

CHROMOSOME NUMBER DETERMINATIONS IN FAM.
COMPOSITAE, TRIBE ASTEREAEE. IV.
ADDITIONAL REPORTS AND COMMENTS ON THE
CYTOGEOGRAPHY AND STATUS OF SOME
SPECIES OF *ASTER* AND *SOLIDAGO*

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ABSTRACT

Chromosome numbers are reported for 206 individuals of 100 taxa and three interspecific hybrids from 18 genera. The majority of the reports are for *Aster* and *Solidago*, with about one fourth of these from populations in Alaska, the Yukon, British Columbia, and Alberta. Nearly all counts confirm previous reports for the taxa; some reports are first counts for one or more of the six Canadian provinces or territories and 30 states of the United States sampled. The cytogeography and taxonomy of *Aster puniceus*, *A. sibiricus* and *A. meritus*, *Solidago guiradonis*, *S. confinis*, *S. spectabilis*, *S. sparsiflora*, and *S. simplex* are discussed. The following first report is included: *Solidago guiradonis*, $2n = 9_{II}$, $2n = 18$.

Key Words: Compositae, Astereae, chromosome numbers, *Aster*, *Solidago*, cytogeography, Canada, United States

INTRODUCTION

Determining the distribution patterns of cytotypes requires numerous counts from the range of a taxon. The determinations listed below are reported as contributions to such studies. This is the fourth in a continuing series of general reports on Astereae by the first author's laboratory (Semple, 1985; Semple and Chmielewski, 1987; Semple, Chmielewski and Lane, 1989).

MATERIALS AND METHODS

Meiotic counts 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 were made from root tip cells taken from transplanted wild rootstocks or from seedlings grown from achenes 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 1 N HCl for 30 min at 60° C before squashing. Anther sacs containing

PMCs and meristematic root tips were squashed in 1% acetic orcein, and counts of chromosomes were made from freshly prepared material. Permanent slides were made in most cases as described by Semple, Brammall and Chmielewski (1981) and remain in the possession of J.C.S.

Vouchers for all counts are deposited in WAT. Identifications were made by J.C.S. with the following exceptions. Guy Nesom and Ron Hartman provided identifications for some *Erigeron* collections and confirmed identifications for some *Erigeron*, *Isocoma*, and *Xylorhiza* collections. In some cases, voucher specimens did not fit a published taxon description in one or more minor traits, such as amount of pubescence; these cases are indicated by the "aff." qualifier in Table 1.

RESULTS AND DISCUSSION

Chromosome number determinations from 206 individuals representing 100 taxa and three interspecific hybrids from 18 genera are reported in Table 1; all location and voucher data are previously unpublished. Populations were sampled in six provinces and territories in Canada and 30 states in the United States. In total, 172 reports are for asters and goldenrods (*Aster*, *Virgularia*, *Virgulus*, *Solidago* and *Euthamia*). Forty-seven of these are from sites in western Canada and Alaska. Nearly all counts confirm previous reports for the taxa and most are presented without comment. Included in Table 1 is the following first report: *Solidago guiradonis sensu stricto*, $2n = 9_{II}$ and $2n = 18$. Many of the counts are first reports for the taxon or ploidy level of a taxon for a particular state or province; e.g., $2n = 32$ for *Aster puniceus* from Minnesota, $2n = 54$ for *A. schreberi* from Ontario, $2n = 36$ for *Heterotheca camporum* var. *glandulissimum* from Kentucky, $2n = 18$ for *Solidago sempervirens* from Maryland, and $2n = 10$ for *Virgulus campestris* from California.

Aster puniceus

The cytogeography of *Aster puniceus* ($2n = 16$, $2n = 32$) was first discussed and illustrated by Semple et al. (1983). Based on counts from 58 sites reported as of 1983 (Huziwara, 1958; Van Faasen, 1963; Löve and Löve, 1964; Van Faasen and Sterk, 1973; Jones, 1980; Semple and Brouillet, 1980; Semple, 1981; Semple

Table 1. Chromosome number determinations of Astereae from Canada and the United States, arranged alphabetically. *Ah* = T. Ahmed; *Bt* = L. Brouillet; *CC#* = C.C. Chinnappa laboratory collection number; *Ch* = J. Chmielewski; *Hd* = S. Heard; *R* = G. Ringius; *S* = J. Semple; *Su* = Bambang Agus Suropto. When voucher specimens did not fit a published taxon description in one or more minor traits, the "aff." qualifier is used.

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- Aphanostephus ramosissimus* DC. $2n = 8 + 2$ supernumeraries. U.S.A. **Texas**. Howard Co.: Farm Rd. 699 N of Farm Rd. 846, S edge of escarpment, *S* 8833.
- Aster alpigenus* (Torr. & Gray) Gray ssp. *andersonii* (Gray) Gray. $2n = 36$. U.S.A. **California**. Sierra Co.: Yuba Pass Rd. ca. 1.5 km SE of junction with Nichols Mill Rd., wet meadow, *S*, *Su* & *Ah* 9325.
- A. anomalus* Engelm. in Torr. & Gray. $2n = 16$. U.S.A. **Missouri**. Crawford Co.: E of Steelville, woods by MO-8, *S*, *Su* & *Ah* 9387.
- A. bracetolatus* Nutt. $2n = 16$. U.S.A. **California**. Sierra Co.: S of Loyalton, Antelope Valley Rd., SW of Sierra Brooks, branch of Smithneck Creek, *S*, *Su* & *Ah* 9317. **Colorado**. Gunnison Co.: 3.3 km W of Crested Butte, Kebler Pass Rd., *S* & *Hd* 7756. **Utah**. Utah Co.: along American Fork Creek, 5 km E of UT-92, *S* & *Ch* 8881; Weber Co.: UT-39 (MP 34.5) ca. 34 mi. W of Woodruff, *S*, *Su* & *Ah* 9255.
- A. breweri* (Gray) Semple. $2n = 9_{II}$. U.S.A. **California**. Sierra Co.: Yuba Pass Rd. (For.Rd.-12) S of CA-49, SE of Berry Creek, *S*, *Su* & *Ah* 9319.
- A. chilensis* Nees. $2n = 64$. U.S.A. **California**. Contra Costa Co.: Charles Tilden Regional Park, Vollmer Peak, ravine, *S*, *Su* & *Ah* 9342; San Mateo Co.: S. San Francisco, by water towers near CA-35, *S* & *Ch* 8913; Sonoma Co.: W of Glenn Ellen, 6471 Sonoma Mt. Rd., *S*, *Su* & *Ah* 9329.
- A. ciliolatus* Lindl. $2n = 48$. CANADA. **Alberta**. Banff Nat'l. Park: L. Minnewanka Rd. ca. 0.2 mi. from Alta-1, *S* & *Bt* 4349 (count by L. Brouillet). **British Columbia**. Kitwanga, S terminus of the Cassiar Hwy., *Ch et al.* CC4761. **Manitoba**. W of Austin, dirt rd. 0.6 mi. N of TransCanada Hwy. and 2.3 mi. E of MB-352, *S* & *Bt* 4179 & *S* & *Bt* 4180 (counts by L. Brouillet).
- A. conspicuus* Lindl. $2n = \text{ca. } 108$. CANADA. **Alberta**. Jasper Nat'l. Park: Miette Hot Spring Rd. 3.5 S of Alta-16 (in Pochahontas), *S* & *Bt* 4333; 0.1 mi. from Patricia L., NW of Jasper, *S* & *Bt* 4331.
- A. cordifolius* L. $2n = 16$. U.S.A. **Vermont**. Caledonia Co.: W of town of Wells River, US-302 1.5 mi W of US-5, *S* & *Bt* 3518 (count by L. Brouillet). $2n = 16 + 2-3$ supernumeraries. **Pennsylvania**. York Co.: PA-372 woods below bridge over Susquehanna R., *S* & *R* 7611. $2n = 32$. CANADA. **Ontario**. Waterloo R.M.: Wellesley Twp., *S* & *Ch* 9098. $2n = 48$. U.S.A. **North Carolina**. Macon Co.: NC-28 N of Gneiss, *S* & *Ch* 6219.
- A. aff. cordifolius* L. $2n = 32$. CANADA. **Ontario**. Waterloo R.M.: Wellesley Twp., *S* & *Ch* 9100.
- A. cordifolius* × *A. pilosus* var. *pilosus*. $2n = 32$. CANADA. **Ontario**. Waterloo Co.: Wellesley Twp., along farm rd., *S* & *Ch* 9099.
- A. dumosus* L. $2n = 32$. U.S.A. **South Carolina**. Florence Co.: US-51 N of Pamlico, *S* & *Ch* 6116.
- A. elliotti* Torr. & Gray. $2n = 16$. U.S.A. **Florida**. Lake Co.: FL-46 at Wekiwa R., *S et al.* 5342.
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Table 1. Continued.

- A. foliaceus* Lindl. $2n = 64$. U.S.A. **Utah**. San Pete Co.: E of Ephraim, rd. to top of Wasatch Plateau, *S & Ch 8891*. Summit Co.: Wasatch N.F., For. Rd. just E of UT-150 just S of N.F. border, *S, Su & Ah 9213*. **Wyoming**. Carbon Co.: S of Arlington, Rocky Creek Trail, ca. 2 km S of I-80, *S, Su & Ah 9205*.
- A. laevis* L. var. *laevis*. $2n = 48$. CANADA. **British Columbia**. N of Windermere, Lake Drive by Wenderemere L., disturbed woods, *S & Bt 4361* (count by L. Brouillet). U.S.A. **Montana**. Silver Bow Co.: SE of Butte, near Continental Drive, ca. 2 mi. E of access to I-90, *S & Bt 4422* (count by L. Brouillet).
- A. lanceolatus* Willd. ssp. *hesperius* (Gray) Semple & Chmielewski. $2n = 64$. U.S.A. **Arizona**. Yavapai Co.: US-89 (MP309) SE of Prescott, by creek, *S & Ch 8998*.
- A. lanceolatus* ssp. *lanceolatus* var. *hirsuticaulis* Semple & Chmielewski. $2n = 32$. U.S.A. **Wisconsin**. Bayfield Co.: WI-27 21.3 km S of Douglas Co. Rd. A, S of Barnes, *S 9084*. Douglas Co.: Co. Rd.-U S of Amnicon Falls State Park, *S 9070*.
- A. lanceolatus* ssp. *lanceolatus* var. *lanceolatus*. $2n = 64$. U.S.A. **Wisconsin**. Douglas Co.: Co. Rd.-U S of Amnicon Falls State Park, *S 9071*.
- A. lanceolatus* ssp. *lanceolatus* × *A. pilosus* var. *pilosus*. $2n = 48$. CANADA. **Ontario**. Waterloo Co.: Wellesley Twp., by RR, *S & Ch 9096*.
- A. lateriflorus* (L.) Britt. $2n = 16$. U.S.A. **North Carolina**. Wilson Co.: NE of Eureka, NC-222 2 mi. N of county line, *S & Ch 6009*. $2n = 32$. **Pennsylvania**. Centre Co.: Nittany Mts., PA-144 just W of Pleasant Gap, *S & R 7602*.
- A. aff. lentus* Greene. $2n = 64$. U.S.A. **California**. Napa Co.: Vallejo, junction of Fairground Rd. and American Cr., SE of Napa, *S & Ch 8912*.
- A. longifolius* Lam. $2n = 80$. U.S.A. **Wisconsin**. Douglas Co.: WNW of Barnes, pond near WI-27, *S 9078*.
- A. linariifolius* L. $2n = 18$. U.S.A. **Florida**. Okaloosa Co.: US-90, E of Crestview, 2 mi W of Shoal R., *S, Bt & Canne 3893*. **Mississippi**. Simpson Co.: MS-13 0.6 mi N of MS-28, S of Mendalhall, *S, Bt, & Canne 3815*.
- A. macrophyllus* L. $2n = 72$. CANADA. **Nova Scotia**. Yarmouth Co.: NS-340 just N of Carleton, *S & Keir 4858*. U.S.A. **Pennsylvania**. Elk Co.: US-219 S of Ridgeway, N of Hwy.-948, *S & R 7594*. **Wisconsin**. Sheboygan Co.: Kettle Moraine State For., Kettle Hole Geological Marker Site, slopes of kettle hole, *S 9091*.
- A. modestus* Lindl. $2n = 18$. CANADA. **Alberta**. Jasper Nat'l. Park: N of Alta-16, W of Clairvaux Creek (trail site), *S & Bt 4323*. **British Columbia**. Cassiar Hwy. 33 km S of Cassiar, Mighty Moes Campground, KP580.2, edge of Cotton L., *Ch et al. CC4726*.
- A. occidentalis* Nutt. $2n = 16$. U.S.A. **California**. Plumas Co.: CA-89 SW of Crescent Mills, *S et al. 5719*.
- A. oolentangiensis* Riddell. $2n = 32$. U.S.A. **Wisconsin**. Douglas Co.: WNW of Barnes, margins of kettle hole pond by WI-27, 2.1 km N of Co. Rd.-A, *S 9082*.
- A. aff. parviceps* (Burgess) Mackenzie & Bush. $2n = 32$. U.S.A. **Missouri**. Washington Co.: MO-8 6.6 km W of Potosi, *S, Su & Ah 9393*.
- A. pilosus* Willd. var. *pilosus*. $2n = 32$ U.S.A. **Arkansas**. Dallas Co.: N of Princeton, AR-9 just N of AR-48, *S & Ch 6402*. **Tennessee**. Williamson Co.: TN-96 E

Table 1. Continued.

- of Triune, *S & Ch* 6289. **West Virginia.** Hampshire Co.: WV-28 4.5 mi. S of Springfield, *S & Ch* 5883. $2n = 48$. U.S.A. **Kentucky.** Hopkins Co.: KY-109 1 km N of Charleston, *S & Su* 9431.
- A. pilosus* Willd. var. *pringlei* (Gray) Blake. $2n = 48$. U.S.A. **Massachusetts.** Berkshire Co.: S of Otis, MA-8 0.9 mi. S of MA-23, *S & Bt* 3628. **Virginia.** Northumberland Co.: Reedville, *S & Ch* 5988.
- A. prenanthoides* Muhl. $2n = 32$. U.S.A. **New York.** Hamilton Co.: NY-28 by Eighth L., *S & Bt* 3665. Lewis Co.: Lowville, NY-26 0.1 mi S of NY-12 & 26, *S & Bt* 3650.
- A. priceae* Britt. $2n = 64$. U.S.A. **Tennessee.** Trousdale Co., US-231 3.3 km N of Cumberland R., *S & Ch* 9129.
- A. puniceus* L. $2n = 16$. CANADA. **Ontario.** Prescott Co.: Hwy-17 between Alfred and Plantagenet, picnic area, *S* 2413. U.S.A. **Michigan.** Mackinac Co.: US-2 10.6 mi. E of Naubinway, *S & Ch* 5007. $2n = 32$. **Minnesota.** Mille Lacs Co.: US-169 between Rum River Rest Area and rd. to Onamia, *S* 9064.
- A. radulinus* Gray. $2n = 27$ (triploid). U.S.A. **California.** Mendocino Co.: E of Ft. Bragg, CA-20 at Chamberlain Creek For. Demonstration Area picnic ground, *S & Hd* 8552. (This is the same population sampled as *S et al.* 5677 and previously reported as triploid by Semple et al., 1983)
- A. reticulatus* Pursh. $2n = 18$. U.S.A. **Florida.** Liberty Co.: NW of Sumatra, near branch of Kennedy Creek by Fl-379, *Godfrey s.n.* (fruit collection only).
- A. schreberi* Nees. $2n = 54$. CANADA. **Ontario.** Halton Reg. Mun.: S of Waterdon, Grindstone Creek Valley, *S, Bradley & Axon* 9047. York Co.: Richmond Hill, golf course, *Ch & Cameron* 2337.
- A. shortii* Lindl. in Hook. $2n = 16$. U.S.A. **Tennessee.** Marshall Co.: Henry Horton State Park, Wilhoite Mill Hiking Trail, *S & Ch* 9116.
- A. sibiricus* L. $2n = 18$. CANADA. **Alberta.** Ghost River Valley, *Chinnappa & Ch* CC4906. Jasper Nat'l. Park: Sunwapta Pass, *S & Bt* 4347. **British Columbia.** Cassiar Hwy., 53 km N of Good Hope, 52 km S of Alaska Hwy., *Ch et al.* CC4713; Chilkat Pass, base of Nahahini Mt., Haines Hwy., KmP147.7, *Ch et al.* CC3959; Teska River Flats, Alaska Hwy., KmP600, *Ch et al.* CC3775. **Yukon.** Carcross Desert N of Carcross, Klondike Loop 2, S of Whitehorse, *Ch et al.* CC3882; Dempster Hwy., KmP107-108, beside Blackstone River, *Ch et al.* CC4512; NE of Stewart Crossing, Siver Trail Hwy., KmP19, *Ch et al.* CC4564; 5 km S of Pelly Crossing, Klondike Loop, KmP460, *Ch et al.* CC4601; South Canol Rd., KmP165, Lapie L. access rd., *Ch et al.* CC4676, *Ch et al.* CC4677; junction of Sheep Creek and Rose River, *Ch et al.* CC4691. U.S.A. **Alaska.** 7 km S of Deadhorse, Dalton Hwy., MP407, Prudhoe Bay, *Ch et al.* CC4387; Edgerton Hwy., MP26-25, 7 mi. N of Chitina, *Ch et al.* CC4069; Edgerton Hwy. near Kennicott River, *Ch et al.* CC4080; just NW of Kiskulana Bridge, MP14, *Ch et al.* CC4075; Richardson Hwy., 7.7 km N of McCullen Creek, 35 km N of Paxson, *Ch et al.* CC4087; Glenn Hwy., 6 km E of Little Nelchina R. Bridge, near Nelchina State Hwy. maintenance station, *Ch et al.* CC4111; Pond E of KmP137.3, Long L., *Ch et al.* CC4134; NE of Fairbanks, Chena Hot Springs Rd., MP39.5, Granite Tours Trailhead, N Fork of Chena River, *Ch et al.* CC4233; Elliot Hwy., just SW of Baker

Table 1. Continued.

- Creek, MP138, *Ch et al. CC4281*; Dalton Hwy., 12.2 mi. N of Coldfoot, MP187.2, *Ch et al. CC4291*.
- A. simmondsii* Small. $2n = \text{ca. } 64$. U.S.A. **Florida**. Indian River Co.: E of Fellsmere, Co. Rd.-512 just E of I-95, *S 7525*.
- A. tradescanti* L. $2n = 16$. CANADA. **Nova Scotia**. Yarmouth Co.: NW of Carleton, NS-340 S of Richfield, edge of lake, *S & Keir 4860*. U.S.A. **Vermont**. Windham Co.: Rockingham, *S 6884*.
- A. umbellatus* Mill. var. *pubens* Gray. $2n = 18$. U.S.A. **Wisconsin**. Douglas Co.: US-2 E of Maple, *S 9703*.
- A. undulatus* L. $2n = 32$. U.S.A. **Alabama**. Cleburne Co.: N of Chulafinnee, US-431 5 mi. S of I-20, *S & Ch 6310*.
- A. urophyllus* Lindl. $2n = 16$. U.S.A. **New York**. Cattaraugus Co.: 7.6 km N of Ellicottville, *S & R 7570*. **Minnesota**. Crow Wing Co.: Nisswa, *S & Hd 8790*. **Missouri**. Washington Co.: MO-8 6.6 km W of Potosi, *S, Su & Ah 9391*. **Wisconsin**. Bayfield Co.: WI-27 21.3 km S of Co. Rd.-A, S of Barnes, *S 9085*.
- Chrysopsis godfreyi* Semple f. *viridis* Semple. $2n = 10$. U.S.A. **Florida**. Bay Co.: Tyndall A.F.B., NCO Beach East, progeny of *A. Johnson 8016a*.
- C. mariana* (L.) Ell. $2n = 8$. U.S.A. **Florida**. Liberty Co.: FL-20 opposite Hosford Fire Tower, *S & Godfrey 3101*.
- Erigeron* aff. *aequilifolius* Hall. $2n = 18$. U.S.A. **California**. Tulare Co.: For. Rd. J-41 E of Johnsondale, 11.5 km W of Sherman Pass Summit, *S & Hd 8652*.
- E. acris* L. ssp. *politus* (E. Fries) Schinz & Keller. $2n = 18$. CANADA. **Alberta**. Jasper Nat'l. Park: ca. 3 mi. W of Jasper, *S & Bt 4328*.
- E. divergens* Torr. & Gray. $2n = 18$. U.S.A. **California**. Mono Co.: N of Lee Vining, shore of Mono L., *S & Hd 8719*. $2n = 36$. **New Mexico**. Taos Co.: NW of Holman, NM-3, MP53, Sipapu Ski Area, *S & Hd 8069*.
- E. eatonii* Gray. $2n = 9_{II}$. U.S.A. **Wyoming**. Albany Co.: Medicine Bow Nat'l. For., S of Lincoln Monument (I-80 at Happy Jack Rd.), *S 8797*.
- E. foliosus* Nutt. var. *hartwegii* (Greene) Jeps. $2n = 18$. U.S.A. **California**. Del Norte Co.: US-199 W of Gasquet, *S & Hd 8520*.
- E. formosissimus* Greene var. *formosissimus*. $2n = 18$. U.S.A. **Arizona**. Coconino Co.: N of Flagstaff, SnoBowl Rd., below ski area, *S & Ch 9002*.
- E. formosissimus* Greene var. *viscidus* (Rydb.) Cronq. $2n = 18$. U.S.A. **New Mexico**. Taos Co.: N of Vadito, NM-3 3.5 km N of NM-75, *S & Hd 8065*.
- E. inornatus* (Gray) Gray. $2n = 18$. U.S.A. **California**. Siskiyou Co.: SW of Etna, S of Etna Summit, *S & Hd 8485*.
- E. simplex* Greene. $2n = 18$. U.S.A. **Colorado**. Chaffee Co.: W of Poncha Springs, US-50 4.4 km E of Monarch Pass, *S & Hd 7741*.
- E. speciosus* (Lindl.) DC. $2n = 18$. U.S.A. **Arizona**. Coconino Co.: N of Flagstaff, Schultz Pass Rd., N of US-180, *S & Ch 9006*.
- E. subtrinervis* Rydb. $2n = 18$. U.S.A. **New Mexico**. Lincoln Co.: W of Alto, NM-532, Sierra Blanca Ski Area, *S & Hd 8094*.
- Euthamia graminifolia* (Salisb.) Nutt. $2n = 18$. U.S.A. **Delaware**. Sussex Co.: US-9, E of Georgetown, 3 km W of DL-30, *S & R 7643*. **Wisconsin**. Douglas Co.: WNW of Barnes, pond near WI-27, 2.1 km N of Co. Rd.-A, *S 9077*.
- Grindelia camporum* Greene. $2n = 12$. U.S.A. **California**. Glenn Co.: NW of Alder

Table 1. Continued.

- Springs, For. Hwy.-7, *S & Hd* 8564. Stanislaus Co.: W of Patterson, Co. Rd. J-17 2.3 km E of Minnear Campground, Frank Raines Park, *S & Hd* 8584.
- Haplopappus gracilis* Nutt. $2n = 4$. U.S.A. **New Mexico**. Catron Co.: US-180 W of Luna, 5.5 mi. E of state line, *S & Hd* 8029.
- H. squarrosus* Hook. & Arn. $2n = 10$. U.S.A. **California**. Monterey Co.: Rd. G-14 S of King City, just N of Liggett Military Base, *S & Ch* 8939; S of Big Sur, E of Pfeiffer Beach, *S & Ch* 8930. Ventura Co.: N of Ventura, Santa Ana Rd. W of CA-33, *S. & Ch* 8968.
- Heterotheca camporum* (Greene) Shinnery var. *glandulissimum* Semple. $2n = 36$. U.S.A. **Kentucky**. Warren Co.: US-213 10.9 km SE of I-65, S of Bowling Green, *S & Ch* 9103.
- H. psammophila* Wagenknecht. $2n = 18$. U.S.A. **Arizona**. La Paz Co.: US-60 just W of Wendon, *S & Ch* 8994.
- Isocoma veneta* (H.B.K.) Greene. $2n = 24$. U.S.A. **California**. Santa Barbara Co.: CA-1 ca. 1 mi. S of CA-135, MP30.1, *S & Ch* 8964. San Diego Co.: Del Mar, near beach, *S & Ch* 8992.
- Leucelene ericoides* (Torr.) Greene. $2n = 32$. U.S.A. **Arizona**. Coconino Co.: SW of Winslow, AZ-87 6.6 km SW of county line, *S & Hd* 7913.
- Machaeranthera tanacetifolia* H.B.K. $2n = 4_{II}$. U.S.A. **Arizona**. Apache Co.: McCarrell Rd by I-40, ca 3 mi. W of Chamber, *S, Su & Ah* 9367.
- Pityopsis falcata* (Pursh) Nutt. $2n = 18$. U.S.A. **Massachusetts**. Barnstable Co.: junction of MA-137 and Long Pond Rd., *S* 3366.
- Prionopsis ciliata* (Nutt.) Nutt. $2n = 12$. U.S.A. **Texas**. Howard Co.: S of Big Spring, FR-700, *S & Hd* 8210.
- Pyrrocoma apargioides* (Gray) Greene. $2n = 12$. U.S.A. **California**. Mono Co.: CA-108 a few km W of US-395, picnic area W of Walker R., *S & Hd* 8722.
- P. uniflora* (Hook.) Greene. $2n = 24$. U.S.A. **Utah**. Emery Co.: UT-29 15.1 km W of UT-57, W of Orangeville, *S & Hd* 7802.
- Solidago altissima* L. var. *altissima*. $2n = 54$. U.S.A. **Nebraska**. Jefferson Co.: US-136 3 mi. N of county line, *S & Bt* 7349.
- S. altissima* L. var. *gilvocanescens* (Rydb.) Semple. $2n = 36$. U.S.A. **Minnesota**. Olmsted Co.: US-14 (MP206), SW of Rochester, *S* 9056.
- S. arguta* Ait. $2n = 18$. U.S.A. **North Carolina**. Transylvania Co.: US-276 near Connestee Falls, *S & Ch* 6174.
- S. caesia* L. $2n = 18$. U.S.A. **Delaware**. New Castle Co.: DL-82 S of Yorklin, ca. 4 km W of DL-52, *S & R* 7620. **Kentucky**. Adair Co.: NW of Toria, beech woods near Cumberland Parkway (MP38.1), *S & Su* 9445. Christian Co.: KY-109 SE of Dawson Spring, N end of Pennyryle Forest St. Pk, *S & Su* 9432. **Maryland**. Washington Co.: US-40 N of Greenbrier State Park, *S & R* 7658-1. **Pennsylvania**. York Co.: PA-372, below W side of bridge at Susquehanna R., *S & R* 7608.
- S. californica* Nutt. $2n = 9_{II}$. U.S.A. **California**. San Benito Co.: W of Hernandez, Coalinga Rd., Lorenzo Vasques Cyn., *S, Su & Ah* 9346.
- S. canadensis* L. aff. var. *canadensis*. $2n = 36$. U.S.A. **Tennessee**. Davidson Co.: junction of TN-171 and US-41, *S & Ch* 9124.
- S. canadensis* L. ssp. *salebrosa* (Piper) Keck. $2n = 18$. U.S.A. **Wyoming**. Teton

Table 1. Continued.

- Co.: US-26 0.3 mi. E of Teton N.F. boundary, *S & Bt* 7219. $2n = 36$. **Colorado**. Gunnison Co.: N of Gunnison, CO-135 7.3 km S of Almont, *S & Hd* 7752. $2n = 54$. **Montana**. Musselshell Co.: US-12 4.2 mi. W of Musselshell, *S & Bt* 6993.
- S. confinis* Gray. $2n = 18$. U.S.A. **California**. Kern Co.: E of Bakersfield, Kern R. canyon, Democrat Flat springs, *S, Su & Ah* 9362. Ventura Co.: N end of Fillmore, *S & Ch* 8970.
- S. guiradonis* Gray. $2n = 9_{11}$. U.S.A. **California**. San Benito Co.: SW of New Idria along Clear Creek, Clear Creek Rd. 4.65 km NE of Coalinga Rd., *S, Su & Ah* 9349, 7.15 km NE of Coalinga Rd., *S, Su, & Ah* 9352. $2n = 18$. **California**. San Benito Co.: SW of New Idria, Clear Creek Rd. 7.3 km NE of Coalinga Rd., along Clear Creek, *S, Su & Ah* 9354, *S, Su & Ah* 9355.
- S. hispida* Muhl. var. *tonsa* Fern. $2n = 18$. CANADA. **Ontario**. Lambton Co.: Pinery Prov. Park, *Bakowsky s.n.*
- S. juncea* Ait. $2n = 18$. U.S.A. **Minnesota**. Sherburne Co.: US-169 near Mississippi R., S of Elk River, *S* 9060.
- S. multiradiata* Ait. $2n = 18$. CANADA. **British Columbia**. S of Chilkat Pass, Haines Hwy., Jarvis Glacier area, Mt. McDonnell, S of Seltat Creek, *Ch et al.* CC3920.
- S. nana* Gray. $2n = 18$. U.S.A. **Colorado**. Gunnison Co.: Kebler Pass Rd. 14.8 km E of CO-133, E of Somerset, *S & Hd* 7779. (This is a correction of a previous report for *S. sparsiflora* in Semple and Chmielewski 1987; see text for discussion.)
- S. parryi* (Gray) Greene. $2n = 18$. U.S.A. **Utah**. Sevier Co.: ca. 18 km S of Gooseberry, near Gooseberry Rd., *S & Ch* 8895.
- S. petiolaris* Ait. var. *petiolaris*. $2n = 36$. U.S.A. **North Carolina**. Richmond Co.: US-1, 4.6 mi. S of NC-220, *S, Brammall & Hart* 3044.
- S. ptarmicoides* (Nees) Boivin. $2n = 18$. U.S.A. **Wisconsin**. Douglas Co.: WNW of Barnes, near pond near WI-27, 2.1 km N of Co. Rd.-A, *S* 9075.
- S. rigida* L. ssp. *humilis* (Porter) Heard & Semple. $2n = 18$. U.S.A. **Minnesota**. Sherburne Co.: US-169 near Mississippi R., S of Elk River, *S* 9057.
- S. rigida* L. ssp. *rigida*. $2n = 36$. U.S.A. **Illinois**. Livingston Co.: E of Forrest, between US-24 and RR, *S & Bt* 7386. Stephenson Co.: US-20 E of Freeport, *S* 9050. **Indiana**. Benton Co.: US-52 just NW of Fowler, *S & Hd* 8335. **Minnesota**. Sherburne Co.: Olmstead Co.: US-14 (MP206), SW of Rochester, *S* 9054.
- S. rugosa* Mill. $2n = 18$. CANADA. **Ontario**. Wellington Co.: Arkell, *S* 7397. $2n = 36$. U.S.A. **Delaware**. Sussex Co.: US-9 3 km W of DL-30, E of Georgetown, *S & R* 7641. **Maryland**. Washington Co.: US-40 N of Greenbrier State Park, *S & R* 7655. $2n = 54$. **New York**. Chataaugus Co.: N of Ellicottville, *S & R* 7571.
- S. sempervirens* L. $2n = 18$. U.S.A. **Delaware**. Sussex Co.: near DL-1, by Delaware Sea Shore State Park, *S & R* 7648. **Maryland**. US-301 1 km E of Drawbridge, N of Grasonville, *S & R* 7633.
- S. simplex* Kunth ssp. *simplex* var. *simplex*. (syn: *S. glutinosa* var. *glutinosa*). $2n = 18$. CANADA. **British Columbia**. Alaska Hwy., KP600, Teska River flats,

Table 1. Continued.

- just N of Teska service station, *Ch et al.* CC3773; Alaska Hwy., 21 km SE of Fireside, *Ch et al.*, CC3783; Cassiar Hwy., 6 km N of Boya L. Provincial Park turnoff, *Ch et al.*, CC4720; Cassiar Hwy., KP729.8, at Yukon border, *Ch et al.*, CC4709; 12 km N of Iskutm just N of Tsasbye Creek, *Ch et al.*, CC4752; Telegraph Creek Rd., 1 km NE of Telegraph Creek, *Ch et al.*, CC4738; Telegraph Creek Rd., 40 km S of Dease L., , *Ch et al.*, CC4735; Telegraph Creek Rd., 5 km S of Dease L., *Ch et al.*, CC4731. **Yukon.** Campbell Hwy., KP570, 21 km SE of Carmacks Junction, *Ch et al.*, CC4606; Campbell Hwy., KP560, just N of turnoff to Frenchman L. Gov't. Campground, *Ch et al.*, CC4608; Campbell Hwy., KP539, N of turnoff to Frenchman L. Gov't. Campground, *Ch et al.*, CC4610; Campbell Hwy., KP410, 10 km SE of Faro Junction, *Ch et al.*, CC4614; S of Whitehorse, Klondike Loop 2, KP108.3, *Ch et al.*, CC3883; Klondike Loop 2, 2 km N of MacGregor Creek, KP406-407, *Ch et al.*, CC4604; 5 km S of Pelly Crossing, Klondike Loop, KP460, *Ch et al.*, CC4600. U.S.A. **Alaska.** N of Dot L., Alaska Hwy., KP1367.5, *Ch et al.*, CC4470; Dempster Hwy., KP12.2, *Ch et al.*, CC4561; Glenn Hwy., 1 km E of Tolsona Lake Rd., W of Tolsona Creek, *Ch et al.*, CC4102; Siver Trail Hwy., NE of Stewart Crossing, KP19, *Ch et al.*, CC4563.
- S. sparsiflora* Gray. $2n = 18$. U.S.A. **Texas.** Culberson Co.: Guadalupe Mountain Nat'l. Park, Bowl Trail, 7700', *S & Hd* 8180. $2n = 36$. **Arizona.** Coconino Co.: N of Flagstaff, SnoBowl Rd., below ski area, *S & Ch* 9003.
- S. spectabilis* (D.C. Eaton) Gray. $2n = 18$. U.S.A. **California.** Modoc Co.: CA-299 12.5 km W of Alturas, N of Rattlesnake Butte, *S, Su & Ah* 9299. Shasta Co.: CA-299, Hat Creek Park, Shasta N.F., near Pit R., bank of Hat Creek, *S, Su & Ah* 9301.
- S. uliginosa* Nutt. $2n = 18$. U.S.A. **Minnesota.** Aitkin Co.: SW of McGrath, bog by MN-18 4 km E of MN-65, *S* 9067. **Wisconsin.** Portage Co.: NE of Stevens Point, WI-10 E of WI-34, marsh, *S* 9086.
- S. wrightii* Gray. $2n = 9_{II}$. U.S.A. **Arizona.** Pima Co.: Mt. Lemmon, near summit, *S, Hd & Love* 7929. $2n = 18$. **Arizona.** Yavapai Co.: just E of Prescott, US-89 (MP317), *S & Ch* 9000. **New Mexico.** Grant Co.: NM-15 39.2 km N of US-180, N of Silver City, *S & Ch* 9039.
- Virgulaster ascendens* (Lindl.) Semple. $2n = 13_{II}$. U.S.A. **Arizona.** Coconino Co.: Spring Valley, 6 mi N of Parks, *S et al.* 5563. $2n = 26$. **California.** Sierra Co.: CA-49 W of Yuba Pass, campground, *S & Hd* 8407. $2n = 52$. **Utah.** Salt Lake Co.: E of Midvale, UT-190, lower end of Big Cottonwood Cyn, *S, Su & Ah* 9239.
- Virgulus* × *amethystinus* (Nutt.) Reveal & Keener (*V. ericoides* × *V. novae-angliae*). $2n = 10$. CANADA. **Ontario.** Waterloo Co.: Wellesley Twp., by RR, *S & Ch* 9093.
- V. campestris* (Nutt.) Reveal & Keener. $2n = 10$. CANADA. **British Columbia.** BC-95 2 km N of Edgemont, 12 km N of Radium, *Ch* CC4899. U.S.A. **California.** Mono Co.: town of Mammoth Lakes, *S & Hd* 8685.
- V. concolor* (L.) Reveal & Keener. $2n = 8$. U.S.A. **Florida.** Leon Co.: W of Tallahassee, *Godfrey* 82228.
- V. ericoides* (L.) Reveal & Keener var. *ericoides*. $2n = 10$. CANADA. **Ontario.**

Table 1. Continued.

Waterloo Reg. Mun.: Wellesley Twp, <i>S & Ch</i> 9094. $2n = 20$. U.S.A. Illinois. Winnebago Co.: Kilbuck Bluffs Forest Reserve, SW of Rockford, <i>S</i> 9048.
<i>V. ericoides</i> var. <i>pansus</i> (Blake) Reveal & Keener. $2n = 10$. U.S.A. Arizona. Yavapai Co.: US-89 NE of Peoples Valley, <i>S & Ch</i> 8995. Utah. Uintah Co.: US-191 2.2 km N of Vernal, <i>S & Ch</i> 8874.
<i>V. falcatus</i> (Lindl.) Reveal & Keener. $2n = 30$. U.S.A. Colorado. Boulder Co.: E of Lyons, <i>S et al.</i> 5815.
<i>V. patens</i> (Ait.) Reveal & Keener var. <i>patens</i> . $2n = 20$. U.S.A. Georgia. Gordon Co.; S bound rest area, I-75 N of Calhoun, <i>S et al.</i> 7403.
<i>V. patens</i> var. <i>patentissimus</i> (Torr. & Gray) Reveal & Keener. $2n = 20$. U.S.A. Arkansas. Yell Co.: E of Danville, AR-10 13.9 km W of AR-7, <i>S & Hd</i> 8288.
<i>Xylorhiza tortifolia</i> (Torr. & Gray) Greene. $2n = 12$. U.S.A. Utah. Garfield Co.: UT-95 at View Point Rd., W of L. Powell and Hite Marina, <i>S</i> 8818.

et al., 1983), Semple et al. (1983) noted that diploids occurred throughout the species' range. The few known tetraploids came from its western margin near the prairies in central Canada and the midwestern United States.

Authenticity of the one tetraploid report from northeastern Iowa (Semple et al., 1983) has come into question, and thus it should be accepted only with caution. We have discovered that the plant in the greenhouse at Waterloo confirmed to be tetraploid *A. puniceus* had the same collection number as a second plant, a tetraploid *A. ontarionis*; thus the Iowa provenance of the *A. puniceus* plant is not certain.

Since 1983, 75 additional sites have been sampled by this laboratory or others, and the distribution of diploids and tetraploids conforms to the pattern illustrated by Semple et al. (1983). Diploids were found at 74 sites in Nova Scotia and Ontario in Canada, and Maine, Michigan, Minnesota, and Virginia in the United States (Table 1; Hill, 1983; Semple, 1985; Chmielewski, 1987). An additional tetraploid (with the *lucidulus* morphotype) was found in eastern Minnesota (Table 1) near the edge of the range. Thus, although one of the four previous tetraploid reports is questioned, the new report replaces it to maintain the pattern as first presented.

Aster sibiricus and A. meritus

In North America, *Aster sibiricus* L. was found to be diploid $2n = 18$ at 43 sites in Alaska, Alberta, British Columbia, North-

west Territories, and the Yukon (Table 1; Mulligan et al., 1972; Semple and Brouillet, 1980; Chinnappa and Chmielewski, 1987). *Aster meritus* A. Nels. has been reported to be tetraploid at four sites in Montana and northwestern Wyoming (Semple et al., 1983; Semple, 1985). The habitats and ranges of the two species do not appear to overlap. *Aster sibiricus* is an alpine/tundra taxon of northern Eurasia, Alaska, and western Canada. *Aster meritus* is a montane to subalpine taxon of the northcentral Rocky Mountains in the United States; it has been treated as *A. richardsonii* Spreng. var. *meritus* (A. Nels.) Raup and *A. sibiricus* L. var. *meritus* (A. Nels.) Raup. Although the two taxa are closely related, we feel species status is more appropriate for the more southern member of the complex. Additional study, however, is recommended to clarify the status of *A. meritus* and its relationship to *A. radulinus*.

Solidago guiradonis*, *S. confinis* and *S. spectabilis

Solidago guiradonis, *S. confinis*, and *S. spectabilis* clearly form a closely related species complex that is the far western element of the *S. missouriensis*/*S. juncea* group of goldenrods. Guirado's goldenrod in the strict sense is an endemic restricted to ultramafic arroyo and creek margins in southern San Benito County, California and adjacent Fresno County. It is morphologically close to and perhaps conspecific with *Solidago confinis*, which occurs in usually boggy or marshy ground and creek margins from San Benito County southward in the coastal ranges and northern Inyo County southward in the Sierras to northern Baja California. Solbrig et al. (1964), Beaudry (1969) and Semple et al. (1989) reported *S. confinis* to be diploid in southern California. The two species differ primarily in basal leaf width and in branching pattern in the club-shaped capitulescence; *S. guiradonis* is narrower in both traits. The counts of $2n = 9_{II}$ and $2n = 18$ (Table 1) are the first reports for *S. guiradonis* in the strictest sense. However, a report by Raven et al. (1960) for *S. confinis* from San Benito County (Solbrig 2816 DS!, CAS!) may represent the first report for *S. guiradonis*, if a broader interpretation of the latter species is adopted. Based on field observations of a number of small and large populations of both taxa, there appears to be only a limited morphological basis on which to separate the two. Character states for diagnostic traits of *Solidago guiradonis* appear only to be extremes at the lower limits of much greater ranges of variation

included in *S. confinis*. It would not be unreasonable to merge the two species under the older name *S. guiradonis* and treat the two at some infraspecific rank. The significance of environmental factors on morphology needs further study; *S. guiradonis* s.s. is endemic to special ultramafic soils and *S. confinis* is not. For clarity we have presented our reports under two names.

Individuals of *Solidago confinis* can be difficult to separate from *S. spectabilis* (D.C. Eaton) Gray, which is native to moist habitats in the Great Basin area and adjacent Sierra Nevadas. The ranges of the two overlap in Inyo and Kern Counties in California. Broad phyllary tips with flat margins are generally diagnostic features of *S. spectabilis*; both *S. confinis* and *S. guiradonis* have narrow phyllary apices with inrolled margins. The number of ray florets does not appear to be diagnostic for any of these three taxa. A multivariate analysis of morphological variation should be undertaken to determine which traits best distinguish the three taxa.

Solidago sparsiflora

Solidago sparsiflora is one of several closely related goldenrod taxa native to the southwestern United States and Mexico; the other two are *S. californica* Nutt. and *S. velutina* DC. Taylor and Taylor (1984) treated *S. sparsiflora* as a subspecies of *S. velutina* with the combination *S. velutina* ssp. *nevadensis* (A. Gray) Taylor and Taylor. Nesom (1989b) noted that the complex included additional Mexican species, and Semple et al. (1990) noted the need for additional study of the complex, which is similar to *S. nemoralis* of the prairies and woodlands of eastern North America. Each member of the complex has a distinct geographic range, and thus the cytogeography of each can be examined separately with caution. Regardless of the epithet applied, a sufficient portion of the range has been sampled to permit some generalizations regarding the cytogeography of *S. sparsiflora*. In total, counts have been reported for 38 locations from the United States (Table 1; Raven et al., 1960; Anderson et al., 1974; Ward and Spellenberg, 1986, as *S. velutina* ssp. *nevadensis*; Semple et al., 1984; Semple, 1985; Semple and Chmielewski, 1987; Semple et al., 1989). Diploids ($2n = 18$) are known from Arizona (12 sites throughout the state), Colorado (six sites generally in the central part of the state), Nevada (one site west of Las Vegas), Texas (Guadalupe Mt.), and Utah (four sites). Tetraploids ($2n = 36$) have been less frequently collected: Arizona (one site near Flagstaff), New Mexico (four

sites), Nevada (one site near Utah), Utah (two sites in the Wasatch Plateau), and Wyoming (one site in the Big Horn Mts.). The single report for a hexaploid ($2n = 54$) is from a site west of Boulder, Colorado. Polyploids occur throughout the range in the United States, but represent a greater portion of the sample in the northern part of the range (five out of the 15 sites north of the 37th parallel) than in the southern part of the range of the species (four out of 24 sites south of the 37th parallel). In addition, the species has been reported to be diploid at three locations in central Mexico (Ward and Spellenberg, 1986). Any study meant to clarify the most suitable rank to assign *S. sparsiflora* will have to take into consideration the fact that the taxon occurs at three ploidy levels. Brammall and Semple (1990) and Semple et al. (1990) determined that in the related *S. nemoralis* complex ploidy level was significant in distinguishing subspecies but was not diagnostic.

In the course of examining vouchers for this report, the voucher for one diploid report for *S. sparsiflora* (Semple and Chmielewski, 1987) was determined to be *S. nana* (location given in Table 1). *Semple and Heard 7799* (WAT!) has the more corymbiform capitulescence and the short dense pubescence on its stems and leaves generally characteristic of *S. nana*. The voucher was collected well after blooming; the involucre at flowering would probably have been larger than normal for *S. sparsiflora*. The voucher is part of the same taxon as the voucher for the only other report for *S. nana* (Semple et al., 1989), which was also diploid.

Solidago simplex

Ringius and Semple (1987) discussed the cytogeography of this species throughout its range under the synonym *Solidago glutinosa*. Nesom (1989a) noted that the types of *S. simplex* and *S. glutinosa* were conspecific and that the former name was older and had nomenclatural priority. Ringius and Semple (1987) determined that all reports for ssp. *simplex* were diploid. The 19 reports for diploids from Alaska and western Canada (Table 1) further confirm that ssp. *simplex* is diploid.

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