

A taxonomic revision of *Allium* (Alliaceae) in the Canadian prairie provinces

Hyeok Jae Choi and J. Hugo Cota-Sánchez

Abstract: The taxonomy, rarity, and conservation status of *Allium* L. is revised for the Canadian prairie provinces, based on analyses of herbarium specimens and fieldwork. Five species are recognized: *Allium schoenoprasum* L., *A. geyeri* S. Watson var. *tenerum* M.E. Jones, *A. textile* A. Nelson & J.F. Macbride, *A. cernuum* Roth, and *A. stellatum* Ker Gawler. Distribution maps and a key to species are provided, as well as complete descriptions of the species examined, including new illustrations, information on nomenclatural types, synonymies, and chromosomal and ecological data. A lectotype is designated for *A. geyeri* var. *tenerum*. In this study, *A. geyeri* var. *geyeri* reported from Alberta and Saskatchewan and ranked in these provinces as having rarity levels S2 and S1, respectively, by the Nature Conservancy, is excluded from the Canadian flora and the rare list of these provinces because it was misidentified from a herbarium specimen of *A. textile*. *Allium tricoccum* Solander in W. Aiton is regarded as a non-native species to Manitoba. The rarity and conservation status of *Allium* in the Canadian prairie provinces is as follows: (i) *A. schoenoprasum*, listed as S2 in Saskatchewan, is rare in Manitoba, although its rarity status has not been formally assessed in the province; (ii) *A. geyeri* var. *tenerum* is the rarest *Allium* taxon, with distribution restricted to the Waterton Lakes National Park areas of Alberta, and is currently listed as S2; and (iii) *A. cernuum* was re-evaluated and a rarity level of S1S2 was recommended for the species in Saskatchewan, particularly in its southwestern distributional habitat.

Key words: *Allium*, Canada, conservation status, prairie provinces, rare species, taxonomy.

Résumé : Les auteurs révisent la taxonomie, la rareté et l'état de conservation des *Allium* L. dans les provinces canadiennes des prairies en se basant sur l'analyse de spécimens d'herbier et de travaux sur le terrain. On reconnaît cinq espèces : *Allium schoenoprasum* L., *A. geyeri* S. Watson var. *tenerum* M.E. Jones, *A. textile* A. Nelson & J.F. Macbride, *A. cernuum* Roth et *A. stellatum* Ker Gawler. Ils présentent des cartes de distribution et une clé pour les espèces ainsi que des descriptions complètes des espèces examinées, incluant de nouvelles illustrations, des informations sur les types nomenclaturaux, des synonymies et des données chromosomiques et écologiques. On désigne un lectotype pour l'*A. geyeri* var. *geyeri*, rapporté en Alberta et en Saskatchewan et classé dans ces provinces comme S2 et S1m, respectivement, par la Nature Conservancy; on l'exclut de la flore canadienne et des espèces rares de ces provinces parce qu'il provient de la fausse identification d'un spécimen d'herbier correspondant à l'*A. textile*. On considère l'*Allium tricoccum* Solander in W. Aiton comme espèce non indigène au Manitoba. La rareté et le statut de la conservation des *Allium* dans les provinces canadiennes des prairies se lit comme suit : (i) l'*A. schoenoprasum* classé comme S2 en Saskatchewan est rare au Manitoba, bien que son statut de rareté n'ait pas été formellement évalué dans la province, (ii) l'*A. geyeri* var. *tenerum* est le taxon le plus rare du taxon *Allium* avec une distribution restreinte au Parc national de Waterton Lakes en Alberta et actuellement classé en S2, et (iii) on réévalue l'*A. cernuum* de le faire passer à S1S2 comme espèce rare en Saskatchewan, surtout dans la partie sud-ouest de son habitat.

Mots-clés : *Allium*, Canada, statut de conservation, provinces des prairies, espèce rare, taxonomie.

[Traduit par la Rédaction]

Introduction

The genus *Allium* L. has been traditionally circumscribed in the tribe Allieae under the Liliaceae (Bentham and Hooker 1883; Lawrence 1951; Xu and Kamelin 2000), but recently this genus has been placed by various authors in its

own family Alliaceae (Dahlgren et al. 1985; Takhtajan 1997; Rahn 1998; Friesen et al. 2000). The genus is characterized by the presence of bulbs enclosed in membranous (sometimes finely fibrous) tunicas, free or almost free tepals, and often a subgynobasic style (Friesen et al. 2006). Most taxa produce remarkable amounts of cystein sulphoxides,

Received 16 February 2010. Accepted 15 June 2010. Published on the NRC Research Press Web site at botany.nrc.ca on 27 September 2010.

H.J. Choi. Division of Forest Biodiversity and Herbarium (KH), Korea National Arboretum, Pocheon, Gyeonggi 487-821, Korea; Department of Biology and W. P. Fraser Herbarium (SASK), University of Saskatchewan, Saskatoon, SK S7N 5E2, Canada.

J.H. Cota-Sánchez.¹ Department of Biology and W. P. Fraser Herbarium (SASK), University of Saskatchewan, Saskatoon, SK S7N 5E2, Canada.

¹Corresponding author (e-mail: hugo.cota@usask.ca).

causing the characteristic odour and taste of garlic, onion, and leek (Fritsch and Keusgen 2006).

With over 800 species, *Allium* is naturally distributed in the Northern hemisphere, mainly in seasonally dry regions (Friesen et al. 2006; Nguyen et al. 2008; Neshati and Fritsch 2009). The greatest diversity of *Allium* occurs in the Mediterranean basin and southwestern and central Asia, which is the primary centre of diversity, but a smaller secondary area of diversification is found in North America (Friesen et al. 2006; Nguyen et al. 2008). The North American centre of diversity is subdivided into two areas: one including the region of Texas, and the other the California Floristic Province (McNeal 1992; Nguyen et al. 2008). Despite the cultural, economic, nutritional, and health significance of *Allium* in human society, to date, its taxonomy remains complex, owing to the proliferation of synonyms and disagreement in taxonomic characters used in species boundaries. In fact, *Allium*'s complex taxonomic history includes 1400 specific epithets, often from inadequate or incomplete material, which are currently under synonymy with existing species (Gregory et al. 1998). Nevertheless, a comprehensive generic monograph has not been compiled since that of Regel (1875).

It has been suggested that *Allium* has been around in the New World since at least the Tertiary Period (Raven and Axelrod 1978), and that approximately 1/6 of the world's *Allium* diversity, i.e., about 96 species, is found in North America north of Mexico, with 12 of those species known from Canada (McNeal 1992; McNeal and Jacobsen 2002). Among these 12 taxa, only one species, *Allium schoenoprasum* L., is widespread in the native floras of both the Old and New World (McNeal 1992; McNeal and Jacobsen 2002). *Allium victorialis* L. also occurs in both Eurasia and North America; however, its North American distribution is restricted to Attu Island, the westernmost island of the Aleutian archipelago (McNeal and Jacobsen 2002). All North American species have a basic chromosome number of $x = 7$, except *A. schoenoprasum*, *Allium tricoccum* Solander in W. Aiton, and *A. victorialis*, which share the same basic chromosome number ($x = 8$) with the majority of Old World species (McNeal 1992; McNeal and Jacobsen 2002).

Several criteria have been used in the classification of *Allium* species. For instance, the sexuality of the plants, structure and shape of the underground parts (including rhizome and bulb), anatomical features of root, leaf, scape, and ovary, as well as basic chromosome number, have been useful at the subgeneric and sectional levels (Fritsch 1992; Hanelt et al. 1992; Kruse 1992; McNeal 1992; Friesen et al. 2006; Gurushidze et al. 2008; Nguyen et al. 2008; Choi 2009). In addition, the shape and size of floral organs such as the perianth, filament, pistil, capsule, seed, and somatic chromosome number have provided diagnostic characters at the specific level (McNeal 1992; Choi et al. 2007; Ko et al. 2009), and scanning electron microscopy (SEM) has allowed the characterization of cell pattern and ornamentation of the bulb coat, leaf, and seed coat, improving the taxonomy of the genus *Allium* (Kruse 1992; McNeal 1992; Choi et al. 2004; Fritsch et al. 2006; Choi 2009).

Even with recent progress, the taxonomic understanding of *Allium* has been limited, in part due to the fact that New

World species are poorly represented in herbaria (McNeal 1992; H.J. Choi, personal observation). The lack of well-preserved voucher specimens regarding the geographic range of the genus has led to the misinterpretation of the patterns of morphological variation in numerous taxa, with subsequent confusion about species boundaries and distribution. While extensive collecting has added valuable material to the American systematic collections, allowing the reappraisal of morphological characters used in *Allium* classification (McNeal 1992), most Canadian herbaria are less diverse but contain valuable historical specimens collected by various botanists from the 1950s to the 1980s (H.J. Choi and J.H. Cota-Sánchez, personal observation). The relatively narrow representation of Canadian *Allium* specimens in North American herbaria is in part related to the few systematic studies dealing with Canadian species. Systematic studies of Canadian *Allium*, excluding that of the Flora of North America (McNeal and Jacobsen 2002), are mainly focused either on the western (e.g., Chinnappa and Basappa 1986) or eastern region (e.g., Barnston 1859; Ownbey and Aase 1955) of the country, areas with relatively more history, interest, and expertise in taxonomy. The paucity of *Allium* taxonomic studies from the Canadian prairies provinces (CPP) is evident.

The Canadian Prairies is a region of Canada for which several natural definitions have been used. Most notably, the CPP comprise the interior plain regions, i.e., the provinces of Alberta, Saskatchewan, and Manitoba, and are an extension of the US Great Plains region. In the past, the prairie landscape was characterized by extensive grasslands, aspen parklands, and an abundance of wetland areas, all supporting a diverse array of native biota (Pasitschniak-Arts and Messier 1999). However, during the last few decades, large areas of prairie have been cleared and converted to cropland. As a result, the prairies now form the largest expansion of agricultural land and one of the most human-altered and fragmented landscapes in Canada (Acton et al. 1998; Fung 1999; Pasitschniak-Arts and Messier 1999).

In addition to hosting unique prairie ecosystem biodiversity, the CPP have numerous native plants, including six *Allium* species, namely *A. schoenoprasum*, *Allium geyeri* S. Watson var. *geyeri*, *A. geyeri* var. *tenerum* M.E. Jones, *Allium textile* A. Nelson & J.F. Macbride, *Allium cernuum* Roth, and *Allium stellatum* Ker Gawler (McNeal and Jacobsen 2002). Nonetheless, previous taxonomic views, e.g., Scoggan (1957), Moss (1959), McNeal and Jacobsen (2002), and Harms (2003), are inconsistent in the number of species recognized for the CPP (Table 1). Among these, *A. geyeri* var. *geyeri* and *A. geyeri* var. *tenerum* have been designated as rare species in Alberta (Kershaw et al. 2001). Similarly, *A. geyeri* var. *geyeri*, in addition to *A. cernuum* and *A. schoenoprasum*, are included in Saskatchewan's rare and endangered plant list (Harms 2003). Finally, *A. tricoccum* is considered a rare plant in Manitoba (Scoggan 1957; White and Johnson 1980); however, this species has not been collected since 1923 (White and Johnson 1980), and its distribution in Manitoba is questionable.

Earlier taxonomies of *Allium* in the CPP do not include a holistic treatment. Here, we address the systematics of *Allium* in the CPP, using, for the first time, a combination of quantitative and qualitative data based on macro- and mi-

Table 1. A comparison of past and present *Allium* classification in the Canadian prairie provinces.

Taxon	Scoggan 1957 (MB)	Moss 1959 (AB)	Harms 2003 (SK)	McNeal and Jacobsen 2002	This paper
1. <i>A. schoenoprasum</i> var. <i>schoenoprasum</i>	-	-	-	+ (AB, SK, MB)	+ (AB, SK, MB)
2. <i>A. schoenoprasum</i> var. <i>sibiricum</i>	+	+	+	Synonym of 1	Synonym of 1
3. <i>A. geyeri</i> var. <i>geyeri</i>	-	+	+	+ (AB, SK)	-
4. <i>A. geyeri</i> var. <i>tenerum</i>	-	+	-	+ (AB)	+ (AB)
5. <i>A. textile</i>	+	+	+	+ (AB, SK, MB)	+ (AB, SK, MB)
6. <i>A. cernuum</i>	+	+	+	+ (AB, SK)	+ (AB, SK)
7. <i>A. stellatum</i>	+	-	+	+ (SK, MB)	+ (SK, MB)
8. <i>A. tricoccum</i>	+	-	-	-	-

Note: AB, Alberta; SK, Saskatchewan; MB, Manitoba; -, not recognized; +, recognized.

cro-morphological characters from vegetative structures, flowers, and seeds, observed in herbarium specimens. The goals of this study are (i) to expand the current knowledge of morphology and distribution, (ii) to address taxonomic issues, clarify type identifications, and provide a taxonomic treatment with new descriptions and illustrations of the species, and (iii) to review the rarity and conservation status of *Allium* in the CPP. The limited research involving CPP species, and the lack of a Saskatchewan flora, in conjunction with relevant unresolved issues surrounding the taxonomy, phylogeny, and evolution of the genus *Allium*, justifies this investigation. In addition to providing an update of the provincial taxonomic treatments and the basis for a future national and global monograph and systematic study of *Allium*, this research contributes to the preservation of traditional taxonomic studies in an era of bioinformatic systems and electronic databases, and is in line with the preservation of the fundamentals of classification and its application in biodiversity and conservation biology studies.

Materials and methods

Our taxonomic revision is based on 716 herbarium specimens, including nine photographs of type specimens from the following herbaria: ALTA, DAO, LINN, MO, NY, SASK, and WIN. A list of the specimens investigated is included (Appendix A). The number of specimens studied per taxon depended on its representation among the collections investigated, the extent of its distributional area, its rarity, and the taxonomic difficulties involved. The number of accessions examined varied from 6 in *Allium geyeri* var. *tenerum* to 198 in *A. textile*. All the species, except *A. geyeri* var. *tenerum*, were also observed and field-collected by the authors in 2009. Material preserved in 70% ethanol (*A. schoenoprasum*, H.J. Choi-sk-4; *A. textile*, H.J. Choi-sk-1, H.J. Choi-sk-2; *A. cernuum*, H.J. Choi-sk-10; *A. stellatum*, H.J. Choi-sk-12, H.J. Choi-sk-16) was used to observe and measure micromorphological characters, cross-sections in leaf and scape, and reproductive organs. Only dried specimens of *A. geyeri* var. *tenerum* were examined for this study because there was no live material available. The general description of the genus *Allium* is based on Choi (2009) as well as the observations indicated above.

General morphology

Characters from vegetative (rhizome, bulb, leaf, and scape) and reproductive (perianth, stamen, pistil, fruit, and seed) structures were analysed in each species (Table 2). Measurements were based on a minimum of 30 and 20 specimens (indicated by an asterisk in Appendix A) for vegetative organs and reproductive parts, respectively, from which the mean and standard deviations were calculated (Table 3). Specimens were observed and photographed using a TESSOVAR Photomacrographic Zoom System with Nikon D100. Segments from the middle third of the second leaf blade and scape were used for anatomical observation of the cross-section. Leaf and scape tissues fixed in 70% ethanol were free-hand sectioned, stained with Safranin O, washed with distilled water, and photographed. Line drawings were generated from photos and voucher specimens using Adobe Photoshop 7.01 (Adobe, www.adobe.com).

Table 2. Qualitative characters used in the taxonomy of *Allium* of the Canadian prairie provinces.

Character	<i>A. schoenoprasum</i>	<i>A. geyeri</i> var. <i>tenerum</i>	<i>A. textile</i>	<i>A. cernuum</i>	<i>A. stellatum</i>
Rhizome	Condensed, oblique	Obsolete, erect	Obsolete, erect	Condensed, oblique	Condensed, oblique
Bulb					
Shape	Cylindrically conical	Ovoid	Ovoid	Ovoid	Ovoid
Texture of tunica	Papery	Fibrous	Fibrous	Membranous	Membranous
Sculpture of tunica	Smooth	Reticulate	Reticulate	Smooth	Smooth
Colour of tunica	Dark brown	Gray to light brown	Gray to light brown	Gray to brown	Gray to brown
Leaf blade					
Apex	Acuminate	Obtuse	Acuminate to acute	Acuminate to obtuse	Acuminate to acute
Shape in cross-section	Terete	Flat to channelled	Channelled to semiterete	Nearly flat	Channelled to V-shaped
Pith in cross-section	Hollow	Solid	Solid	Solid	Solid
VB in cross-section	2-rowed	1-rowed	1-rowed	1-rowed	1-rowed
Scape					
Shape in cross-section	Terete	Terete to minutely angular	Terete	Terete to angular	Terete to dully angular
Pith in cross-section	Hollow	Solid	Solid	Solid	Solid
VB in cross-section	2-circular	2-circular	2-circular	2- to 3-circular	2- to 3-circular
Before anthesis	Erect	Curved	Curved	Recurved	Recurved
At flowering	Erect	Erect	Erect	Recurved	Erect
Umbel					
Shape	Subglobose	Hemispheric to globose	Subfascicled to hemispheric	Hemispheric to globose	Subfascicled to hemispheric
Bulblil	Absent	Developed	Absent	Absent	Absent
Perianth					
Shape	Campanulate	Campanulate to urceolate	Campanulate to urceolate	Campanulate	Stellate
Colour	Reddish pink to deep lilac	Pink to white	White	Pink to white	Deep pink
Midvein	Reddish	Reddish	Reddish to greenish	Greenish	Reddish
Inner tepal					
Shape	Oblong-lanceolate	Oblong to lanceolate	Oblong	Ovate	Elliptical-lanceolate
Apex	Acute	Acute to obtuse	Obtuse	Acute	Acute
Outer tepal					
Shape	Oblong-lanceolate	Oblong to lanceolate	Broadly ovate to lanceolate	Oval to orbicular	Elliptical
Apex	Acute	Acute to obtuse	Acute to obtuse	Subrounded	Acute
Filament					
Inner filament	Non-exserted	Non-exserted	Non-exserted	Exserted	Non-exserted
Outer filament	Non-exserted	Non-exserted	Non-exserted	Exserted	Exserted
Ovary					
Shape	Ellipsoid	Subglobose	Subglobose	Subglobose	Subglobose

Table 2 (concluded).

Character	<i>A. schoenoprasum</i>	<i>A. geveri</i> var. <i>tenerum</i>	<i>A. textile</i>	<i>A. cernuum</i>	<i>A. stellatum</i>
Appendage	Hood-like	Crest-like	Absent	Crest-like	Crest-like
Style	Non-exserted	Non-exserted	Non-exserted	Exserted	Exserted
Flowering	June–August	June–July	May–July	June–August	July–September
Capsule	Ellipsoid	Cordiform	Cordiform	Cordiform	Cordiform
Seed	Elliptical	Broadly oval	Broadly oval	Oval	Oval
BCN	$x = 8$	$x = 7$	$x = 7$	$x = 7$	$x = 7$

Note: VB, vascular bundles; BCN, basic chromosome number.

Microstructures

For the observation of micromorphological structures of leaf epidermis, stomatal apparatus, and seed testa, tissues were fixed in 70% ethanol, washed twice with 0.1 mol/L phosphate buffer (pH 6.8), refixed in 2.5% glutaraldehyde, dehydrated in an ethanol–acetone series, critical-point dried with Polaron E3000 Series II, mounted on stubs, and coated with gold in an Edwards S150B ion sputter coater. In all cases, at least five samples per taxon were analyzed, characterized, and photographed with a Philips 505 SEM (Fig. 1).

Map of geographic distribution

A map depicting the distributional range was prepared for each taxon based on herbarium specimens investigated as per Appendix A (Fig. 2). The maps were generated using a customized map development tool specially designed and based on the open-source code Google™ Maps API on-line development tool. The mapping software and data used can be found at the W.P. Fraser Herbarium (SASK) Web site (herbarium.usask.ca/MapDevelopment/mapsChoi.html). A data table of *Allium* localities for the CPP was generated to separate specimens by species and localities. Where specific latitude and longitude information was not provided in the voucher specimen, the coordinates were estimated based on the provided locality information using the Natural Resources Canada on-line Atlas of Canada reference maps (atlas.nrcan.gc.ca/site/english/maps/topo/map). Once the data table was linked to the mapping program, the maps were plotted. The Google™ map was imported into Adobe Photoshop 7.01 as a JPEG graphic, and the boundaries of the map were removed so that only the provinces of Alberta, Saskatchewan, and Manitoba remained. The source of ecological information is from data on specimen labels and the authors' field observations.

Results and discussion

Taxonomic characters

Macromorphological characters

Our data indicate that several macromorphological characters, such as the shape and development of rhizome, texture and sculpture of the bulb's outer tunica, shape and structure of leaf and scape in cross-section, number of leaves, the growing pattern of the scape, bulbil development, shape and size of various floral parts are useful diagnostic traits at the specific level. The qualitative and quantitative taxonomic characters of the *Allium* species in the CPP are summarized in Tables 2 and 3 along with a general description of their variability.

Microstructures of leaf epidermis

The leaf epidermal cells of the species investigated are usually rectangular to linear in shape, with straight anticlinal walls (Figs. 1A–1H; Choi et al. 2004). *Allium schoenoprasum* exhibits only cells of the linear type (Figs. 1A and 1E). Within species, the shape of the epidermal cells is similar on the adaxial and abaxial side of the leaf. The cuticular cell sculpture pattern is smooth (Figs. 1B, 1C, 1F, and 1G) or ridged (Figs. 1A, 1D, 1E, and 1H). *Allium stellatum* is distinguished by the prominent ridged walls (compared with

Table 3. Quantitative characters used in the taxonomy of *Allium* of the Canadian prairie provinces.

Character	Measurement minimum (mean ± SD) and maximum					
	<i>A. schoenoprasum</i>	<i>A. geyeri</i> var. <i>tenerum</i>	<i>A. textile</i>	<i>A. cernuum</i>	<i>A. stellatum</i>	
Rhizome length (mm)	5.0 (7.03±1.64) 10.0	1.2 (1.93±0.43) 2.7	0.5 (1.33±0.40) 2.3	2.0 (4.88±1.48) 7.7	2.0 (4.28±1.42) 7.0	
Bulb diameter (mm)	7.0 (10.04±2.91) 15.0	10.0 (15.84±2.55) 20.0	7.0 (12.88±3.56) 25.0	8.3 (14.19±2.92) 22.0	8.0 (12.95±2.09) 17.7	
Leaf sheath height (cm)	7.0 (13.63±4.55) 20.0	5.0 (8.09±2.17) 13.0	3.5 (6.93±3.02) 10.0	3.0 (6.80±1.70) 10.0	5.0 (7.47±1.35) 11.0	
Leaf blade						
Number (ea)	1 (1.40±0.49) 2	3 (3.72±0.73) 5	2 (2.18±0.46) 4	3 (4.76±1.16) 7	3 (3.86±0.91) 7	
Length (cm)	15.0 (24.00±3.97) 40.0	12.0 (16.93±3.64) 25.0	8.0 (13.43±3.43) 20.0	5.0 (18.00±4.84) 27.5	15.0 (22.75±4.05) 36.0	
Width (mm)	2.0 (4.58±2.16) 9.0	2.0 (2.57±0.55) 4.0	1.0 (1.71±0.67) 3.0	1.2 (3.81±1.83) 8.0	1.0 (1.84±0.51) 3.6	
Scape						
Length (cm)	12.0 (34.47±8.47) 50.0	15.0 (35.77±9.85) 50.0	10.0 (17.74±6.80) 37.0	13.5 (34.66±11.87) 48.0	25.0 (37.13±7.11) 62.0	
Width (mm)	2.0 (4.24±2.07) 8.0	1.5 (2.46±0.47) 3.1	0.8 (1.71±0.56) 3.0	1.1 (2.06±0.65) 4.0	1.3 (1.76±0.35) 2.8	
Inflorescence						
Flower number (ea)	16 (42.00±15.52) 80	5 (7.08±2.75) 13	7 (20.03±7.82) 41	12 (22.60±7.57) 42	10 (21.68±8.38) 54	
Bulbil number (ea)	—	8 (16.25±4.82) 20	—	—	—	
Height (H, mm)	20.0 (29.20±4.79) 35.0	15.0 (18.47±2.16) 22.0	12.0 (20.30±7.30) 42.0	17.0 (26.43±5.69) 42.0	16.0 (22.06±4.23) 34.0	
Width (W, mm)	25.0 (32.90±4.18) 40.0	18.4 (22.04±2.52) 26.0	18.0 (32.04±8.76) 55.0	21.0 (33.45±5.43) 46.3	24.0 (35.85±6.12) 48.2	
H/W (ratio)	0.7 (0.89±0.12) 1.0	0.7 (0.84±0.08) 1.0	0.5 (0.63±0.12) 1.0	0.5 (0.79±0.12) 1.0	0.5 (0.62±0.07) 0.8	
Pedicel length (mm)	5.0 (6.61±1.14) 10.0	5.0 (8.74±3.16) 17.0	4.0 (10.30±3.75) 20.0	6.0 (12.00±3.31) 20.0	8.5 (14.32±2.90) 20.2	
Bract length (mm)	11.0 (14.00±2.39) 20.0	7.1 (8.88±1.20) 11.0	7.5 (11.10±1.73) 16.0	9.0 (12.11±1.24) 13.5	9.3 (12.59±2.38) 19.7	
Bulbil						
Length (mm)	—	5.0 (7.51±1.54) 10.5	—	—	—	
Width (mm)	—	2.5 (3.65±0.70) 5.0	—	—	—	
Inner tepal						
Length (L, mm)	11.0 (12.67±1.25) 15.0	8.0 (8.23±0.21) 8.5	4.5 (6.45±1.40) 8.8	5.0 (5.17±0.30) 6.0	7.2 (7.40±0.14) 7.7	
Width (W, mm)	2.5 (3.08±0.40) 3.5	2.0 (2.30±0.22) 2.5	2.0 (2.43±0.23) 2.8	3.0 (3.85±0.33) 4.3	2.3 (3.21±0.46) 3.5	
L/W (ratio)	3.7 (4.12±0.42) 4.8	3.2 (3.61±0.38) 4.3	1.8 (2.67±0.54) 3.1	1.2 (1.36±0.16) 1.7	2.1 (2.35±0.41) 3.2	
Outer tepal						
Length (L, mm)	10.0 (12.20±1.57) 15.0	7.5 (7.91±0.30) 8.5	4.0 (5.94±1.20) 7.8	3.8 (4.49±0.39) 4.8	6.0 (6.03±0.07) 6.2	
Width (W, mm)	2.7 (3.03±0.25) 3.5	2.5 (3.06±0.31) 3.5	2.5 (3.04±0.47) 3.9	3.1 (3.92±0.30) 4.2	2.8 (2.94±0.09) 3.0	
L/W (ratio)	3.8 (3.97±0.09) 4.1	2.3 (2.61±0.26) 3.1	1.4 (1.97±0.37) 2.6	1.0 (1.15±0.09) 1.3	2.0 (2.05±0.08) 2.2	
Filament						
Inner length (mm)	4.0 (5.30±0.77) 7.0	7.1 (7.66±0.31) 8.3	3.2 (4.21±0.77) 5.3	7.5 (7.94±0.48) 9.0	7.0 (7.10±0.18) 7.5	
Outer length (mm)	3.7 (5.03±0.79) 6.7	6.0 (6.78±0.84) 8.3	2.7 (3.44±0.68) 4.5	3.5 (6.86±1.79) 9.0	7.0 (7.22±0.18) 7.5	
Anther length (mm)	1.3 (1.40±0.08) 1.5	1.1 (1.38±0.17) 1.5	0.9 (1.19±0.23) 1.5	1.8 (1.88±0.08) 2.0	2.0 (2.22±0.13) 2.4	
Ovary						
Length (mm)	2.3 (2.53±0.21) 2.8	2.3 (2.78±0.24) 3.1	1.3 (1.72±0.29) 2.0	2.2 (2.59±0.26) 3.0	2.7 (2.98±0.18) 3.2	
Width (mm)	1.8 (2.07±0.25) 2.4	2.0 (2.41±0.41) 3.0	1.4 (1.63±0.18) 1.9	2.4 (2.61±0.19) 3.0	3.0 (3.63±0.41) 4.0	
Ovule number*	2	2	2	2	2	

Table 3 (concluded).

Character	Measurement minimum (mean ± SD) and maximum				
	<i>A. schoenoprasum</i>	<i>A. geyeri</i> var. <i>tenerum</i>	<i>A. textile</i>	<i>A. cernuum</i>	<i>A. stellatum</i>
Capsule					
Length (mm)	4.1 (4.23±0.06)	4.3	Unknown	3.8 (4.92±0.91)	4.0 (4.38±0.22)
Width (mm)	3.2 (3.35±0.11)	3.5	Unknown	4.3 (5.06±0.43)	4.1 (4.43±0.16)
Seed					
Length (mm)	3.3 (3.35±0.08)	3.6	Unknown	2.5 (3.35±0.37)	2.5 (2.76±0.21)
Width (mm)	1.5 (1.65±0.08)	1.8	Unknown	2.0 (2.18±0.12)	1.5 (1.86±0.18)

*Number of ovules per locule.

A. schoenoprasum, with minute ridged walls). This character varies among species, but displays consistency within the same taxon. It is particularly useful in distinguishing *A. cernuum* (Figs. 1C and 1G) from its close relative *A. stellatum* (Figs. 1D and 1H).

The stomatal apparatus in *Allium* of the CPP is amphistomatic (found on the both sides of leaf) and anomocytic. In *A. schoenoprasum*, the stomata are more or less raised from the epidermal surface (Figs. 1A and 1E), while in the other taxa these structures are clearly depressed (Figs. 1B–1D and 1F–1H).

Seed testa sculptures

Allium testa topography usually involves the analysis of the shape of anticlinal cell walls, including the boundary relief and undulation pattern, as well as the microrelief of the periclinal cell wall, which is sometimes divided into a central field and a peripheral anticlinal field (Kruse 1992). In the CPP *Allium*, the more or less flat periclinal walls of the seed coat can be divided in three types: minutely roughened, granulate, and verrucate (Figs. 1I–1P). The minutely roughened type, characterized by the lack of a relief (although a slight microrelief may be evident) is an attribute of *A. stellatum* (Figs. 1L and 1P), and the granulate type is characteristic of *A. schoenoprasum* and *A. textile* (Figs. 1I, 1J, 1M, and 1N). The verrucate type, distinguished by a conspicuous verruca in the central region of each anticlinal cell wall, is in turn seen in *A. cernuum* (Figs. 1K and 1O) and *A. geyeri* (Fig. 19 of Kruse 1988). This demonstrates that seed testa sculpture is a source of traits valuable for *Allium* taxonomy, and imparts key characters useful for distinguishing closely related species, e.g., *A. geyeri* from *A. textile*, and *A. cernuum* from *A. stellatum*. Conversely, the straight pattern of the anticlinal cell boundaries is a shared, uninformative character in the taxonomy of the CPP alliums (Figs. 1M–1P), but the putative significance of this character in the systematics of *Allium* in Canada and (or) the rest of the world should not be ruled out.

Taxonomic treatment of *Allium* of the Canadian prairie provinces

The following taxonomic treatment is based on a wide array of macro- and micro-morphological characters. The reader is advised that characters indicated within square brackets are absent in the species of the CPP but used in the description of *Allium* in floras and monographs throughout the world.

Allium L., Sp. Pl. 1: 294 (1753)

TYPE: *Allium sativum* L. (lectotype).

DESCRIPTION: Herbs perennial, bulbiferous. Rhizomes condensed [or elongated], sometimes obsolete (not rhizomatous), erect to horizontal. Bulbs tunicate, solitary to clustered, [sometimes with basal bulbels], cylindrical to globose; tunicas membranous, papery, or fibrous, smooth to reticulate. Leaves alternate; leaf sheaths [buried] or exposed over ground; leaf blades linear [or rarely elliptical to oval], flat, angular, or terete, with one or two rows of vascular bundles, and solid or hollow in cross-section, sessile, attenuate, [or rarely narrowed into pseudo-petiole at base], acuminate [to rounded] in apex; leaf epidermal cells rectangular to

Fig. 1. Epidermal cells of leaf (A–H) and seed testa (I–P) in *Allium* of the Canadian prairie provinces. Figs. 1A–1D, adaxial view; Figs. 1E–1H, abaxial view. From the left to right: *A. schoenoprasum* [H.J. Choi-sk-4 (SASK)]; *A. textile* [H.J. Choi-sk-1 (SASK)]; *A. cernuum* [H.J. Choi-sk-10 (SASK)]; and *A. stellatum* [H.J. Choi-sk-12 (SASK)]. Lc, linear cell; Rc, rectangular cell; Cr, ridged cuticle; Rs, raised stomata; Ds, depressed stomata; Pw, periclinal wall; Aw, anticlinal wall; C, channel; V, verruca.

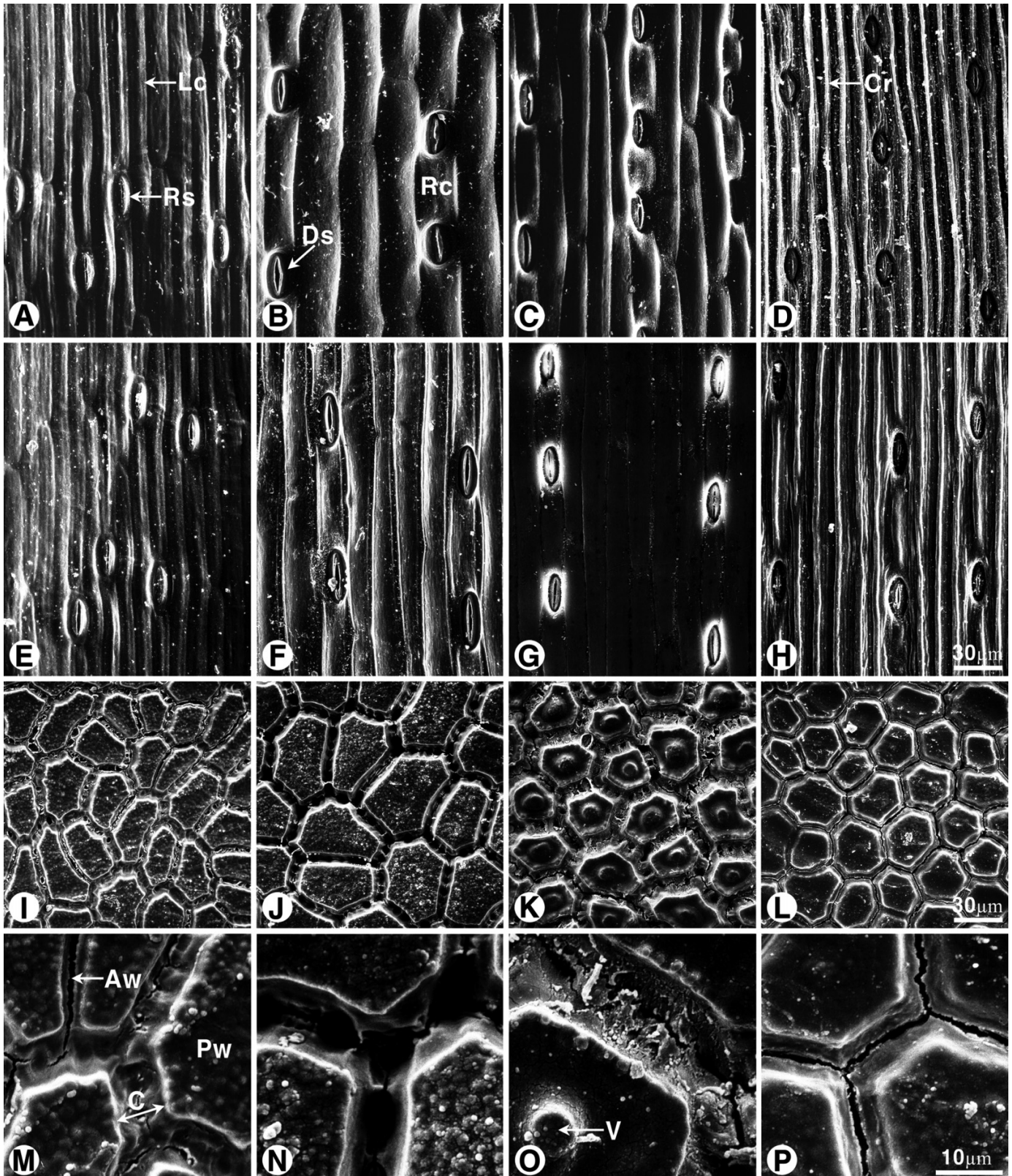
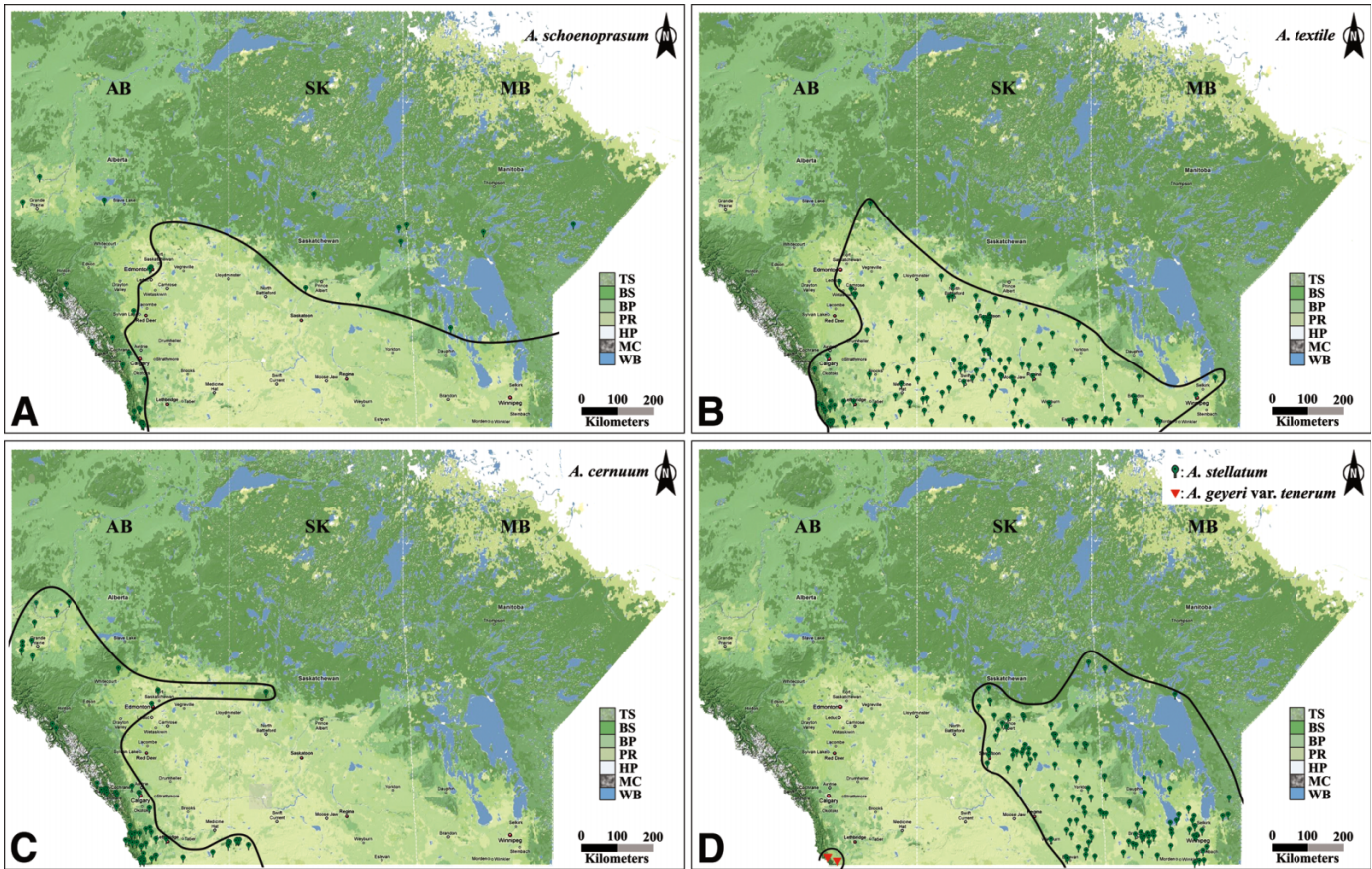


Fig. 2. Geographic distribution and estimated edge (—) of *Allium* species in the Canadian prairie provinces. (A) *A. schoenoprasum*, (B) *A. textile*, (C) *A. cernuum*, (D) *A. stellatum* and *A. geyeri* var. *tenerum*. AB, Alberta; SK, Saskatchewan; MB, Manitoba; WB, water body; MC, mountain cordillera; HP, Hudson plain; PR, prairie; BP, Boreal Plain; BS, Boreal Shield; TS, Taiga Shield.



linear, sometimes with well-developed cuticles; stomatal apparatus usually amphistomatic and anomocytic. Scapes usually central from bulbs, [slender or] stiff, erect to recurved at the upper parts, terete, angular, [or flattened-winged], with 1- to 3-circular vascular bundles, and solid or hollow in cross-section. Inflorescences terminal, usually an umbel, sometimes replaced totally or partially by bulbils, wholly enclosed by a scarious spathe-like bract before flowering; umbels fascicled to globose; pedicels terete [or rarely angular], thinner [or rarely thicker] than the scapes, equal [to distinctly unequal] in length. Flowers bisexual [or rarely unisexual], regular, actinomorphic; perianth campanulate to stellately spreading, with greenish or reddish mid vein abaxially; tepals 6, in 2 series, usually unequal, connate at base, persistent after flowering; inner ones oblong to ovate, acute to obtuse at apex; outer ones oblong to orbicular, acute to subrounded at apex; stamens 6; filaments adnate to the lower part of tepals, exserted or not, connate and usually dilated at base, entire [or toothed at margin]; anthers 2-locular, longitudinally dehiscent, usually elliptical, yellowish [or reddish]; ovary superior, greenish, [reddish, or brownish], trigonous [or not], sometimes with crest-like (apical) or hood-like (basal) appendages, locules 3, ovules usually 2 per locule, placenta axile; style 1, erect, filiform, exserted or not; stigma conically smooth, [capitate, or rarely trifid]. Fruit capsules, dehiscent, [subglobose], ellipsoid, or cordi-

form, trigonous [or not]. Seeds black, elliptical to circular, flat to circular in cross-section; periclinal walls [smooth], minutely roughened, granulate, or verrucate; anticlinal walls straight, curved [or undulated]. Basic chromosome numbers $x = 7, 8, [or 9]$.

REMARKS: In this revision of the CCP *Allium* five species are recognized, namely: *A. schoenoprasum*, *A. geyeri* var. *tenerum*, *A. textile*, *A. cernuum*, and *A. stellatum* (Table 1).

We believe that the existing records of *A. geyeri* var. *geyeri* in the CPP are the result of misidentification of herbarium specimens, the identity of which we have verified to be *A. textile*. Therefore, despite the fact that *A. geyeri* var. *geyeri* is listed as S1 (five or fewer occurrences and particularly vulnerable to extinction) in Saskatchewan (Harms 2003) and as S2 (6–20 occurrences) in Alberta (Kershaw et al. 2001), we propose the exclusion of this species from the rare list in these provinces and thus from the Canadian flora. The records of *Allium* in the Alberta and Saskatchewan Conservation Data centres further support the removal of *A. geyeri* var. *geyeri* from the Canadian Flora.

Allium tricoccum is also excluded from this taxonomic study because there is no substantial evidence of its present occurrence in Manitoba, where it was previously reported. Currently, only one specimen of *A. tricoccum* (DAO 157082), a collection by W.R. Leslie in 1923 from Morden, about 60 miles southwest of Winnipeg, exists on record

(Scoggan 1957). However, Lowe (1943) does not mention *A. tricoccum* in his list of Manitoba plants, nor does Marshall (1989) in the Pembina Hills flora. We deduce that the only voucher specimen may have come from a cultivated plant (annotated by W.G. Dore in 1971). There is always the possibility that the specimen was collected from plant-

ings at the Agriculture Canada Research Station in Morden. The range of *A. tricoccum* extends to northeastern North Dakota (McNeal and Jacobsen 2002), so there is a faint possibility that it might be found in the Pembina Hills area (E. Punter (WIN), personal communication, 2010).

Key to the species of the Canadian prairie provinces

- 1a Leaf blades terete, with two rows of vascular bundles and hollow in cross-section, epidermal cells linear; scapes hollow in cross-section; tepals 10–15 mm long; ovary ellipsoid, with hood-like appendages at base; capsules ellipsoid; seeds elliptical, angular in cross-section. *A. schoenoprasum*
- 1b Leaf blades flat, channelled, semiterete, or V-shaped, with one row of vascular bundles and solid in cross-section, epidermal cells rectangular to linear; scapes solid in cross-section; tepals 3.8–8.8 mm long; ovary subglobose, without appendages or with crest-like appendage at apex; capsules cordiform; seeds oval to broadly oval, semiterete in cross-section. 2
- 2a Rhizomes nearly obsolete, erect, 0.5–2.7 mm long; tunicas of bulbs fibrous, reticulate; outer filaments non-exserted; styles non-exserted; seeds broadly oval. 3
- 2b Rhizomes condensed, oblique, 2–7.7 mm long; tunicas of bulbs membranous, smooth; outer filaments exerted, seeds oval 4
- 3a Leaves usually 3 or 4; umbels with 8–20 bulbils; perianth pink to white; ovary with crest-like appendages at apex; seed testa with verrucate periclinal cell walls *A. geyeri* var. *tenerum*
- 3b Leaves usually 2; umbels without bulbils; perianth white; ovary without appendages at apex; seed testa with granulate periclinal cell walls *A. textile*
- 4a Leaf blades nearly flat in cross-section; scapes recurved at the upper parts before and after anthesis; perianth campanulate (tepals erect), pink to white, with greenish midveins, inner tepals ovate, 5–6.7 mm × 3–4.3 mm; outer tepals oval to orbicular, subrounded at apex, 3.8–4.8 mm × 3.1–4.2 mm; inner filaments exerted; seed testa with verrucate or rarely minutely roughened periclinal cell walls *A. cernuum*
- 4b Leaf blades nearly channelled to V-shaped in cross-section; scapes recurved at the upper parts before anthesis and becoming erect during flowering; perianth stellate (tepals spreading), deep pink, with reddish midveins, inner tepals elliptical-lanceolate, 7.2–7.7 mm × 2.3–3.5 mm; outer tepals elliptical, acute at apex, 6–6.2 mm × 2.8–3 mm; inner filaments non-exserted; seed testa with minutely roughened periclinal cell walls *A. stellatum*

Allium schoenoprasum L., Sp. Pl. 1: 301 (1753)

LECTOTYPE: Siberia and the Baltic Region. *LINN 419.37* (LINN photo!).

= *A. sibiricum* L., Mant. Pl. Altera: 562 (1771).

LECTOTYPE: Siberia *LINN 419.38* (LINN photo!).

= *A. schoenoprasum* L. var. *lautentianum* Fernald, Rhodora 28: 167 (1926).

HOLOTYPE: Canada, Newfoundland & Labrador, St. John's Island, St. John's Bay: in clay mixed limestone gravel, barren. 31 July 1925, *M.L. Fernald et al. 27824* (?; Isotype: NY photo!).

ILLUSTRATION: Figure 3.

DESCRIPTION: Rhizomes condensed, distinctly oblique, 5–10 mm long. Bulbs cylindrically conical, 7–15 mm in diameter; tunicas papery, smooth, dark brown. Leaves 1 or 2; leaf sheaths 7–20 cm high; leaf blades terete, with two rows of vascular bundles and hollow in cross-section, acuminate at apex, 15–40 cm × 2–9 mm; epidermal cells linear, with centrally ridged cuticles. Scapes erect before and after flowering, terete, with 2-circular vascular bundles and hollow in cross-section, 12–50 cm × 2–8 mm. Umbels subglobose, 20–35 mm × 25–40 mm, without bulbils, 16–80 flowered; pedicels 5–10 mm long; bracts 11–20 mm long. Perianth

campanulate, reddish pink, with reddish midveins, inner tepals nearly equal to outer ones, oblong-lanceolate, acute at apex, 11–15 mm × 2.5–3.5 mm; outer tepals oblong-lanceolate, acute at apex, 10–15 mm × 2.7–3.5 mm; filaments non-exserted, 3.7–7 mm long; anthers 1.3–1.5 mm long; ovary ellipsoid, with hood-like appendages at base, 2.3–2.8 mm × 1.8–2.4 mm; style non-exserted. Capsules ellipsoid, 4.1–4.3 mm × 3.2–3.5 mm. Seeds elliptical, angular in cross-section, 3.3–3.6 mm × 1.5–1.8 mm; periclinal testa cell walls granulate.

CHROMOSOME NUMBER: $2n = 16$ (Chinnappa and Basappa 1986; McNeal and Jacobsen 2002).

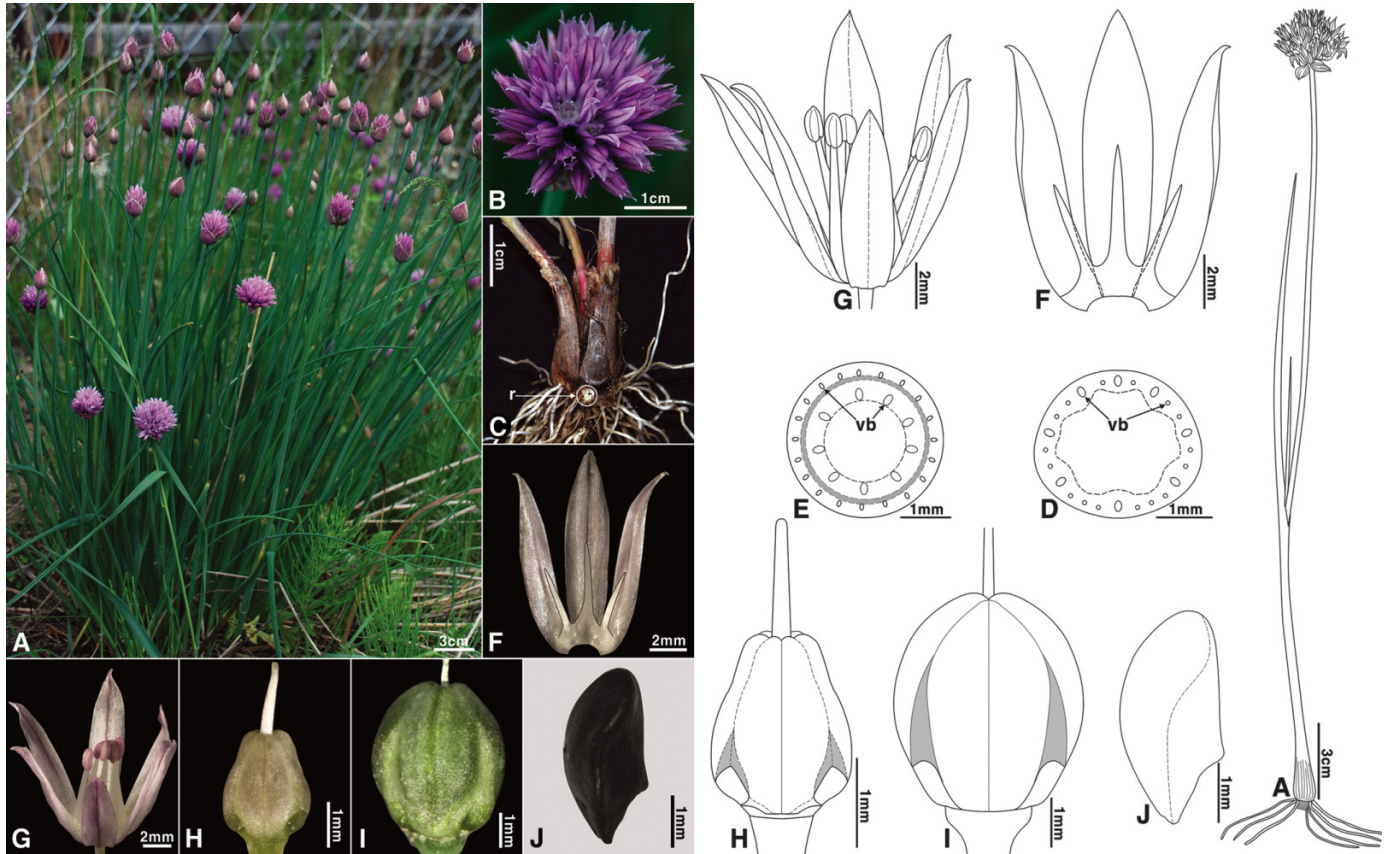
DISTRIBUTION: Europe, Asia, and North America.

CANADIAN PRAIRIE PROVINCES: Wet meadows, rocky or gravelly mountain slopes, stream banks, and lake shores of Alberta, Saskatchewan, and Manitoba (Fig. 2A).

PHENOLOGY: Flowering from June to August.

REMARKS: Owing to the difficulty in separating native populations from those that appear to have escaped from cultivation, McNeal and Jacobsen (2002) were not able to accurately map the distribution of this native species. In this revision and according to voucher specimens, we propose a distribution including boreal areas, mountainous regions, and

Fig. 3. *Allium schoenoprasum* [H.J. Choi-sk-4 (SASK)]. (A) Habit, (B) inflorescence, (C) underground structure (r, rhizome), (D) shape of leaf in cross-section (vb, vascular bundles), (E) shape of scape in cross-section (dark area, fiber), (F) tepal and filament arrangement, (G) perianth, (H) pistil (dark area, hood-like appendage), (I) capsule (dark area, hood-like appendage), (J) seed.



Taiga Shield of the CPP, except the central and southern-most areas of the prairies (Fig. 2A).

CONSERVATION STATUS: This species has been listed as a rare plant in Saskatchewan. It is ranked as S2 by the Saskatchewan Conservation Data Centre (SCDC) (2009). Harms (2003) includes it in the threatened (THR) category, which indicates an imperilled species likely to become endangered due to its rarity. Our distribution map confirms the rare status of this species as evidenced by the existence of few collections in Saskatchewan and Manitoba, with five and four localities, respectively (Fig. 2A). To our knowledge, there is no designation record about this plant's rarity status in Manitoba. We recommend a more thorough survey to evaluate its distribution and demography to accurately determine the rarity category of this species.

Allium geyeri S. Watson var. *tenerum* M.E. Jones, Contr. W. Bot. 10: 28 (1902)

LECTOTYPE (DESIGNATED HERE): United States: Idaho, Washington. 15 July 1899. M.E. Jones 6597 (MO photo!; isolectotype: NY photo!).

ILLUSTRATION: Figures 4B–4F.

DESCRIPTION: Rhizomes nearly obsolete, erect, 1.2–2.7 mm long. Bulbs ovoid, 7–15 mm in diameter; tunics fibrous, reticulate, gray to light brown. Leaves 3–5; leaf sheaths 5–13 cm high; leaf blades flat to adaxially channelled, with one row of vascular bundles and solid in cross-section, ob-

tuse at apex, 12–25 cm × 2–4 mm. Scapes curved before anthesis and becoming erect in flowering, terete, with 2-circular vascular bundles and solid in cross-section, 15–50 cm × 1.5–3.1 mm. Umbels hemispheric to globose, 15–22 mm × 18.4–26 mm, 5–13 flowered, flowers mostly replaced by 8–20 bulbils; pedicels 5–17 mm long; bracts 7–11 mm long. Perianth campanulate to urceolate, pink to white, with reddish midveins, inner tepals narrower than outer ones, oblong to lanceolate, acute to obtuse at apex, 8–8.5 mm × 2–2.5 mm; outer tepals oblong to lanceolate, acute to obtuse at apex, 7.5–8.5 mm × 2.5–3.5 mm; filaments non-exserted, 6–8.3 mm long; anthers 1.1–1.5 mm long; ovary subglobose, with crest-like appendages at apex, 2.3–3.1 mm × 2–3 mm; style non-exserted. Capsules cordiform. Seeds broadly oval, semicircular in cross-section; periclinal testa cell walls verrucate (Fig. 19 of Kruse 1988).

CHROMOSOME NUMBER: $2n = 28, 35, 42$ (McNeal and Jacobsen 2002).

DISTRIBUTION: North America.

CANADIAN PRAIRIE PROVINCES: Meadows and damp places along streams in mountainous areas of southwesternmost Alberta (Fig. 2D).

PHENOLOGY: Flowering from June to July.

CONSERVATION STATUS: This variety has been listed as S2 together with var. *geyeri* in Alberta (Kershaw et al. 2001). Although field population studies are lacking, herbarium records indicate that *A. geyeri* var. *tenerum* is the rarest *Allium*

Fig. 4. *Allium geveryi*. (A) *A. geveryi* var. *geveryi* [V. Komarkova s.n. (SASK 48385) from Colorado, USA] (number beside the images represents the leaf count for that individual), (B–F) *A. geveryi* var. *tenerum* [J. Looman 22960 (SASK 123070)]: (B) habit, (C) inflorescence (b, bulbil; r, bract), (D) outer tunica of bulb, (E) tepal and filament arrangement, (F) pistil (dark area, crest-like appendage).



species in the CPP. Its distribution is restricted to the Waterton Lakes National Park areas of Alberta (Fig. 2D). The rarity of this taxon in Canada may be correlated with this species being at its northernmost range limits, as it is a relatively common species in the US (McNeal and Jacobsen 2002). Regardless of this distributional pattern, proactive research (such as population monitoring) should be implemented to protect this species in Canada in an effort to understand the geographic range limits of the Canadian population, which is a key issue in conservation biology.

Allium textile A. Nelson & J.F. Macbride, Bot. Gaz. 56: 470 (1913)

HOLOTYPE: United States: banks of the Missouri. Collected by Nuttall. Plate No. 1840 (Bot. Mag. 43, 1815!).

≡ *A. geveryi* S. Watson var. *textile* (A. Nelson & J.F. Macbride) B. Boivin, Naturaliste Canad. 94: 521 (1967).

= *A. aridum* Rydb., Fl. Rocky Mts. 159: 1061 (1917).

HOLOTYPE: United States: Wyoming, Green River. 25 June 1895. *P.A. Rydberg 2605* (NY; isotype: NY photo!).

ILLUSTRATION: Figure 5.

DESCRIPTION: Rhizomes nearly obsolete, erect, 0.5–2.3 mm long. Bulbs ovoid, 7–25 mm in diameter; tunics fibrous, gray to light brown. Leaves 2–4; leaf sheaths 3.5–10 cm high; leaf blades adaxially channelled to semiterete, with one row of vascular bundles and solid in cross-section,

acuminate to acute at apex, 8–20 cm × 1–3 mm; epidermal cells rectangular to linear, with smooth cuticles. Scapes curved before anthesis and becoming erect in flowering, terete, with 2-circular vascular bundles and solid in cross-section, 10–37 cm × 0.8–3 mm. Umbels subsfasciated to hemispheric, 12–42 mm × 18–55 mm, without bulbils, 7–41 flowered; pedicels 4–20 mm long; bracts 7.5–16 mm long. Perianth campanulate to urceolate, white, with reddish midveins, inner tepals narrower than outer ones, oblong, obtuse at apex, 4.5–8.8 mm × 2–2.8 mm; outer tepals broadly ovate to lanceolate, acute to obtuse at apex, 4–7.8 mm × 2.5–3.9 mm; filaments non-exserted, 2.7–5.3 mm long; anthers 0.9–1.5 mm long; ovary subglobose, without appendages, 1.3–2 mm × 1.4–1.9 mm; style non-exserted. Capsules cordiform, 3.5–4.6 mm × 3.6–5.2 mm. Seeds broadly oval, semicircular in cross-section, 2.5–3 mm × 1.8–2.1 mm; periclinal testa cell walls granulate.

CHROMOSOME NUMBER: $2n = 14, 28$ (Chinnappa and Basappa 1986; McNeal and Jacobsen 2002).

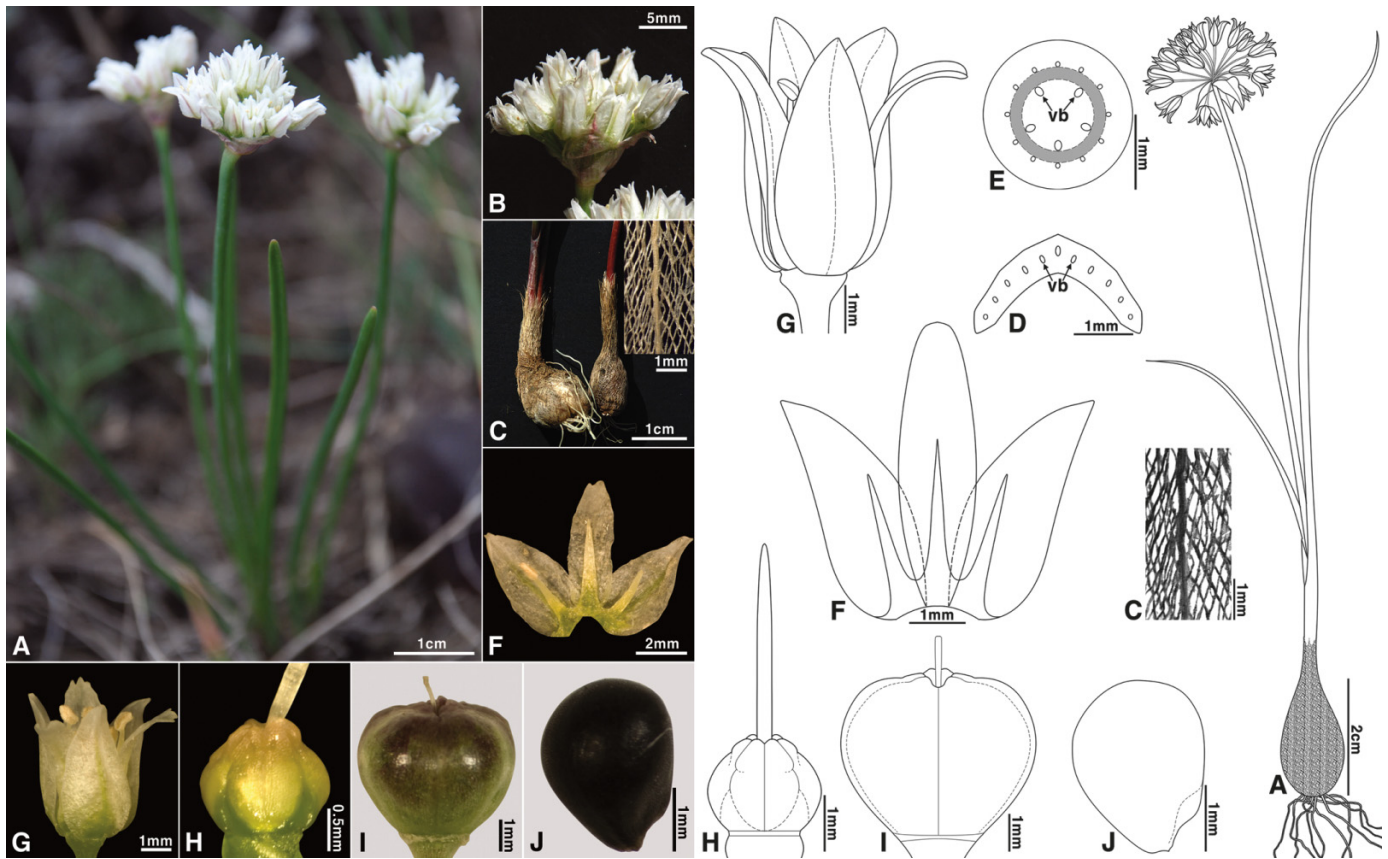
DISTRIBUTION: North America.

CANADIAN PRAIRIE PROVINCES: Dry grasslands, hills, and riversides of Alberta, Saskatchewan, and Manitoba (Fig. 2B).

PHENOLOGY: Flowering from May to July.

REMARKS: *Allium textile*, the most widespread species of the genus in the CPP (Fig. 2B), exhibits extreme variability in plant length, leaf number, and floral size. Although the leaves are in general two, some specimens may have three

Fig. 5. *Allium textile* [*H.J. Choi-sk-1* (SASK)]. (A) Habit, (B) inflorescence, (C) underground structure and outer tunica of bulb, (D) shape of leaf in cross-section (vb, vascular bundles), (E) shape of scape in cross-section (dark area, fiber), (F) tepal and filament arrangement, (G) perianth, (H) pistil, (I) capsule, (J) seed.



or four leaves (Table 3). Based on field observations, we noted that individuals with three or four leaves (*H.J. Choi-sk-2*) tend to develop a longer perianth than those individuals with two leaves (*H.J. Choi-sk-1*). Specimens of *A. textile* with more than three leaves have been misidentified as *A. geyeri* var. *geyeri* in various Canadian herbaria, but the former is easily distinguished from the related *A. geyeri* var. *geyeri* by its white perianth (as opposed to pink to white) and absence of crest-like ovarian appendage (as opposed to distinct appendages), as well as a longer pedicel and shorter scape (Tables 2 and 3; Figs. 4A and 5). Similarly, the type specimen of *A. geyeri* var. *geyeri* from the Rocky Mountains filed at NY (G. Vasey *s.n.*, isosytype) shows several differences from the Canadian (Alberta and Saskatchewan) specimens labeled “*A. geyeri* var. *geyeri*”, especially in inflorescence size and perianth colour. Moreover, *A. textile* is easily distinguished from *A. geyeri* because the former has granulate seed testa cell walls without verrucae (Figs. 1J and 1N), while the latter is known to have verrucate walls (Fig. 19 of Kruse 1988; McNeal and Jacobsen 2002).

Allium cernuum Roth, Arch. Bot. (Leipzig) 1: 40 (1798)

NEOTYPE: (T.D. Jacobsen 1980, p. 151) Canada. In rocky meadow, 0.62 km east of Elko, British Columbia. 2 July 1941, W.A. Weber 2248 (WS; isoneotype: GH, UC, MO, WTU, NY photo!).

= *A. allegheniense* Small, Bull. New York Bot. Gard. 1: 279–280 (1899).

SYNTYPE: United States: Georgia, White Co., Yonah Mountain, alt. 2000–3025 ft. a.s.l. (1 foot = 0.3048 m) 4 September 1894. J.K. Small *s.n.* (NY photo!); North Carolina, Watauga Co., in the vicinity of Blowing Rock, 18 August 1890, A.A. Heller 168 (NY photo!); North Carolina, Caldwell Co., east of Blowing Rock, alt. 3500–4000 ft. a.s.l. 24 August 1893, A.A. Heller *s.n.* (NY photo!).

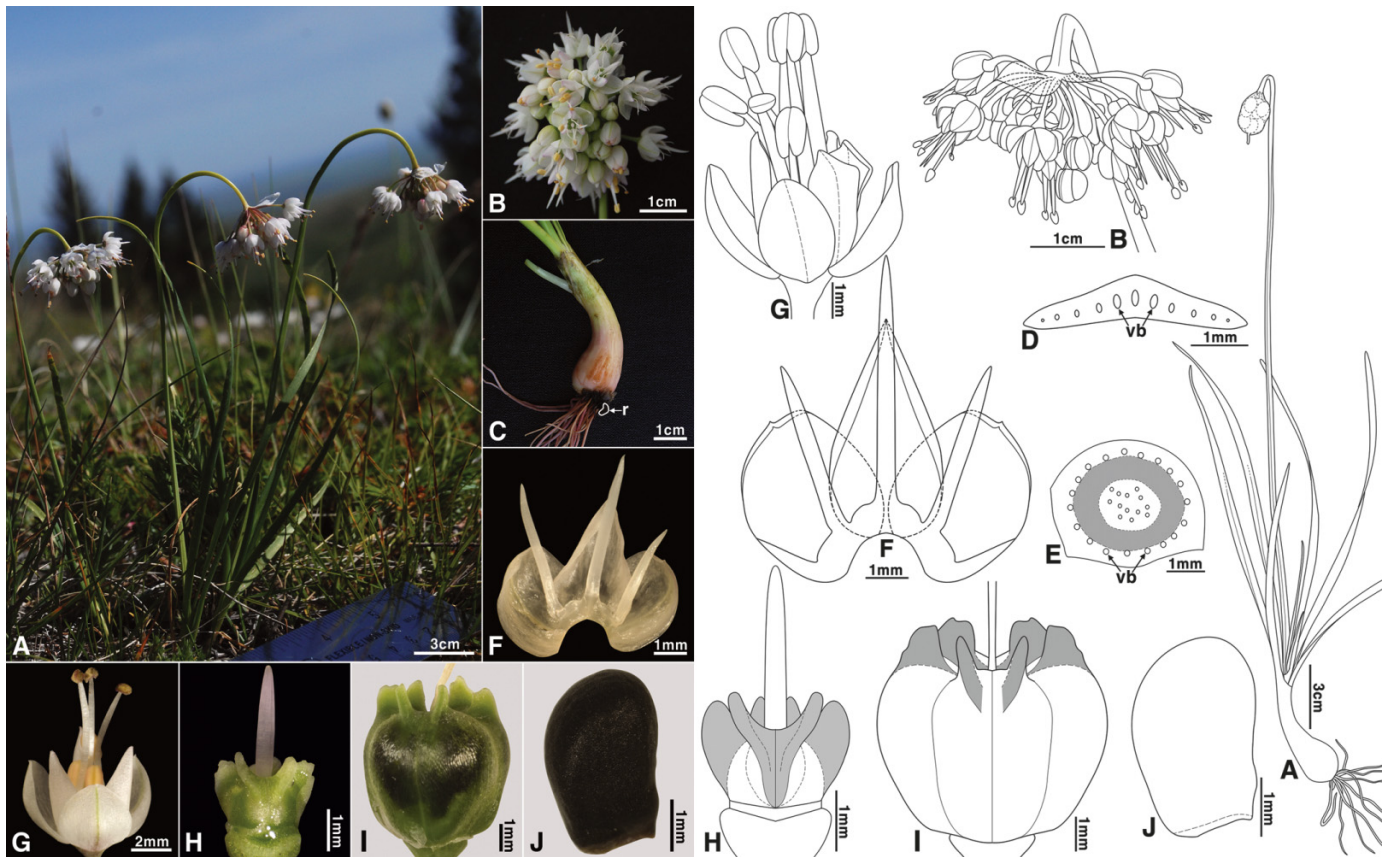
= *A. recurvatum* Rydb., Mem. New York Bot. Gard. 1: 94 (1900).

HOLOTYPE: United States: Montana, mountain near Indian Creek, alt. 8000 ft. a.s.l. 2 July 1897, P.A. Rydberg & E.A. Bessey 3850 (NY photo!).

ILLUSTRATION: Figure 6.

DESCRIPTION: Rhizomes condensed, oblique, 2–7.7 mm long. Bulbs ovoid, 8.3–22 mm in diameter; tunicas membranous, smooth, gray to brown. Leaves 3–7; leaf sheaths 3–10 cm high; leaf blades nearly flat, with one row of vascular bundles and solid in cross-section, acuminate to obtuse at apex, 5–27.5 cm × 1.2–8 mm; epidermal cells rectangular to linear, with smooth cuticles. Scapes recurved at the upper parts before and after anthesis, terete to angular, with 2- to 3-circular vascular bundles and solid in cross-section, 13.5–48 cm × 1.1–4 mm. Umbels hemispheric to globose, 17–42 mm × 21–46.3 mm, without bulbils, 12–42 flowered; pedicels 6–20 mm long; bracts 9–13.5 mm long. Perianth campanulate, pink to white, with greenish midveins, inner tepals unequal to outer ones, ovate, acute at apex, 5–6 mm × 3–4.3 mm; outer tepals oval to orbicular, sub-

Fig. 6. *Allium cernuum* [H.J. Choi-sk-10 (SASK)]. (A) Habit, (B) inflorescence, (C) underground structure (r, rhizome), (D) shape of leaf in cross-section (vb, vascular bundles), (E) shape of scape in cross-section (dark area, fiber), (F) tepal and filament arrangement, (G) perianth, (H) pistil (dark area, crest-like appendage), (I) capsule (dark area, crest-like appendage), (J) seed.



rounded at apex, 3.8–4.8 mm × 3.1–4.2 mm; filaments exerted, 3.5–9 mm long; anthers 1.8–2 mm long; ovary subglobose, with crest-like appendages at apex, 2.2–3 mm × 2.4–3 mm; style exerted. Capsules cordiform, 3.8–6.5 mm × 4.3–6.5 mm. Seeds oval, semicircular in cross-section, 2.5–3.8 mm × 2–2.4 mm; periclinal testa cell walls verrucate or very rarely minutely roughened.

CHROMOSOME NUMBER: $2n = 14$ (Chinnappa and Basappa 1986; McNeal and Jacobsen 2002).

DISTRIBUTION: North America.

CANADIAN PRAIRIE PROVINCES: Dry hills and arid slopes of Alberta and Saskatchewan (Fig. 2C).

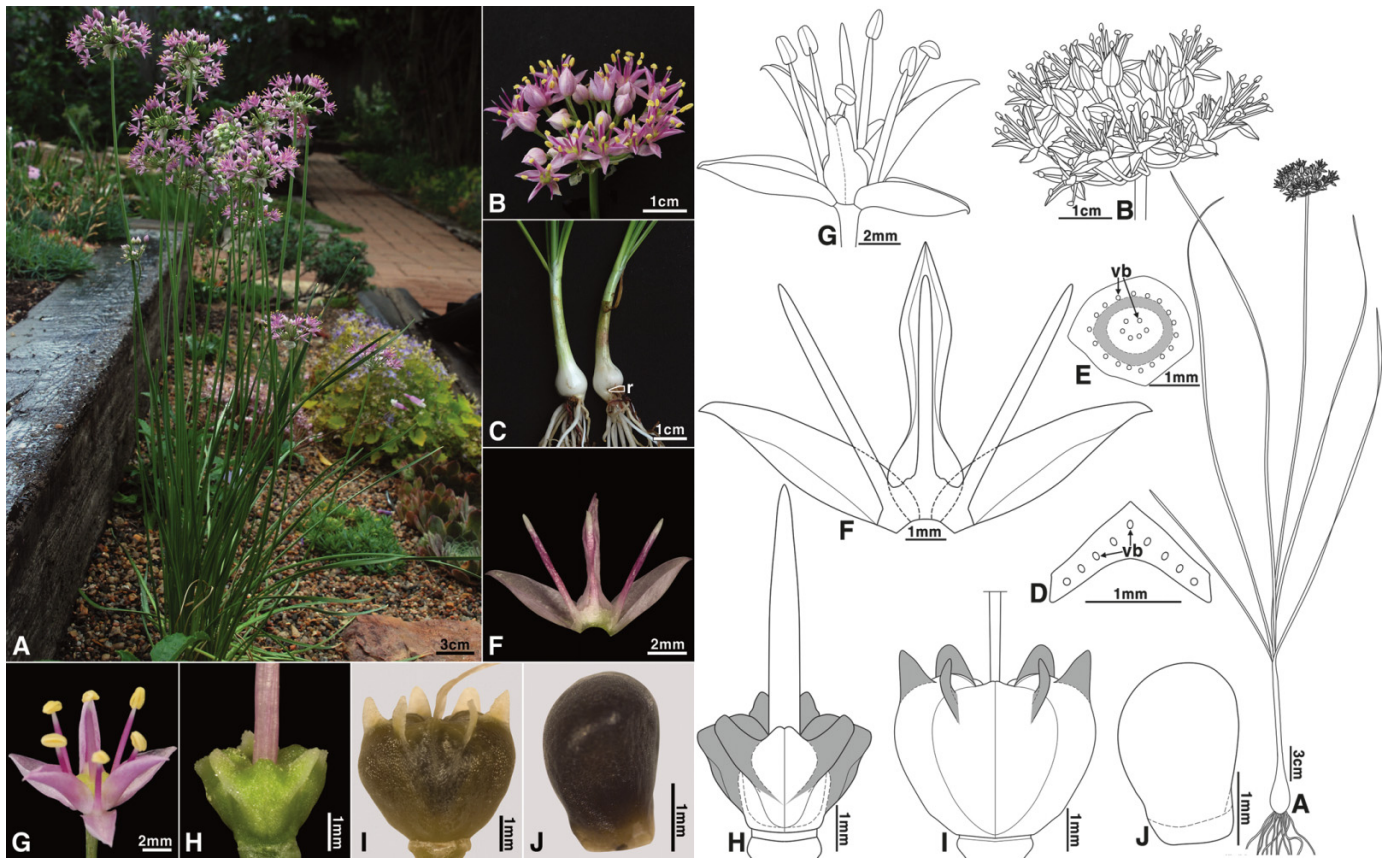
PHENOLOGY: Flowering from June to August.

REMARKS: Taxonomically, *A. cernuum* is closely related to *A. stellatum* (McNeal and Jacobsen 2002). The character most commonly used to differentiate these two species is the orientation of the umbel-shaped inflorescence. In both species, the inflorescence may often be nodding (recurved) in the budding stage, but in *A. stellatum* the inflorescence usually becomes erect during anthesis (Figs. 7A and 7B). In *A. cernuum*, the scape remains permanently curved near the apex (Figs. 6A and 6B), but sometimes the inflorescence may become erect or nearly so (McNeal and Jacobsen 2002; Choi and Cota-Sánchez 2009). In addition, the perianth shape in *A. cernuum* is campanulate with ascending tepals (Table 2; Fig. 6G), while in *A. stellatum* it is stellate

with apically spreading tepals (Fig. 7G). Also *A. cernuum* differs from *A. stellatum* in having verrucate seed testa periclinal cell walls (Figs. 1K, 1L, 1O, and 1P).

CONSERVATION STATUS: Despite being one of the most widespread North American species of the genus (McNeal and Jacobsen 2002), *A. cernuum* is quite rare in Saskatchewan and is ranked as S1S2 by the SCDC. Similarly, Harms (2003) includes it in the vulnerable (VUL) category, which indicates a species at risk because of the declining numbers and typically found in 16 to 25 sites, which are reasons for special concern. Various populations of *A. cernuum* have been reported in two localities of Saskatchewan, one in the Meadow Lake area (central-western Saskatchewan) and another one in the Cypress Hills region (southwestern Saskatchewan) (Fig. 2C). We found a population of this species in the latter locality in July 2009 (Fig. 6), located near roads and margin of cliffs at an altitude of ca. 1300 m a.s.l. growing together with *Apocynum androsaemifolium* L., *Campanula rotundifolia* L., *Eriogonum flavum* Nutt., *Monarda fistulosa* L., and *Potentilla fruticosa* L. (Choi and Cota-Sánchez 2009). Contrary to McNeal and Jacobsen (2002), who indicate that *A. cernuum* prefers moist soils in mountainous and cool regions, the southwestern Saskatchewan population of *A. cernuum* occurs on dry, gravelly to sandy soils. Field data and label specimens indicate that the flowering period of this population occurs from the second week of July to

Fig. 7. *Allium stellatum* [H.J. Choi-sk-12 (SASK)]. (A) Habit, (B) inflorescence, (C) underground structure (r, rhizome), (D) shape of leaf in cross-section (vb, vascular bundles), (E) shape of scape in cross-section (dark area, fiber), (F) tepal and filament arrangement, (G) perianth, (H) pistil (dark area, crest-like appendage), (I) capsule (dark area, crest-like appendage), (J) seed.



the first week of August (although 2009 may have been a somewhat atypical year for phenotypic observations, V. Harms, University of Saskatchewan, personal communication, 2010). In terms of population size and number of individuals, our estimate in southwestern Saskatchewan is about 300 individuals, distributed in an area of ca. 0.5 ha. In some areas it was locally abundant, to the extent that it formed an herbaceous mat.

According to herbarium records from 1949 and 1950 at SASK, *A. cernuum* has been collected at Meadow Lake, Alcott Creek, and two other nearby areas in the central-western portion of the province. Nonetheless, the original fescue prairie habitat indicated in label specimens no longer exists, especially in areas near roads. In addition, the recent clearing of the original vegetation and the prevailing habitat in Alcott Creek and surrounding areas, which are quite swampy and unsuitable for *A. cernuum* to grow, have apparently played a major role in the perceptible waning of this population (K. Remarchuk, University of Saskatchewan, personal communication, 2010). Conversely, during our summer 2009 visit to the Central Block locality of the Cypress Hills population, we found only two individuals. It is likely that the low population number of *A. cernuum* in the Central Block is due to ecological factors affecting the reproductive rate. Although more fieldwork is necessary to have an accurate assessment of the current populations, some inferences can be made with

these data and observations. Foremost, it appears that the general Meadow Lake area population have vanished, at least from the most accessible areas, primarily because of human activities, which suggests the need for the enforcement of better conservation practices in the preservation of species at risk. Our data for the southwestern population are encouraging in terms of population demographic number, suggesting that this species might not be well categorized within the S1S2 rank as indicated by the SCDC and Harms' VUL status may be more appropriate as this species is locally abundant. However, considering that the existence of the Meadow Lake population is questionable, and only a couple of individuals were recorded in the Cypress Hill, we recommend maintaining the rank of this species as S1S2 until wide-ranging surveys are conducted in these two localities.

Allium stellatum Ker Gawler, Bot. Mag. 38: 1576 (1813)

HOLOTYPE: United States: banks of the Missouri. Collected by Nuttall. The drawing was taken from an imported specimen that bloomed at Fraser's nursery, in Sloane-Square, in late June. Plate No. 1576 (Bot. Mag. 37–38, 1813!).

ILLUSTRATION: Figure 7.

DESCRIPTION: Rhizomes condensed, oblique, 2–7 mm long. Bulbs ovoid, 8–17.7 mm in diameter; tunicas membranous, smooth, gray to brown. Leaves 3–7; leaf sheaths 5–11 cm high; leaf blades channelled to V-shaped, with one row of

vascular bundles and solid in cross-section, acuminate to acute at apex, 15–36 cm × 1–3.6 mm; epidermal cells rectangular to linear, with centrally ridged cuticles. Scapes usually recurved at the upper parts before anthesis and becoming erect in flowering, terete to dully angular, with 2- to 3-circular vascular bundles and solid in cross-section, 25–62 cm × 1.3–2.8 mm. Umbels subfascicled to hemispheric, 16–34 mm × 24–48.2 mm, without bulbils, 10–54 flowered; pedicels 8.5–20.2 mm long; bracts 9.3–19.7 mm long. Perianth stellate, deep pink, with reddish midveins, inner tepals unequal to outer ones, elliptical-lanceolate, acute at apex, 7.2–7.7 mm × 2.3–3.5 mm; outer tepals elliptical, acute at apex, 6–6.2 mm × 2.8–3 mm; filaments exerted (outer) or not (inner), 7–7.5 mm long; anthers 2–2.4 mm long; ovary subglobose, with crest-like appendages at apex, 2.7–3.2 mm × 3–4 mm; style exerted. Capsules cordiform, 4–5 mm × 4.1–5 mm. Seeds oval, semicircular in cross-section, 2.5–3.3 mm × 1.5–2.2 mm; periclinal testa cell walls minutely roughened.

CHROMOSOME NUMBER: $2n = 14$ (McNeal and Jacobsen 2002).

DISTRIBUTION: North America.

CANADIAN PRAIRIE PROVINCES: Open plains and wooded areas of Saskatchewan and Manitoba (Fig. 2D).

PHENOLOGY: Flowering from July to September.

REMARKS: This species is widely distributed and relatively common in the prairie and adjacent boreal plains of south-eastern Saskatchewan and southern Manitoba. Its closely related species, *A. cernuum*, occurs allopatrically in the mountainous and boreal shield areas of western Alberta and two isolated parts of Saskatchewan (Figs. 2C and 2D).

Acknowledgements

We are thankful to V. Harms and D. Litwiller for comments on early drafts of the manuscript; C. Peters and D. Peters provided assistance in the mapping process. We also thank E. Punter for helping us to track *A. tricoccum* in Manitoba, the curators of ALTA, DAO, LINN, MO, NY, SASK, and WIN for lending material for study, and to SASK personnel for their assistance and for facilitating the loan of material. This research was partially supported by the Canada Foundation for Innovation, the Flora of Saskatchewan Association, the Korea National Arboretum, and the Museums Assistance Program.

References

- Acton, D.F., Padbury, G.A., and Stushnoff, C.T. 1998. The ecoregions of Saskatchewan. Hignell Printing Limited, Winnipeg, Man.
- Barnston, J. 1859. Geographical distribution of genus *Allium* in British North America. *Can. Nat. Geol.* **4**: 116–121.
- Bentham, G., and Hooker, J.D. 1883. *Ordo CLXXVIII Liliaceae. In Genera Plantarum. Vol. 3. Edited by G. Bentham and J.D. Hooker.* Lovell Reeve & Co., London, UK. pp. 748–804.
- Chinnappa, C.C., and Basappa, G.P. 1986. Cytology of some western Canadian *Allium* species. *Am. J. Bot.* **73**(4): 529–534. doi:10.2307/2444258.
- Choi, H.J. 2009. Systematics of the genus *Allium* (Alliaceae) in Korea and northeastern China. Ph.D. thesis, Department of Biology, The Chungbuk National University, Cheongju, Chungbuk, Korea.
- Choi, H.J., and Cota-Sánchez, J.H. 2009. Nodding onion (*Allium cernuum*), a rare plant in Saskatchewan. *Blue Jay*, **67**(4): 249–252.
- Choi, H.J., Jang, C.G., Ko, S.C., and Oh, B.U. 2004. Leaf epidermal structure of the *Allium* L. and its taxonomic significance. *Korean J. Plant Taxonomy*, **34**(2): 97–118.
- Choi, H.J., Jang, C.G., Lee, Y.M., and Oh, B.U. 2007. A taxonomic study of Korean *Allium* L. based on morphological characters. *Korean J. Plant Taxonomy*, **37**(3): 275–308.
- Dahlgren, R.M.T., Clifford, H.T., and Yeo, F.T. 1985. *The Families of the Monocotyledons.* Springer-Verlag, Berlin, Germany.
- Friesen, N., Fritsch, R.M., Pollner, S., and Blattner, F.R. 2000. Molecular and morphological evidence for an origin of the aberrant genus *Milula* within Himalayan species of *Allium* (Alliaceae). *Mol. Phylogenet. Evol.* **17**(2): 209–218. doi:10.1006/mpev.2000.0844. PMID:11083935.
- Friesen, N., Fritsch, R.M., and Blattner, F.R. 2006. Phylogeny and new intrageneric classification of *Allium* (Alliaceae) based on nuclear ribosomal DNA ITS sequences. *Aliso*, **22**: 372–395.
- Fritsch, R.M. 1992. Sepal nectarines in the genus *Allium*. The genus *Allium* — taxonomic problems and genetic resources. *In Proceedings of an International Symposium, Gatersleben, Germany, 11–13 June 1991. Edited by P. Hanelt, K. Hammer, and H. Knupffer.* Gatersleben, Germany. pp. 77–85.
- Fritsch, R.M., and Keusgen, M. 2006. Occurrence and taxonomic significance of cysteine sulphoxides in the genus *Allium* L. (Alliaceae). *Phytochemistry*, **67**(11): 1127–1135. doi:10.1016/j.phytochem.2006.03.006. PMID:16626766.
- Fritsch, R.M., Kruse, J., Adler, K., and Rutten, T. 2006. Testa sculptures in *Allium* L. subg. *Melanocrommyum* (Webb & Berth.) Rouy (Alliaceae). *Feddes Repert.* **117**(3-4): 250–263. doi:10.1002/fedr.200611094.
- Fung, K.I. 1999. *Atlas of Saskatchewan.* PrintWest, Saskatoon, Sask.
- Gregory, M., Fritsch, R.M., Friesen, N., Khassanov, F.O., and McNeal, D.W. 1998. *Nomenclator Alliorum: Allium names and synonyms—a world guide.* Royal Botanic Gardens, Kew, Richmond, Surrey, UK.
- Gurushidze, M., Fritsch, R.M., and Blattner, F.R. 2008. Phylogenetic analysis of *Allium* subg. *Melanocrommyum* infers cryptic species and demands a new sectional classification. *Mol. Phylogenet. Evol.* **49**(3): 997–1007. doi:10.1016/j.ympev.2008.09.003.
- Hanelt, P., Schulze-Motel, J., Fritsch, R.M., Kruse, J., Maass, H., Ohle, H., and Pistrick, K. 1992. Infrageneric grouping of *Allium* - the Gatersleben approach. *The Genus Allium – Taxonomic Problems and Genetic Resources. In Proceedings of an International Symposium, Gatersleben, Germany, 11–13 June 1991. Edited by P. Hanelt, K. Hammer, and H. Knupffer.* Gatersleben, Germany. pp. 107–123.
- Harms, V.L. 2003. Checklist of the vascular plants of Saskatchewan and the provincially and nationally rare native plants of Saskatchewan. University Extension Press, University of Saskatchewan, Saskatoon, Sask.
- Jacobsen, T.D. 1980. The neotypification of *Allium cernuum* Roth (Liliaceae). *Taxon*, **29**: 150–151.
- Kershaw, L., Gould, J., Johnson, D., and Lancaster, J. 2001. *Rare vascular plants of Alberta.* The University of Alberta Press and the Canadian Forest Service, Alberta.
- Ko, E.M., Choi, H.J., and Oh, B.U. 2009. A cytotoxic study of *Allium* (Alliaceae) sect. *Sacculiferum* in Korea. *Korean J. Plant Taxonomy*, **39**(3): 170–180.
- Kruse, J. 1988. Rasterelektronenmikroskopische untersuchungen an

- samen der gattung *Allium* L. III. Kulturpflanze, **36**(3): 355–368. doi:10.1007/BF02034817.
- Kruse, J. 1992. Variability of testa sculptures in the genus *Allium* L. The genus *Allium* — taxonomic problems and genetic resources. In Proceedings of an International Symposium, Gatersleben, Germany, 11–13 June 1991. Edited by P. Hanelt, K. Hammer and H. Knupffer Gatersleben, Germany. pp. 181–182.
- Lawrence, G.H.M. 1951. Taxonomy of vascular plants. Macmillan Publishing Co., New York, N.Y.
- Lowe, C.W. 1943. List of the flowering plants, ferns, club mosses, mosses and liverworts of Manitoba. Natural History Society of Manitoba, Winnipeg, Man.
- Marshall, H.H. 1989. Pembina Hills flora. Morden and District Museum (1971). Inc., Morden, Man.
- McNeal, D.W. 1992. Taxonomy of North American species of *Allium*. In The genus *Allium* — taxonomic problems and genetic resources. The Proceedings of an International Symposium, Gatersleben, 11–13 June 1991. Edited by P. Hanelt, K. Hammer, and H. Knupffer Gatersleben. pp. 195–204.
- McNeal, D.W., and Jacobsen, T.D. 2002. *Allium* L. In Flora of North America. Vol. 26. Edited by Editorial Committee of Flora of North America. NYBG Press, New York, N.Y. pp. 224–276.
- Moss, E.H. 1959. *Allium* L. In Flora of Alberta. University of Toronto Press, Toronto, Ont. pp. 178–179.
- Neshati, F., and Fritsch, R.M. 2009. Seed characters and testa sculptures of some Iranian *Allium* L. species (Alliaceae). Feddes Reper. **120**(5-6): 322–332. doi:10.1002/fedr.200911112.
- Nguyen, N.H., Driscoll, H.E., and Specht, C.D. 2008. A molecular phylogeny of the wild onions (*Allium*; Alliaceae) with a focus on the western North American center of diversity. Mol. Phylogenet. Evol. **47**(3): 1157–1172. doi:10.1016/j.ympev.2007.12.006. PMID:18226928.
- Ownbey, M., and Aase, H.C. 1955. Cytotaxonomic studies in *Allium* I. The *Allium canadense* alliance. Res. Stud. State Coll. Wash. **23**(Suppl.): 1–106.
- Pasitschniak-Arts, M., and Messier, F. 1999. Status of small mammals on the prairies: research priorities and implications for conservation. In Provincial Museum of Alberta National History Occasional Paper 24, Proceedings of the 15th Prairie Conservation and Endangered Species Conference, Saskatoon, Sask., 19–22 February 1998. Edited by J. Thorpe, T.A. Steeves, and M. Collop. Curatorial Section Provincial Museum of Alberta, Edmonton, Alta. pp. 32–36.
- Rahn, K. 1998. Alliaceae. In The families and genera of vascular plants. Vol. 3. Edited by K. Kubitzki. Springer-Verlag, Berlin, Germany. pp. 70–76.
- Raven, P.H., and Axelrod, D.I. 1978. Origin and relationships of the Californian flora. Univ. Calif. Publ. Bot. **72**: 1–134.
- Regel, E. 1875. Alliorum adhuc cognitorum monographia. Trudy Imper. S.-Peterburgsk. Bot. Sada, **3**: 1–266.
- Saskatchewan Conservation Data Centre. 2009. Vascular plant species list. Regina, SK. [Online]. Available from www.biodiversity.sk.ca/Docs/ranking.pdf [accessed 19 July 2009].
- Scoggan, H.J. 1957. *Allium* L. In Flora of Manitoba. National Museum of Canada, Ottawa, Ont. pp. 206–207.
- Takhtajan, A. 1997. Diversity and classification of flowering plants. Columbia University Press, New York, N.Y.
- White, D.J., and Johnson, K.L. 1980. The rare vascular plants of Manitoba. Syllogeus, **27**: 1–52.
- Xu, J.-M., and Kamelin, R.V. 2000. *Allium* L. In Flora of China. Vol. 24. Edited by Z.Y. Wu and P.H. Raven. Science Press, Beijing, China, and Missouri Botanical Garden Press, St. Louis, Mo. pp. 165–202.

Appendix A. List of representative specimens examined in this study

The specimens used for quantitative characters are indicated with an asterisk (*).

Allium schoenoprasum L.

CANADA: Alberta, Wood Buffalo National Park, Benchmark Creek, 12 July 1993, A.G. Schwarz 1170 (ALTA 112491*); Police Outpost Provincial Park, 3 July 2000, M.A. McPherson 1-000703 (ALTA 114742*); White Mud Creek, near Edmonton, 23 June 1939, G.H. Turner 1308 (DAO 777439); 2 miles (1 mile = 1.61 km) east on the road to Nanton, 19 July 1966, J. Looman 10444 (SASK 102172*); east of Crypt Lake, 23 July 1970, J. Kuijt et al. 4393 (ALTA 45660*); 7 miles north of Twin Butte, south of Pincher Creek, 17 June 1971, P.J. Scott 1414 (ALTA 27960); 6 miles northwest of Waterton Lakes National Park, 29 July 1950, W.G. Dore & A.J. Breitung 12167 (DAO 777443*); Waterton Lakes National Park, south of Belly River Campground, 13 July 1961, F. Sudol 133 (DAO 777437*); Chief Mountain, 12 July 1967, J. Looman 100678 (SASK 102173*); Waterton Lakes, near lake shore, 23 July 1940, L.T. Carmichael 22 (DAO 777442*); Eagle River near Waterton National Park, 17 June 1982, J. Looman 22959 (SASK 123069*); north of Waterton, 23 June 1930, W.C. McCalla 3582 (ALTA 37195*); 3 miles southwest of Pincher Creek, 11 July 1972, T.D. Allen 212 (DAO 655562); north bank of St. Patrick's Island, Calgary, 28 June 1949, W.C. MaCalla 10428 (ALTA 37198*); 5 miles west of Pincher Creek, 28 July 1939, S.S. Survey 127 (ALTA 4829*); Upper Rowe Lake trail, 29 July 1970, G. Armstrong & J. Nagy 4660 (ALTA 45659*); Castle River region, 6 August 1944, R.G.H. Cormack 599 (ALTA 4830); Carbondale River, 18 July 1944, R.G.H. Cormack 362 (ALTA 4831*); 5 km south of Benalto, 18 July 1975, J. Looman 21220 (SASK 120456*); West Castle, ? September 1982, M. Campbell 12 (WIN 42309*); Sentinel Mountain, 24 July 1967, J. Looman 10944 (SASK 102174); along road to Plateau Mountain, vicinity of Crownsnest forest district, 24 June 1964, B. de Vries 2420-64 (DAO 777435); Plateau Mountain, mountain side just below the 8200 ft (1 foot = 0.3048 m) plateau, 3 August 1959, R.C. Russell S59276 (DAO 777436*); Mountain Portage, 5 July 1992, K. van Pelt 92-51 (SASK 143353*); vicinity of Gorge Creek, RB Miller Biological Station, 29 July 1967, R. McLachlan 239 (ALTA 118736*); south of Exshaw, 2 July 1972, J. Looman 15996 (DAO 227582*); Kananaskis Ski area, 28 June 1974, M. Dumais & R. Kempnisky s.n. (SASK 158545); Snow Creek Pass, about 30 miles north-northwest of Banff, 26 July 1959, T. Mosquin 3448 (DAO 777434*); Banff National Park, vicinity of Mt. Temple Ski Lodge, 7 July 1945, A.E. Porsild & A.J. Breitung s.n. (ALTA 100020*); Faust, Lesser Slave Lake (south shore), 30 June 1929, E.H. Moss 1795 (ALTA 4824); near Lake Louise, Banff National Park, 13 July 1942, W.C. McCalla 7157 (ALTA 37196*); 0.5 miles northwest of Lake Louise road junction along Highway 1, 21 August 1953, J.A. Calder & D.B.O. Savile 12179 (DAO 777966); Ya-Ha-Tinda ranch, Red Deer River Valley, Banff National Park, 5 August 1967, P.W. Stringer s.n. (ALTA 41522); west side of island in the Peace River, 19 September 1977, C. Bradley

s.n. (ALTA 75466*); east side of Maligne Lake, ca. 0.5 miles south of Rainbow Lodge, 6 August 1957, *L. Jenkins 7793* (DAO 777965); Medicine Lake, Jasper National Park, 5 July 1939, *E.H. Moss 4802* (ALTA 4826); Peace River, Dunvegan Provincial Park, 22 July 1947, *E.H. Moss 7467* (ALTA 4828); 4 miles northeast of Beaverlodge, 1 August 1948, *L. Jenkins 601* (DAO 154072*).

Saskatchewan, west shore of Namew Lake, 27 June 1985, *V.L. Harms 34145* (DAO 704949); Amisk Lake, 1 July 1953, *J.H. Hudson 1247* (DAO 7777432*); Golburn, 21 June 1941, *A.J. Breitung 1128* (ALTA 36304); Sucker River Settlement, 20 miles north of La Ronge, 28 July 1979, *Anna Leighton 192* (SASK 74852); Besnard Lake, 21 June 1995, *M.M. Hart 40* (SASK 137564); White Swan Lake, 17 June 1987, *D.R. Shanner 14* (SASK90150); 4 miles east of Uranium City on Black Bay, Lake Athabasca, 1 July 1953, *W. Lahii 2271* (DAO 777433); Lake Athabasca, 12 July 1982, *R. Wright & J.S. Rowe 2C* (SASK 78750*); Candle Lake, 24 June 2009, *H.J. Choi-sk-4* (SASK*).

Manitoba, Schist Lake, ? June 1952, *N.J. Freedman s.n.* (WIN 7725*); Gods Lake, 11 July 1991, *E. Punter s.n.* (WIN 52730*); Oxford Lake, Hayes River system, 130 miles northeast of Lake Winnipeg, 30 June 1949, *C. Bradley s.n.* (ALTA 4835); Minago River, north of Lake Winnipeg, 12 July 1948, *H.J. Scoggan 64008* (WIN 7724*); Grand Rapids, Lake Winnipeg, near the old Hudson's Bay Co. tramway portage, 23 August 1948, *H.J. Scoggan 4856* (ALTA 4834*); York Factory, Hay Island, 24 July 1949, *H.J. Scoggan 6042* (WIN 7723*); on Highway 10, just across from the Elk Horn Ranch, 22 June 1979, *W.A. Wojtas 438* (ALTA 105033*).

Allium geoyeri S. Watson var. *tenerum* M.E. Jones

CANADA: Alberta, Mountain View, 28 June 1902, *s.n.* (DAO 777560*); Twin Butte, 12 July 1942, *J.J. Sexsmith 26* (ALTA 4822*); east of Waterton Lakes National Park, 12 June 1933, *W.C. McCalla 3885* (ALTA 37203*); Waterton Lake National Park, slope of Mt. Glendown, 16 July 1953, *A.J. Breitung 16094* (ALTA 4821*); Red Rock Canyon, Waterton, Lake National Park, 18 June 1935, *E.H. Moss 3153* (ALTA 4817*); Spread Eagle River near Waterton Lake National Park, 17 June 1982, *J. Looman 22960* (SASK 123070*).

Allium textile A. Nelson & J.F. Macbride

CANADA: Alberta, Macleod District, 9 June 1940, *R.H. Dixon 1612* (DAO 154075*); north of Garden Plain, 29 May 1970, *J. Looman 13936* (SASK 102220*); Red Deer River, southwest of Vevis, 26 May 1973, *M.G. Dumais 6122* (ALTA 44965*); Red Rock Canyon, Waterton Lakes National Park, 18 June 1933, *E.H. Moss 13153* (ALTA 4846); Big Valley, 8 July 1927, *A.H. Brinkman 2795* (DAO 154074*); south-facing slope on the north side of Reesor Lake, Cypress Hills, 16 June 1971, *P.J. Scott 1305* (ALTA 38596*); 1.5 miles north of Red Deer River on Highway 41, 12 May 1981, *D.M. Fabijan 162* (ALTA 104338); Elkwater Lake, 2 June 1951, *R.C. Russell S5159* (DAO 777561*); Suffield region, South Saskatchewan River, 25 May 1972, *C.W. Scotter & H.J. Armbruster 23061* (DAO 137965); 21 km north of Medicine Hat, Fish Creek Area, 11 May 1995, *G. Trottier 503* (ALTA 105945*); near Manyberries, 23 May 1972,

J. Looman 16863 (SASK 102228*); 3 miles east of Cereal on Highway 9, 15 June 1982, *D.M. Fabijan 559* (ALTA 109027); Sandy Point, 28 May 1971, *J. Looman 15691* (SASK 102225*); Provost Area, Horseshoe Lake, 23 July 1974, *A. Klar 790* (ALTA 79734); west of Wainwright at Battle River (campsite) of Highway 14, 19 May 1973, *M.G. Dumais 6050* (ALTA 45071*); 5 miles southwest of Vermilion, 7 June 1956, *C.D. Bird 32* (ALTA 21389*); south of Seven Persons, 29 May 1963, *J. Looman 7761* (SASK 102211*); northwest of Aden, 19 May 1976, *J. Looman 21425* (SASK 102232*); Dinosaur Provincial Park, Brooks, 18 May 1968, *J. Hermanns s.n.* (ALTA 24858); University of Alberta Kinsella Ranch, near saline lake, 20 June 1987, *Santosh Kohli 87-103* (ALTA 94190*); Taber area, Chin coulee, 7 June 1975, *A. Klar 1035* (ALTA 79737*); west road allowance of Highway 36, 1 km north of Scandia campground, 5 May 1981, *D.M. Fabijan 114* (ALTA 104336*); Paintearth, Doan Farm, 25 June 1974, *A. klar 492* (ALTA 79732*); Kitsim Reservoir, 25 June 1975, *J. Looman 20802* (SASK 102230); Fescue grassland, southwest of Police Lake, 11 June 1974, *K. Shaw 2384* (ALTA 75464); Drumheller, west side of river, 31 May 1974, *M.G. Dumais 6513* (ALTA 72147*); Camorose area, 25 May 1973, *A. Klar 40* (ALTA 79736); west of Drumheller, 26 May 1964, *J. Looman 8606* (WIN 59447); 1 mile east-northeast of Taylor, 23 May 1971, *H.W. Pinel & C.A. Wallis V-65* (DAO 167003); Battle River, ca. 15 miles south of Camrose, 25 May 1973, *M.G. Dumais 6102* (ALTA 44983*); Lethbridge, 13 May 1941, *E.H. Moss 1049* (DAO 777559*); Kneehill Municipal District, 31 May 1993, *I.D. Macdonald 26031* (SASK 137765); lower slope of Mt. Galway just below rock wall, Waterton Lakes National Park, 23 June 1965, *J.G. Packer s.n.* (ALTA 32004); Nevis, 6 km southwest of town, 25 May 1973, *A. Klar 70* (ALTA 79735); south of Kimball, 11 June 1974, *J. Looman 19785* (SASK 102231); near Macleod, 29 May 1952, *E.H. Moss 9749* (ALTA 4848); Cardston, 11 July 1964, *G.W. Scotter 10078* (DAO 777567*); 5 miles northwest of Bocket, south side of Oldman River, 9 June 1982, *J. Campbell-Snelling & M. Chambers 508* (ALTA 108124); Sofa Creek, 17 June 1969, *J. Nagy & W. Blais 1125b* (DAO 616858); Perennial Meadow, Waterton Lakes National Park, 27 June 1953, *J.J. Sexsmith 356* (ALTA 4851); prairie along the Waterton River, 12 July 1953, *A.J. Breitung 15770* (ALTA 4854); 21 miles west of junction of highways 1 and 3, west of Fort MacLeod at bridge over Pincher Creek, 6 June 1963, *L.C. Sherk & R.L. Taylor 140* (DAO 777565*); Oldman River, north of Pincher, 21 June 1940, *S.S. Survey 857* (ALTA 4853); Pass Creek, Waterton Lakes National Park, 10 June 1961, *F. Sudol 8* (DAO 777564*); hillside above 7th St. and 4th Ave., northwest Calgary, 13 May 1961, *P. Barclay 90* (ALTA 118684); hillside below Earl Grey Crescent, Calgary, 27 May 1961, *P. Barclay 142* (ALTA 118683); North Hill, Calgary, 17 June 1929, *W.C. McCalla EE3558* (ALTA 104222*); ca. 30 miles north of Lundbreck, 23 Jun 1955, *R.G.H. Cormack 53* (ALTA 23876); 8 miles southwest of Pincher Creek, 20 June 1940, *E.H. Moss 833* (DAO 777562*); Lundbreck Falls near the town of Lundbreck, 4 July 1999, *M.A. McPherson 79-990704* (ALTA 119854); Cochrane Hill, east of St. Mary's Church, 13 June 1982, *D.M. Fabijan 541* (ALTA 104339); Coleman, 27 June

1964, *B. de Vries* 2317-64 (DAO 154073); immediately north of Alberta Biological Station, 14 June 1961, *J.R. Corefoat & E.H. Moss s.n.* (ALTA 096211); north bank of Sheep River, west of Beaver Pond, 14 June 1966, *B.J. Golberg* 148 (ALTA 71415); Allerston, 26 June 1958, *B. Boivin & J.M. Perron* 12230 (DAO 126253); Hoodoos, 7 miles east of Drumheller, 20 May 1963, *P. Barclay* 919 (ALTA 102150).

Saskatchewan, Frenchman Creek badlands, 27 May 1969, *J. Looman* 12270 (SASK 102215); Little Woody, 30 June 1926, *L. Marie s.n.* (DAO 777538); Antler, 24 June 1951, *B. Boivin* 7425 (DAO 777551); Moosomin study area, NE 1/4 Sec 35 T13 R32 W1, 16 June 1968, *M. Dennington s.n.* (SASK 124526); Oxbow, ?, *s.n.* (SASK 6759); Moose Mountain Creek Valley, ca. 1 mile above confluence with Souris River, southeast 1/4 Sec 21 T3 north R2 W2, 3 June 1987, *V.L. Harms* 37334 (SASK 92946); Crooked Lake, 30 May 1960, *B. de Vries* 680 (DAO 777557); north of Whitewood, Qu'Appelle River, 15 May 1963, *J. Looman* 7497 (SASK 102207*); Sturgis, 6 June 86, *D.F. Hooper & L. Baker* 86060604 (SASK 83639); Souris River Valley, just north of Roche Percee Provincial Park Campground, 26 May 1986, *V.L. Harms et al.* 35338 (DAO 688400); Melville District, Fairy Hill, 1 July 1951, *B. Boivin & W.G. Dore* 7531 (ALTA 73382*); Bienfait, 4 June 1947, *Wm. Shevkenek s.n.* (DAO 777536); Estevan, south edge southwest 1/4 13-2-VIII west 2nd, 20 June 1961, *J.H. Hudson* 2092 (DAO 777556); Souris River Valley, Estevan area, ca. 1.5 km south, 26 May 1986, *V.L. Harms et al.* 35244 (SASK 127823); Katepwa, 34 May 1941, *L.T. Carmichael R-22* (DAO 777540); northwest of dry lake, Strawberry Lakes, 12 miles south of Indian Head, 3 June 1965, *C.J. Jones et al.* 288 (SASK 32285); Lebret, 12 June 1943, *R.C. Russell & H.W. Mead* S 1103 (DAO 777787*); Weyburn, 3 June 1958, *B. Boivin & J.M. Perron* 11855 (ALTA 73377*); township 20 Rg 14 Sec 17, near Saskatchewan Landing, 17 June 1969, *W. Pyle w-25-5* (SASK 122443); Prudhomme, 7 June 1935, *R.C. Russell & E.T. Howe s.n.* (DAO 777545*); Spalding, 10 August 1952, *G.W. Selleck s.n.* (DAO 777552); Regina, 6 June 1947, *L.T. Carmichael* 273 (DAO 777789); east of Lumsden, 4 May 1985, *A.M. Tuchscherer* 1985-07 (SASK 79536); Nokomis, 9 June 1941, *O.C. Furniss s.n.* (SASK 144934); Avonlea, 2 miles east, 20 May 1949, *B. Rawlinson & G. Ledingham* 49-129 (SASK 6756); Humboldt, 11 June 1934, *R.C. Russell & W.T. Maguie s.n.* (DAO 777535*); Big Muddy Valley, ca. 7 miles from the Montana border, 26 June 1940, *W. Shevkenek* 106 (DAO 777534); Findlater, 23 June 1954, *G.W. Selleck* 61 (DAO 777548*); Key West P.F.R.A Community Pasture, near Ormiston, 5 June 1985, *B. Kishchuk* 14 (SASK 90466); northwest of Baildon, 14 June 1955, *C.H. Hood* 9 (DAO 777550*); Harptree, 5 miles au nord-est, 4 June 1958, *B. Boivin & J.M. Perron* 11868 (ALTA 73376*); Moose Jaw, Thunder Creek, 19 May 1985, *B. Cooper* 14 (SASK 81453); Aylesbury, 16 May 1951, *B.J. Sallans & R.C. Russell* S4194 (DAO 777530*); Dana, 10 June 1935, *H.W. Mead & R.C. Russell s.n.* (SASK 83428); Prince Albert, 5 June 1940, *O.C. Furniss s.n.* (SASK 144140); Keeler, 5 May 1949, *R.J. Ledingham & R.C. Russell* S4912 (DAO 777549); east of Mortlach, 16 May 1963, *J. Looman* 7561 (SASK 102209*); Mortlach,

southeast 1/4 27-17-1 west 3rd, 21 May 1950, *J.H. Hudson* 39 (DAO 777553); near Eyebrow Lake, 24 May 1981, *T. Misfeldt* 1 (SASK 74989*); 3 miles east of Coderre, 28 May 1986, *D.G. Huel* 25 (SASK 81261*); Rosthern, 10 May 1939, *G. Stevenson* 10 (DAO 777537*); Kettlehut Lake, 31 May 1981, *J.H. Hudson* 4106 (SASK 171754); Wood River, Gravelbourg area, 17 June 1981, *A. Schewe & B. Consult* 96 (SASK 141716); Gravelbourg, 2 miles a l'ouest, 10 June 1958, *B. Boivin & J.M. Perron* 11996 (ALTA 73374); Saskatoon, Sutherland, 14 May 1925, *R.C. Russell s.n.* (SASK 83423*); Elbow (Tugt's Bay), northwest 13 Tp25 Rg5 west 3, 21 May 1992, *B. Wait* 53 (SASK 13604); 2 km southwest of Elbow, 5 June 1975, *S.L. Gray* 1696 (SASK 66915*); east end of Saskatoon, 19 July 1950, *R.C. Russell* S.5077 (SASK 83431); ca. 1 mile north of Saskatoon, north Chemical Terraces on northwest shore of South Saskatchewan River, 31 May 1993, *M. Lineman* 9310-008 (SASK 169340); Cranberry Flats, 25 May 1972, *V.L. Harms* 18523 (SASK 46614); east end of University Bridge, Saskatoon, 3 June 1971, *Maryann Verbin s.n.* (SASK 66074); Saskatoon, 28 May 1938, *W.P. Fraser* 13 (ALTA 36305*); Danielson Provincial Park, 3 June 1975, *J. Looman* 20468 (SASK 102233); 5.1 miles south and 1.5 miles west of Saskatoon, 24 May 1972, *s.n.* (SASK 50204*); Beaver Creek, ca. 9 miles south of Saskatoon, 17 May 1978, *D. Adams* 4 (SASK 70938*); Biddulph Half-Section, 16 miles south of Saskatoon, 11 June 1971, *V.L. Harms* 17371 (SASK 44451); 2 km south of Saskatoon, just north of Riverside Country Club Golf Course, 27 May 1985, *V.L. Harms* 33730 (DAO 702456); Dunblane, 30 May 1961, *M.S. B. & R.C. Russell s.n.* (SASK 83432*); north of Ernfold, 29 May 1969, *J. Looman* 12335a (SASK 102217); Riverhurst Ferry, 9 June 1974, *J.H. Hudson* 2910 (DAO 355805); 10 miles west of Saskatoon, 3 June 1955, *L.W. Gellela s.n.* (SASK 6754); Outlook, 10 June 1950, *R.C. Russell* S5048 (DAO 777528*); Ceepee, 6 May 1952, *G.W. Selleck s.n.* (SASK 6766); Borden Campsite, Highway 16 crosses the North Saskatchewan River, 24 May 1986, *J.B. Korol* 20 (SASK 81361); South Saskatchewan River, north of Gouldtown, 2 June 1970, *J. Looman* 13978 (SASK 102222); Asquith, 3 June 1952, *R.C. Russell* S52354 (DAO 777547*); Redberry Lake, 23 June 1929, *R.C. Russell s.n.* (SASK 83422); south of Rush Lake, 24 May 1963, *J. Looman* 7623 (SASK 102208); Rush Lake, 3 June 1936, *J.L. Bolton* 97 (SASK 6762); southeast of Gergovia, 1 June 1969, *J. Looman* 13962 (SASK 102221); 9 miles west of Birsay, 30 May 1996, *D. Bizecki-Robson* 61 (SASK 137979*); Val Marie, 9 June 1982, *J. Looman* 22945 (SASK 123057); Matador Field Station, 21 May 1969, *N.A. Skoglund* 40 (DAO 607717); Swift Current, 24 June 1947, *A.J. Breitung* 4061 (DAO 777790); east of Matador, 22 May 1969, *J. Looman* 12227 (SASK 120377); Landing Provincial Park, 45km north of Swift Current, 18 July 1985, *M. Maier* 53 (SASK 81177); north of Pennant, 28 May 1969, *J. Looman* 12292 (SASK 102218); Middle Ranch, Great Sand Hills, R23 T17 S3, 8 May 1966, *Markham & Gatehouse* 31 (SASK 122092); south end of Murray Lake, 21 June 1970, *J. Ternier* 15 (SASK 170009); Battleford, 1 June 1911, *W. Robbins s.n.* (DAO 777788); Gull Lake, 13 May 1963, *J. Looman* 7502 (SASK 102206); north of Shackleton, 20 May 1971, *J. Looman* 15652 (SASK

102223); Tompkins, 8 miles au sud, Russeau Bridge, 13 June 1958, *B. Boivin & J.M. Perron 12031* (DAO 126255); Spring Valley Ranch, 26 June 1975, *J. Looman 20847* (SASK 102229); Dulwich, 19 June 1991, *J.H. Hudson 4984* (SASK 171758*); The Great Sand Hills region, 24 June 1978, *L. Townley-Smith 78221* (SASK 69414); east of Glidden, 27 May 1970, *J. Looman 13810* (SASK 102219); Arena Community Pasture, 30 May 1972, *J. Looman 16887* (SASK 102227*); 6 miles south of Maple Creek, 4 June 1958, *J. Looman 1053* (SASK 102214); Cypress Hills, Birch Creek Ranger Station, 15 July 1947, *A.J. Breitung 4825* (DAO 777558); Battle Creek Community Pasture, 29 May 1972, *J. Looman 16883* (SASK 102226); Maple Creek, 8 June 1953, *S. Zilke 187* (SASK 6763); north of Cypress Hills Park, 12.2 miles southeast of Maple Creeks on road to Fort Walsh, 29 May 1962, *J.M. Gillett & R.L. Taylor 10919* (DAO 777546); Hoosier town site, 21 May 1930, *L. Jenkins s.n.* (DAO 777554*); Manitou Lake, 2 July 1945, *H. Groh 2446* (DAO 777532); gully just south of Marsden, 8 June 1982, *P. Burton s.n.* (SASK 134045); near Horsham, 27 May 1971, *J. Looman 15679* (SASK 102224); Stranraer, 18 May 1985, *J.H. Hudson 4484* (SASK 90740*); Punnichy, 1 June 1948, *R.C. Russell 2813* (DAO 777539); Carnduff, 4 June 1960, *B. Boivin 13440* (ALTA 73378); east of University of Saskatchewan, Saskatoon, 3 June 2009, *H.J. Choi-sk-1* (SASK*); east end of University Bridge, Saskatoon, 4 June 2009, *H.J. Choi-sk-2* (SASK*).

Manitoba, Souris River, north of Lauder, 12 June 1990, *G.M. Keleher s.n.* (WIN 49853); Nature Conservancy of Canada, near Plum lakes, 8 July 1981, *s.n.* (WIN 46012); Virden, 29 May ?, *W. Krivda V-46* (DAO 777520); Petite rivière Tête-à-la-Biche, 5–6 miles au nord-ouest de Coulter, 5 June 1960, *B. Boivin 13477* (SASK 120489*); Asessippi, 8 July 1983, *J.L. Parker 83-303* (WIN 39447); Pierson, southwest Manitoba, 26 June 1950, *W.G. Dore & D.R. Lindsay 11103* (DAO 777521); Shellmouth, 21 May 1972, *J.L. Parker 2365* (WIN 26454); Asessippi Provincial Park, ? ? 1978, *s.n.* (WIN 42551); Pierson Wildlife Management Area, 7 miles southwest of Pierson, 31 May 1975, *R.W. Knapton 5* (WIN 32072*); Souris River Site 1/1, NE1/4, S6, T1, R26W, 16 May 1990, *J.M. Shay 90-44* (WIN 51233); Bellevue Hill, 2 June 1969, *Nagy & Blais 636* (WIN 25055); Alexander, 4 June 1949, *C. Thomas s.n.* (WIN 7705); Winnipeg, ? 1939, *H.A. Fowler s.n.* (DAO 777524); Swan Lake, 7 June 1930, *K.W. Neatby & R.F. Peterson s.n.* (DAO 777786); Crystal City, ? 1935, *C. Thomas s.n.* (WIN 7706); Ninette, 2 June 1960, *B. Boivin 13413* (ALTA 73379); Souris River, 8 miles north of Minto, 14 June 1950, *H.J. Scoggan & W.K.W. Baldwin 7169* (ALTA 4859); Brandon Hills, 12 miles south of Brandon, 8 June 1950, *W.G. Dore 10635* (DAO 777522*); Brandon, 29 May 1947, *H.H. Marshall 32* (ALTA 49397*); 8 miles south of Brandon, 8 June 1950, *W.G. Dore 10649* (DAO 777523; WIN 7701*); tributary of Little Saskatchewan River, northeast of Dam, Brandon, 29 May 1954, *R.D. Bird s.n.* (ALTA 4860).

Allium cernuum Roth

CANADA: Alberta, Cypress Hills, Reesor Lake area, 17 July 1963, *R.D. Newsome 296-63* (SASK 27245); Cypress Hills Area, Grant Creek, 13km south of the Cypress Hills,

20 July 1975, *A. Klar 1592* (ALTA 79740); Laurier Lake, 3 km south of lake, 3 July 1976, *A. Klar 2047* (ALTA 80982*); Whitney and Laurier Lakes, 11 July 1975, *A. Klar 1392* (ALTA 79739*); Timber Creek, 10 July 1978, *J. Looman 22743* (SASK 102528); north side of Cypress Hills north slope, slope of Gros Ventre Creek coulee, ca. 5 km west of Elkwater, 17 September 1995, *I.D. Macdonald 950917b2* (ALTA 102004); Milk River, 5 August 1959, *R.C. Russell S59290* (SASK 83808); Lethbridge, 8 August 1952, *R. Connell s.n.* (SASK 26700*); Fort Saskatchewan, 2–3 miles east of town, 23 June 1971, *M.G. Dumais 5512* (ALTA 37319*); north edge of Fort Saskatchewan, 21 August 1950, *G.H. Turner 7388* (DAO 123399*); Macleod, 28 July 1940, *R.H. Dixon 1597* (DAO 123388); Cardston, 11 July 1964, *G.W. Scotter 10089* (DAO 777962); St. Mary River, 12 August 1975, *K. Shaw 2877* (ALTA 75468*); 5 miles west of Cardston, 27 July 1950, *W.G. Dore 12093* (DAO 123416*); 10 miles south of Cardston, 3 August 1950, *W.G. Dore & A.J. Breitung 12276* (DAO 123415); Edmonton, 8 July 1937, *J.J. Sexsmith 4* (DAO 123421*); Trout Creek, Claresholm, 29 July 1950, *K.F. Best 501* (SASK 102177); Edmonton River Valley, 400 m west along bike trail from Emily Murphy Park to Hawrelak Park, 2 August 2003, *A. Bergstrom 4* (ALTA 118917); Beaver Creek, Claresholm, 19 July 1950, *K.F. Best 388* (SASK 102243*); cliff above Bow River, 17 miles north of Blackie Post Office, 1 August 1960, *J.A. Bailey 2945* (ALTA 119442*); Piegan Indian Reserve, 3 miles east of Brocket, 10 August 1950, *W.G. Dore & A.J. Breitung 12510* (DAO 123385); west of Claresholm, 3 August 1959, *R.C. Russell S59228* (DAO 123403; SASK 83807*); Waterton Lakes National Park, Sofa Creek Beaver Ponds, 27 July 1970, *G. Armstrong & J. Nagy 4508* (ALTA 45665); prairie along the Waterton River, 12 July 1953, *A.J. Breitung 15770* (ALTA 4854); Waterton Lakes National Park, 11 August 1976, *G.W. Scotter 23690* (DAO 152039); Twin Butte, 11 July 1963, *J. Looman 8186* (SASK 102190); Lake View Ridge, Waterton Lake National Park, 3 August 1969, *J. Nagy 2616* (ALTA 45664); near north entrance, Waterton Lakes National Park, 27 July 1967, *P.W. Stringer s.n.* (ALTA 41524*); Cameron Creek, Waterton Lakes National Park, 1 August 1042, *W.C. MacCalla 7211* (ALTA 37188); Mt. Sofa, Waterton Lake National Park, 17 July 1972, *P. Kuchar 2678* (ALTA 46230); Mt. Crandell, Waterton National Park, 1 August 1946, *H.A. Senn 2615* (ALTA 4808); bank of Blakiston Creek, Mt. Blakiston, Waterton National Park, 22 June 1965, *J.G. Packer 2875* (ALTA 32106*); sandy loam near Pincher, 2 August 1939, *E.H. Moss 244* (DAO 123387*); southwest of Pincher Creek, 25 July 1959, *E.H. Moss 15* (DAO 123389); Okotoks, 27 July 1950, *E. G. Anderson 1027* (ALTA 4809); Mt. Carthew, 9 August 1959, *R.L. Taylor & G. Staudt 4349* (DAO 123413); Porcupine Hills, Upper Oldman River, 29 July 1971, *s.n.* (ALTA 57527); Red Rock Canyon, Waterton Lakes National Park, 26 August 1963, *W.G. Dore 20707* (DAO 123411*); Waterton Lakes National Park, Trail from Rowe Lakes, 29 July 1970, *G. Armstrong & J. Nagy 4717* (ALTA 45662); 1 mile north of Red Rock, Waterton Lake National Park, 8 August 1969, *J. Nagy 2846* (ALTA 45663*); North Hill, Calgary, 29 July 1952, *W.C. MacCalla 11769* (ALTA 37194); Fescue

Prairie, west of Calgary, 14 July 1946, *E.H. Moss* 7135 (ALTA 4796*); left shore of Bow River of Bowman Park, Calgary, 9 July 1944, *G.H. Turner* 4142 (ALTA 36513); near Midnapore, south of Calgary, 12 August 1950, *W.C. McCalla* 11277 (ALTA 37193); 7 miles southwest of Lundbreck, 18 July 1967, *J. Looman* 10774 (SASK 102193); Oldman River valley, 2 miles west of Maycroft, 31 July 1976, *D. Coxson* 143 (ALTA 85574); 5 miles east of Bellevue, 16 July 1974, *Hainault* 6513 (DAO 833313); Big Hill Springs Provincial Park, 2 August 1967, *J. Looman* 11078 (SASK 102195); Racehorse Creek, 21 July 1967, *J. Looman* 10840 (SASK 102192*); up hill overlooking Racehorse Creek, west of Gap Ranger Station, Crownest Forest Reserve, 30 July 1955, *R.G.H. Cormack* 228 (ALTA 23877*); Mt. Timothy and up to Fly Hill, 28 July 1955, *R.G.H. Cormack* 214 (ALTA 23879*); in the region between the headwaters of the Oldman and Livingstone rivers, 12 August 1975, *D. Jaques* 5772 (ALTA 90072); Livingstone Falls, 22 July 1967, *J. Looman* 10878 (SASK 102194); Highway 3, 5 miles east of BC border, 16 July 1974, *Hainault* 6548 (DAO 833314); Coyote Lake Nature Sanctuary, 11 July 2008, *D.M. Fabijan* 3208 (ALTA 120062); bridge on Sheep River at mile 12 along Sheep forestry road, vicinity of Gorge Creek, University of Alberta, Dept. of Zoology, RB Miller Biological Station, 11 July 1961, *J.R. Carefoot* s.n. (ALTA 096210); near the Crownest summit, 13 August 1974, *Reid et al.* 1136 (ALTA 75846*); on road to Sundre from Nordegg-Cochrane Forestry Road, 24 June 1974, *M. Dumais* 7004 (ALTA 71920); xeric south-facing slopes in the Marmot Creek Basin cirque, Mt. Allan, 6 August 1975, *S. Carroll* 180 (ALTA 76690); Carbondale area, 5 July 1949, *A.C. Budd* 1359 (SASK 102241*); Barrier Lake, Kananaskis Forest Experimental Station, 25 July 1950, *R.D. Whitney* 50/242 (DAO 123419); south-southeast-facing grass-forbs slopes on northeast flank of Mt. Heart, northwest of Barrier Lake, near Mt. Pidgeon fire lookout, ? July 1973, s.n. (ALTA 90062); Boulton Creek Cabin, 27 July 1976, *D.F. Brunton* 1186 (DAO 169750*); Kananaskis Country, 26 August 1993, *K. Olson* 17 (WIN 54152); Highwood Pass, mile 92 Kananaskis Forestry Road, west-facing slope of Highwood Range, 5 miles northwest of Mt. Head, 8 August 1969, *J.G. Packer* 1969-398 (ALTA 27099*); Banff National Park, 9 August 1966, *R. Hnatiuk* s.n. (ALTA 104289); Banff National Park, Banff Area, Mt. Sulphur, southwest of Village, 3 September 1984, *V. L. Harms* 33689 (SASK 124867); Mt. Cascade, Banff National Park, 6 August 1962, *P. Barclay* 660 (ALTA 102918*); Upper Hot Springs, Banff National Park, 3 August 1940, *E.H. Moss* 5019 (ALTA 4794); Banff National Park, 5 August 1966, *R. Hnatiuk* s.n. (ALTA 41075); Bow River Valley, southwest slope of Mt. Cory, 6 miles west of Banff, 22–25 June 1945, *A.E. Porsild* & *A. J. Breitung* 13129 (ALTA 100025); Banff National Park, Mt. Bourgeau, 10 miles west of Banff, *A.J. Breitung et al.* 3313 (DAO 121761); Redearth Creek, Banff National Park, 8 July 1967, *P.W. Stringer* s.n. (ALTA 41523*); Mt. Eisenhower Forest Experiment Station, Banff National Park, 14 July 1968, *T. Mosquin* & *J.R. Seaborn* 7107 (DAO 123400*); Windy Point Ridge, west of Highway 11, overlooking Abraham Lake, 14 August 2007, *D.M. Fabijan* 2822 (ALTA 118164*); Windy Point, 22 miles west of Nordegg, 29 Au-

gust 1968, *M.G. Dumais* 4758 (ALTA 28759); Kootenay Plains Ecological Reserve, 10 July 2007, *D.M. Fabijan* 2607 (ALTA 118163*); Cline River, at bridge on the David Thompson Highway, 27 mile east of Jasper-Banff park boundary, 2 July 1968, *M.G. Dumais* & *K. Anderson* 2915 (ALTA 28664); about 7 miles west of Peace River town, 5 August 1971, *B. Heywood* 203 (ALTA 39412); Peace River, 16 August 1946, *H. Groh* 2781 (DAO 123395); vicinity of Jasper, 2 miles east of town, 14 July 1960, *A.E. Porsild* 22500 (ALTA 100217*); Jasper National Park, 1 km northwest of Henry House, 16 July 1974, *T.D. Lee* & *W.M. Peterson* s.n. (ALTA 56137); Jasper National Park, Pyramid Bench, 17 September 2005, *S. Griffith* s.n. (ALTA 115063); Jasper Fish Hatchery, Jasper National Park, 12 July 1967, *P.W. Stringer* s.n. (ALTA 41525); 6 miles west of Dunvegan on grass slope of Piece River, 16 May 1977, *C. Wallis* s.n. (ALTA 75467); Saddle River Valley Wanhams, Prestville region, 20 July 1947, *E.H. Moss* 7427 (DAO 123390*); Sprit River, Peace River District, 13 September 1939, *H. Groh* 953 (DAO 123394); Forestry Trunk Road, Wilson Creek, 22 August 1967, *J. Looman* 11372 (SASK 102191*); along Peace River between BC border and Dunvegan, north shore of Piece River just west of largest island chain, 23 July 1981, *H.L. Dickson* & *E. Harsaeni* 4857 (DAO 690157); near Bear Lake, Grand Prairie area, 8 August 1952, *D.R. Lindsay* 316 (DAO 123391); Red Willow River, 14 miles southwest of Beaverlodge, 27 July 1947, *L. Jenkins* 339 (DAO 123396); Experimental station, Beaverlodge, 2 miles WE of station, 2 July 1947, *L. Jenkins* 313 (DAO 123397).

Saskatchewan, Meadow Lake, 10 July 1950, *W. MacNeill* S5014 (DAO 123384); Rapid View, ca. 50 km west of Meadow Lake town, ? June 1952, *W.J. Bobier* 3 (SASK 102240); Ravenscrag Butte, 6 August 1981, *J.H. Hudson* 4174 (SASK 72872*); Cypress Hills, T8, R26, S27, 27 July 1964, *R.D. Newsome* 500-64 (DAO 123373*); Center Block Cypress Hills, southeast 1/4 17-8-26W3rd, 2 September 1957, *J.H. Hudson* 2011 (DAO 123382); Cypress Hills Provincial Park, Lookout Point, 9 August 1972, *V.L. Harms* 19225 (SASK 46600*); Cypress Hills, Gap road between CB & WB, 5 July 2003, *Randy* & *Olson* s.n. (SASK 086851); Cypress Hills, west Block, From east boundary of park to 1 km west of entrance NW1/4 Sec 31 T7 R28 & NE1/4 Sec 36 T7 R29 W3, 14 July 1986, *V.L. & R.M. Harms* 36564 (SASK 94151*); Cypress Hills Park, 20 July 1947, *A.J. Breitung* 4921 (DAO 123374); Birch Creek Ranger Station, Cypress Hills, 15 July 1947, *A.J. Breitung* 4836 (DAO 123375*); Cypress Hills: T8, R30, S12, 27 July 1962, *R.D. Newsome* 162-62 (SASK 27247*); Beaver Trail, Cypress Hills Park, 11 August 1974, *Hainault* 7122 (DAO 139552); West Block of Cypress Hills, 20 July 2000, *J.H. Hudson* 5458 (SASK 149940*); Alcott River, Meadow Lake Forest Reserve Woodlang, 16 May 1949, *W. MacNeill* S2993 (DAO 123383; SASK 83810); Conglomerate Cliffs, Cypress Hills Interprovincial Park, 22 July 2009, *H.J. Choi-sk-10* (SASK*).

Allium stellatum Ker Gawler

CANADA: Saskatchewan, Piwei Hills, 24 July 1949, *J.S. Rowe* 1190 (DAO 386795); Spalding, 2 August 1954, *G.W. Selleck* & *Verla* 132 (DAO 123331); Bison enclosure,

north of Lake Audy, 13 August 1979, *W.J. Cody* 24658 (ALTA 105034*); east of Prince Albert, Forest Reserve, SE1/4 Sec 31 T48 R23 W2, 7 August 1996, *D. Paterson* 13 (SASK 140466); Welby, 24 July 1943, *J.A. Campbell s.n.* (SASK 102248); Carnduff, 15 July 1938, *J.L. Bolto s.n.* (SASK 102236); southeast of Wawota (northeast of Carlyle), 4 August 1981, *K. Kennet* 48 (SASK 75793*); Wawota, 13 August 1948, *R.C. Russell* 4870 (DAO 123345); Bredenbury, T23 R33 W1, 11 July 1981, *A. Schewe & B. Consult* 140a (SASK 75943); Amisk Lake, 1.25 miles north of Denare Beach, 30 July 1954, *J.H. Hudson* 1543 (DAO 123329); 2 miles west of Wroxton, T26 R34 W1, 7 August 1992, *M. Diduck* 09 (SASK 135986); Pepaw Prairie, south of Pepaw lake, 4.1km south of McBride Lake Road, 25 July 1985, *V.L. & R.M. Harms* 34612 (DAO 701487); Moose Mountain Creek Valley, 10 miles north & 0.5 to 1 mile west of Oxbow, 26 July 1987, *V.L. Harms* 38163 (SASK 129347); Oxbow, 15 August 1962, *J. Looman* 7221 (SASK 102254*); Moose Mountain Creek Valley, ca. 1 mile above confluence with Souris River, 25 July 1987, *V.L. Harms* 38109 (SASK 129244*); Pepaw River, 8.2 km east of McBride Lake Resort, along "McBride Lake Road", 25 July 1985, *V.L. & R.M. Harms* 34573-A (DAO 689535); 10 miles au nord de Whitewood, 5 August 1951, *B. Boivin & J.M. Cillelt* 8539 (DAO 123351); Pepaw River bluffs, 9 July 1981, *V.L. Harms et al.* 29652 (SASK 93798); Langbank, 5 August 1953, *A.B. Dickey* 22-32 (SASK 93722); 4 miles west of Stockholm, 15 August 1963, *J.F. Alex & J. Gebhardt* 1241 (DAO 643686); 1 mile north of Hudson's Bay Junction, 23 July 1940, *A.J. Breitung* 727 (ALTA 36303*; DAO 123337); Yorkton, 26 July 1946, *W.J. Cody* 1946 (DAO 123343); Waldron, 26 August 1914, *S.J. Neville* 1138 (DAO 123338); Sturgis, 23 July 1986, *D.F. Hooper & L. Baker* 86072317 (SASK 83544); Stoughton area, LSD 2NE1/4 Sec 1 T06 R05 W2, 15 July 1997, *J. Marchand & C. Bradley s.n.* (SASK 141866*); north of Kipling, near Pipestone Creek, 17 July 1981, *T. Misfeldt* 129 (SASK 74988*); Good Spirit Lake, along southwest side, 24 July 1985, *V.L. Harms* 34441 (SASK 127666); Shoal Lake Indian Reserve, Carrot River Valley, ca. 0.5km west of Pakwaw Lake village, 18 July 1984, *V.L. Harms et al.* 32850 (DAO 687860); 4 km south of Reserve, ca. 0.5 km west of Highway 9 on Piwei Forest Road, just north of Etomami River and west of confluence with Piwei River, 28 July 1985, *V.L. & R.M. Harms* 34637 (SASK 127663); Good Spirit Lake, southwest side, 21 July 1985, *V.L. & R.M. Harms* 34331 (DAO 701495); north of Crooked Lake, 27 July 1959, *B. de Vries* 226 (DAO 123327); Melville, 31 July 1933, *H. Groh s.n.* (DAO 123340); Tecumseh, S15, T10, R7 west 2nd, 14 August 1962, *J. Looman* 7121 (DAO 123353); Souris River Valley, ca. 3 miles west to southwest of Estevan, NW1/4 Sec 18 T2 R8 W2, 20 July 1987, *V.L. & R.M. Harms* 37864 (SASK 129243); 6 miles west of Corning, 30 July 1982, *J.H. Hudson* 4241 (SASK 171823); Souris River Valley, southwest corner of NE1/4 Sec 34 T2 R9 W2, 17 July 1987, *V.L. & R.M. Harms* 37713 (DAO 736352); Macoun, 14 August 1950, *W.G. Dore & A.J. Breitung* 12557 (ALTA 4840); Greenwater Lake, 8 August 1987, *D. Miller* 8738 (SASK 90222); 12 miles north of Balcarres, 22 July 1978, *J.H. Hudson* 3608 (DAO 335495*); Fishing Lake, 3 August 1985, *R.R. Hooper* 85080309 (SASK 83722*); Bjorkdale, ? June ?, *J. Laycock s.n.* (DAO 123348); Pre Ste Marie, 28 July 1933, *A.J. Breitung s.n.* (DAO 123336); Strawberry Lakes, 12 miles south of Indian Head, 5 August 1971, *G.J. Jones* 854 (DAO 658472*); Kelliher, 6 August 1928, *R.C. Russell s.n.* (SASK 83413); New Osgood, 11 July 1912, *S.J. Neville* 1135 (DAO 123344); Wellington PFRA Community Pasture, 1 August 1985, *B. Kishchuk* 94 (SASK 90479); Watson, 19 July 1952, *R.C. Russell* S 52 261 (DAO 123354); Leroy, 26 July 1935, *R.C. Russell s.n.* (SASK 83409); Annaheim, 23 July 1924, *G.A.S. & R.C. Russell s.n.* (SASK 83412*); St. Gregor, 9 August 1934, *R.J. Ledingham s.n.* (SASK 83411*); 4 miles east of Lanigan, 21 July 1989, *B. Zettl* 07-89-17 (SASK 90560*); north of campground on east side of Waldsea Lake, 26 July 1987, *D. Turner* 87-71 (SASK 90310); 16 miles north of Kinistino, at north end of James Smith Reserve prairie-Fairground, 17 August 1968, *N. Senser s.n.* (SASK 38153); Waldsea Lake, ca. 7 miles northwest of Humboldt in poor aspen woods at campsite on east Shore of lake "Salted water", 5 August 1967, *M.G. Dumais* 1858 (ALTA 23818); west half of Fort a la Corne area, near confluence of North & South Saskatchewan Rivers, 24 August 1980, *B. Godwin & L. Baschak* 485A (SASK 134285); Humboldt, 3 August 1939, *R.C. Russell s.n.* (DAO 123339); north end at Last Mountain Lake, 29 August 1985, *T. Jorgenson* 8 (SASK 81309*); Middle Lake, 18 July 1910, *W. W. Robbins* 63 (DAO 123352*); Carmel, 28 July 1957, *R.C. Russell* S 57008 (SASK 83404); Bruno, 28 July 1957, *R.C. Russell* 57014 (DAO 123328*); Meacham, 3 August 1952, *E. Ching et al.* 1095 (SASK 171819*); outskirts of Prince Albert, 28 July 2001, *A. Germann* 46 (SASK 160757); north Prince Albert, Little Red River Regional Park, 28 July 2001, *S. Crouch* 37 (SASK 160527); Young, 23 August 1956, *J. Looman* 614 (SASK 102256); Prince Albert, 26 July 1954, *M.A. Welsh s.n.* (SASK 2582); 1 mile north of St. Louis, 11 August 1946, *H.A. Senn et al.* 2795 (DAO 123334); Macdowall, 10 September 1959, *R.C. Russell* S59116 (SASK 83403); Macdowall, 28 July 2009, *H.J. Choi-sk-12* (SASK*); Martensville, 11 August 2009, *H.J. Choi-sk-16* (SASK*); Batoche National Historic Site of Canada, 88 km northeast of Saskatoon, ? ? 1988, *E. Hooper s.n.* (SASK 176916); Duck Lake Site 1, 5 miles northeast, 19 August 1955, *G.W. Selleck* 328 (DAO 123330); Rosthern, 30 July 1916, *s.n.* (SASK 6741*); Shellbrook, 19 August 1910, *s.n.* (SASK 6740); Prince Albert National Park, where Fox Creek joins the Sturgeon River, 18 August 1972, *T.F. Cameron* 664 (SASK 55168*); south of Beaver creek bridge, south of Saskatoon, 25 August 1968, *H. Nusche* 6813 (ALTA 116895); Sturgeon Lookout Point, 10.6 km southeast of Sturgeon Crossing on West Boundary Road, about 1 km south of road, 21 July 2003, *V.L. Harms* 44367 (SASK 162555*); 2-3 miles northeast of Sutherland along road near river, 14 August 2007, *H. Nusche* 66/32 (ALTA 116896); ca. 1 mile north of Saskatoon, 26 July 1993, *M. Lineman* 9310-149 (SASK 169357*); north of Junction highways 5 & 11, 26 July 1971, *N.A. Skoglund* 587 (SASK 43511); Saskatoon, 12 July 1922, *W.P. Fraser s.n.* (SASK 83410*); Martensville, 0.5 miles west & 1 mile north off Main Street, 23 June 1996, *V. Leuschen s.n.* (SASK 141474); Wasstrom's Flats, southwest 1/4 S27 T54 R05 W3, 19 July 2003, *V.L. Harms*

44271 (SASK 164264*); 6.4 km north of Saskatoon, 4 August 2008, *C. Peters 65* (SASK 179169*); Saskatoon, north part NE 1/4 18-36-5W 3rd, 8 September 1951, *J.H. Hudson 833* (DAO 123335); Biddulph Half-Section Natural Area (University of Saskatchewan Study Area), 21 km south of Saskatoon along Rt. 219, just north of White Cap Indian Reserve, 5 August 1982, *V.L. Harms 31308* (DAO 734464*); Shell Lake, 27 July 1988, *J.H. Hudson 4801* (SASK 88798*); Manitou Lake, 1 August 1947, *C. Frankton & R. Bibbey 426* (DAO 123346), 6 miles north of Peebles, 31 July 1953, *G.W. Selleck 31* (DAO 123332); 0.5 miles a l'est de Manor, Marge d'une tremblaie, 31 July 1951, *B. Boivin 8391* (ALTA 73380).

Manitoba, Spruce hills Park, 22 August 1974, *Hainault 7299* (DAO 139554); 30 miles south of Brandon, near the Souris River, 8 August 1958, *J.M. Gillett & H.J. Scoggan 10114* (DAO 123307*); Bison enclosure, north of Lake Audy, 13 August 1979, *W.J. Cody 24658* (DAO 286167); Riding Mountain National Park, S6-T21-R20, 27 July 1953, *A. & D. Love 6181* (DAO 123317); 12 km west of Souris, 11 August 1973, *J. Looman 19455* (SASK 102260); Brokenpipe Lake, 17 July 1972, *J.L. Parker s.n.* (WIN 27809*); Grande Clarière, west of Hartney, 40 miles southwest of Brandon, 29 July 1951, *H.J. Scoggan 10091* (WIN 7718*); Viriden, 23 July 1921, *H. Groh s.n.* (DAO 123314); Melita, in southwest corner of Manitoba, 23 July 1951, *H.J. Scoggan 9896* (ALTA 4842); Lyleton, 20 miles southwest of Melita, 2 August 1953, *H.J. Scoggan 11517* (ALTA 4841); Saint-Lazare, 8 July 1951, *B. Boivin & W.G. Dore 7730* (DAO 123319); Assessippi, 29 July 1985, *J.L. Parker 85-786* (WIN 42438); Cranberry portage, ? June 1950, *N.J. Freedman s.n.* (WIN 7709*); Duck Mountain Provincial Park, east of Boggy Creek, 26 July 1968, *J. Looman 11895* (SASK 102255); east of Boggy Creek Park, 10 August 1970, *J. Looman 15400* (SASK 102258); near Victor, 24 July 1943, *J.A. Campbell s.n.* (SASK 102247); Benito, ?, *L.S. Matthews s.n.* (WIN 7708); Shoal Lake, 15 July 1989, *L.M. Ross s.n.* (WIN 49602*); Quesnel Lake, 4 August 1974, *G.M. Keleher 74-250* (WIN 28576); Bird River, 11 July 1981, *K. A. Fregs s.n.* (WIN 45320); Stevenson's Point, Lac du Bonnet, 16 July 1977, *G.M. Keleher 327* (DAO 313272); MacArthur Falls, 10 July 1980, *B. Schewe 23* (WIN 38573); Black River at Highway 304, 11 July 1993, *E. & D. Punter s.n.* (WIN 55023*); Friedensfeld, 5 August 1977, *J. Looman 21970* (SASK 123209); Tolstoi, NW33-1-6E, 9 August 1996, *L. Reeves s.n.* (WIN 59723); Rosa, 7.75 miles north on Highway 59 from the junction of Highway 59 and PR. 201, 2 August 1996, *P. Pohrebniuk 11* (WIN 61022); ditch on north side of Springfield Road, 6 August 1983, *A. McIlraith s.n.* (WIN 40566); entre Otterburne et Kleefeld, 16 August 1958, *B. Boivin et al. 12934* (ALTA 73381*); Ridgeville, 16 August 1937, *H.M.H. & E.T.H. s.n.* (SASK 83406); Bird Hill Park, 18 August 1980, *S.L. Konrad 29* (WIN 38527); Winnipeg, Pipestone Rd. at Mollard Avenue, 12 August 1975, *G.M. Keleher 211* (DAO 136597); Oak Hammock Marsh SEC 17SW, 1 August 1974, *W. Buchanan & J. Holmes s.n.* (DAO 798170); Arnaud, 30 July 1939, *J.A. Campbell s.n.* (SASK 102245); St. Norbert along railroad, 21 July 1952, *A. & D. Love 5645* (DAO

123316); Emerson, Township 1, Range 2, east of principal meridian, 6 August 1957, *I.J. Bassett & J.W. Kemp 3477* (DAO 123326); St. James, Daisy Road. at Prairie View Rd., 25 July 1968, *J.M. Walker 5212* (WIN 17426); Stony Mountain, 31 August 1922, *H. Groh s.n.* (DAO 123303); Deer Lodge, Winnipeg, 9 August 1928, *R.F. Peterson s.n.* (DAO 123324); Teulon, 29 July 1928, *R.F. Peterson s.n.* (DAO 123325); Balmoral, 27 July 1946, *A.C. Budd & W.A.H. 49* (SASK 102251); Rosser, 20 July 1922, *H. Groh s.n.* (DAO 123312); Narcisse Wildlife Management Area, 30 July 1998, *T. Ruta & M. Kowalchuk 342* (WIN 69764*); St. Laurent, ? August 1913, *S.G. Churchward s.n.* (WIN 7712); near St. Ambroise, 16 July 1978, *D. Punter 7864* (WIN 70938); Morden, 31 July 1941, *E.W. Hart 1941* (ALTA 49396); Playgreen Lake, off north end of Lake Winnipeg, 23–25 July 1948, *H.J. Scoggan 4189* (ALTA 4811*); south of Portage-la-Prairie, 14 August 1984, *D. Punter s.n.* (DAO 464522); Portage la Prairie, ? July 1891, *J. Keraduoning s.n.* (DAO 123320*); Stephenfield Reservoir, 22 July 1978, *G.M. Keleher 454* (DAO 313263); Highway 240, 4 km south of Delta, 14 August 1980, *C. Welham 23* (WIN 38572*); Ashern, 100 miles northwest of Winnipeg, 15 July 1951, *H.J. Scoggan 9547* (WIN 7726); 25 km north of St. Martin, 8 August 1982, *M.J. Shchepanek & A.W. Dugal 4530* (SASK 80412); 3 km northwest of Pilot Mound, 6 August 1995, *A. Tomac 25* (WIN 58085); Sidney, 22 August 1946, *W.L. Gordon 2218* (DAO 126261); Spruce Woods Provincial Park, 24 July 1985, *D. Peterkin 24* (WIN 44439); 1.8 km west of Secondary Highway 351 on Highway 1, along small road between divided highway, 3.8 km west of Sidney, 23 July 1994, *H.L. Dickson & D.L. Dickson 6625* (DAO 685811); 5 km north of Glenboro, 22 July 1973, *J. Looman 18952* (SASK 102259); south of Campsite, south of Carberry along Highway 258, 24 August 1968, *T. Campbell C573* (DAO 618592); 10.7 miles west of Carberry Junction and Highway 1, 3 August 1968, *W.N. Chunys 980* (ALTA 39466); 10 km south of Carberry, 15 August 1977, *J. Looman 22067* (SASK 102261); Shilo Military Reserve, 28 July 1978, *G.M. Keleher 493* (DAO 313271); Sainte-Rose-du-Lac, 8 miles au nord, Transition entre 1' *Andropogonetum* et le *Populetum*, 19 July 1955, *B. Boivin & T. Mosquin 10991* (DAO 123322); southeast corner of junction of Highway 15 and Highway 302, 1.25 km west of Vivian, Map 62 H/16, UTM 812286, 14 August 2001, *A. Knispel 11* (WIN 67899); north of Toutes Aides, 5 August 1975, *J. Looman 21389* (SASK 102262); Aweme, ? August 1910, *N. Criddle s.n.* (DAO 123313); Cartwright, Lisgar District, 20 August 1946, *H.A. Senn & W.L. Gordon 3037* (DAO 123315); CFB Shilo, 28 July 1993, *J. Shay 93-101* (WIN 67604); Jack Pine plantations, CFB Shilo, Shilo, 8 August 1986, *Geoff Jones s.n.* (WIN 54680); east of Douglas, 22 July 1946, *A.C. Budd & W.A.H. 3* (SASK 102249); Roseneath, 8 August 1956, *N.G. Perret 13553* (SASK 102257); Roseneath School District, 8 August 1956, ? *54* (WIN 49748*); Souris River Valley, 35 km south of Brandon, 6 October 1985, *Geoff Jones s.n.* (WIN 54679); Brandon, 23 July 1946, *H. Marshall 5* (DAO 123309*).