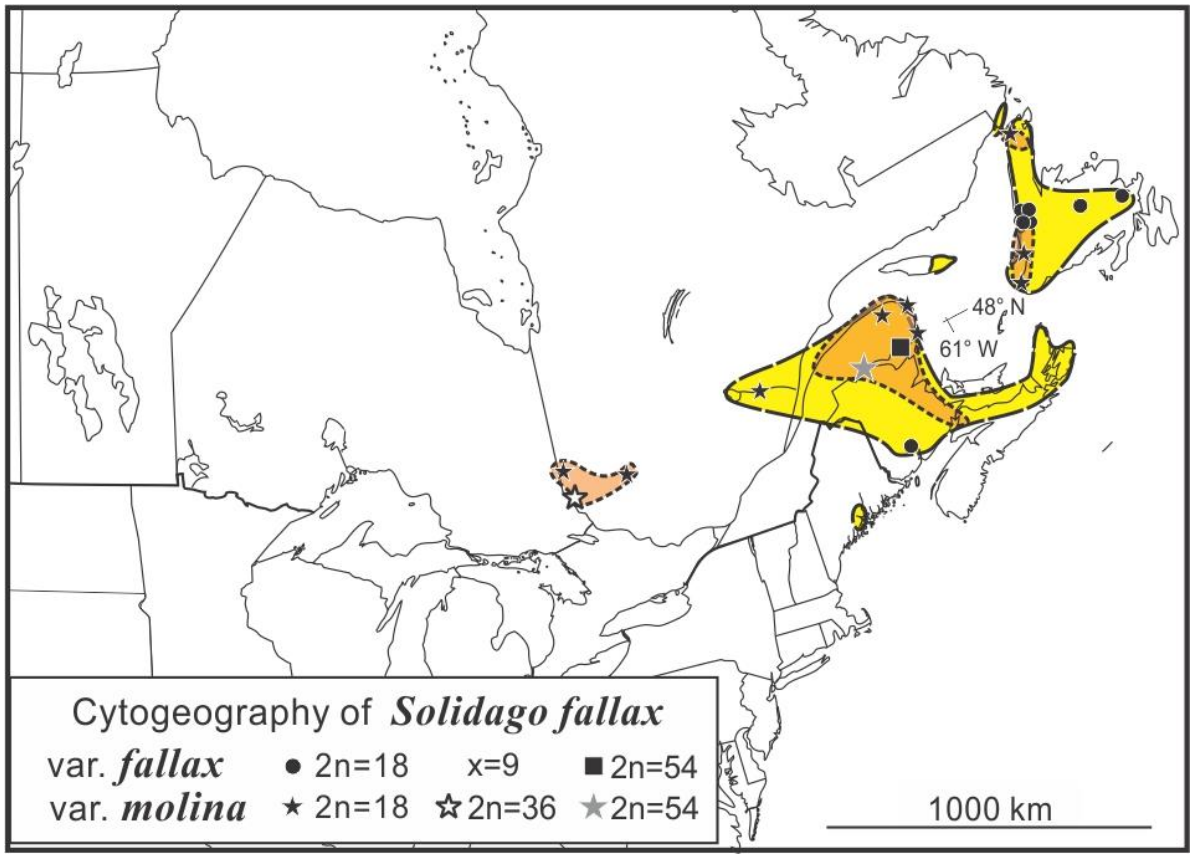


Figure 4. Cytogeography of *Solidago fallax* based on all published counts.

In total, 186 counts from 176 locations are known for *Solidago lepida*; 21 diploid counts from 19 locations, 8 tetraploid counts from 7 locations, and 69 hexaploid counts from 67 locations for var. *lepida* (Fig. 5, black dots for diploids, white squares with black outlines for tetraploids, large black squares for hexaploids) and 17 diploid counts from 17 locations, 9 tetraploid counts from 9 locations, and 62 hexaploid counts from 55 locations for var. *salebrosa* (Fig. 5, small black stars for diploids, white stars with black outlines for tetraploids, and large inverted gray stars for hexaploids). *Solidago lepida* is the only species of ser. *Canadenses* occurring in the Rocky Mts. from Alaska to New Mexico and across Canada north of the prairies and into Ontario north of Lake Superior to Hudson Bay. Scattered populations further east in Canada are likely introduced relatively recently. A tetraploid collection of var. *salebrosa* from Nuevo León, Mexico, appears to be a long-distance disjunct skipping over mountainous habitats in Coahuila, Mexico. A diploid report from Nuevo León was published for *S. canadensis* subsp. *salebrosa* (Piper) Keck by Ward & Spellenberg (1986). The voucher (*Ward, Spellenberg, & Soreng 80-057* – NMC NMC038810!) does not fit well in *S. lepida* due to its inflorescence shape and is here identified as *S. pringlei* Fern. and, thus, is the voucher for the only chromosome number report for *S. pringlei*. The inflorescence is more similar to that seen in specimens of *S. elongata*, but the stem pubescence fits well with other Mexican species of *Solidago* ser. *Tortifoliae*.

Only 2 diploid counts 2*n*=18 and 1 tetraploid count 2*n*=36 have been reported for *Solidago rupestris* (Fig. 6). The species is uncommon in the western portion of the range, with counts from Kentucky and Tennessee, and rare to threatened in the disjunct eastern portions of the range, with no counts from Pennsylvania, Maryland (S1 status — Maryland Natural Heritage Program 2021), eastern West Virginia (Semple & Frye 2017), and northern Virginia (critically imperiled — Townsend 2022).

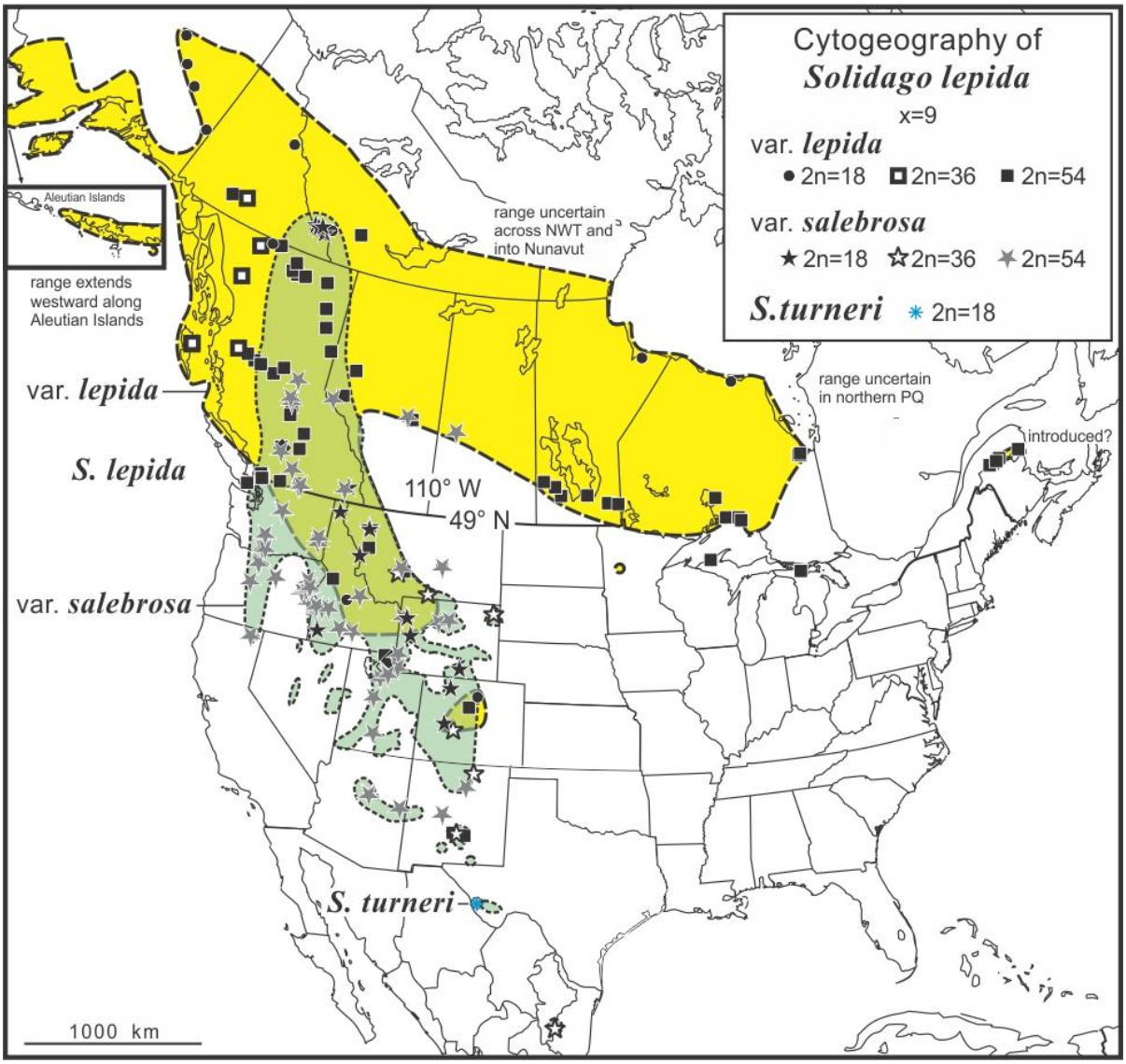
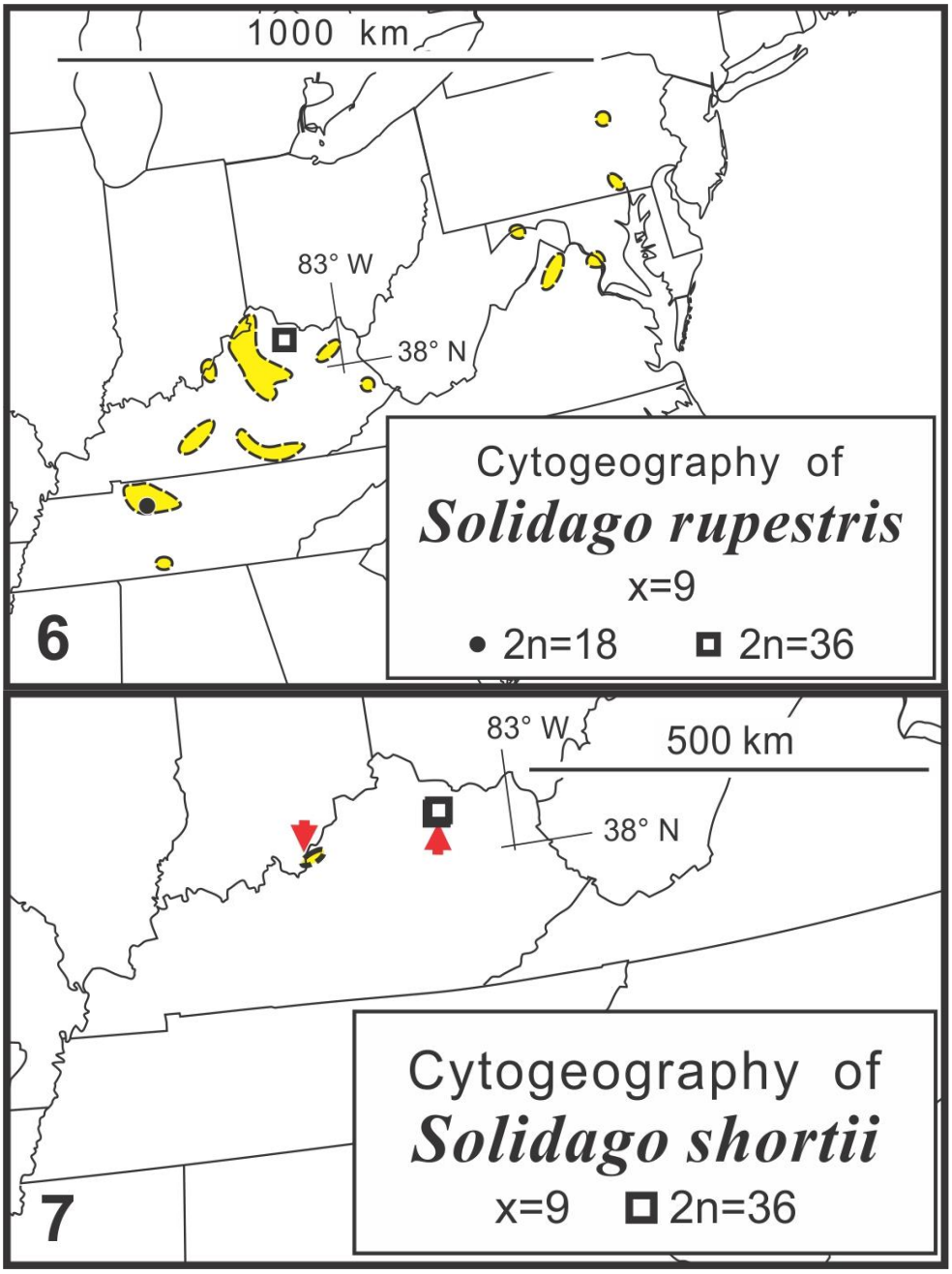


Figure 5. Cytogeography of *Solidago lepida* and *S. turneri* based on all published counts across the range of *S. lepida*; populations in southern Ontario and along the border of New Brunswick and Québec are possibly introduced; *S. turneri* is known from one diploid collection in Presidio Co., Texas.



Figures 6-7. Cytogeography of *Solidago rupestris* and *S. shortii* based on all published counts; red arrows indicate the two disjunct areas of distribution of the very rare *S. shortii* in Kentucky and adjacent southern Indiana.

Clearly more field work yielding more chromosome counts is needed to determine if there is any pattern to the distribution of ploidy levels within the range of the species. Alternatively, ploidy levels might be estimated from DNA extracted from herbarium specimens using the methods described in Martino et al. (2020) for *S. gigantea* Ait.

Three tetraploid counts of 2*n*=36 from the Blue Lick Springs area in of northern Kentucky have been reported for *Solidago shortii* (Beaudry 1963; Semple & Cook 2004). No counts have been reported from the other known populations in the Falls of the Ohio River area in Indiana and

Kentucky. The species is listed as Endangered by the U.S. Fish and Wildlife Service (Baskin et al. 2000; Smith et al. 2004; Homoya & Abrell 2005).

Solidago turneri is known from only one location in Presidio Co., Texas (Fig. 5, blue star burst) and was recently described (Semple 2021). The single collection of the species was reported to be diploid 2*n*=9II by Powell & Turner (2005) under the name *S. gigantea* Ait. In the protologue, Semple (2021) showed in a multivariate analysis that *S. turneri* has very long narrow leaves compared to *S. lepida*, to which *S. turneri* is assumed to be closely related. The ploidy level of the few collections of *S. lepida* from the same region in Texas has not been determined. The nearest known diploids in *S. lepida* occur in Colorado and further north.

ACKNOWLEDGEMENTS

This work was supported by a Natural Sciences and Engineering Research Council of Canada Discovery Grants to the first author. This work could not have been completed without the multiple decades of collecting and chromosome counting by the late John K. Morton and the late Joan Venn, my colleagues in the Department of Biology, University of Waterloo. Open access to the JKM personal herbarium (donated to TRT), which includes more than 740 collections of ser. *Canadenses*, was graciously provided by J.K. Morton.

LITERATURE CITED

Baskin, J.M., J.L. Walck, C.C. Baskin, and D.E. Buchele. 2000. Ecology and conservation biology of the endangered plant species *Solidago shortii* (Asteraceae). Native Pl. J. 1: 35–41.

Beaudry, J. R. 1963. Studies on *Solidago* L. VI. Additional chromosome numbers of taxa of the genus *Solidago*. Canad. J. Genet. Cytol. 5: 150–174.

Beaudry, J.R. and D.L. Chabot. 1957. Studies on *Solidago* L. — I. *S. altissima* L. and *S. canadensis* L. Contrib. Inst. Bot. Univ. Montreal. 70: 65–72.

Beaudry, J.R. and D.L. Chabot. 1959. Studies on *Solidago* IV. The chromosome numbers of certain taxa of the genus. Canad. J. Bot. 37: 209–288.

Carr, D.G., R.M. King, A.M. Powell, & H. Robinson. 1999. Chromosome numbers in Compositae. XVIII. Amer. J. Bot. 86: 1003–1013.

Chinnappa, C.C. and J.G. Chmielewski. 1987: 1. Miscellaneous counts from western North America. Sida 12: 409–417.

Cronquist, A. 1980. Vascular Flora of the Southeastern United States. I. Asteraceae. Univ. North Carolina Press, Chapel Hill.

Cronquist, A. 1994. Intermountain Flora: Vascular Plants of the Intermountain West, U.S.A. Vol. 5. Asterales. New York Botanical Garden, Bronx, New York.

Homoya, M.A. and D.B. Abrell. 2005. A natural occurrence of the federally endangered Short's goldenrod (*Solidago shortii* T. & G.) (Asteraceae) in Indiana: Its discovery, habitat, and associated flora. Castanea 70: 255–262.

Löve, Á. and D. Löve. 1982a. In A. Lovë (ed.). IOPB chromosome number reports LXXV. Taxon 31: 342–368.

Löve, Á. and D. Löve. 1982b. In Á. Löve (ed.). IOPB chromosome numbers of reports LXXVII. Taxon 31: 766–768.

Martino, M., J.C. Semple, and J.B. Beck. 2020. Two cytoype niche shifts are of different magnitude in *Solidago gigantea*. Amer. J. Bot. 107: 1567–1576.

Maryland Natural Heritage Program. 2021. List of Rare, Threatened, and Endangered Plants of Maryland. Maryland Department of Natural Resources, Annapolis.

Melville, M.R. and J.K. Morton. 1982. A biosystematic study of the *Solidago canadensis* (Compositae) complex. I. The Ontario populations. Canad. J. Bot. 60: 976–997.

Morton, J.K, J. Venn, and J.C. Semple. 2022. Chromosome number determinations in *Solidago brendae*, *S. canadensis*, *S. fallax*, and *S. lepida* (Asteraceae: Astereae). Rhodora 123: 345–352.

Powell, A.M. and B.L. Turner. 2005. Documented chromosome numbers 2005: 1. Miscellaneous counts from western Texas, mostly Trans-Pecos. Sida 21: 1663–1664.

Semple, J.C. 2003. New names and combinations in goldenrods, *Solidago* (Asteraceae: Astereae). Sida 20: 1605–1616.

Semple, J.C. 2013. A new species of *Triplinerviae* goldenrod in eastern Canada (Asteraceae: Astereae): *Solidago brendiae*. Phytoneuron 2013-57: 1–9.

Semple, J.C. 2021. *Solidago turneri*, a new species of goldenrod in *S.* subsect. *Triplinerviae* (Asteraceae: Astereae) from the Big Bend area of Texas. Phytoneuron 2021-21: 1–11

Semple, J.C. 2022—frequently updated. Classification and Illustrations of Goldenrods. <https://uwaterloo.ca/astereae–lab/research/goldenrods/classification-and-illustrations)> Accessed 10 Jan 2022.

Semple, J.C. 2022. The cytogeography of *Solidago altissima* in North America (Asteraceae: Astereae). Phytoneuron 2022-16: 1–14.

Semple, J.C. and J.B. Beck. 2021. A revised infrageneric classification of *Solidago* (Asteraceae: Astereae). Phytoneuron 2021-10: 1–6.

Semple, J.C. and J.G. Chmielewski. 1987. Chromosome numbers in Fam. Compositae, Tribe Astereae. II. Additional Counts. Rhodora 89: 319–325.

Semple, J.C. and R.E. Cook. 2004. Chromosome number determinations in fam. Compositae, Tribe Astereae. VII. Mostly eastern North American and some Eurasian taxa. Rhodora 106: 253–272.

Semple, J.C. and C. Frye. 2017. A collection of *Solidago rupestris* (Asteraceae: Astereae) from Mineral Co., West Virginia. Phytoneuron 2017-13: 1–3.

Semple, J.C., R.A. Brammall and J. Chmielewski. 1981. Chromosome numbers of goldenrods, *Euthamia* and *Solidago* (Compositae-Astereae). Canad. J. Bot. 59: 1167–1173.

Semple, J.C., J. G. Chmielewski, and ChunSheng Xiang. 1992. Chromosome numbers in Fam. Compositae, Tribe Astereae. IV. Additional reports and comments on the cytogeography and status of some species of *Aster* and *Solidago*. Rhodora 94: 48–62.

Semple, J.C., R.E. Cook, and E. Owen. 2015. Chromosome numbers in Fam. Compositae, Tribe Astereae. VIII. Eastern North American taxa. II. Rhodora 117: 80–91.

Semple, J.C., Jie Zhang and ChunSheng Xiang. 1993. Chromosome numbers in Fam. Compositae, Tribe Astereae. V. Eastern North American taxa. Rhodora 95: 234–253.

Semple, J.C., H. Faheemuddin, M. Sorour, and Y.A. Chong. 2017. A multivariate study of *Solidago* subsect. *Triplinerviae* in western North America: The *Solidago lepida* complex (Asteraceae: Astereae). Phytoneuron 2017-47: 1–43.

Semple, J.C., G.S. Ringius, C. Leeder, and G. Morton. 1984. Chromosome numbers of goldenrods, *Euthamia* and *Solidago* (Compositae: Astereae). II. Additional counts with comments on cytogeography. Brittonia 36: 280–292.

Semple, J.C., G.S. Ringius, C. Leeder, and G. Morton. 1985. Erratum. Chromosome numbers of goldenrods, *Euthamia* and *Solidago* (Compositae: Astereae). II. Additional counts with comments on cytogeography. Brittonia 37: 121.

Semple, J.C., R.E. Cook, G.H. Morton, J.B. Beck, and R.M. Lopez Laphitz. 2019. Chromosome number determinations in Fam. Compositae, Tribe Astereae. IX. North American taxa. II. Rhodora 121: 37–53.

Smith, B.D., A.T. Denham, J.B. Beck, and P.J. Calie. 2004. High resolution GIS mapping and current status of the ten viable populations of Short's goldenrod (*Solidago shortii*-Asteraceae) in Kentucky. Sida 21: 1121–1130.

Taylor, R.L. and G.A. Mullligan. 1968. Flora of the Queen Charlotte Islands. Part 2. Cytological Aspects of the Vascular Plants. Queen's Printer, Ottawa.

Townsend, J.F. 2022. Natural Heritage Resources of Virginia: Rare Plants. Virginia Dept. of Conservation and Recreation, Richmond.

Ward, D.E. and R.W. Spellenberg. 1986. Chromosome counts of angiosperms of western North America. Phytologia 61: 119–125.

Zhao, Zai-Ming. 1996. Documented chromosome numbers 1996.2. Miscellaneous U.S.A. and Mexican species, mostly Asteraceae. Sida 17: 259–263.

Appendix 1. Previously unpublished chromosome counts for *Solidago elongata* and *S. lepida*. All vouchers in WAT; *Bt* = L. Brouillet, *Ch* = Chmielewski, *S* = J.C. Semple.

Solidago elongata Nutt. — 2*n*=18 **USA**. **Oregon.** Douglas Co., Diamond Lake, OR-138, boat landing, *S & Bt 7160*.

Solidago fallax (Fern.) Semple var. *molina* (Fernald) Semple — *2n*=18 **CANADA**. **Newfoundland.** Division 9, Morton & Venn NA12305 (TRT; count by J.K. Morton).

Solidago lepida DC. var. *lepida* — 2n=18 **CANADA**. **Northwest Territories**. Nahanni National Park Reserve, Flat River Warden's Cabin, *S 11159*. **British Columbia.** Alaska Hwy, 31 km SE of Fireside, N of Liard Hotsprings, *Ch et al. CC3781*. Yukon Territory. North Canol Rd., KP371, N of Mt. Sheldon, *Ch et al. CC4629*, S of Ross River townsite, *Ch et al. CC4661*. **USA**. **Alaska.** Dalton Hwy, Yukon R. Crossing, campsite, *Ch et al. CC4285*; Fairbanks, Phillips Field Rd., near Nome Drive, cross from Alaska Beverage Co., *Ch et al. CC4231*. NE of Fairbanks, Chena Hot Springs Rd., Chena Hot Springs, *Ch et al. CC4234*. — 2n=36 **CANADA**. British Columbia. Cassier Hwy, 49 km N of Good Hope, 56 km S of Alaska Hwy, *Ch et al. CC4714*; Telegraph Creek Rd., 57 km S of Dease Lake, *Ch et al. CC4736*

Solidago lepida DC. var. *salebrosa* (Piper) Semple — 2*n*=18 **USA**. **Colorado.** Routt Co., US-40 S of Steamboat Springs and E of CO-131, *S & B. Semple 5572*. — 2*n*=36 **USA**. **Montana.** Broadwater Co., US-287 21 mi E of Townsend, *S & Bt 7007*.

Solidago multiradiata Ait. × *S. lepida* DC. var. *lepida* — 2*n*=18 — **CANADA**. Ontario. Polar Bear Prov. Park, Peawanuck, *Clements & Clements 176*.

Appendix 2. Previously published chromosome counts from individuals of *Solidago brendae*, *S. canadensis*, *S. elongata*, *S. fallax*, *S. lepida*, *S. rupestris*, *S. shortii*, and *S. turneri*; *Bt* = L. Brouillet, *Ch* = J. Chmielewski; *MM* = M. Melville; *M & V* = J.K. Morton & J. Venn; *S* = J.C. Semple

Solidago brendae Semple — 2*n*=18 **CANADA**. **New Brunswick**. Northumberland Co., *S & Keir 4682* (WAT; Semple et al. 1985; as *S. can.*); York Co., *S 11515* (WAT; Semple et al. 2019). **Nova Scotia.** Cape Breton Co., *S & Keir 4773* (WAT; Semple et al. 1985 *S. can.* var. *can.*). **Ontario.** Cochrane Dist.: Cochrane, *MM 417* (WAT; Melville & Morton 1982 as *S. can.* var. *can.*), *MM 446* (WAT; Melville & Morton 1982 as *S. can.* var. *can.*), *MM 453* (WAT; Melville & Morton 1982 as *S. can.* var. *can.*), *MM 471* (WAT; Melville & Morton 1982 as *S. can.* var. *can.*), *MM 476* (WAT; Melville & Morton 1982 as *S. can.* var. *can.*), *MM 478* (WAT; Melville & Morton 1982 as *S. can.* var. *can.*), *MM 506* (WAT; (Melville & Morton 1982 as *S. can.* var. *can.*), *MM 515* (WAT; (Melville & Morton 1982, S. can. var. can.), *MM 529* (WAT; MMelville & Morton 1982 as *S. can.* var. *can.*) *MM 540* (WAT; Melville & Morton 1982 as *S. can.* var. *can.*), *MM 541* (WAT; MM & M 1982 as *S. can.* var. *can.*), *MM 550* (WAT; Melville & Morton 1982 as *S. can.* var. *can.*), *MM 554* (WAT; (Melville & Morton 1982 as *S. can.* var. *can.*), *MM 556* (WAT; Melville & Morton 1982 as *S. can.* var. *can.*), *MM 946* (WAT; Melville & Morton 1982 as *S. can.* var. *can.*), *MM 1622* (WAT; Melville & Morton 1982 *S. can.* var. *can.*), *MM & Blok 1625* (WAT: Morton et al. 2022), *MM 1626* (WAT; Melville & Morton 1982 as *S. can.* var. *can.*), *MM 1640* (WAT; Melville & Morton 1982 *S. can.* var. *can.*), *MM 1644* (WAT Melville & Morton 1982 *S. can.* var. *can.*), *MM 1652* (WAT; Melville & Morton 1982 as *S. can.* var. *can.*), *MM 1657* (WAT; Melville & Morton 1982 as *S. can.* var. *can.*), *MM 1659* (WAT; Melville & Morton 1982 as *S. can.* var. *can.*), *MM 1663* (WAT; Melville & Morton 1982 as *S. can.* var.

can.), *MM 1676* (WAT!; Melville & Morton 1982 as *S. can.* var. *can.*), *MM 1677* (WAT; Melville & Morton 1982 as *S. can.* var. *can.*); Thunder Bay Dist.. W of Geraldton, *MM 961* (WAT; Melville & Morton 1982 as *S. can.* var. *can.*). **Prince Edward Island.** Prince Co., *M & V NA12045* (TRT: Morton et al. 2022). **Québec.** Abitibi Co., *M & V NA15351* (TRT: Morton et al. 2022), *M & V NA15354* (TRT: Morton et al. 2022); Argenteuil Co. *Beaudry 56-494* (MT; Beaudry & Chabot 1959 *S. can*. var. *can.*); Charlevoix-Est Co., *M & V NA15252* (TRT: Morton et al. 2022), *M & V NA15253* (TRT: Morton et al. 2022); Nord-du-Quebec Co., Chibougamau area, *M & V NA15360* (TRT: Morton et al. 2022), *M & V NA15335* (TRT: Morton et al. 2022), *M & V NA15337* (TRT: Morton et al. 2022); Gaspé Peninsula, *Dansereau 56-257* (MT; Beaudry & Chabot 1959 as *S. can.* var. *can.*), *Dansereau 56-264* (MT; Beaudry & Chabot 1959 as *S. lepida* var. *fallax*), *Dansereau 56-269* (MT; Beaudry & Chabot 1959 as *S. lepida* var. *fallax*), *S & B. Semple 11430* (WAT; Semple 2013), *S 11432* (WAT; Semple 2013), *S & B. Semple 11433* (WAT; Semple 2013), *S 11434* (WAT; Semple 2013), *S & B. Semple 11443* (WAT; Semple 2013), *S 11436* (WAT), *M & V NA17571* (TRT: Morton et al. 2022), *M & V NA17579* (TRT: Morton et al. 2022), Matamek River, *M & V NA15275* (TRT: Morton et al. 2022); Rimouski Co., *M & V NA17521* (TRT: Morton et al. 2022); Saguenay-Lac St-Jean Co., *M & V NA15272* (TRT: Morton et al. 2022), *M & V NA15274* (TRT: Morton et al. 2022), *M & V NA15325* (TRT: Morton et al. 2022); Temiscamingue Co., *M & V NA15358* (TRT: Morton et al. 2022), *M & V NA15364* (TRT: Morton et al. 2022), *M & V NA15374* (TRT: Morton et al. 2022).

Solidago aff. *brendae* Semple — 2*n*=18 **CANADA**. **Ontario.** Cochrane Co., *MM 531* (WAT; Melville & Morton 1982 as *S. can.* var. *can.*); Timiskaming Dist.: *MM 393* (WAT; Melville & Morton 1982 as *S. can.* var. *can.*), *MM 1690* (WAT; Melville & Morton 1982 as *S. can.* var. *can.*). **Québec.** Gaspé Peninsula: *M & V NA17563* (TRT: Morton et al. 2022); Nord-du-Quebec Co., Mistassini, *M & V NA15333* (TRT: Morton et al. 2022); Saguenay-Lac St-Jean Co., *M & V NA15325* (TRT: Morton et al. 2022); Reserve la Vérendrye, *Cook & Seiden C-91* (WAT; Semple et al. 2019 as *S. fallax* var. *molina*), *Cook & Seiden C-120* (WAT; Semple et al., 2019 as *S. fallax* var. *molina*).

Solidago brendiae × aff. *S. lepida* — 2*n*=3x=27 **CANADA**. **Ontario.** Cochrane Dist. Greenwater Prov. Park, *MM & Blok 1629* (WAT: Morton et al. 2022).

Solidago canadensis L. var. *canadensis* (reported as *S. canadensis* var. *canadensis* unless otherwise indicated) —2*n*=9_{II} **CANADA**. **Ontario.** Bruce Co., *S 2770* (WAT; Semple et al. 1981), *S & Brammall 2790* (WAT; Semple et al. 1981); Huron Co. *S 2766* (WAT Semple et al. 1981), *S 2767* (WAT; Semple et al. 1981); Russell Co., *S & K. Shea 2416* (WAT; Semple et al. 1981). **USA**. **Massachusetts.** Plymouth Co., *S 9181* (WAT; Semple et al. 1993). **Michigan.** Lenawee Co., *G. Morton 6637* (NY; Semple et al. 2019). **North Carolina.** Cumberland Co.: *Keil 11644* (not seen; Keil & Pinkava 1979 to sp. as *n*=9). **New Jersey.** Morris Co., *G. Morton 6241* (UCHT; Semple et al. 2019), *G. Morton 6242* (UCHT; Semple et al. 2019), *G. Morton 6243* (UCHT; Semple et al. 2019); Warren Co., *G. Morton 6315* (NY; Semple et al. 2019), *G. Morton 6316* (NY; Semple et al. 2019), *G. Morton 7923* (UCHT; Semple et al. 2019). **New York.** Rockland Co. *G. Morton 6191* (UCHT; Semple et al. 2019), *G. Morton 6192* (UCHT; Semple et al. 2019); Westchester Co., G. Morton 5174 (NY; Semple et al. 2019), *G. Morton 5178* (NY; Semple et al. 2019), *G. Morton 5179* (NY; Semple et al. 2019), *G. Morton 5180* (NY; Semple et al. 2019), *G. Morton 5181* (NY; Semple et al. 2019). **Ohio.** Licking Co., *G. Morton 6725* (NY; Semple et al. 2019). **Virginia.** Bath Co., *G. Morton 6512* (NY; Semple et al. 2019). — 2*n*=9_{II}+0-1 **CANADA**. **Québec.** Argenteuil Co., *Beaudry et al 55-41* (MT; Beaudry & Chabot 1959 to sp.). — 2n=9_{II}+3 **USA**. **West Virginia.** Greenbrier Co., *G. Morton 6544* (NY; Semple et al. 2019) — 2*n*=18 **CANADA**. **New Brunswick.** Gloucester Co., *M & V NA17588* (TRT: Morton et al. 2022); Saint John Co., *M & V NA11980* (TRT: Morton et al. 2022); Westmorland Co., *M & V NA11986* (TRT: Morton et al. 2022). **Nova Scotia.** Halifax Co. Bedford area, *Kapoor 69-117-2* (SMUH not seen; Kapoor 1970), *S & Keir 4799* (WAT; Semple et al. 1985). **Ontario.** Algoma Dist.: *MM 600* (WAT; Melville & Morton 1982), *MM 605* (WAT; Melville & Morton 1982); Bruce Co., *M & V NA10789* (WAT; Melville & Morton 1982); *Cook & Faulkenham 11* (WAT; Semple & Cook 2004), *Cook & Faulkenham 14* (WAT; Semple & Cook 2004), *S 2770* (WAT; Melville & Morton 1982), *S 2790* (WAT; Melville & Morton 1982), *MM 64* (WAT; Melville & Morton 1982), *MM 80* (WAT; Melville & Morton 1982); Elgin Co., *MM 1886* (WAT; Melville & Morton 1982), *MM 1879* (WAT: Morton et al. 2022); Essex Co., *MM 1899* (WAT; MM & M 1982), *MM 1498* (WAT: Morton et al. 2022); Frontenac Co., *MM 1811* (WAT; Melville & Morton 1982), *S 10658* (WAT; Semple & Cook 2004); Glengarry Co., *MM 1781* (WAT; Melville & Morton 1982); Haldimand-Norfolk R.M., *MM* 1867 (WAT; Melville &

Morton 1982), *MM 1870* (WAT; MMelville & Morton 1982); Halton Reg. Mun., *MM 170* (WAT; Melville & Morton 1982); Huron Co., *S 1767* (WAT; Melville & Morton 1982), *S 2766* (WAT; Melville & Morton 1982); Kenora Dist., *MM 1106a* (WAT; Melville & Morton 1982); Kent Co., *MM 1895* (WAT; Melville & Morton 1982), *MM 1900* (WAT; Melville & Morton 1982); Lanark Co., *MM & Bt 1309* (WAT; Melville & Morton 1982, *MM 1805* (WAT; Melville & Morton 1982); Lennox & Addington Co., *MM & Bt 1334* (WAT; Melville & Morton 1982); Manitoulin Dist., *Morton NA12670* (WAT; Melville & Morton 1982); Middlesex Co., *MM 1912* (WAT; Melville & Morton 1982); Muskoka Co., *MM 826* (WAT; Melville & Morton 1982); Niagara Reg. Mun., *MM 1861* (WAT; Melville & Morton 1982), *MM 1862* (WAT; Melville & Morton 1982); Nipissing Co., *MM 341* (WAT; Melville & Morton 1982), *MM 343* (WAT; Melville & Morton 1982), *MM 1355* (WAT; Melville & Morton 1982), *MM 1835* (WAT; Melville & Morton 1982); Ontario Co., *MM 201* (WAT; Melville & Morton 1982), *MM 223* (WAT: Morton et al. 2022); Ottawa-Carlton Reg. Mun., *MM 1299* (WAT; Melville & Morton 1982), *MM 1798* (WAT; Melville & Morton 1982); Parry Sound Co., *MM & Bt 1370* (WAT: Morton et al. 2022); Peel Co., *S & Cook 10653* (WAT; Semple & Cook 2004); Perth Co., *Ringius 1510a* (WAT; Semple et al. 1985), Peterborough Co., *MM 1710* (WAT; Melville & Morton 1982), *MM 1850* (WAT; Melville & Morton 1982); Prescott Co., *MM 1788* (WAT; (Melville & Morton 1982); Rainy River Dist., *MM 1034* (WAT; MM & M 1982); Renfrew Co., *MM & Bt 1342* (WAT; Melville & Morton 1982), *MM 1820* (WAT; Melville & Morton 1982), *MM 1826* (WAT; (Melville & Morton 1982), *MM 1829* (WAT; Melville & Morton 1982); Russell Co., *MM & Bt 1282* (WAT; Melville & Morton 1982), *MM 1284* (WAT; Melville & Morton 1982); Stormont Co., *MM & Bt 1268* (WAT; Melville & Morton 1982); Sudbury Co., *MM 692* (WAT; Melville & Morton 1982), *MM 725* (WAT!; Melville & Morton 1982), *MM 1603* (WAT; Melville & Morton 1982), *MM & Blok 1609a* (WAT; MM & M 1982), *MM 1613* (WAT; Melville & Morton 1982), *MM 1617* (WAT; Melville & Morton 1982), *MM 1691* (WAT; Melville & Morton 1982), *MM 1695* (WAT; Melville & Morton 1982); Thunder Bay Dist., *MM 941* (WAT; Melville & Morton 1982); Timiskaming Dist.: *Slater* 3 (WAT; Semple et al. 1985); Victoria Co., *MM 280* (WAT; Melville & Morton 1982), *MM 281* (WAT; Melville & Morton 1982), *MM 1705* (WAT; (Melville & Morton 1982); Wellington Co., *Ringius 1525* (WAT; Semple et al. 1985), *Ringius 1526* (WAT; Semple et al. 1985), *Ringius 1528* (WAT; Semple et al. 1984). **Prince Edward Island.** Kings Co., *M & V NA12091* (TRT: Morton et al. 2022). **Québec.** Abitibi Co., *M & V NA15357* (TRT: Morton et al. 2022); Argenteuil Co, La Fontaine 55-10 (MT not seen; Beaudry & Chabot 1957); *Beaudry et al. 56-495* (MT; Beaudry & Chabot 1959); Cap St-Jacques, *Beaudry & Rolland-Germain 63-238-1* (MT; Beaudry 1969), *Beaudry & Rolland-Germain 63-238-2* (MT; Beaudry 1969), *Beaudry & Rolland-Germain 63-238-3* (MT; Beaudry 1969), *Beaudry & Rolland-Germain 63-238-4* (MT; Beaudry 1969), *Beaudry & Rolland-Germain 63-238-5* (MT; Beaudry 1969); Deux Montagnes, *Beaudry 55-208* (MT; Beaudry & Chabot 1959); Drummond Co., *M & V NA12550* (TRT: Morton et al. 2022); Lac Ouareau, *Löve, Löve & Rouseau 6977* (CAN; Löve & Löve 1982b; to sp.; the collection number is the same as for a *Euthamia graminifolia*); Levis Co., *M & V NA15240* (TRT: Morton et al. 2022); Montérégue Co., *M & V NA15233* (TRT: Morton et al. 2022); Montmorency Co., *M & V NA15260* (TRT: Morton et al. 2022); Montreal, La Fountaine 55-175 (MT not seen; Beaudry & Chabot 1957); Rouville Co., *S & Brouillet 3422* (WAT; Semple et al. 1981); Roxton Falls, *S & Brouillet 3420* (WAT; Semple et al. 1981); Sherbrooke Co., *LaFontaine 55-10* (MT not seen; Beaudry & Chabot 1957), *LaFontaine 55-120* (MT; Beaudry & Chabot 1959), *LaFontaine 55-135* (MT; Beaudry & Chabot 1959), *M & V NA11930* (TRT: Morton et al. 2022), *M & V NA17501* (TRT: Morton et al. 2022). **NETHERLANDS**. *Morton s858* (TRT: Morton et al. 2022). **NORWAY**. *Morton s823* (TRT: Morton et al. 2022). **UNITED KINGDOM**. *Morton s856* (TRT: Morton et al. 2022); VC2, *Morton 5252* (TRT: Morton et al. 2022); Surrey, *S 10390* (WAT (Semple & Cook 2004). **USA**. **Massachusetts.** Norfolk Co., *S & Brouillet 3539* (WAT; Semple et al. 1981); Worcester Co., *Beaudry 57-19-2* (MT; Beaudry & Chabot 1959), *Beaudry 57-19-3* (MT!; Beaudry & Chabot 1959); Plymouth Co., *S & Brouillet 3549* (WAT; Semple et al. 1981); Worcester Co., *S 686*6 (WAT Semple et al. 1985). **Maine.** Franklin Co., *M & V NA11938* (TRT; Morton et al. 2022); Penobscot Co., *Ringius 1628* (WAT; Semple et al. 1985). **Michigan.** Chippewa Co., *Hiltunen 60-222-1* (MT; Beaudry 1969), *Hiltunen* 60-222-2 (MT; Beaudry 1969), *Hiltunen 60-223-1* (MT; Beaudry 1969), *Hiltunen 60-223-2* (MT; Beaudry 1969), *Hiltunen 60-223-3* (MT; Beaudry 1969), *Hiltunen 60-224-1* (MT Beaudry 1969, *Hiltunen 60-224-2* (MT!; Beaudry 1969), *Hiltunen 60-224-3* (MT; Beaudry 1969), *Hiltunen 60-224-a1* (MT; Beaudry 1969); *Hiltunen 60-224a-2* (MT; Beaudry 1969). **New Hampshire.** Coos Co., *Ringius 1582* (WAT; Semple et al. 1985); Grafton Co., *M & V NA17652* (TRT. Morton et al. 2022). **New York.** Clinton Co., *M & V NA17673* (TRT: Morton et al. 2022); Hamilton Co., *S & Bt 3667* (WAT; Semple et al.); Oneida Co., *Semple 3374* (WAT; Semple et al. 1981). **Vermont.** Orleans-Lamoille Co., *S & Bt 3442* (WAT; Semple et al. 1981); Washington Co., *S & Bt 3446* (WAT; Semple et al. 1981); Windham Co., *Semple & Keir 4959* (WAT; Semple et al. 1985). — 2*n*=18+0-2 **CANADA**. **Québec.** Argenteuil Co., Beaudry 55U-220 (MT; Beaudry & Chabot

1959), *Beaudry 56-494* (MT; Beaudry & Chabot 1959). — 2n=18+1 CA PQ Argenteuil Co., *Beaudry & Rolland-Germain 56-494* (MT; Beaudry & Chabot 1959). — 2*n*=18+1 **CANADA**. **Québec.** Argenteuil Co., *Beaudry et al. 56-494* (MT; Beaudry & Chabot 1959). — 2*n*=18+2-3. **CANADA**. **Québec.** Montréal Co., *LaFontaine 55-175* (MT; Beaudry & Chabot 1959).

Solidago canadensis L. aff. var. *canadensis* — 2*n*=18 **CANADA**. **Ontario**. Temiskaming Dist.: *MM 401* (WAT; Melville & Morton 1982 as. *S. can.* var. *can.*). **POLAND**. *Morton s624* (TRT; Morton et al. 2018 received as *S. aspera*).

Solidago canadensis L. var. hargeri Fernald (published as S. canadensis var. hargeri unless otherwise indicated) — 2*n*=9$_{II}$ **USA**. **Kansas.** Wabaunsee Co., *G. Morton 5116* (NY; Semple et al. 2019). **Tennessee.** Clairborne Co., *G. Morton 2925* (NY; Semple et al. 2019), *G. Morton 2926-1A* (NY; Semple et al. 2019), *G. Morton 2926B* (NY; Semple et al. 2019), *G. Morton 2926-1A&B* (NY; Semple et al. 2019, *G. Morton 2926A&B* (NY; Semple et al. 2019); *G. Morton 2926-1B* (NY; Semple et al. 2019). **Virginia.** Rappahannock Co., *G. Morton 5123* (NY; Semple et al., 2019). —2n=9II+4 **USA**. **Kansas.** Wyandotte Co., *Ward 81-598* (NMC; Ward & Spellenberg 1986 as var. *can.*). — 2*n*=18 **CANADA**. **Ontario.** Brant Co., *MM 1925* (WAT; Melville & Morton 1982), *Ringius 1394* (WAT; Semple et al. 1985); Essex Co., *MM 1496* (WAT: Morton et al. 2022); Haldimand-Norfolk Reg. Mun.; *MM 1868* (WAT; Melville & Morton 1982); Hamilton-Wentworth Reg. Mun., *Pringle 1372* (HAM; Pringle 1979), *MM 1859* (WAT; Melville & Morton 1982); Kent Co., *MM 1902* (WAT; Melville & Morton 1982); Lambton Co., *MM 1910* (WAT; Melville & Morton 1982), *MM 1490* (WAT: Morton et al. 2022); Middlesex Co., *MM 1911* (WAT; Melville & Morton 1982), *MM 1915* (WAT; Melville & Morton 1982), *MM 1918* (WAT: Morton et al. 2022); Niagara Reg. Mun., *MM 1863* (WAT; Melville & Morton 1982). **Québec.** Chambly Co., *Beaudry 55-225* (MT; Beaudry & Chabot 1959). **GERMANY**. *J.K. Morton s.n.* (TRT: Morton et al. 2022). POLAND. *Morton 5252* (TRT: Morton et al. 2022). **UNITED KINGOM**. Surrey, *Semple 10389* (WAT; Semple & Cook 2004 as "naturalized European race", corrected to var. *harg.* Semple et al. 2015). **USA**. **Indiana.** Porter Co., *Beaudry & Gagnon 61-356-1* (MT; publication unknown); Wayne Co., *Morton NA18715* (TRT: Morton et al. 2022). **Iowa.** Polk Co., *M & V NA16012* (TRT: Morton et al. 2022). **Kentucky.** McCracken Co., *M & V NA18741* (TRT: Morton et al. 2022); Trigg Co., *M & V NA16225* (TRT: Morton et al. 2022). **Minnesota.** Winona Co., *M & V NA15660* (TRT: Morton et al. 2022). **Missouri.** Oregon Co., *M & V NA16244* (TRT: Morton et al. 2022). **New York.** Allegany Co., *M & V NA18670* (TRT: Morton et al. 2022); Oneida Co., *M & V s.n.* (TRT. Morton et al. 2022). **Ohio:** Franklin Co., *M & V NA18711* (TRT: Morton et al. 2022); Montgomery Co., *M & V NA18716* (TRT: Morton et al. 2022). **Pennsylvania.** Fayette Co., *M & V NA16133* (TRT: Morton et al. 2022), *M & V NA16134* (TRT: Morton et al. 2022); Fulton Co., *M & V s.n.* (TRT: Morton et al. 2022); Wyoming Co., *M & V NA16070* (TRT: Morton et al. 2022). **Virginia.** Bath Co., *S 10728* (WAT; Semple and Cook 2004), *Cook & Tereszchuk 378* (WAT; Semple et al. 2015); Roanoake Co., *M & V NA16152* (TRT: Morton et al. 2022). canadensis var. hargeri 2n=18 US WV Greenbriar Co., US-219, ca. half way between Droop and Renick, M & V NA16145 (TRT: Morton et al. 2022). **West Virginia.** Monroe Co., *Cook & Tereszchuk 343* (WAT; Semple et al. 2015). **Wisconsin.** Langlade Co., *M & V NA15202* (TRT: Morton et al. 2022). — 2*n*=18+1-2 POLAND. (not seen; Malecka 1989 as *S. can.* var. "scabra").

Solidago elongata Nutt. — 2*n*=18 **USA**. **California.** Butte Co., *Semple & Heard 8432* (WAT; (Semple et al. 1989, as S. can.); Calaveras Co., *S & Heard 8782* (WAT; Semple et al. 1989, as *S. can.*); Eldorado Co., *Semple & Heard 8910* (WAT; Semple et al. 1989, as S. lepida); Mendocino Co., *S & Heard 8550* (WAT; Semple et al. 1989 as *S. can.*), *S & Heard 8543* (WAT; Semple et al. 1989, as *S. can.*); Modoc Co., *S et al. 9295* (WAT; Semple et al. 2001; as *S. can.* ssp. *elong.*), *S et al. 9296* (WAT; Semple et al. 2001 as *S. can.* ssp. *elong.*), *S et al. 9297* (WAT; Semple et al. 2001 as *S. can.* ssp. *elong.*); Mono Co., *S & Heard 8725* (WAT; Semple et al. 1989 as *S. can.*); Plumas Co., *S et al. 5722* (WAT; Semple et al. 1985 as *S. can.* "western phase"); San Mateo Co., *S & Heard 8591* (WAT; Semple et al. 1989 as *S. can*.); Sierra Co., *S & Heard 8406* (WAT; Semple et al. 1989 as *S. can*.); Siskiyou Co., *S & Heard 8460* (WAT; Semple et al. 1989 as *S. can*.); Tolumne Co., *Beaudry 59-237* (MT; Beaudry 1969 as *S. elong.*); Tulare Co., *S & B. Semple 5647* (WAT; Semple et al. 1985, *S. can.* "western phase"), *S & Heard 8660* (WAT; Semple et al. 1989, as *S. can.*). **Oregon.** Clatsop Co., *S & Bt 7114* (WAT; Semple et al. 1985, *S. can*. "western phase"); Douglas Co., *S & Bt 7151* (WAT; Semple et al. 1985 *S. can.* "western phase", *S & Bt 7158B* (WAT; Semple et al. 1989 as *S. can.*); Hood River Co., *S & Bt 7094* (WAT; Semple et al. 1985 *S. can.* "western

phase"), *S & Bt 7099* (WAT; Semple et al. 1985 as *S. can.* "western phase"), *S & Bt 7100* (WAT; Semple et al. 1985 as *S. can.* "western phase"); Klamath Co., *S & Bt 7132* (WAT; Semple et al. 1985 as *S. can.* "western phase"); Lake Co., *G. Morton 5046* (NY; Semple et al. 2019; as *S. elong*.); Lane Co., *S & Bt 7170b* (WAT, Semple et al. 1985 as *S. can.* "western phase"); Lincoln Co., *Beaudry 62-144-1* (MT; Beaudry 1969 as *S. elong.*), *Beaudry 62-144-2* (MT; Beaudry 1969 as *S. elong*.). **Washington.** Grays Harbor Co., *S & Xiang 10278* (WAT; Semple et al. 2001; as *S. can*. ssp. *elong.*); Whatcom Co., *S & Xiang 10289* (WAT; Semple et al. 2001 as *S. can.* ssp. *elong.*). — $2n=18_{II}$ **USA**. **California.** Mendocino Co., *S & Heard 8537* (WAT; Semple et al. 1989 as *S. can.*). — 2*n*=36 **USA**. **California.** Sierra Co., *S & Heard 8403* (WAT; Semple et al. 1989, as *S. can.*).

Solidago fallax (Fernald) Semple var. *fallax* — 2*n*=18 **CANADA**. **Newfoundland.** Division 5, *M & V NA12430* (TRT: Morton et al. 2022), *M & V NA12436* (TRT: Morton et al. 2022), *M & V NA12191* (TRT: Morton et al. 2022); Division 6, *M & V NA12261* (TRT: Morton et al. 2022); Division 7, *M & V NA12249* (TRT: Morton et al. 2022), *M & V NA12159* (TRT: Morton et al. 2022). **Québec.** Chicoutini Co., *M & V NA15315* (TRT: Morton et al. 2022). — 2*n*=54 CA PQ Gaspésie Co., *S & B. Semple 11446* (WAT; Semple et al. 2019).

Solidago fallax (Fernald) Semple var. *molina* (Fernald) Semple — *2n*=18 **CANADA**. **Newfoundland.** Division 4, *M & V NA12129* (TRT: Morton et al. 2022), *M & V NA12485* (TRT: Morton et al. 2022); Division 9, M & V NA12305 (TRT: Morton et al. 2022). **Québec.** Gaspé Peninsula, *M & V NA17560* (TRT: Morton et al. 2022), *M & V NA17567* (TRT: Morton et al. 2022), *S & B. Semple 11439* (WAT; Semple et al. 2019). — 2*n*=36 **CANADA**. **Québec.** Lac Temiscamingue, *M & V NA15370* (TRT: Morton et al. 2022), *M & V NA15371* (TRT: Morton et al. 2022). — 2*n*=54 **CANADA**. **Québec.** Gaspé Peninsula, *M & V NA17599* (TRT: Morton et al. 2022). — 2*n*=ca. 54 **CANADA**. **Québec.** Gaspé Peninsula, *M & V NA17584* (TRT: Morton et al. 2022).

Solidago lepida DC. var. *lepida* — 2*n*=18 **CANADA**. **Manitoba.** York Factory, *Löve & Löve S3744* (WIN or COLO, not seen; Löve & Löve 1982a; as *S. can*. ssp. *can.*). **Northwest Territories.** Nahanni Nat. Park Reserve, *S et al. 11167* (WAT; Semple et al. 2019), *S et al. 11169* (WAT; Semple et al. 2019). **Ontario.** Cochrane Dist., *MM 1676* (WAT; Melville & Morton 1982 as *S. can.* var. *can.*), *MM 1675* (WAT: Morton et al. 2022) *MM 1682* (WAT: Morton et al. 2022); Kenora Dist., *Clements & Clements s.n.*-1 (WAT; Semple et al. 1993 as *S. lep.*), *Clements & Clements s.n.*-2 (WAT; Semple et al. 1993 as *S. lep*.). **USA**. **Alaska.** Alaska Hwy, *Ch et al. CC2441* (WAT; Chinnappa & Chmielewski 1987 as. *S. can.*); Richardson Hwy, *Ch 3126* (WAT; Semple et al. 2019). **Colorado.** Gunnison Co., *S & Heard 7753* (WAT; Semple & Chmielewski 1987 as *S. can.* "montane form"). **Idaho.** Custer Co., *S & B. Semple 11367* (WAT; Semple et al. 2019); Owyhee Co., *S & Xiang 10258* (WAT; Semple et al. 2001 as *S. can*. ssp. *salebrosa*). **Montana.** Lake Co., *S 11371* (WAT; Semple et al. 2019). — 2*n*=36 **CANADA**. **British Columbia.** E of Hazelton, *S & B. Semple 10635* (WAT; Semple et al. 2001 as *S. can.* ssp. *elong.*); Haida Gwaii (Queen Charlotte Is.), Graham Is., *Calder & Taylor 36880* (GH; Taylor & Mulligan 1968 as *S. can*.), *Calder & Taylor 35934* (DAO; Taylor & Mulligan 1968 as *S. can.*); Lone Butte, *Chinnappa Lab. CC-BC1* (UAC; Semple et al. 1989 as *S.* aff. *lep.*). **Yukon Territory.** NW of Jakey, *S & B. Semple 10622* (WAT; Semple et al. 2001 to sp.). **USA**. **Montana.** Glacier Co., *S & B. Semple 11381* (WAT; Semple et al. 2019). — $2n=27_{II}$ U.S.A. **Colorado.** Jefferson Co., *G. Morton & Anderson 4993* (NY; Morton 1984 as *n*=27 as *S. gigantea* var. *shinnersii*). **New Mexico.** Lincoln Co., *Ward 81-440* (NMC; Ward & Spellenberg 1988 as *S. can.* var. *scabra*). — 2*n*=54 **CANADA**. **Alberta.** Bezanson, *S & B. Semple 10612* (WAT (Semple et al. 2001 as *S. can.* ssp. *salebrosa*), Elk Island N.P., *M & V NA14171* (TRT: Morton et al. 2022); Fort Saskatchwan, *G.H. Turner 55 S-277-1* (MT; count by J. Beaudry unpublished?); W of Hinton, *S & Bt 4306* (WAT: Morton et al. 2022); Little Smoky, *S 10607* (WAT; Semple et al. 2001 to sp.); E of Vegreville, *M & V NA14188* (TRT: Morton et al. 2022), *M & V NA14189* (TRT: Morton et al. 2022). **British Columbia.** Alaska Hwy, *Semple & B. Semple 10620* (WAT; Semple et al. 2019); Cassiar Hwy, *M & V NA13662* (TRT: Morton et al. 2022); Cawston, M & V NA13512 (TRT: Morton et al. 2022); Fort Nelson, *M & V NA14147* (TRT: Morton et al. 2022); N of Houston, *M & V NA13657* (TRT: Morton et al. 2022); SE of Keremos, *M & V NA13515* (TRT: Morton et al. 2022); Liard Hot Springs, Alaska Hwy, *M & V NA14123* (TRT: Morton et al. 2022); Manning Park, M & V NA13510 (TRT: Morton et al. 2022); Moricetown, *M & V NA13651* (TRT: Morton et al. 2022); Mt. Currie, *M & V NA13628* (TRT: Morton et al. 2022), *M & V NA13629* (TRT: Morton et al. 2022); S of Pouce Coupe (Dawson Creek), *M & V NA14161* (TRT: Morton et al.

2022); Prince George, *M & V NA13649* (TRT: Morton et al. 2022); Quesnel, M & V NA13639 (TRT: Morton et al. 2022); 70 Mile House, *M & V NA13638* (TRT: Morton et al. 2022); Surrey, *MM BC6* (TRT: Morton et al. 2022); between Toad River and Muncho Lake, *M & V NA14125* (TRT: Morton et al. 2022), W of Toad River, *Semple & B. Semple 10618* (WAT; Semple et al. 2001 to sp); Trail Is., *Morton s.n.* (TRT: Morton et al. 2022); W of Vanderhoof, *M & V NA13644* (TRT: Morton et al. 2022); Wonowon, *M & V NA14149* (TRT: Morton et al. 2022); N of Wonowon, *M & V NA14151* (TRT: Morton et al. 2022). **Manitoba.** Assessipi Park, M & V NA14216 (TRT: Morton et al. 2022) Sandilands Prov. Forest, *M & V NA14257* (TRT: Morton et al. 2022); Hwy-1, W of MB/ON border, *M & V NA14255* (TRT: Morton et al. 2022); Onanole, *M & V NA14222* (TRT: Morton et al. 2022); E of Roblin, *M & V NA14213* (TRT: Morton et al. 2022); NW of Winnipeg, *M & V s.n.* (TRT: Morton et al. 2022). **New Brunswick.** Restigouche Co., *S & B. Semple 11451* (WAT; Semple et al. 2019), *Semple & B. Semple 11452* (WAT; Semple et al. 2019); York Co., *M & V NA17615* (TRT: Morton et al. 2022; also *S. altissima* under this same number). **Northwest Territories.** Fort Simpson, *S & Cli-Michaud 11173* (WAT; Semple et al. 2019). **Ontario.** Cochrane Dist.. *MM & Blok 1667* (WAT!; MM & Morton'82; to sp.), *MM & Blok 1668* (WAT; Melville & Morton 1982 to sp.), *MM & Blok 1674* (WAT; Melville & Morton 1982 to sp.); Thunder Bay Dist., *MM 929* (WAT; Melville & Morton 1982 to sp.), *MM 954* (WAT!; Melville & Morton 1982 to sp.), *S & B. Semple 6760* (WAT; Semple et al. 1984 to sp.), *M & V NA14275* (TRT: Morton et al. 2022), *M & V NA14277* (TRT: Morton et al. 2022). **Québec.** Gaspé Peninsula: *M & V NA17568* (TRT: Morton et al. 2022), *M & V NA17598* (TRT: Morton et al. 2022). **Yukon Territory.** Irons Creek, *M & V NA14115* (TRT: Morton et al. 2022); S of Whitehorse, *M & V NA13705* (TRT: Morton et al. 2022). **USA**. **Arizona.** Coconino Co., *M & V s.n.* (TRT: Morton et al. 2022). **Colorado.** Boulder Co., *Semple & B. Semple 5817* (WAT; Semple et al. 1984, as *S. gigantea*). **Idaho.** Valley Co., *S & Bt 7066* (WAT; Semple et al. 1984, as S. gigantea). **Montana.** Broadwater Co., *S & Xiang 10329* (WAT; Semple et al. 2001 as *S. gigantea* "shinnersii"); Gallatin Co., *S & Xiang 10243* (WAT; Semple et al. 2001, as *S. gigantea* "shinnersii"); Powell Co., *S & Xiang 10312* (WAT; Semple et al. 2001, as *S. gigantea*). **New Mexico.** Lincoln Co., *S & Heard 8130* (WAT; Semple & Chmielewski 1987 as *S. gigantea*). **Utah.** Cache Co., *S & B. Semple 11277* (WAT; Semple et al. 2019). — 2*n*=ca. 54 **CANADA**. **British Columbia.** E of Priceton, *M & V NA13340* (TRT: Morton et al. 2022). **Québec.** Gaspé Peninsula: *M & V NA17569* (TRT: Morton et al. 2022), *M & V NA17582* (TRT: Morton et al. 2022), *M & V NA17602* (TRT: Morton et al. 2022).

Solidago lepida DC. aff. var. *lepida* — 2*n*=54 **CANADA**. **Ontario.** Haldimand-Norfolk Reg.Mun., *MM 1874* (WAT; Melville & Morton 1982 as S. alt.); Manitoulin Dist., *M & V NA17686* (TRT: Morton et al. 2022); Nipissing Dist., *MM & Bt 1366* (WAT; Melville & Morton 1982 as *S. alt.*); Rainy River Dist., *MM 1056* (WAT; Melville & Morton 1982 as *S. alt.*); Sudbury Dist., *MM 1601* (WAT; Melville & Morton 1982 as *S. alt.*).

Solidago lepida DC. var. *salebrosa* (Piper) Semple (as *S. lepida* var. *salebrosa* unless otherwise indicated) — 2*n*=9$_{II}$ **USA**. **Wyoming.** Sublette Co., *Spellenberg & Soreng 1239* (NMC!;Ward & Spellenberg 1986 as *S. can.* var. *can.*). —2*n*=18 **CANADA**. **British Columbia**. S of Movie, *S & Bt 4376* (WAT: Morton et al. 2022). **Northwest Territories.** Nahanni N.P.R., *S 11154* (WAT; Semple et al. 2019), *Semple et al. 11157* (WAT; Semple et al. 2019), *S et al. 11163* (WAT; Semple et al. 2019). **USA**. **Colorado.** Gunnison Co., *S & Heard 7755* (WAT; Semple & Chmielewski 1987 as *S. can.* "montane form"), *S & Heard 7754* (WAT; Semple et al. 2001, as *S. can.* ssp. *salebrosa*), *M & V s.n.* (TRT: Morton et al. 2022); Routt Co., *S & B. Semple 5772* (WAT: Morton et al. 2022). — 2*n*=18 **USA**. **Idaho**. Boundary Co., *S & Bt 4381* (WAT: Morton et al. 2022); Idaho Co., *S & Bt 4410* (WAT: Morton et al. 2022); Kootenai Co., *S & Bt 4384* (WAT: Morton et al. 2022). **Wyoming.** Carbon Co., *Semple et al. 9209* (WAT; Semple et al. 2001, as *S. can*. ssp. *salebrosa*); Teton Co., *S & Bt 7219* (WAT; Semple et al. 1992 as *S. can.* ssp. *salebrosa*). — 2*n*=18$_{II}$ **USA**. **Colorado.** Boulder Co., *King K10387* (US not seen; Carr et al. 1999 as *S. gigantea*). — 2*n*=36 **USA. Colorado.** Gunnison Co., *S & Heard 7752* (WAT; Semple et al. 1992 as S. can. ssp. salebrosa). **Montana.** Carbon Co., *S & Xiang 10239* (WAT; (Semple et al. 2001 as *S. can.* ssp. *salebrosa*). **New Mexico.** Colfax Co., *M & V NA15961* (TRT: Morton et al. 2022); Lincoln Co., *S & Heard 8129* (WAT; Semple & Chmielewski 1987 as *S. can.* "montane form"), *Semple & Heard 8129A* (WAT; Semple & Chmielewski 1987 as *S. can*. "montane form"). **Wyoming.** Crook Co., *M & V NA15698* (TRT: Morton et al. 2022). — 2*n*=27$_{II}$ **USA**. **Oregon.** Baker Co., *G. Morton & Anderson 5084* (NY!; Morton 1984; to sp.; as *n*=27; as *S. gig.* var. *shinnersii*), *G. Morton & Anderson 5086* (NY; Morton 1984; as *n*=27; S. gig. var. *shinnersii*); Harney Co., *Solbrig 2908* (NY; Raven et al. 1960 as *S. can*. aff. var. *salebrosa*); Wasco Co., *G.*

Morton & Anderson 5050 (NY; Morton 1984; as *n*=27 as *S. gigantea* "leaves glabrous group"); Whitman Co., *G. Morton & Anderson 5075* (NY; G. Morton 1984; as *n*=27 as *S. gigantea* "leaves glabrous group). — 2*n*=54 **CANADA**. **Alberta.** Jasper Nat. Pk., *S & Bt 4326* (WAT; Semple et al. 2019). **British Columbia.** Cawston, *M & V NA13512* (TRT: Morton et al. 2022); Fairmont Hot Springs, *S & Bt 4378* (WAT: Morton et al. 2022); SE of Keremos, *M & V NA13516* (TRT: Morton et al. 2022); Mt. Currie, *M & V NA13626* (TRT: Morton et al. 2022), *M & V NA13627* (TRT: Morton et al. 2022); E of Pavilion, *M & V NA13624* (TRT: Morton et al. 2022). **Saskatchewan.** Battleford, *M & V NA14195* (TRT: Morton et al. 2022). **USA**. **Arizona.** Apache Co., *M & V NA15907* (TRT: Morton et al. 2022); Coconino Co., *M & V NA15876* (TRT: Morton et al. 2022). **California.** Modoc Co., *S et al. 9294* (WAT; Semple et al. 2001 as *S.* aff. *gigantea*). **Idaho.** Ada Co., *M & V NA15731* (TRT: Morton et al. 2022), *M & V NA15732* (TRT: Morton et al. 2022), *M & V NA15733* (TRT: Morton et al. 2022); Boise Co., *S & Bt 7064* (WAT; Semple et al. 1984 as *S. can.* "western phase"); Jerome Co., *M & V NA15728* (TRT: Morton et al. 2022), *M & V NA15729* (TRT: Morton et al. 2022); Twin Falls Co., *M & V NA15730* (TRT: Morton et al. 2022); Uster Co., *S & Bt 7038* (WAT; Semple et al. 1984 as. *S. gigantea*). **Montana.** Broadwater Co., *S & Xiang 10324* (WAT; Semple et al. 2001 as *S. can.* ssp. *salebrosa*); Flathead Co., *Semple 11369* (WAT; Semple et al. 2019); Musselshell Co., *S & Bt 6993* (WAT; Semple et al. 1992 as *S. can.* ssp. *salebrosa*); **New Mexico.** Colfax Co., *M & V NA15962* (TRT: Morton et al. 2022); San Miguel Co., *M & V NA15946* (TRT: Morton et al. 2022); Socorro Co., *M & V NA15940* (TRT: Morton et al. 2022); Taos Co., *M & V NA15959* (TRT: Morton et al. 2022). **Oregon.** Malheur Co., *M & V NA15734* (TRT: Morton et al. 2022), *M & V NA15735* (TRT: Morton et al. 2022), *M & V NA15739* (TRT: Morton et al. 2022); Schute Co., *M & V NA15749* (TRT: Morton et al. 2022), *M & V NA15750* (TRT: Morton et al. 2022); Wheeler Co., *M & V NA15742* (TRT: Morton et al. 2022). **Utah.** Garfield Co., *S 11254* (WAT; Semple et al. 2019); Juab Co., *S & Ch 8889* (WAT; Semple et al. 1989 as *S. can.*); Rich Co., *M & V NA15718* (TRT: Morton et al. 2022); Salt Lake Co., *S et al. 9245* (WAT; Semple et al. 2001 as *S. can*. ssp. *salebrosa*); Summit Co., *S et al. 9238* (WAT; (WAT; Semple et al. 2001 as *S. can*. ssp. *salebrosa*); Weber Co., *M & V NA15724* (TRT: Morton et al. 2022). **Washington.** Chelan Co., *Semple & Xiang 10298* (WAT; Semple et al. 2001 as *S. can.* ssp. *salebrosa*), *S & Xiang 10299* (WAT; Semple et al. 2001 as *S. can.* ssp. *salebrosa*); Klickitat Co., *S & Bt 7088* (WAT; Semple 1985 to sp.), *S & Bt 7089* (WAT; Semple 1985 to sp.); Whitman Co., *S & Bt 4387* (WAT: Morton et al. 2022); Yakima Co., *S & Bt 7078* (WAT; Semple et al. 1985 as *S. can.* "western phase"). **Wyoming.** Hot Springs Co., *M & V NA15704* (TRT: Morton et al. 2022); Lincoln Co., *M & V NA15715* (TRT: Morton et al. 2022), *M & V NA15716* (TRT: Morton et al. 2022); Teton Co., *S & Bt 7203* (WAT; Semple et al. 1985 as *S. can.* "western phase"); Uintah Co., *S et al. 9211* (WAT; Semple et al. 2001 as *S. can.* var. *salebrosa*; Washakie Co., *M & V NA15703* (TRT: Morton et al. 2022), *S & Bt 4446* (WAT: Morton et al. 2022). — 2*n*=ca. 54 **USA**. **New Mexico.** Taos Co., *M & V NA15956* (TRT: Morton et al. 2022). **Oregon.** Crook Co., *M & V NA15746* (TRT: Morton et al. 2022).

Solidago lepida DC. aff. var. *salebros*a (Piper) Semple — 2*n*=9_{II} **MEXICO**. **Nuevo Leon.** *Ward, Spellenberg & Soreng 80-057* (NMC; Ward & Spellenberg 1986, as *S. can*. ssp. *salebrosa*). — 2*n*=18 **USA**. **Montana.** Lake Co., *S & B. Semple 11376* (WAT; Semple et al. 2019). — 2*n*=18_{II}, 2*n*=36 **MEXICO**. **Nuevo Leon.** *Nesom et al. 7739* (TEX; Zhao Zai-Ming 1996 as *S. gigantea*). — 2*n*=36 **USA**. **New Mexico.** Colfax Co., *M & V NA15961* (TRT: Morton et al. 2022). — 2*n*=54 **CANADA**. **British Columbia.** Prince George, *M & V NA13648* (TRT: Morton et al. 2022); N of 100 Mile House, *M & V NA13642* (TRT: Morton et al. 2022); Princeton, *M & V NA13507* (TRT: Morton et al. 2022), *M & V NA13508* (TRT: Morton et al. 2022)

Solidago lepida var. *lepida* × *S. altissima* L. var. *altissima* — 2*n*=54 **CANADA**. **Ontario.** Algoma Co., *MM 643* (WAT; Melville & Morton 1982 "verging to *lepida*").

Solidago rupestris Raf. — 2*n*=18 **USA**. **Tennessee.** Dickson Co., *Beaudry & DeSelm 57-470* (MT; Beaudry 1963), *Beaudry & DeSelm 57-471* (MT; Beaudry 1963). — 2*n*=36 **USA**. **Kentucky.** Robertson Co., *S & Suripto 9594* (WAT; Semple et al. 1993).

Solidago shortii Torr. & Gray — 2*n*=36 **USA**. **Kentucky.** Nicholas Co., *Beaudry & Smith 57-281* (MT: Beaudry 1963), *Beaudry & Smith 57-282* (MT: Beaudry 1963), *S & Suripto 9598* (WAT: Semple et al. 1993; location corrected in Semple & Cook 2004).

Solidago turneri Semple — $2n=9_{II}$ **USA**. **Texas.** Presidio Co., *Matt & B.L. Turner 23-181* (TEX; Powell & Turner 2005 as *S. gigantea*, ident. corrected in Semple 2021).